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Wireless Weekly

Vol. 7. No. 19.

DESIGNING NEXT SEASON'S PORTABLE SET

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

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Fewer Stations and Higher Power

NOW that the original novelty of broadcasting has worn off, the public is looking more and more to its value as a distraction and amusement. Everyone agrees that no single programme can satisfy all tastes, and it is conceded that a choice of two or three programmes is really necessary. At the present time, while excellent reproduction is obtainable from the local station, alternative programmes, other than those of Daventry, are rarely obtainable in a quality that will satisfy the discriminating listener.

The reason for this lies in the fact that the distant stations require considerable amplification to give good loud-speaker strength, and this amplification brings in all kinds of extraneous noises and interference from broadcasting stations other than those to which we wish to listen. To listen with a really sensitive receiver to broadcasting over the band of frequencies between 1,200 and 500 kc. (250 and 600 metres) is a revelation of the immense amount of interference occurring at the present time through lack of co-ordination between the broadcasting authorities in the various countries.

There has been a number of conferences, and steps are being taken to bring about a better state of affairs, but the fact remains that from 1,500 to 500 kilocycles there are a maximum of one hundred and one frequencies available, assuming that all of the stations concerned adhere strictly to their frequencies without any deviation.

One solution proposed is that there should be a considerable reduction in the number of stations, and, at the same time, an increase of the power of each station. If this scheme were carried out in Britain, many of the relays would be discarded, while the power of the main stations would be increased to give service to those who have previously relied upon the relay stations. Such a scheme has a very strong appeal, particularly to the listener who is anxious to obtain two or three different programmes at will, free from interference, and of a quality which will satisfy him as well as with the local station.

CONTENTS

Capt. H. J. Round, in a highly illuminating article in *Wireless* last October, dealt very fully with, and made a number of suggestions about, the scheme for increasing the power of main stations, and we are glad to know that the British Broadcasting Company is giving serious consideration to such a scheme. Capt. Round's original suggestion was that all of the present relay stations should be shut down, and the power of the present main stations increased to ten or fifteen kilowatts, with possibly two more stations added.

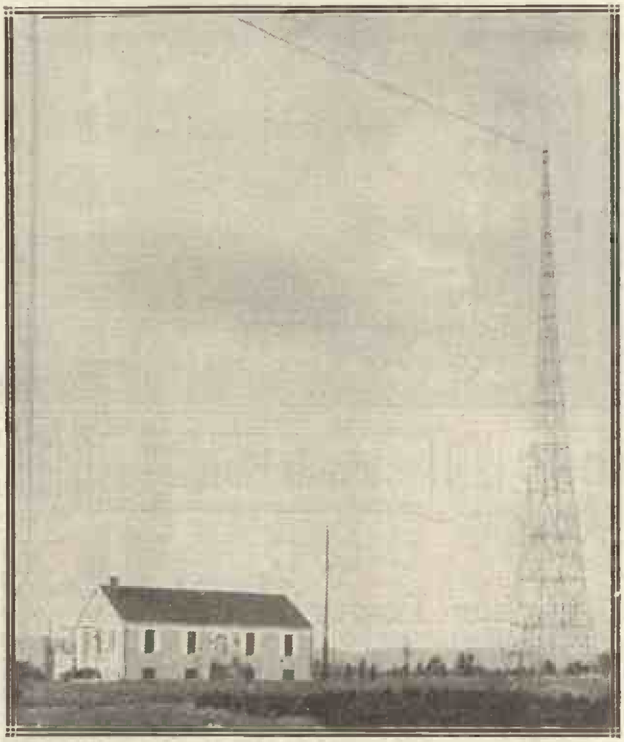
This increase of power would, in Capt. Round's estimation, triple the range of good reception, and if additional stations were put up at Cambridge and at Plymouth, only one or two isolated places would lack several programmes, even with quite inexpensive receivers. It is one of the advantages of a unified wireless control, such as we have in this country, that once such a scheme is approved, it can be put into execution very rapidly, the programmes being allotted to the various stations so as to give a good alternative in the way of items.

This scheme of increasing the power of main stations and reducing the total number of stations is not the only solution of the present broadcast chaos, but it is one which, we think, will have a strong appeal to a very large number of listeners, and we invite our readers' views on the matter.

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

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

January 27, Vol. 7, No. 19.



In this general view of the new station the special short-wave aerial is clearly visible close to the building. It is of the vertical type which has been used so successfully at KDKA.

THE NEW WJZ STATION

First details of the super-power station at Bound Brook, received from our American representative.

THE new broadcasting station, "2XAR," near Bound Brook, N.J., 35 miles from New York City, has a rating of the order of 50 kw. input to aerial, and is America's "Daventry." Its associated studio is at the Æolian Hall, in West 42nd Street, New York City, with which it is connected by three pairs of telephone wires. It operates on a wave of 659 kc. (455 metres).

One of the two 300-foot aerial towers may be seen on the right of one of the photographs on these pages. They are 700 feet apart. At the left-rear of the same view may be seen the hut which accommodates the variable and remotely-controlled condensers in series with the aerial.

When the towers are earthed their natural period more closely approximates the broadcast band than it does when they are insulated. Hence insulated foundations are used.

The Aerial

The antenna is of "T" type and of cage construction, 220 feet high and 220 feet in horizontal length. It is held in mechanical tension by means of a 2,000-lb. weight, and is protected from mechanical overload by means of a "weak link," near one of the strain insulators, this link being designed to part when the strain reaches 4,400 lbs.

Earthing Arrangements

The earthing system consists of numerous copper wires, radiating from the main building, and buried several feet in the earth—an interesting reversion to the practice of pre-broadcast days.

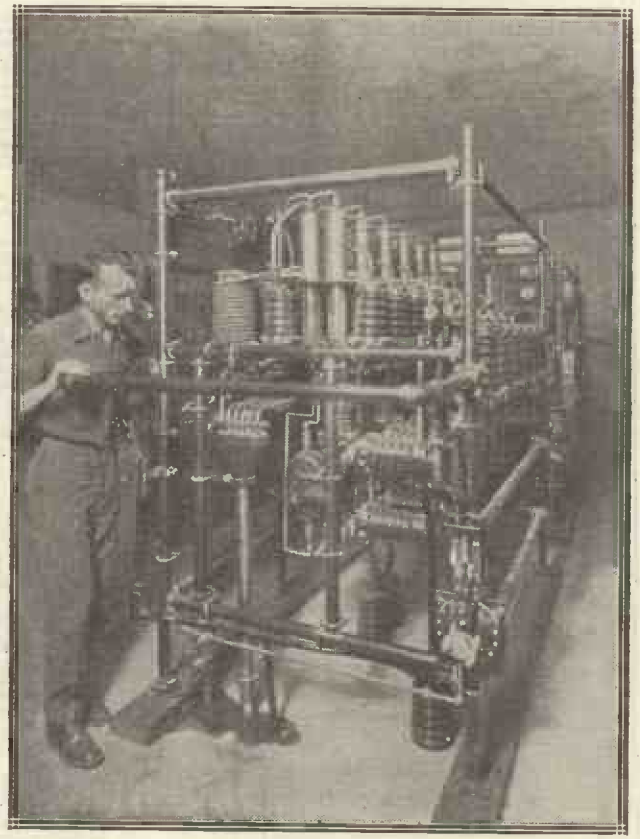
To ensure freedom from radiation of harmonics which might produce interference with listeners in the immediate neighbourhood of the station, the transmitting room is entirely enclosed in a copper shield. Readers may remember that a similar precaution was taken at Leafield in 1924, with very beneficial results.

Transmitting Plant

The valve filaments are lighted by 15-volt direct current, and the plates are energised at a potential of 10,000 volts through a vacuum tube rectifier.

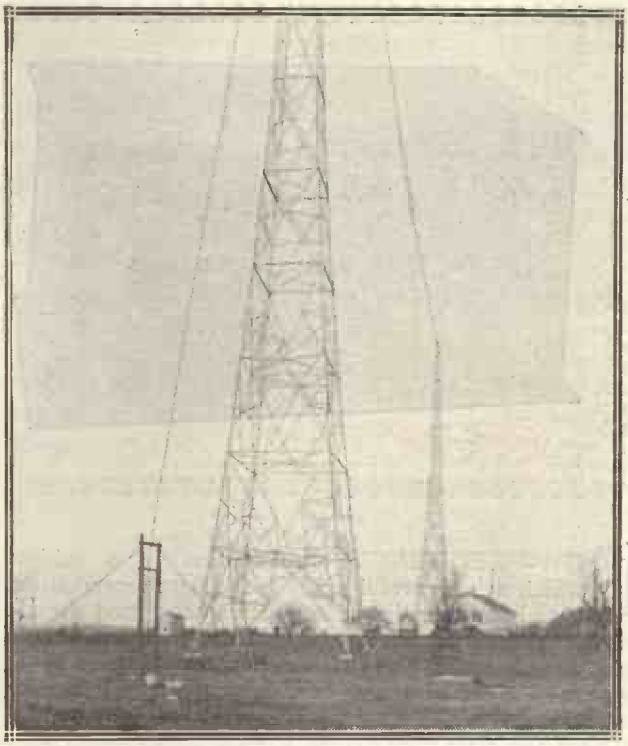
The transmitters are in duplicate, and in each are employed six oscillator and twelve modulator valves of the water-cooled type. The fact that the station requires 3,300 gallons per minute for cooling purposes will help to give an idea of its magnitude.

One of the photographs clearly shows the water-cooling arrangements in one of the modulator frames.



The main modulator frame of the lower-frequency transmitter. Note the arrangements for the water cooling of the valves. The spirals of piping serve to provide a long leakage path.

The new broadcasting station erected by the Radio Corporation of America at Bound Brook, New Jersey, must rank as one of the most powerful in the world. It possesses two complete transmitters with separate aerials, one working on 3,000 kc. (100 metres) (2 XAR) and the other on the normal broadcast band.



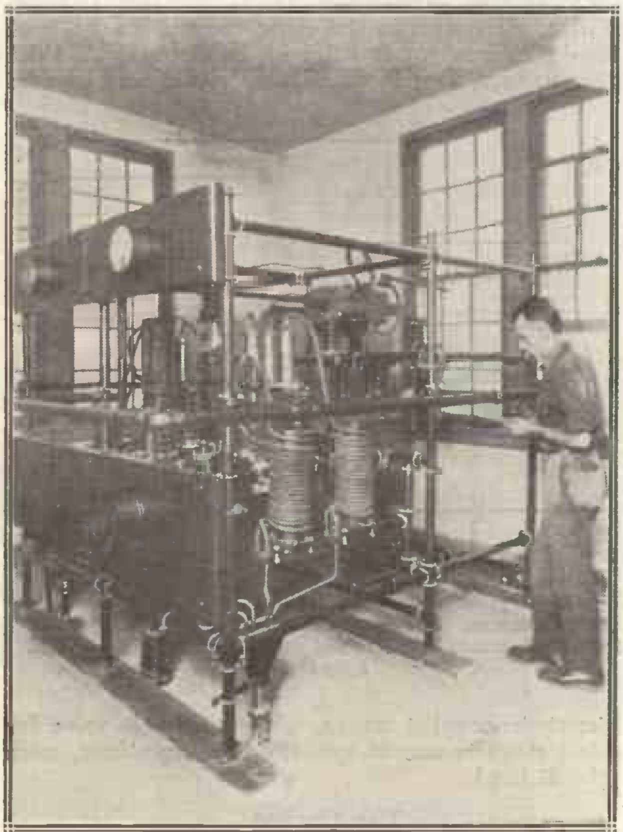
The problem of maintaining a constant safe tension on the aerial has been solved by bringing the halyard down to the erection visible in the foreground, where a 2,000lb. weight provides the necessary constant pull.

The coils at the back are composed of rubber water pipe, and their purpose is to provide a long "leak-path" to earth. Incidentally the use of such a device at Daventry—where the valves are also water-cooled—is obviated by discharging the cooling-water through a discontinuous spray, according to Moggridge's patent. At the bottom-right of the same view the device for automatically cutting off the power in the event of the failure of the water supply is visible.

Tuning Devices

The station is tuned by means of a variometer, consisting of one movable turn of copper tubing at the end of the coupling coil, and by remotely-controlled variable condensers (separately housed) in series with the aerial circuit.

The aerial tuning condensers are controlled by small electric motors driving through a reduction gearing. These condensers, like all the other radio frequency condensers in the station, have thick, rigid plates with rounded edges and air dielectric. The control of these motors is effected by small switches on the oscillator frames.



The oscillator frame of the 3,000 kc. transmitter. The water cooling system is particularly elaborate on this set. Note the single-turn variometer coil coupled to the main inductance.

Power Supply

The power equipment running gear is placed in the basement. Power is derived from alternative sources through a small sub-station placed at the left of one of the nearest towers.

Short-Wave Possibilities

In addition to the apparatus described, the station is completely equipped to broadcast on a frequency of the order of 3,000 kc. (100 m.). The short-wave oscillator is shown in one of the photographs. One of the thick plates of the air condenser may be noted at the back, in front of the attendant. The associated antenna is composed of a rigid copper tube, supported by the post in the middle of one of the upper views. This antenna, also, is energised through a variable series condenser, mounted outside the station building.

Re-broadcasting Experiments

Already the station has been picked up on its lower frequency and re-broadcast in England by the B.B.C. Its inauguration marks a further milestone in the development of radio, and makes possible many more such experiments in international linking of broadcasting systems.

Bound Brook, by the way, is within sight of the multiple Transatlantic transmitting station of the Radio Corporation of America, at New Brunswick, N.J.

Getting the Best from a Choke Amplifier

By JOHN W. BARBER.

Choke-coupled low-frequency amplifiers are gaining in popularity at the present time, and these notes have been prepared to cover a number of the more important points concerning their effective use, since their behaviour differs in some respects from that of more familiar types.

LOW-FREQUENCY amplification is a subject which needs careful study if the best reproduction is to be obtained, but in general very good signals will be obtainable, with good quality, if a few simple rules are observed, and it is the purpose of these notes to assist the experimenter in obtaining the best quality and volume from an amplifier employing choke coupling between the note magnifying stages.

An Advantage of the System

Fig. 1 shows a simple three-valve receiver, consisting of a detector valve followed by two stages of choke-coupled note magnification. It will be seen that the method of coupling is similar to resistance capacity, the resistance being replaced by a choke. The comparatively low direct-current resistance of the choke as against that of the resistance obviates the necessity for such a high anode voltage as is required with resistance coupling, this being a consideration which greatly favours the choke amplifier.

Choice of Valves

A very important point in the successful operation of a receiver is the choice of suitable valves, and in this connection the correct course to adopt in most cases is to employ a valve having a high amplification factor as V2, due to the fact that the amplification obtained by the choke system takes place solely in the valve itself.

It being desirable to employ special valves in the choke stages, care must be taken to ensure that the correct type is used, and the D.E.5B may be mentioned as representative of the general type suitable for this work. Grid bias of about one and a-half volts will be necessary with the valve mentioned, in order to prevent grid current from flowing, and should be applied in all cases.

For Strong Signals

As this type of valve has a limited grid swing, it is not capable of handling very great volume, and should it be desired to obtain the loudest possible signals, it may be desirable in some cases to employ a valve with a lower amplification factor but much larger permissible grid swing in the choke-coupled stages. Such a valve may be found among the small power valves of medium impedance. These, however, are only recommended for choke amplification in special cases where very powerful signals are to be handled, as mentioned above. These valves will deal with considerably larger powers than the D.E.5B type, and with 120 volts on the anode will require a negative grid bias of four to six volts.

The Last Valve

Never use a valve of high amplification factor in the last stage, since it is totally unsuitable for the operation of a loud-speaker, for which purpose a low-impedance power valve must be used if good results are to be obtained. When dealing with ordinary powers, then, use valves of the D.E.5B, D.F.A.4, etc., class in the choke-coupled stages, with a low-impedance power valve in the last stage. With higher powers, medium-impedance valves may be used

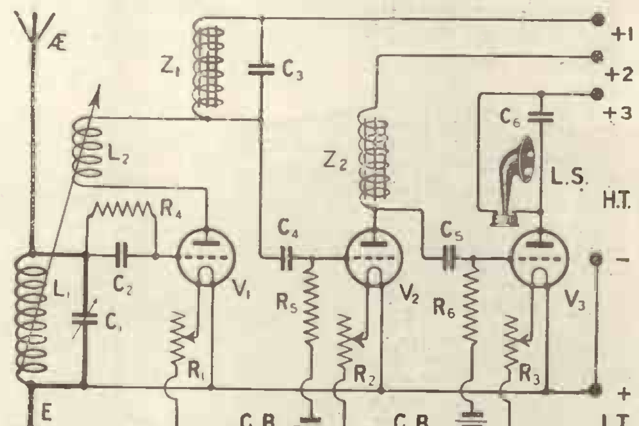


Fig. 1.—A good choke-coupled circuit for comparatively short distances. The capacity of the condenser C3 should be the minimum value found to be effective as an H.F. by-pass.

in the choke-coupled stages, while a suitable valve for the last stage is one of specially low impedance, such as the D.E.5A.

The Chokes

The chokes themselves are of primary importance. It is absolutely useless to employ special valves, and to provide suitable high-tension supply and grid-bias voltage, if the choke coil itself is unsuitable. Chokes of low impedance are bound to result in disappointment and should be studiously avoided, a good safe minimum value of inductance for use in choke-capacity amplifiers being fifty henries.

A Common Misapprehension

A word here as to substitutes for commercial choke coils may not be out of place. First, there is, in the minds of many, a belief that secondary windings of ordinary low-frequency transformers may be used as chokes, while if the two windings are correctly joined in series, quite satisfactory results may be obtained. Let me state most emphatically that this is not the case with the average transformer.

The vast majority of low-frequency transformers at present upon the market are totally unsuitable for use as chokes, even when both windings are used, and it may be of interest in this connection to state that, during experiments with choke amplification prior to publishing an article entitled "A Unit Choke Amplifier" in the *Wireless Constructor,* April, 1925, the author tested every low-frequency transformer in his possession, and none was found suitable, or in most cases even tolerable. The only real substitute which he found for a commercial choke coil was that useful article the Ford car ignition coil, the secondary of which makes an excellent choke. Make certain, then, that when building a choke amplifier you purchase chokes of proved efficiency.

Coupling Condensers

The next point calling for attention is the insulation resistance of the coupling condensers. These must be of the best possible quality, as perfect insulation here is an essential if the purest tone is to be obtained.

It must be remembered that these condensers, as well as acting as the "pass-on" from one valve to the next, also have to withstand the anode voltage, and if the insulation is not beyond reproach, we are faced with the possibility of the grid receiving a positive bias.

Effect of Poor Insulation

This may be of sufficient magnitude either to reduce or nullify the negative bias applied by external means, if not actually to produce a definite positive voltage, in which case it will be impossible to obtain clear tone from the loud-speaker.

The original single-stage choke amplifier described by the author in "The Wireless Constructor," April, 1925, issue.

The capacity of these coupling condensers is by no means critical, any value from .007 μF upwards to about .25 μF being suitable in practice. It is not advisable to go below about .007 μF capacity, and the author personally favours a condenser having a capacity in the neighbourhood of .01 μF.

Grid Leaks

The author, in connection with previous articles on receivers employing choke coupling, has received many letters to the effect that the amplifier portion worked

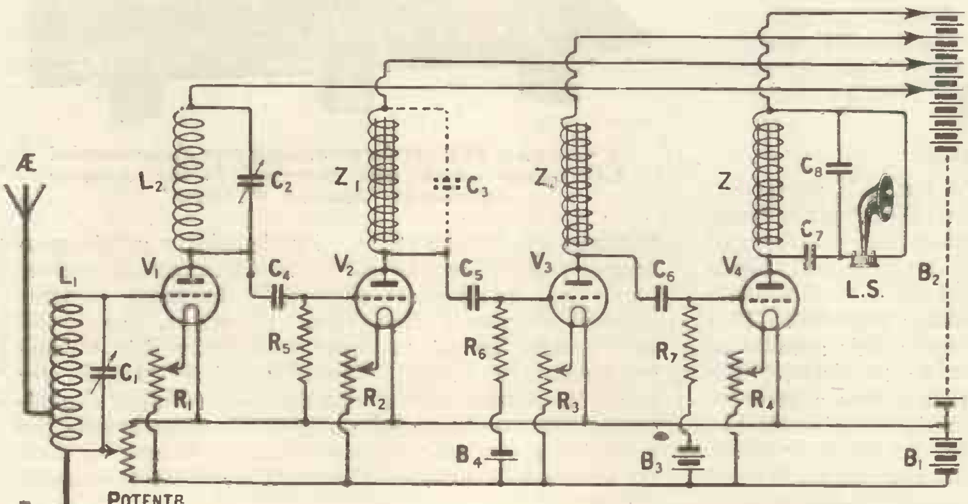
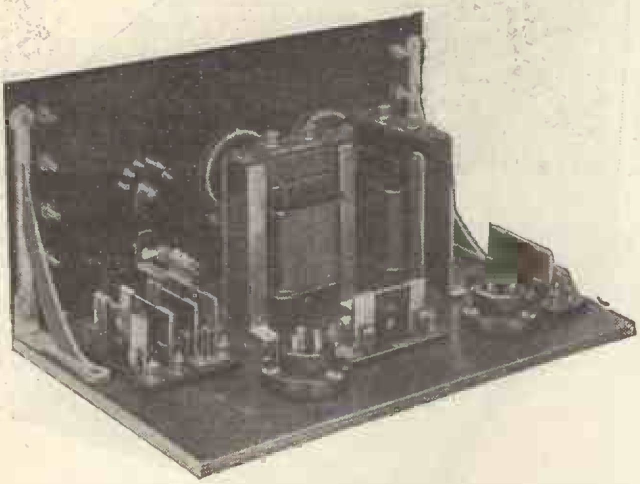


Fig. 2.—If self-oscillation troubles are experienced in a choke amplifier, a remedy may be found in adjustment of the capacity of C3, or the insertion of a radio frequency choke in the grid lead of V3.

just as well when the grid-leak was removed, and considerable surprise has been expressed on this point. The leak value recommended in such circuits is very low, a usual value being half a megohm, while even lower resistances, of the order of 80,000 ohms, have been used with quite good results. Such low resistance paths may easily be present accidentally in the set. For instance, the panel may have been marked out with a pencil, dust may have collected between terminals, and so on, so that it is quite possible, as



Inter-action effects are usually less troublesome in choke amplifiers than in the transformer type, and therefore less care is needed in spacing out the components.

readers have found, to dispense with the leak and still obtain fairly good signals. Reproduction will usually, however, be improved if such leakages are eliminated, and the correct grid-leak employed as originally intended.

Oscillation Troubles with Choke Amplifiers

Considerable trouble may sometimes be experienced with choke amplifiers due to self-oscillation at high frequency giving rise to a grid-leak howl. A very simple and almost invariably effective cure for this is to shunt the first choke Z1 in Fig. 2 by a small fixed condenser C3. This condenser should be of the smallest capacity which is found to stop the howl completely. In some extreme cases it may be found that to achieve the desired end this condenser must be so large that it produces an objectionable alteration in the quality of reproduction. An alternative can then be found in the insertion of a large *radio* frequency choke in the grid lead of V3 (Fig. 2).

A Curious Fault

A certain choke amplifier in the author's possession gave trouble of a peculiar form, the signals being satisfactory for a short period, after which a form of grid tick commenced, followed by a short howl, again followed by another spell of good signals, the whole cycle of operations being continuously repeated. This caused the writer some anxiety, and a fair amount of time was expended in endeavouring to discover the cause. It was at first thought that it was a form of the high-frequency trouble previously mentioned, but as the shunting condenser referred to failed to effect a cure, this was decided not to be the case. Several other things were investigated as being possible causes, such as the grid-leaks, until eventually a new grid battery was substituted for the one in use, when the trouble immediately disappeared!

Tone Control

It is always advisable to provide some form of tone control device, and in a choke amplifier an alternative method of control is available to that usually employed, namely, shunting the loud-speaker with a condenser, although this condenser may also be necessary.

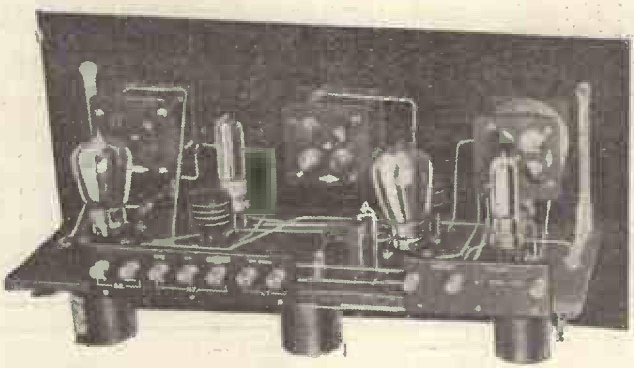
It will be found that the tone can be lowered to the desired degree by shunting the first choke with a condenser, the value of which will be between .0005 μF and about .002 μF in most cases.

Output Filters

The shunting condenser across the loud-speaker should preferably be of the interchangeable variety, in order that the most suitable value may be employed, while in certain cases better reproduction may be obtained if a filter circuit is employed. This consists of a choke coil connected between the high-tension supply and the plate of the last valve, a condenser of large capacity being joined between the plate and one side of the loud-speaker, the other side of which is joined to the side of the choke remote from the anode. The usual tone control condenser may be joined across the loud-speaker terminals, and if due care is taken in the choice of condensers the resulting signals should be of excellent quality.

Volume Obtainable

It must be understood that a choke amplifier will not give the same volume, valve for valve, as the transformer amplifier, but against this must be set the greater purity obtained in the former case. In cases where greater volume than that obtained with two choke stages is required, a very useful combination, and one which can be adjusted to give quite satisfactory results, consists of a transformer-coupled stage,



A rear view of a set incorporating two choke-coupled L.F. valves which was described in the January number of "Modern Wireless."

followed by a choke stage. By choosing a good transformer and suiting the valves to the circuit, a receiver employing this system may easily be made to give signals singularly free from distortion, and will undoubtedly appeal to those who desire fair volume combined with purity. The effect of the transformer stage is, of course, to give a somewhat higher amplification than would a choke stage, and consequently the amplifier gives volume somewhat in excess of that obtainable with an equivalent number of choke-coupled stages.

AERIAL COUPLING ARRANGEMENTS FOR NEUTRODYNE CIRCUITS

By G. P. KENDALL, B.Sc.

The suitability of the aerial coupling circuit has a considerable bearing upon the efficiency of a neutrodyne receiver, and deserves careful consideration.

EVERYONE who has used neutrodyne receivers to any great extent must have realised that the ideal receiver is one in which the neutralising adjustment "stays put" over the whole of the tuning range of the instrument. With a receiver which conforms to this requirement, for example, if the circuit is adjusted so that it is just below the edge of self-oscillation, and, therefore, in its most sensitive condition at any given point upon the range of frequencies which it covers, it will be in precisely the same condition at any other point upon its tuning range.

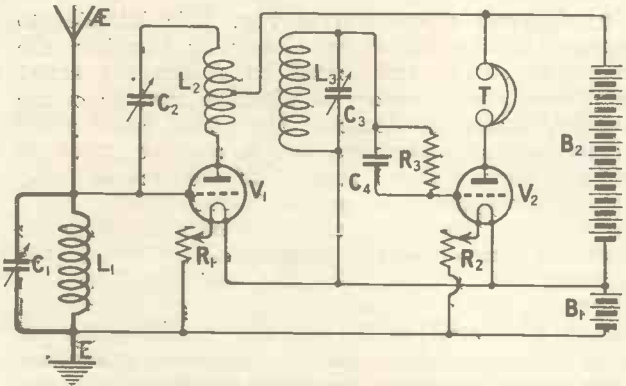


Fig. 1.—The direct coupled aerial is not often used in neutrodynes because its degree of selectivity is low.

An Ideal

This, of course, is an ideal state of affairs, and as such is very hard to realise in practice. With many neutrodyne sets it is found that if the aerial and earth are removed, and the neutralising adjustment so placed that the set does not oscillate at one end of the tuning range, it will either oscillate strongly at the other end or be found to be some distance below the oscillation point.

Hence, it has to be assumed that the set will not maintain itself in its most sensitive condition over its whole tuning range, and to make certain that even the weakest of signals are picked up, it is usually necessary to make slight readjustments of the neutralising controls as searching proceeds.

The Reasons

It is not perhaps surprising that most neutrodyne circuits should behave in this way, when it is remembered that valve circuits in general oscillate more freely at the lower end of their condenser scales, as witness the familiar behaviour of a single valve reaction set, and there are, of course, other contributory causes in a neutrodyne circuit. These effects may in some neutrodyne receivers be modified by the fact that a magnetic coupling is involved in the neutrodyne feed-back arrangement, which will, of course, feed back more energy at the higher frequencies than at the lower.

Effects of the Aerial Circuit

That the matter is not quite so simple as might be inferred from a consideration of the points affecting these phenomena is unfortunately only too true, since it must be remembered that these circuits will always be used in conjunction with some sort of aerial and earth system. Upon connecting the aerial and earth to such a receiver the position becomes at once very much worse, since we have the aerial damping affecting in a manner which may be altogether irregular the conditions in the stabilised circuit and upsetting still further the power of the neutralising arrangement to maintain a constant adjustment over the tuning range.

The Simplest Arrangement

The simplest possible arrangement for coupling the aerial and earth to the receiving set is shown in Fig. 1, which will be seen to consist of the conventional parallel-tuned direct-coupled circuit with the now popular method of neutralisation control from a split primary high frequency transformer. In this arrangement the aerial damping will be added to that normally existing in the first tuned circuit, and will affect the neutrodyne control to a considerable extent, but it will do so in a more or less regular manner over the whole of the tuning scale.

Lack of Selectivity

Such variations as there may be in its effect as the tuning of the circuit is varied are not as a rule very

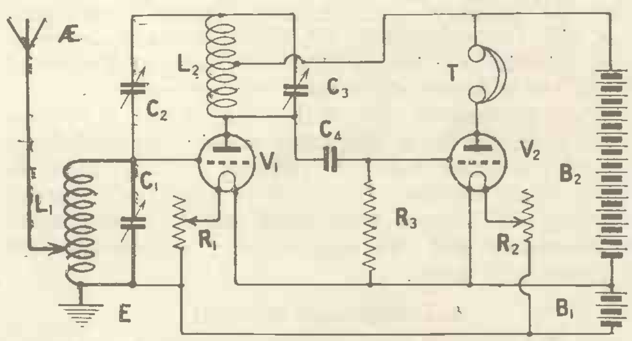


Fig. 2.—The auto-coupled arrangement is particularly prone to cause variations in the neutrodyne adjustment.

great, and if this arrangement were free from certain other defects, it would undoubtedly be one of the most effective possible ways of using a neutrodyne scheme. As a matter of fact, this arrangement is not an effective way of making use of the neutrodyne circuit, since in general it will not oscillate at all with a full-size aerial, except possibly at very low settings of the aerial condenser, and therefore the point of a neutralising scheme is rather lost, since it may be found to be altogether unnecessary.

Lightly Damped Circuits

The selectivity of the whole arrangement is decidedly poor as a rule, and it is rarely used. The

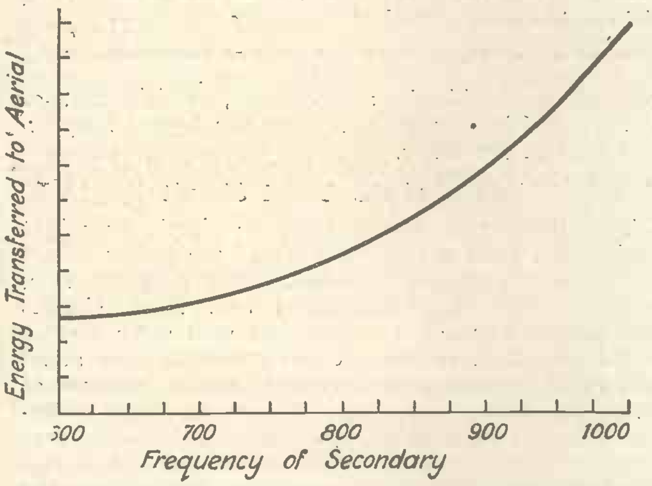


Fig. 3.—Illustrating the amount of energy transferred from secondary to aerial at various frequencies.

natural attraction of a neutrodyne circuit is to be found in the fact that one can use one of the lightly damped primary and secondary tuning schemes which confer a much higher degree of selectivity, without trouble from self-oscillation on the part of the high frequency valve, and we will consider now how the aerial damping affects the neutralising adjustment in such cases.

Effect of Auto-Coupling

The simplest of these schemes is shown in Fig. 2, and it will be seen to consist of the familiar auto-coupled arrangement. It has been shown that in this scheme the number of turns included in the aerial circuit has actually a tuning effect upon that circuit, the coupling of the primary and secondary being so tight that a double-humped resonance curve is obtained upon varying the primary turns, and, further, that when the primary circuit actually comes into resonance with the received signal, signal strength becomes poor, selectivity is low, and the damping of the aerial circuit has a heavy effect upon the secondary.

It will be seen at once that if the circuit is neutrodyned correctly for a frequency widely removed from that of resonance with the primary circuit, upon re-tuning to the resonant frequency in question the aerial damping will have a very much greater effect upon the secondary and the neutrodyning adjustment will be completely upset.

A Dangerous Method

It will be seen that the arrangement is often a decidedly dangerous one for neutrodyne work unless considerable care is taken in the choice of the number of turns to be included between aerial and earth. In actual practice this statement reduces to the practical rule that the number of turns in the aerial circuit must be so low that there is no risk whatever of tuning that circuit to one of the received frequencies at either end of the tuning scale.

A Warning

In practice, therefore, the smallest possible number of turns should be used which is consistent with reasonably good signal strength. Any sacrifice in signal strength which results may be somewhat offset in the estimation of the user by the fact that a direct gain in selectivity follows. Incidentally, I should like to add that recent experimental work has convinced me that it is not good practice to use a fixed tapping point upon such a circuit, when it is remembered how wide is the frequency band which it is now required to cover in a broadcast receiver.

Even with a relatively small number of turns in the primary circuit there will still be a difference in the amount of energy transferred back to the aerial at the opposite ends of the tuning scale, or, to put the matter somewhat differently, the effect of the aerial damping will be different at different tuning adjustments.

Back Transference Effects

The diagram reproduced in Fig. 3 is intended to illustrate this point more clearly by showing the amount of energy transferred back into the aerial circuit from the secondary at different settings of the secondary tuning condenser. The actual curve given is more or less imaginary, but it may be taken to convey a fairly truthful account of the sort of thing which can happen under practical conditions.

In drawing this diagram it was assumed that the resonant frequency of the primary circuit was in the neighbourhood of 1,200 kilocycles, and it will be seen how very widely the amount of energy transferred back to the aerial varies over the tuning range of 600 to 1,000 kilocycles, which is, of course, a measure of the degree to which the aerial damping is transferred to the secondary circuit, and in that circuit affects the neutrodyne adjustment.

"Tight Coupling"

The inductively-coupled type of circuit with a roughly-tuned primary, sometimes called a semi-

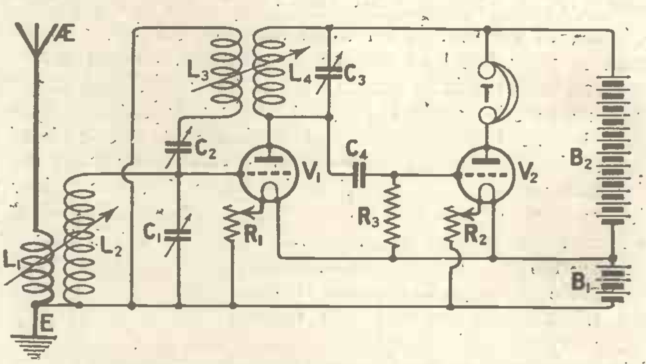


Fig. 4.—A variable coupling between aerial and secondary may assist in maintaining a constant neutrodyne adjustment.

aperiodic aerial circuit, conforms fairly closely to the auto-coupled type in its behaviour in the respect which we are at the moment considering.

Provided that the coupling between the primary and secondary is sufficiently tight for the rough-tuning properties of the primary to be utilised in the ordinary manner, this circuit corresponds very closely to the auto-coupled one, and the same arguments in regard to the effect of the primary damping upon the secondary circuit hold good.

Use of Variable Coupling

One of these circuits is illustrated in Fig. 4, and it will be seen that a possible variation of coupling between primary and secondary is indicated therein. This is sometimes found convenient, since it enables one to compensate for the different effects of the aerial damping upon different tuning adjustments, so that one setting of the neutrodyne condenser can be made to serve for the whole tuning range. Nevertheless, this is adding another adjustment to the set, and thus we have lost the desirable condition of a " stay put " receiver.

Adjustment of Turns

The same arguments as to the turn numbers of the primary circuit apply as before, and it would seem that one of the best schemes here is either to use a tapped coil or to provide a socket for a plug-in inductance, one of the ordinary standard types being employed. Any change of turns in the primary circuit will again affect the neutrodyne control to some extent, and it may be found that readjustment is again necessary.

Imperfect as it is, the circuit illustrated in Fig. 4 probably represents the best method of aerial coupling of those yet considered, since by means of a suitable choice of primary coils and possibly an adjustment of the coupling between primary and secondary, it is possible to secure such a combination as will give a very fair practical degree of uniformity of neutrodyne adjustment.

A Neglected Circuit

At the present time it is somewhat unusual to see any consideration given to the old-fashioned separately tuned loose-coupled primary and secondary type of circuit, but this arrangement has certain valuable advantages for neutrodyne purposes. A typical circuit, making use of separately tuned primary and secondary, is given in Fig. 5, which will be seen to incorporate a particularly effective method of neutrodyne control. The degree of energy transference between primary and secondary and back from secondary to primary, the latter being the effect which causes the imposition of the aerial damping upon the secondary, is, of course, dependent to some extent upon the frequency of reception, but if this coupling is made sufficiently weak to produce the desired amount of selectivity, the effect in question is reduced to a very marked extent.

A Valuable Method

When a really weak degree of coupling can be arranged between primary and secondary this arrangement becomes a particularly good one, and it is possible to so adjust it that it holds its neutrodyne adjustment reasonably well over the whole tuning range. I should add, in passing, that the arrangement of a really weak degree of coupling is by no means so easy a matter as one is apt to suppose. The mere placing of a pair of coils in a two-coil holder at a wide angle is by no means sufficient to achieve the desired end. In the course of experiments which I recently conducted upon the resonance properties of certain typical circuits, I found that with two coils of a well-known make in an ordinary two-coil holder a double-humped resonance curve was actually being produced until the coils were at a little more than right angles to each other!

And Its Drawbacks

The drawback to this type of circuit is to be found in the fact that, unless the coupling is really excessively weak, the effect of the aerial damping still has a considerable influence upon the secondary, and, therefore, when the primary is detuned from the secondary the back-transference of energy is reduced, and the circuit will probably oscillate. If the neutralising adjustment is so arranged that this does not take place the amount of back-transference of energy which takes place when both circuits are in tune flattens the tuning considerably; in other words, the amount of natural reaction which is permitted is less than would be beneficial.

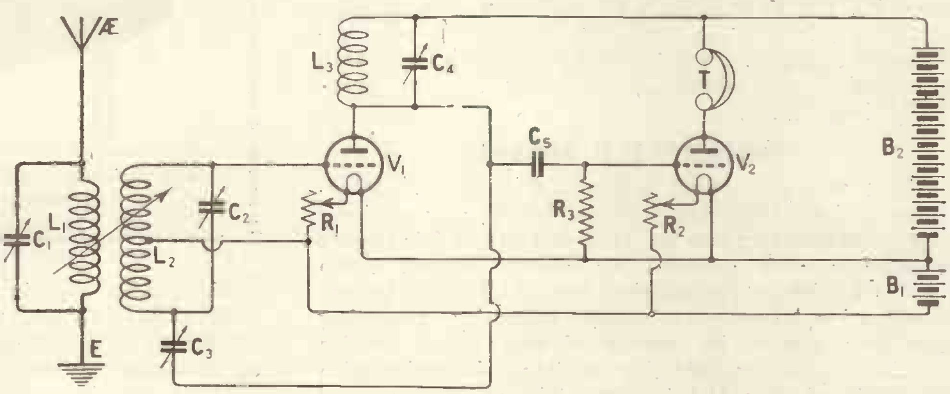


Fig. 5. — The fully-tuned primary and secondary circuit possesses considerable advantages in a neutrodyne receiver.

Conclusion

To sum up this brief survey, it would seem that of the simpler types of circuits, the tightly-coupled roughly-tuned primary is to be preferred, that the fully-tuned primary and secondary with extremely weak coupling is probably the most effective, but against this must be set the fact that an additional tuning control is introduced. This perhaps is not quite so serious a matter as it would at first sight seem, since the tuning of the aerial circuit will usually not be particularly sharp.

One cannot escape the conclusion that for neutrodyne purposes, at least, we really want a new method of coupling the aerial which shall give a reduced amount of damping in some form of secondary circuit, and which shall yet impose a substantially constant damping load at all frequencies.

An Oscillator-Coupler for KDKA

By A. JOHNSON-RANDALL.

One of the great attractions of the superheterodyne receiver is the ease with which it may be adapted to work on the higher frequencies. In these notes the author gives the necessary data as to turn numbers for making such a conversion in a very simple manner.

The finished coupler. Note that the turns of the windings are slightly spaced.

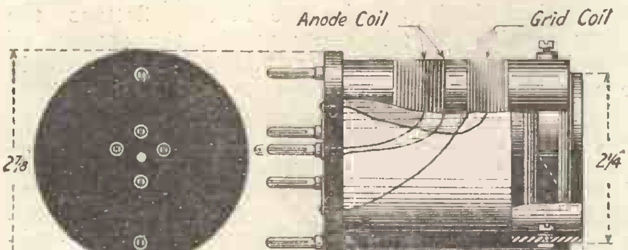
WITH its effective amplification at all frequencies the supersonic heterodyne receiver becomes a practical proposition for reception on the short waves, and much interesting work can be done with its aid.

Amplification Difficulties on Short Waves

It is a recognised fact that ordinary high-frequency amplification on frequencies in the neighbourhood of 5,000 kc. (60 metres) is, with our present knowledge of the art, hopelessly inefficient, the effects of inter-electrode capacity, together with stray couplings, both capacitative and magnetic, rendering the set practically inoperative.

"Straight" H.F. Methods

About two years ago, when KDKA (the Westinghouse station at Pittsburg, Pennsylvania) was working on approximately 3,000 kc. (100 metres), a fair degree of success was attained by certain expert radio engineers with sets employing straight high-frequency amplification, one well-known authority obtaining promising results by means of two tuned anodes stabilised by a non-inductive resistance in series with the anode of each H.F. valve. The results obtained with these two stages were said to be equal to those obtained with one ordinary tuned anode on the normal broadcast band.



Details of the plug-in arrangement used by the author. The connections from the moveable grid coil pass to the pins via two metal strips inside the outer tube.

Recent Tendencies

Such a method, although deserving favourable comment, can only be described as a "losser" method, and it is extremely doubtful if such means would meet with any degree of success on frequencies of the 5,000 kc. order.

Since these experiments the general tendency seems to have been to revert to the Reinartz type of circuit, consisting of a detector valve and one or more stages of low-frequency magnification.

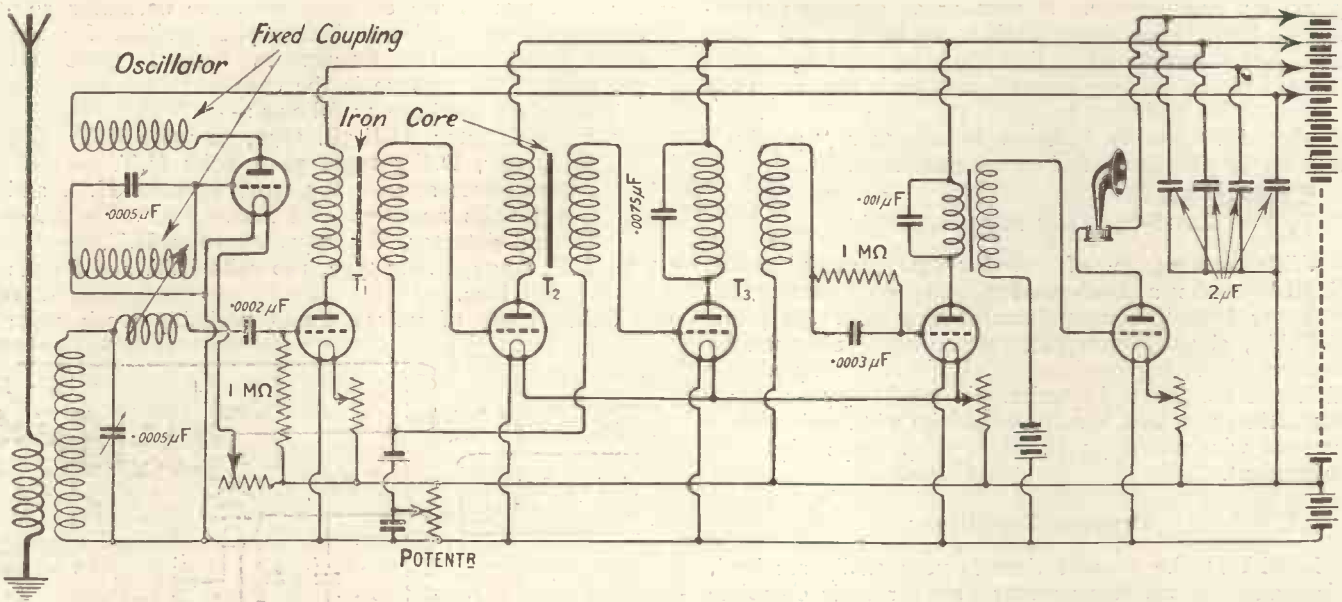
With the increased popularity of the supersonic heterodyne receiver on the broadcast band, however, one's thoughts naturally turn to the adaptation of the supersonic method to reception on the higher frequencies.

Modification of Existing Superheterodynes

The writer having had some considerable practical experience with supersonic reception on the broadcast band, decided to turn his attention to the modification of an existing receiver to meet the requirements of reception on 5,000 kc. The decision was made partly from the desire to investigate the possibilities of the supersonic principle on these high frequencies and partly with a view to making a comparison with the ordinary detector valve-note magnifier method.

The Set Used

The supersonic receiver chosen was the smaller of the two in use at the time, and consisted of a detector valve followed by two beat tone stages, a second detector, and a stage of low-frequency magnification. The beat tone stages comprised three Silver-Marshall transformers (the beat frequency filter and two intermediate transformers) peaking at a frequency of 55.6 kc. (approximately 5,400 metres).



The circuit under discussion is a very simple one. T1, T2 and T3 are the intermediate frequency coupling units.

The Oscillator

A separate oscillator of the plug-in type (actually one of Messrs. Peto-Scott's standard oscillators with the grid coil tuned and the turns suitably adjusted) was employed, the pick-up coil being connected in the grid circuit before the grid condenser.

At the writer's request Messrs. Peto-Scott made up another oscillator suitable for the higher frequencies to plug straight into their standard base.

This oscillator coupler is of a non-standard pattern, the ebonite former having a smaller diameter than that of the ordinary broadcast type, and being threaded to enable a spaced winding to be employed. The pick-up coil is threaded also and rotates inside the oscillator grid coil, making contact with two pins at the base by means of brass strips.

Short-Wave Windings

To commence with, nine turns of No. 22 s.w.g. d.s.c. wire were wound in the threads to form the grid coil, which was tuned by a .0005 μF variable condenser (an Igranic square-law pattern with a National "Velvet Vernier" dial fitted to it), and the anode coil consisted of ten turns of the same gauge wire. The pick-up coil had eight turns.

Oscillator Valve

Using a D.E.5 valve as an oscillator, and with a suitable adjustment of the pick-up coil, no difficulty was found in obtaining fairly uniform oscillation, although the well-known "clicking" effect, which denotes the cessation of oscillation, was noticeable at a few settings of the oscillator condenser. This effect was eliminated by reducing the pick-up coil turns to six and carefully adjusting its position.

Aerial Tuning Circuits

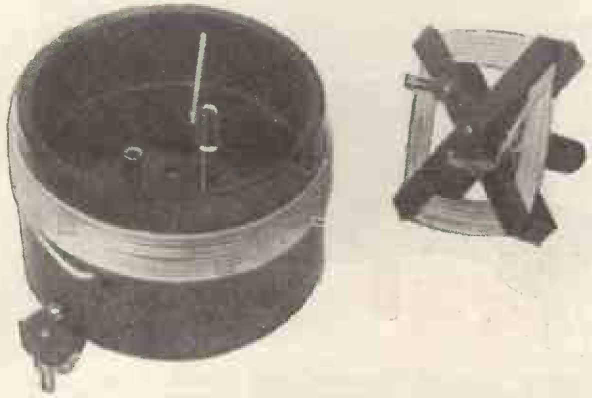
Using a coil of eight turns of 18 s.w.g. d.c.c. wire on a 3-inch former, roughly wound, tuned by a .0005 μF variable condenser for the grid coil of the first detector circuit and an "aperiodic" aerial coil of twelve turns of No. 22 s.w.g. d.c.c. on a small X-former inserted inside the grid coil, no difficulty was found in tuning in KDKA at overpowering strength on the telephones without any low-frequency amplification.

The Aerial

A small indoor aerial was used, consisting of a length of No. 20 enamelled wire stretched across a room on the ground floor, uninsulated apart from the enamel covering, and the ordinary earth system. It was also found that a Gambrell a/2 coil used as the grid inductance with five turns of No. 22 s.w.g. d.c.c. wire wound very roughly, hank fashion, around the outside, would *just* tune in KDKA on the extreme lower end of the scale of the .0005 μF condenser.

Adjustment of Turns

Since with the oscillator as described KDKA came in at about one-third of the oscillator condenser, an



This unit with its interchangeable primary is used as the aerial and secondary coupler.

attempt was made to get lower by reducing the number of turns on the grid and anode coils. The number of turns at present in use are six for both coils, and there are four turns on the pick-up coil.

Tuning Range

It is difficult to say how low the oscillator will function efficiently, but the writer has not yet been successful in tuning in WGY on approximately

7,500 kc. (40 metres). A number of amateurs working on frequencies above KDKA can be received, however, but it would appear that the stray capacity effects present in the existing arrangement limit the frequency range. In addition to this, the type of oscillator described begins to function in a rather "patchy" manner on the lower end of its condenser.

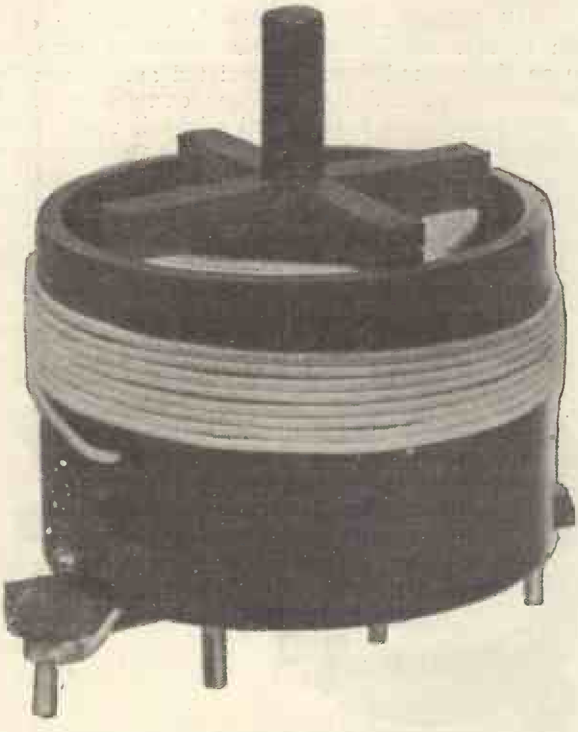
Loud-Speaker Requirements

With one stage of low-frequency magnification KDKA works a loud-speaker quite well during his "dinner hour" concert (commencing at 11.30 p.m., G.M.T.), slightly increased volume being obtained by the use of the big outdoor aerial with a .00005 μF air dielectric condenser in series. It would appear, however, that the best results would be obtained with a vertical wire about 35 ft. high, or perhaps higher if convenient.

Present Conditions

KDKA at the present time is very easily received, his transmissions being remarkable for their complete absence of distortion, the only trouble, in fact, being the regular and rapid fading which takes place.

With a supersonic receiver it seems that KDKA can be received at any time during his periods of working, the "children's hour" before the dinner hour



A nearer view of the aerial and secondary unit which shows that the thick wire used gives a spacing effect by virtue of its springiness.

programme having been listened to on several occasions with the arrangement described.

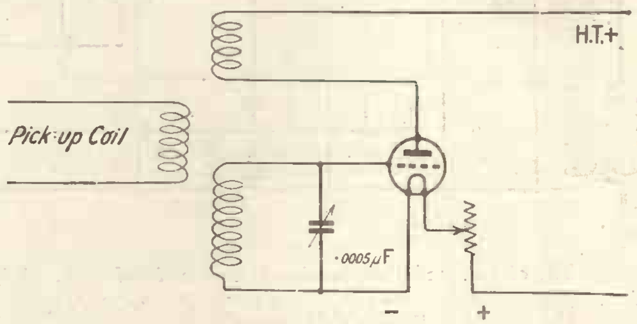
Ease of Operation

Tuning is delightfully simple, and hand-capacity effects are conspicuous by their absence. One point is interesting to note. On the ordinary broadcast band, with the particular receiver under discussion, the best results are obtained with the oscillator condenser set to the lower heterodyne position for any given station. On frequencies around 5,000 kc. (60 metres) the reverse is the case.

The valves used are as follows:—

First detector, D.E.5B. type, 50 volts H.T.
Oscillator, D.E.5 type, 30-45 volts H.T.
Intermediate stages, B.5 type, 45 volts H.T. and 1.5 volts negative grid bias.
Second detector, B.5 type, 45 volts H.T.
L.F. stage, D.E.5 type, 120 volts H.T. and 6 volts grid bias.

Other types of valves would probably work quite



The connections of the oscillator unit. The "pick-up" coil is the one connected in series with the grid lead of the first detector valve.

well, but the use of a low-impedance valve with a high emission seems to be important in the case of the oscillator.

Alternative Methods

It may possibly be thought that the construction of the oscillator coupler is a somewhat difficult matter, but this is not the case. It is not absolutely essential that the turns should be spaced on a threaded former, as shown, although the grooves certainly have the advantage of facilitating the adjustment of the number of turns, the 22 s.w.g. wire retaining its position without special precautionary measures, such as wax or varnish.

So long as the main dimensions are not departed from, ordinary double cotton-covered wire could be used without spacing, and, in addition, the gauge of wire need not be identical with that mentioned.

Plug-in Arrangements

The spacing of the pins on the base in the case of those for the grid and anode coils conforms to the usual standard valve socket arrangement, and the distances can be set off with the aid of a valve template. The pins for the pick-up coil connections may be spaced at some arbitrary distance from the centre of the base, the actual dimensions being relatively unimportant.

Alternatively, terminals could be used throughout, although such a procedure would, of course, make interchangeability difficult.

Pick-up Winding

The number of turns on the grid coil must be adjusted to suit the intermediate frequency transformers in use, those on the anode being such as to ensure steady oscillation over the complete range of settings of the oscillator condenser.

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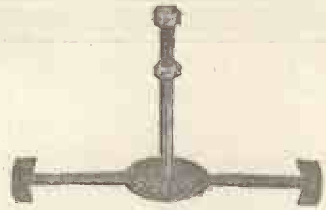

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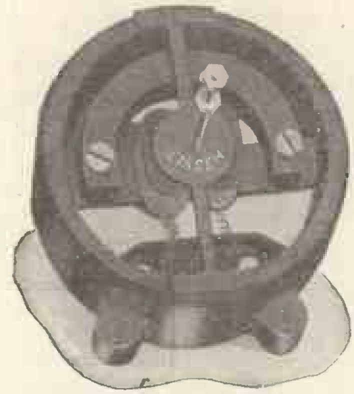

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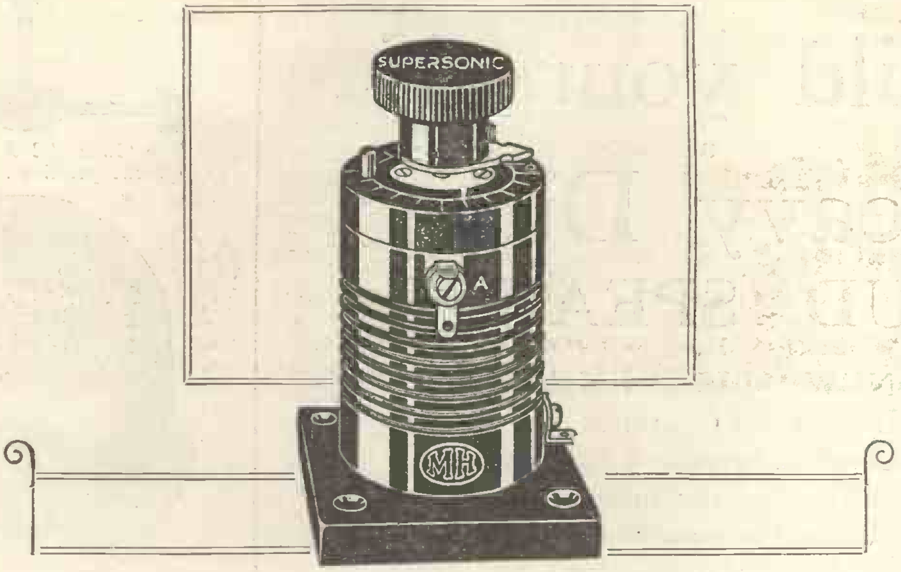

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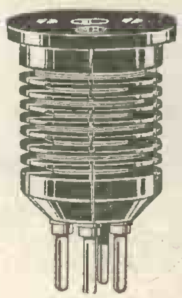

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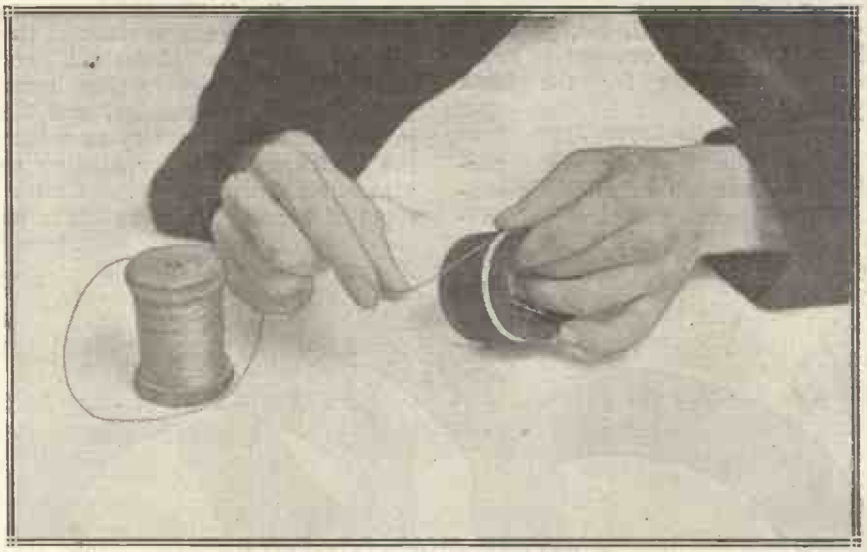
High-Frequency Chokes and their Construction

The H.F. choke is one of the easiest of all components to make, the simplest types of winding serving the purpose as effectively as the most elaborate constructions.

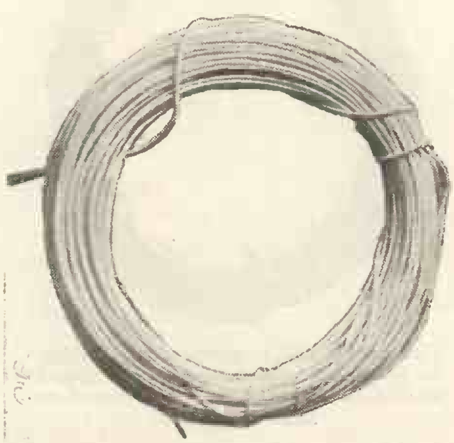


"A piece of tube, a small quantity of wire, and a little patience."

THERE seem to be quite a number of experimenters who would not hesitate to embark upon the construction of an elaborate multi-valve set, yet who regard a high-frequency choke as something rather mysterious which it is safer to buy, because they do not possess sufficient knowledge of correct turn numbers and construction to make it for themselves. As a matter of fact, of course, to construct high-frequency chokes for oneself is the simplest of matters; all that is required being a very general understanding of the principal requirements and the necessary shillingsworth or so of wire and a little patience.

The Requirements

The requirements in a high-frequency choke are simple: it must be of a sufficient inductance to provide the required impedance at the frequency at which it is to work, and its self-capacity must be reasonably low. The required inductance will, of course, vary according to the purpose to which the choke is to be put, and it will in each case be a *minimum* value above which no improvement results, and below which it is not advisable to go lest the choke loses its efficacy.



The simple hank coil is perfectly effective as a choke, and is particularly easy to wind and mount in the set.

Turn Numbers

To obtain an idea of the correct sizes of choke coils for various purposes, we will consider first what is probably the commonest application of the choke in amateur practice, viz., in a Reinartz circuit for reception upon the broadcast band of frequencies.

For this purpose a standard plug-in coil of 150 turns as a minimum will serve, a No. 200 being slightly to be preferred. Any larger size is satisfactory, but a greater inductance than that given by a No. 200 is not necessary. If these sizes are kept in mind, it will serve as a basis for comparison with the other types of coil which we shall be considering later.

The Simplest Construction

For the broadcast frequencies, then, at any rate in the Reinartz circuit, what we must do is to produce a coil having an inductance very roughly equivalent to that of a No. 200 standard plug-in coil wound upon some system which gives a reasonably low self-capacity. The simplest coil of all is, of course, that known as a "hank" winding, and it is easy to make one of these coils which shall be equivalent turn for turn to a standard plug-in inductance, by making it of the same mean diameter as the coil with which it is being compared. If the finished hank has a mean diameter of about 2¾ in., it will be found that if it is wound with 200 turns it will be fairly closely equivalent in inductance to a standard No. 200 plug-in coil, and this method of winding has the great attraction of simplicity and ease of construction to commend it. Hank coils can be quite easily wound by hand—that is to say, without the aid of any former—and the operation is rendered considerably easier if an assistant pays the wire off from the bobbin as winding proceeds.

A Surprisingly Efficient Coil

The hank coil is a surprisingly efficient one, in that its capacity is fairly low, and its high-frequency resistance is low compared with that of many more elaborate systems of winding. For radio frequency choke purposes upon the ordinary broadcast frequencies it is extremely convenient, since it is especially easy to mount in a set by fastening it down on the baseboard by means of a strip of ebonite through which a screw is passed at the centre. The winding of the coil is a simple matter by hand, as has been explained, but it may, if preferred, be wound upon an empty jam jar, the finished hank being slipped off when the winding has been completed, and bound with tape or merely with the ends of the wire to prevent it from coming adrift.

Low Resistance Unnecessary

The high-frequency resistance of hank coils is fairly low, as has been mentioned, but this is a point of minor importance in connection with chokes, and it may therefore be decided that the gauge of wire to be used may be dictated largely by convenience, and not by its effect upon the resistance of the coil. In general, therefore, it is customary to use quite fine gauges, regardless of the effect upon the shape or resistance of the coil, No. 30 or 32 double cotton covered being eminently suitable for the hank type.

The Single-Layer Type

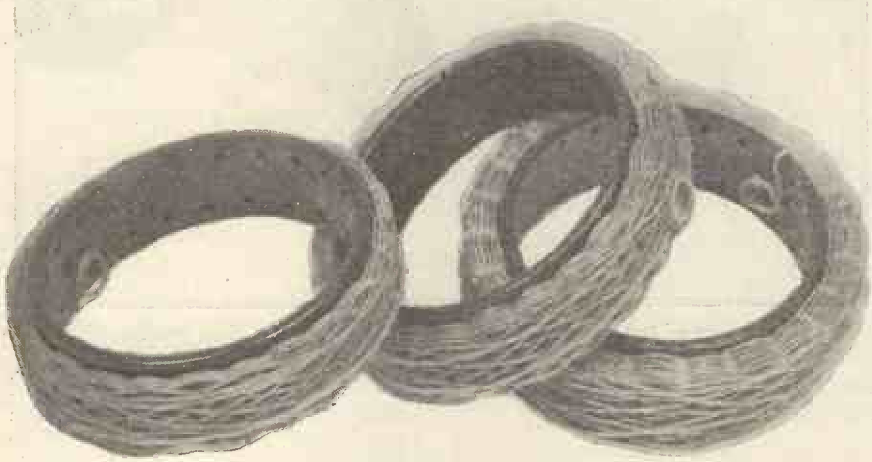
Those who like to make a particularly neat job of all their constructional work will be well advised to construct a single-layer choke, this also being a particularly easy type to produce. All that is required is a small piece of cardboard or ebonite tube, say, 2 inches in diameter, a small quantity of fine wire and the usual amount of patience. Really fine gauges of wire are suitable, say No. 32 or 34, preferably silk-covered in order that the finished winding may occupy as small a space as possible. Upon a 2-in. tube 300 turns are indicated. The necessary length of the tube should be ascertained by consultation of a turns per inch table, after a decision upon the gauge of wire to be used, which is largely a matter of the particular size which you happen to have available.

Other Types

For work upon the ordinary broadcast frequencies, as has been stated, almost any sort of winding will serve for a choke and any of the recognised types of multi-layer coils will serve, such as the lattice, honeycomb, slab, etc., and it is largely a matter of the particular kind of winding which the experimenter finds easiest to carry out. The number of turns for any given system will be very much the same provided that care is taken to arrange that the mean diameter of the turns of the finished coil shall be about 2¾ in., this being the standard figure for plug-in coils.

Short-Wave Requirements

For short-wave work the requirements in a choke coil are somewhat more severe than upon the broadcast frequencies, and the greatest care is necessary to reduce the self-capacity of the winding to reasonable proportions. Certain types of winding are therefore to be preferred to others, the single layer being probably the most effective and at the same time convenient to work with.



Those constructors who like elaborate work for its own sake may adopt any of the recognised types of multi-layer windings.

The number of turns required upon a choke for a short-wave Reinartz receiver is a somewhat variable matter and will rarely exceed fifty. The effect of the size of the choke seems a little indeterminate in short wave sets, since it certainly has an unexpected bearing upon the satisfactory operation or otherwise of the set, and also affects the frequency range to which the grid circuit of the receiver will tune. A certain amount of experimenting should therefore be regarded as necessary in any individual set, and for this reason it is sometimes recommended that a socket be provided for plug-in coils to be used, those of a really good make being quite effective for this purpose.

The Basket Coil as a Choke

An alternative to the single layer coil which is eminently suitable for short-wave choke winding is the basket. It is easily made in small sizes, only a few minutes being occupied in its construction, and it gives the required low capacity winding. It is preferably left "dry" and tied together with thread.

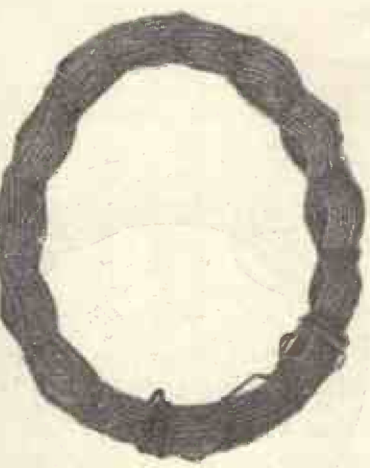
Transmitting Chokes

High-frequency chokes for transmitting purposes call for a good deal more care in design and construction than those used in a receiving set, since they have to carry more considerable currents and also they have to withstand high-frequency voltages of much greater magnitude. Their current-carrying capacity must therefore be adequate, and they must be capable of withstanding considerable voltages across their turns and between the ends of the winding.

The ordinary multi-layer types are therefore practically ruled out, and indeed they would in any case be unnecessary, in view of the fact that most transmission is done in these days on quite short waves, where only a small number of turns is required in the chokes,

Advantages of Single-Layer Chokes

It is probably easiest to make a really sound and reliable job with a single layer winding, but considerable care should be exercised in choosing a former upon which to wind the coil. Since it is remembered that one end of the coil may be at a very considerable high-frequency potential to earth, it is well to choose a material for the tube with reasonably low dielectric losses: some experimenters even go so far as to say that a skeleton former should always be used, and perhaps this is a wise course. Probably one of the best chokes can therefore be constructed by using a skeleton former such as one of those sold for the so-called "low-loss" coils, and winding this with the required number of turns of a moderately robust gauge of wire, say No. 24, preferably enamelled.



The basket coil is particularly suitable for short-wave work, and is very quickly wound in the small sizes needed for such a purpose.

G. P. K.

SHORT-WAVE Notes & News

THE writer of these notes suffered a severe shock last week when, less than twelve hours after writing " Short-Wave Notes and News " for last week's issue, he listened on the 6,667 kc. band. He had just made the statement that Transatlantic conditions were thoroughly bad, and that BZ-1AB had been the only station heard.

Immediately after, with the coming of the cold weather, they improved until they were better than the writer ever remembers them before. He logged eighty-five Americans in about an hour!

A Sudden Change

This was on Tuesday, January 12, and the good conditions held until the following Friday, when the American signals began to die away again. Several 5th district stations (chiefly in Alabama and Texas, nearly 4,500 miles distant) were heard at equal strength with the nearer East Coast stations.

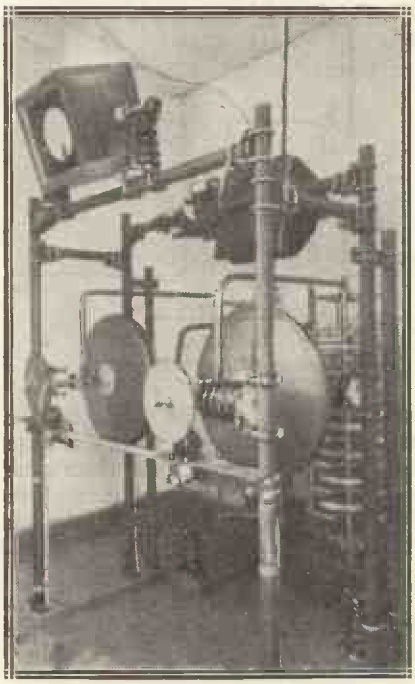
Apparently this bears out the remarks made some time ago about the relation between low temperature and good reception on the higher frequencies.

The Irish Intermediate

We have had a note from a reader to the effect that the Irish Free State uses the intermediate " GW," not " IR." He apparently has not seen the correction which appeared in an issue shortly after the list of intermediates was published. It is, of course, impossible to print a completely revised list for the sake of one altered intermediate. In this connection we should be glad to learn of the whereabouts of certain stations using the intermediate " NA." NA-1Q and NA-1G were heard on the afternoon of Sunday, January 17.

A Surprise

C-8AR, the only Newfoundland station working, startled Europeans recently by coming through at very good strength at about 18.00 G.M.T. He works on 6,667 kc. and sounds just like the European stations working on that frequency, except that he is, perhaps, a little stronger. He should provide a good " half-way " station for low-power transmitters who find it difficult to work the U.S.A. reliably. We hear that 2NM has already worked him, on telephony.



One of the special features of the new high power broadcasting station at Bound Brook, N.J., is the elaborate nature of the aerial tuning devices. The variable condensers are seen here, with the small electric motors used to control them from a distance.

Further Work with Panama

Several other stations have made contact with 99X (Cocosolo, Panama) mentioned in these notes a short time ago, among them being 2KW, who is putting out a signal worthy of his call-sign!

A Link with China

We hear from G-5KU that messages from China are apparently relayed to Europe with much greater ease, using New Zealand as an intermediate point, than by direct transmission. Two messages have already arrived via the route FI-8QQ (Saigon, Indo-China), Z-2AC, F-8JN, G-5KU, G-2NM. It is certain that the New Zealand signals are much more easily received in this country than those from any Chinese station that we have yet heard.

News from Palestine

Various stations with call-signs beginning with " 6Z " are now operating on Government work in Palestine. 6ZK and 6ZM are those most frequently heard, and they work with GHB and GHA (Malta). R.A.F. tests form a prominent part of their schedules, and they have already been heard in New Zealand.

2KF's Latest

2KF has worked Australian 5BG, of Dulwich, South Australia, this being A-5BG's first contact with this country. 2LZ worked him shortly after. 2KF has also worked O-A6N once again, and several new " O's " (South African) have been heard in this country.

Good Work in the Netherlands

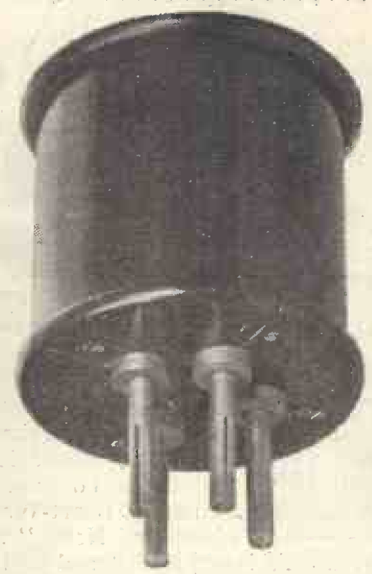
Some useful work has recently been done on the 6,667 kc. band by certain Dutch amateurs, who, calling in the services of other operators, have arranged almost continuous twenty-four-hour tests to attempt to determine the best time of the day for communication over a given distance. We hope to publish some definite data on these tests later.

QRA's FOUND AND WANTED

Exigencies of space compel us to hold over this week's list of addresses.

AN IMPROVISED APERIODIC TRANSFORMER

The semi-aperiodic type of H.F. transformer receives very little attention nowadays, but for certain special purposes it is quite a useful component.



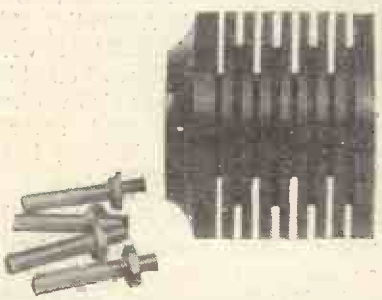
The starting-point is any standard plug-in transformer.

PRESENT-DAY tendencies in development of high-frequency amplification run mostly in the direction of tuned stages, with or without some scheme of negative reaction to prevent self-oscillation, and we are rather apt to forget another system of coupling which has in certain cases some very solid advantages. The system of coupling referred to is that which employs an aperiodic (or, more correctly, semi-aperiodic) transformer.

The principal attraction about these semi-aperiodic methods of intervalve coupling is to be found in the fact that with their aid a stage of high-frequency amplification can be added to a receiver without adding another tuning control, and a particularly useful application of such untuned intervalve couplings may be found in the superheterodyne receiver.

Application to Superheterodynes

A superheterodyne, of course, in practically every case, already incorporates two tuning controls, which are, as a rule, particularly critical, and the addition of a third tuning control for the purpose of securing a stage of high-frequency amplification in front of the first detector is not desired by many experimenters. Under such circumstances considerable benefit can still be obtained by adding a high-frequency stage coupled by one of the untuned methods, and the transformer type is convenient, since it is very easily made interchangeable, and therefore is flexible as to frequency range.

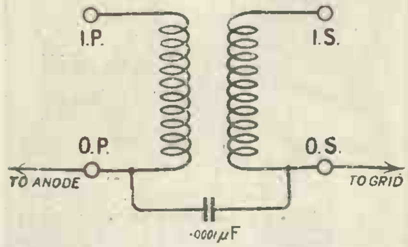


The first step is to take out the pins and remove the existing winding.

The Starting Point

Most of us have lying about one or two of the standard tuned type of high-frequency transformers, and with the aid of one of these a very effective semi-aperiodic type can be improvised, the result being to give the desired interchangeability without any constructional work upon the part of the experimenter.

To convert one of the standard tuned types of H.F. transformers to the semi-aperiodic variety, it is only necessary to rewind it with a suitable number of turns of fine resistance wire, and for the purpose No. 40 single silk-covered Eureka or similar material will suit quite well. It can also be done by the use of a still finer gauge, say No. 42 or 44, of copper wire, but since such wire is considerably more difficult to wind, the resistance variety is recommended.



The scheme of connections recommended.

Rewinding

Rewinding one of these transformers is usually quite a simple matter. First take out the pins, and then it will generally be found that the beginning and end of the primary and secondary windings can be identified quite easily. Start unwinding the secondary from the finishing end, and carefully count the number of turns in each slot. Next remove the primary winding, again counting the turns and preserving the two lengths of wire so obtained, in case it is ever desired to rewind the transformer for its original purpose.

Turn Numbers

It is next necessary to decide upon the number of turns for the new windings, and this will depend upon whether it is decided to produce a coupling unit which is intended to cover the whole of the broadcast band, as in the case of the original tuned transformer, or whether it is decided to use two transformers, one for the upper part of the band and one for the lower. The latter course is recommended.

Use of One Unit

However, it is quite possible to obtain very fair results with only one transformer, and if it is decided to use one only, the number of turns which was found upon the original transformer should be increased by 60 per cent. of both primary and secondary, and this new number used in winding on the resistance wire. For example, a popular make of transformer carries 40 turns in each slot for both primary and secondary, and this will therefore be increased to 64 turns in each slot. The new windings should be put on in exactly the same way as the original ones, the primary winding going in first, its starting end being secured under the appropriate pin (which is, of course, screwed back into the former before commencing to wind).

Turn Numbers for Two Units

If it is desired to use two transformers, one for the higher part of the frequency band employed for broadcasting, say, between about 1,200 and 800 kilocycles, and another for the range between 800 and 500 kilocycles, the first should have 50 per cent. more turns than the normal tuned transformer for the 1,000- to 500-kilocycle range (300-600 metres), and the second one 100 per cent. more turns.—G.P.K.

OPERATING YOUR SET

This week's notes will be found helpful by everyone who has discovered the difficulty of re-capturing a distant station without the aid of a calibration chart.

THE calibration of the apparatus which is to be used for actual reception, as distinct from the calibration of wavemeters, is a subject which has not received much attention. Readers of *Wireless Weekly* will by now be familiar with the Radio Press calibration scheme arranged for their benefit, and no doubt many have taken advantage of the tests so far carried out, and have noted on the tuning dials of their apparatus the correct settings for various broadcasting stations.

Wavemeters

The calibration of wavemeters is a fairly straightforward operation, whatever method is adopted. They are normally constructed with a fixed inductance and a variable capacity, or *vice versa,* for each range of frequencies, so that there is only one variable quantity to be checked.

In a receiver, however, calibration is likely to be more complex. Such accuracy as is possible with a wavemeter can hardly be expected with an instrument which has two or more variable tuning controls in it, and these not infrequently interdependent for different frequency settings.

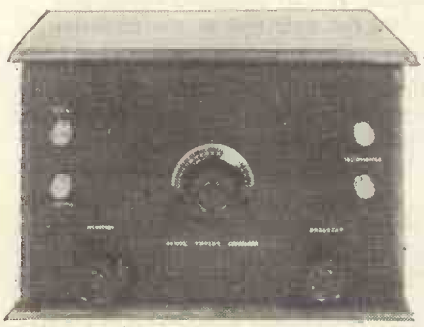
It is proposed to indicate this week the types of receivers which may be calibrated with reasonable hopes of success, and the methods which may be adopted for simple and also for more elaborate instruments.

Single-circuit Receivers

Consider first of all the "straight" single-valve circuit, with direct aerial coupling and variable magnetic reaction. Here there are normally two variables, the tuning condenser and the reaction coupling, and variations of the latter will have some effect on the setting of the former. These variations, however, provided that the aerial system and the H.T. and L.T. values are unchanged, will be fairly constant; that is to say, that the same settings of coil coupling and condenser dial will always tune the circuit to the same frequency.

Approximate Calibration

It will be readily apparent, however, that these settings will not be reproducible with any great accuracy unless a scale of some sort is fitted to the coil-holder, and special precautions are taken to ensure constancy of H.T. and L.T. values.



When the set possesses only one dial, calibration is a very simple matter, but the presence of a reaction control introduces a source of considerable variation.

An approximate calibration chart may, however, be drawn for the receiver, giving frequencies within a few degrees. The approximate frequency range covered by different sizes of coils may also be ascertained, so that the calibration of such a receiver is quite worth carrying out as a rough guide to the correct settings for stations.

"Reinartz" Circuits

Receivers using one of the forms of "Reinartz" circuit are simpler to calibrate. In them the second variable, in addition to the tuning condenser, is the condenser controlling reaction. For the mere mechanical reason that this is fitted with a dial the repetition of settings is simplified. A greater advantage is that variations of this capacity control of reaction do not usually have so much effect on the setting of the main tuning condenser. A certain amount of interaction between the variable condensers must be expected.

Short-wave Difficulties

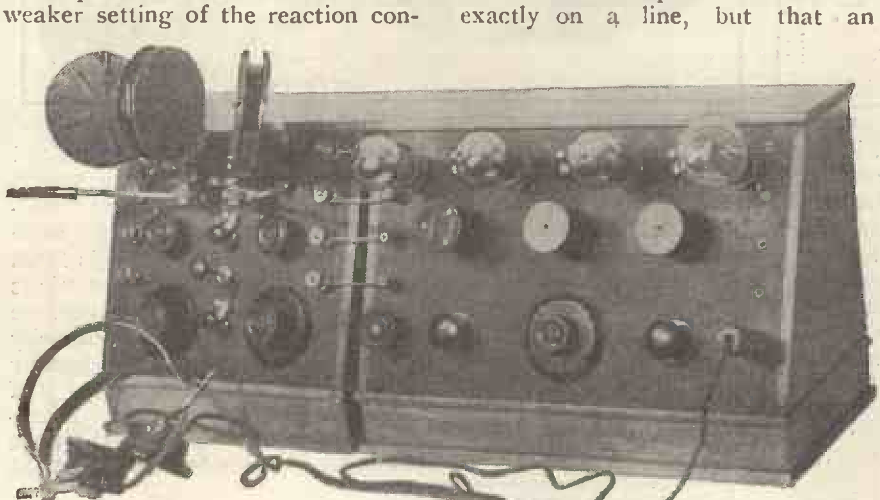
At the higher frequencies it is not unusual to find that a receiver will not oscillate readily at certain frequencies, either because of the natural frequency of the aerial system or for other reasons. At the corresponding points on the tuning condenser scale, the reaction condenser will naturally need to be turned further towards its maximum end to approach the oscillation point or actually to produce oscillations. This will render necessary a further readjustment of the tuning condenser.

Effect on the Chart

The result of these special adjustments at certain points on the tuning scale will be to make any calibration chart that is drawn far from straight. It will not be sufficient under such conditions to note the readings for stations at the upper and lower ends of the scale, plot frequency (or wavelength) against dial settings, and join the extreme points with a straight line (a square law condenser is assumed). It will be necessary to check the calibration of the whole scale by noting the settings for a number of stations, and securing some accurate check on their frequencies.

Variable Factors

It is important to note that for accuracy in the calibration of either a wavemeter or a receiver the high-tension and low-tension values must be kept reasonably constant, and the same valve should be used. The substitution of a different type of valve for that used when the receiver was calibrated is likely to upset the readings altogether, even to render them practically valueless. Similarly, an increase in anode voltage or filament current will generally lead to the production of oscillations at a weaker setting of the reaction control, thereby rendering the calibration chart inaccurate.



With multi-valve receivers the first step is to decide which of the circuits is likely to maintain a constant calibration. It will usually be sufficient for practical purposes to make out a chart for only one of the circuits.

Multi-circuit Receivers

In receivers of a more complex type than those discussed so far, such as those employing one or more stages of high-frequency amplification, more accurate calibration is often possible. The first step is to decide which of the various circuits is likely to maintain its calibration most constantly, and this choice will depend largely upon the method of reaction control employed. For example, in a receiver incorporating one stage of tuned anode coupling with reaction upon the aerial, the anode circuit is the one to calibrate, since there are relatively few factors to upset the readings, these being mainly changes of valve, H.T. and L.T. supply.

Taking the Readings

Having decided upon the circuit to be calibrated, a number of stations of known frequencies are tuned in and identified, and the settings of the chosen circuit recorded. The calibration chart is then prepared by making a vertical scale on squared paper to represent either wavelength or frequency and another horizontally to represent dial reading. If the readings taken are then plotted a line will result which should be more or less straight, if a square law condenser and a scale of wavelength or a straight line frequency condenser and a scale of frequency has been used.

Divergences

As a matter of fact, if stations well distributed over the dial have been recorded, it will probably be found that the points do not fall exactly on a line, but that an "average" line can be drawn such that they all fall fairly close to it, some diverging slightly on one side and some on the other.

Using the Chart

Once such a chart has been made it will be found almost as useful as a wavemeter, since intermediate frequencies or wavelengths can be read off the line which has been drawn, the condenser set to the reading indicated for the station it is desired to hear, and then the other dial can be revolved until the station is picked up, any slight readjustment in the calibrated circuit then being made to give the best signals.

The Aerial Circuit

The readings of the aerial (or secondary circuit) condenser may, of course, also be recorded for future reference, or a second chart may even be made out, but this is not recommended, since *one* calibration chart for a two-circuit receiver is usually all that is required.

Three-circuit Sets

In sets employing three tuned circuits the same procedure of tuning in stations of known frequency is followed at various points upon the band over which it is desired to make a chart. In this case, however, it will usually be desirable to calibrate two of the circuits, and sometimes even all three. This latter course is recommended in sets such as the various neutrodyne designs incorporating two stages of H.F. amplification, since here there are often no variable couplings, reaction or other, to upset the calibration subsequently.

A Warning

Remember, however, that such sets are particularly sensitive to changes of valves, etc., and also that readjustment of the neutrodyne condensers will likewise upset the calibration somewhat.

A point which should be mentioned in connection with the making of calibration charts is that square-law condensers only give a true straight line characteristic when used in a circuit with certain definite stray capacities, coil capacities, etc., and therefore slight divergencies from the theoretical graph must be expected. These are usually most noticeable below about 30 degrees on the dial scale, and it is not, as a rule, worth while to carry the calibration down below that point.

Frequency Charts

If it is preferred to make out the calibration chart in frequencies, the same method of plotting the chart will obtain, except that the dial readings (with most dials) will, of course, be reversed, larger scale readings meaning lower frequencies and *vice versa*. The same precaution relative to the lower capacity end of the scale should also be observed. Only with specially-designed coils and condensers is it possible to obtain a straight line over the whole scale.

TRANSATLANTIC BROADCASTING TESTS

An addition which should be made to the table of stations given on page 670 of this issue is Berlin, which will take part in the tests on January 26, 28 and 29, at 594 kc. (505 metres).

Among the American stations, we are informed that WBOQ and WAHG, both at Richmond Hill, N.Y., will be working each night of the tests at frequencies of 4,762, 1,271 and 949 kc. (63, 236 and 316 metres).

THE COLVERN SELECTOR LOW LOSS
Reading to 1,3,600th capacity
Capacity—
·0005 mfd. - £1 1 0
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One hole fixing.
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Descriptive Folder upon request.

COLVERN INDEPENDENT. VERNIER Price 2/6
Ask your dealer also for the Colvern Low Loss Coil Former Price 6/-

enables calibration and relocation to a high degree of accuracy!

CALIBRATION with certainty to the 1,000th part of the variable capacity. This is the tuning efficiency obtained with the Colvern Selector. The complete circle of the dial is divided to provide a value of 100 degrees for every rotation of the index. Pre-supposing your condenser and inductance to cover 300 metres, the degree interval represents .3 metres — obviously every station can be calibrated definitely.

The Colvern is logically the only condenser worthy of the attention of serious experimenters. An insulated spindle reduces the effect of hand capacity to a minimum, a point of paramount importance in the reception of distant signals

See the Colvern at your dealer's!

THE COLVERN LOW LOSS SELECTOR
(Geared 20-1.)

COLLINSON PRECISION SCREW Co., Ltd.,
Provost Works, Macdonald Road, Walthamstow, London, E.17.
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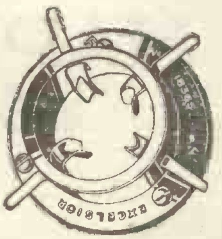
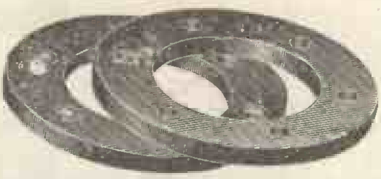


EXCELSIOR
ANTI-CAPACITY
VALVE HOLDER

This holder, for which we are Sole London Distributors, dispenses with screws and pins as contact points, the valve legs being secured in 4 U spring pieces which have on each end a soldering tag. The centre is air dielectric. The metal valve body is kept well away from the contact spring by the high rim of the valve holder, thus keeping capacity down to a minimum.

No. RV40/19 Type D8 Panel Mounting 1/- each.
RV40/20 ,, D7 Baseboard ,, 1/- each.

EBONITE COIL FORMERS
LOW LOSS



A distinct advance on the old style former and one that will immediately appeal to amateurs and experimenters. 6 lengths of screwed rod and 2 end discs comprise a complete former. The screwed rod ensures accuracy in winding and spaces each turn from its neighbour.

EBONITE SCREWED RODS

No.
RC35/7 4 in. length 6d. ea. RC35/9 7 in. length 10d. ea.
RC35/8 6 in. ,, 8d. ea. RC35/10 9 in. ,, 1/- ea.
Ebonite Discs RC35/6 3 in. or 4 in. diameter 7d. per pair.

Please order from your Local Wireless Dealer.

Brown Brothers Limited
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THOMSON AND BROWN BROTHERS LTD
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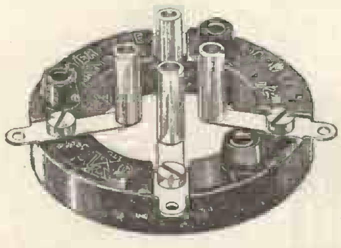
Valve Power

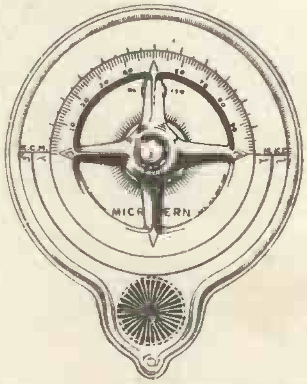


Low loss, shock absorbing, non-microphonic and universal fitting, the Antipong Valve Holder gives your sets more valve power and saves your valves from accidental shocks and jars. Costing so little it adds much to the strength and purity of your signals. Fit Antipong in all your sets.

BOWYER-LOWE
ANTIPONG
VALVE HOLDERS

Obtainable from good dealers everywhere, or **3/-** *direct from Bowyer-Lowe Co., Ltd. - Letchworth*

The elegant Tuning Dial— *the Microvern*



Modern wireless construction demands that elegance shall be the keynote of the finished set—nothing showing but a dial or dials. A mere "knob and dial" is not sufficient—it must provide for vernier control and the recording of stations. The Igranic - Pacent Microvern—is standard equipment on many of the most famous receivers in the world—because it is the most elegant and practical dial.

It is a combined operating knob and vernier control. Fitted with a slow motion mechanism having a reduction ratio of 5 to 1, possessing unique features. No gears are used and there is no backlash or alteration to tuning when the hand is removed from the knob.
The outside diameter is 4¾in. and the dial acts effectively as an electrostatic shield, preventing hand capacity effects.
Stations can be recorded with pencil by name, wavelength or frequencies and the records easily and cleanly erased with a damp cloth.

Price (Gold or Silver finish) - 8/6.

The Igranic-Pacent Microvern is one of the famous Pacent Radio Essentials of which Igranic Electric Co., Ltd., are now exclusive manufacturing licensees. We will be glad to send you the Igranic–Pacent List, P.28 on request.

Exclusive Manufacturing Licensees of **IGRANIC ELECTRIC COMPANY LIMITED** *PACENT Radio Essentials.*

149, Queen Victoria St., London. Works: Elstow Road, Bedford.

Wireless News in Brief.

International Broadcasting. We gather that great enthusiasm is being shown by the listening public in America over the Trans-atlantic Broadcasting Tests which are now in progress. Large prizes are offered to successful listeners in the many competitions which have been organised. In last year's tests over 15,000 American listeners reported reception of overseas broadcasting stations, and it is expected that this number will be greatly exceeded this year.

* * *

"Beam" Wireless. According to a statement by the Marconi Company, the beam stations which the company is erecting for the British Government and for the Governments of the Dominions and India, are making satisfactory progress. The completion of the Canadian and South African stations has been delayed by the illness of Senatore Marconi and Mr. Franklin, but since the work of construction commenced, Senatore Marconi and his staff have been able to make some important improvements in short-wave communication which are to be embodied in the new stations.

The beam services between this country and South Africa and Canada should be ready for working in April next, and the services with India and Australia will be in operation about the middle of August. The company is also constructing stations connecting Portugal and her colonies, and linking up Portugal with the rest of the world.

* * *

Marconi Contract. The Peruvian Government has ratified the contract with the Marconi Company for the administration of the Peruvian posts, telegraphs and wireless for twenty-five years. A construction programme has been initiated, involving the expenditure of £500,000, and including the erection of a beam station to communicate with the United States, Argentina, Brazil and Chili.

* * *

Wireless on Trawler. The second largest French steel trawler, the *Neptunia*, was launched recently from the Ouse shipbuilding yard at Selby, the vessel's owners, a Havre company, fitting the latest wireless equipment with 3,000 miles radius, so that her owners can keep in touch with her during her journeys of six weeks to the Grand Banks and White Sea.

* * *

Ether "Trespassing." An important step has been taken by the United States Government in ordering proceedings to be instituted against the Zenith Radio Corporation, Chicago, for working on a frequency other than that allotted for its use. When the Zenith Company applied for a licence, they were informed that no separate frequency was available, and they were given permission to share a frequency with a Denver station. Recently the Zenith Company commenced broadcasting on a frequency allotted to Canada, but hitherto unused. The forthcoming action will be the first test of the Government's power to regulate frequencies.

* * *

Line Breakdowns. Wireless has proved itself a useful auxiliary service to the ordinary telegraph in many places during the last few weeks. During one day recently the great French station at Saint Assise transmitted 32,000 words to London and other places when the ordinary telegraph lines were under great pressure owing to breakdowns.

* * *

"Wired" Wireless! The Hague telephone administration has succeeded, after many experiments, in working out plans for a system which would enable telephone subscribers to be supplied direct with wireless programmes. We understand that the Municipality will shortly decide whether the scheme will be carried out.

* * *

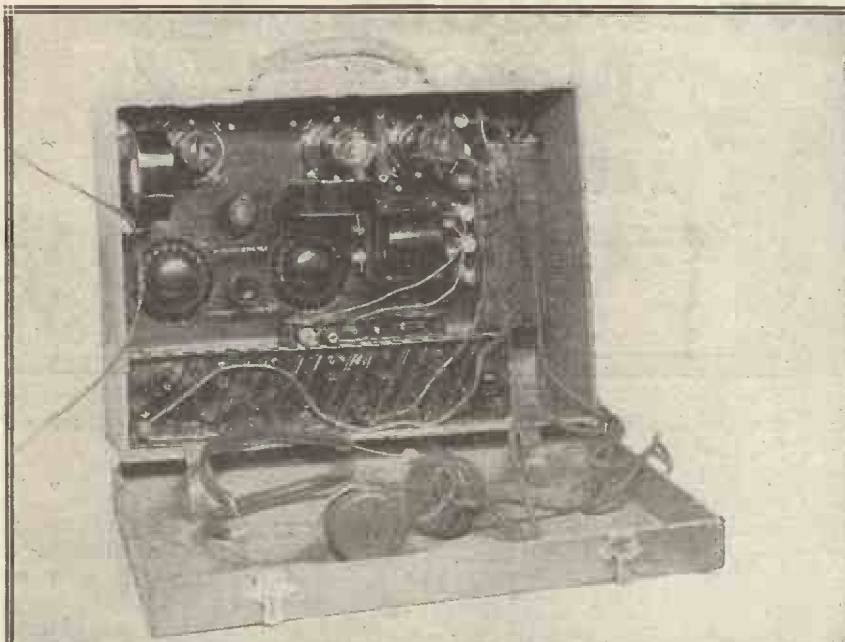
New Foreign Services. Wireless telegraph services have now been inaugurated by the Marconi Company between Great Britain and Jugo-Slavia and Bulgaria.

* * *

That Joke. A considerable amount of alarm, and subsequently criticism, followed the simultaneous broadcasting of a humorous news bulletin by Father Ronald Knox. The bulletin centred mainly around a revolution of the unemployed in London, and several listeners who missed the preliminary announcement that the item to follow was not to be regarded seriously, were much alarmed by the reports they heard.

* * *

Ship Wireless Strike. We learn that the Ministry of Labour has refused the application of the Association of Wireless and Cable Telegraphists to hold a Court of Inquiry into the strike of sea-going wireless operators. In the reply it was stated that the main object of a Court of Inquiry was to provide a means by which the public may be informed of the causes and circumstances in which a trade dispute is likely to arise or has arisen.



Mr. Harris has designed a number of successful portable sets, the one illustrated being described in "The Wireless Constructor" for May, 1925.

Designin[g]
Season's P[...]

By PERCY W. H[...]

Those of us who design our own [...] the commencement of the work [...] points out that the present time i[...] start, and in this preliminary artic[...] a number of the [...]

WHEN this article appears you may be looking out of the window on a snowy waste, or, more likely, on a far less inspiring vision of slush. In any case, you may wonder why the present moment has been chosen to publish an article on the design of a portable receiver—surely a type of instrument for bright, warm and sunny days. The truth of the matter is that we usually start our work on portable sets much too late in the season. Naturally, when a man builds a portable receiver from a finished design, there is still much time to spare before he need commence activities, but the experimenter who likes to work out his own salvation, and who desires to try a number of experiments before finally deciding on his summertime receiver, can find no better time than the present in which to start.

The First Essential

The first requirement of a portable set is that it should be portable! This fact is so obvious that it is all too frequently ignored. I have seen and handled (or tried to handle) many a so-called "portable" receiver which was far heavier, bulkier, and generally more unwieldy than many a set for which no claim to portability is made. It cannot be too strongly emphasised that the construction of a portable receiver does not merely consist of assembling a number of components, together with a unspillable accumulator, in a heavy leather suit case.

Circuits for Portable Receivers

Provided we have in mind exactly what we require, there is no great difficulty in choosing the circuit. The circuit can be considered under the three headings of "straight," reflex and superheterodyne. The straight circuit is always with us; the reflex has waned in popularity considerably since really efficient dull-emitter valves have been available, while the superheterodyne is really the only portable receiver that can be satisfactorily used with a frame. Which of the circuits to use will largely depend upon whether we are "out for" the local station only or desire to seek further afield; whether or not you are able to use an aerial of reasonable size other than the frame, and whether you desire to use telephones or loud-speaker.

Portability, Bulk and Weight

I have seen "portable" sets which, with the aid of a strong assistant and a good heave, can just be lifted into the back seat of a car, and I have also seen a "portable" which will fit into a space no larger than that of a small attaché case. Alternatively it is possible to obtain a reflex superheterodyne in portable form with batteries and built-in loud-speaker, smaller than the average week-end case.

In arriving at our design we must also consider whether the reduction of bulk is a desirable objective, and whether, apart from size, weight is any special consideration. Obviously the cyclist who desires to attach his portable set to his machine will consider matters from a different viewpoint from that taken by the motorist with a large and powerful car. Boy Scouts—and there exist no keener devotees to the art—will also be vitally concerned in this question of weight.

Valves

It is often forgotten that a great proportion of the total weight of a portable receiver is taken up by the case itself and the batteries. Dry cells do not always effect an economy in weight or bulk, and a suitable small portable and unspillable accumulator to run, say, three two-volt valves will occupy less space, and will certainly weigh less than the necessary dry cells to run three .06 ampere dull emitters. It is therefore wise to decide quite early the kind of valve we propose to use, so that we can consider the battery problem in its right proportions.

Battery Life

A number of lengthy tests have shown that a longer life is obtainable from dry cells of the ordinary

ng Next
ortable Set

ARRIS, M.I.R.E.

able set each year are apt to leave il the spring arrives. Mr. Harris by no means too early to make a gives some valuable assistance upon nts to be decided.

bell-ringing size when the current taken from them is in the neighbourhood of $\frac{1}{4}$ ampere, but in portable sets efficiency of discharge of batteries has often to be sacrificed to obtain portability. Be careful when choosing your valves to take only those which require a relatively small anode voltage for satisfactory working.

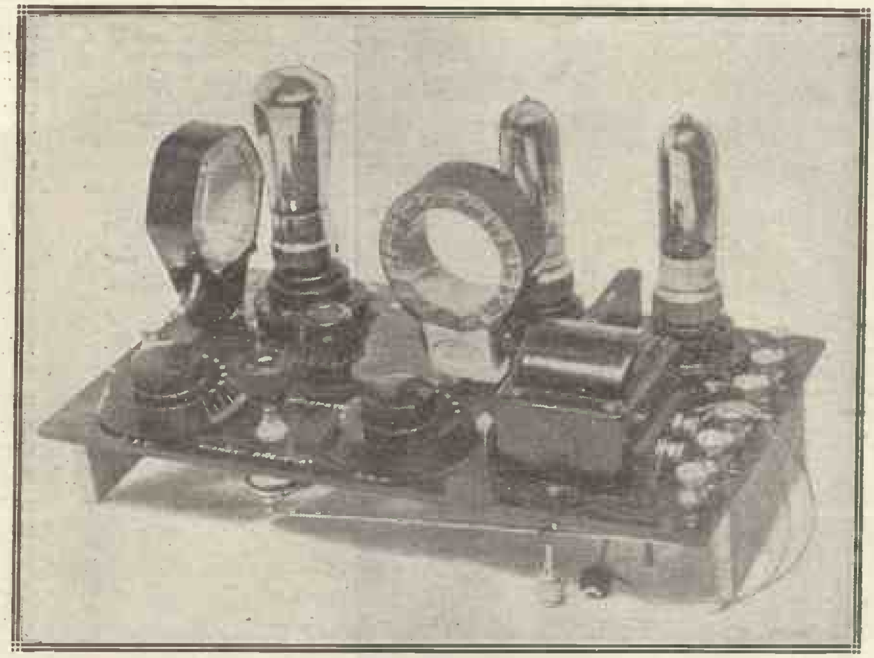
If note magnifiers are used, aim at getting a high efficiency per stage. It is the additional weight of high-tension battery necessary to give adequate signals that rather rules out the resistance-capacity method of low-frequency coupling in portable sets.

Circuits for the Local Station

If the local station only is desired there is a great deal to be said for a detector and two transformer-coupled note magnifiers, using two-volt valves with a small unspillable accumulator and Reinartz reaction to bring the detector valve up to its most sensitive state. A 60-volt high-tension battery and 10-ampere hour (actual) unspillable accumulator will serve admirably in such a case.

Reinartz reaction has the merit of being very nice to control, enabling the valve to be worked reasonably near to the oscillation point, so as to get good amplification without the inconvenience attending the usual form of magnetic reaction and its plug-in coils and coil-holder.

Very compact variable condensers can now be obtained, and the coils can be of basket pattern supported just underneath the panel. If, in addition to this, fairly flat L.F. transformers are used, such as



This set was so designed as to be entirely independent of its carrying case, into which it fits in the manner illustrated on the opposite page.

those made by Messrs. Gambrell, C.A.V., and others, the total depth of the instrument can be made quite small.

H.T. Economy

The .06 ampere type of dull emitter is frequently chosen for portable sets, owing to its small demand in the way of filament current. An advantage sometimes overlooked is that these same valves make a very small demand upon the high-tension battery. In my experience it is difficult to get satisfactory loud-speaker reproduction at any volume with such valves (although it is by no means impossible), and if small current consumption is a desideratum it is preferable to substitute for the last stage one of the small power valves designed to use only .12 ampere or so.

Built-in Loud-Speakers

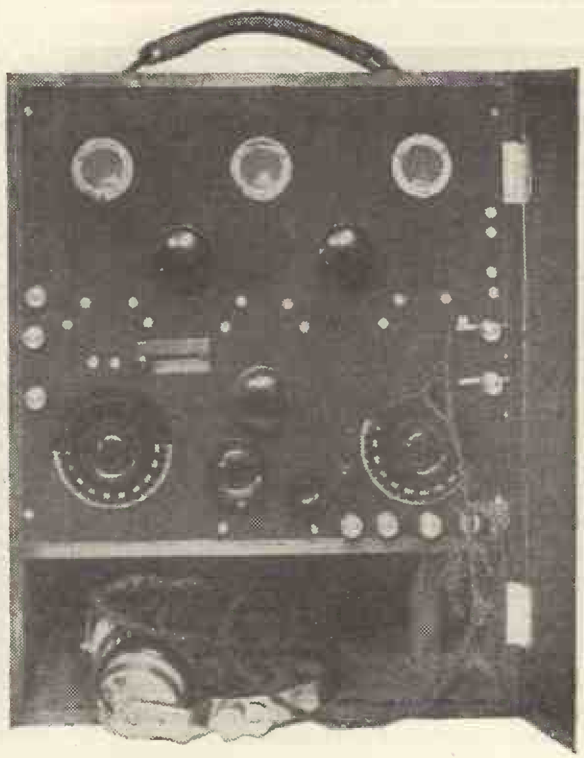
Probably the majority of portable sets are made to use with loud-speakers, and there are considerable advantages in using a set in which the loud-speaker is an integral part of the design. Fortunately there are now available a number of small loud-speakers, such as the "Ultra," hornless, the "Beco," and others, which take remarkably little space. When the utmost compactness is required, good use can frequently be made of the small loud-speaker horn sold by the American Hard Rubber Co., under the name of "Radion." It is a remarkably compact little horn, and a single telephone ear-piece can be fitted at the smaller end, thus providing the necessary sound-producing mechanism.

Choice of Components

It goes without saying that shock-absorbing valve sockets will be used in all portable receivers, as they considerably increase the length of life of the valves, and at the same time if the valves are at all microphonic it will make the receiver much more pleasant to handle.

Variable condensers should be very carefully chosen, as there is a wide difference in size between the various makes. The most compact of all variable condensers are those made with the moving and fixed plates within the dial itself. The "Dial-o-densor," made by Portable Utilities, Ltd., is an example of such an instrument.

Space can be saved without any loss in efficiency by mounting the valve sockets in such a way as to place the valves parallel with the front or back of the panel. Quickly detachable connections are often an



A portable set in a specially designed cabinet, described by Herbert K. Simpson in the July, 1924, issue of "Modern Wireless"

advantage when a set has to be used with an outside aerial and earth. "Newey" terminals are very useful in this connection.

Using Car Batteries

If the set is to be used with a motor-car an appreciable weight can often be saved by dispensing with the low-tension accumulator or dry cells and making connection with the car batteries. This, however, requires some thought if it is to be effected properly. Most American and many British cars have six-volt lighting systems, although a number of British and Continental cars use 12 volts. It is inadvisable for any but skilled electricians to tamper with the accumulator connections on a car, but if a six-volt system is in use a small connector can be inserted in one of the lamp sockets (the socket of an inspection lamp is very convenient). Be particularly careful in such cases to see that suitable filament resistances are used. The ordinary dull-emitter filament resistances designed for use with .06 ampere valves are made for use with four- and not six-volt accumulators. I do not recommend the use of 12-volt lighting sets for wireless purposes, and, in any case, remember that the engine must be stopped before any such connections are made.

Eliminating Coil-Holders

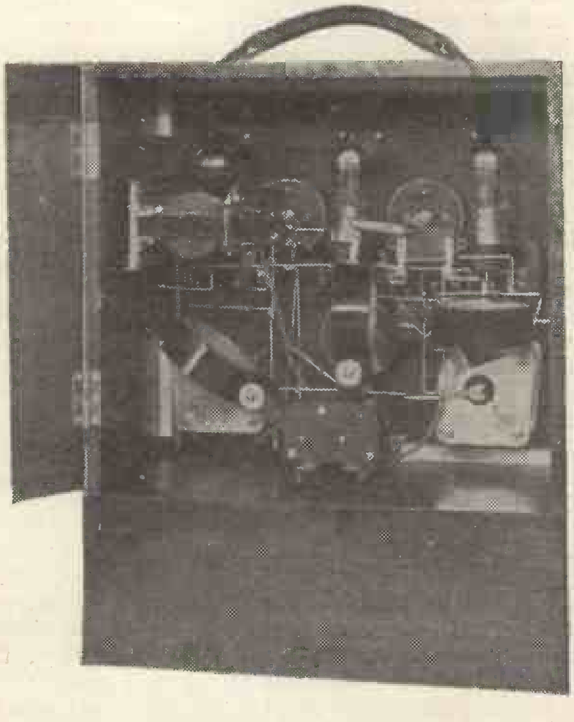
It is a great convenience when designing a portable set to use some circuit which does not require the conventional two-coil holder, as this, with its accompanying coils, take up a considerable space. This is one of the reasons why I favour the Reinartz type of reaction in the portable set, for the tuning coils are then fixed in relation to one another. If high-frequency amplification is used, the tapped anode coil designed for such purposes by several firms will be found helpful, as it takes comparatively little space, and obviates the necessity of carrying a number of different tuning coils for the anode circuit when a wide wavelength range is desired.

Other Components

The ordinary small components, such as fixed condensers, grid-leaks, etc., require no special mention, except that particular care should be taken to see that the grid-leak is securely fixed. Nothing is more annoying than to find that one cannot get signals owing to the fact that the grid-leak has dropped out of its clips, thus requiring the removal of the panel before one can remedy this matter.

Wiring Up

Considerable experience in portable sets has shown me that for wiring up the square bus-bar wiring method should *not* be used. It is peculiarly susceptible to troubles due to vibration, and joints soon come unsoldered. The use of flexible tinned copper wire, rather thin, and sleeved in insulating tubing, is unquestionably the most practical solution of the problem.

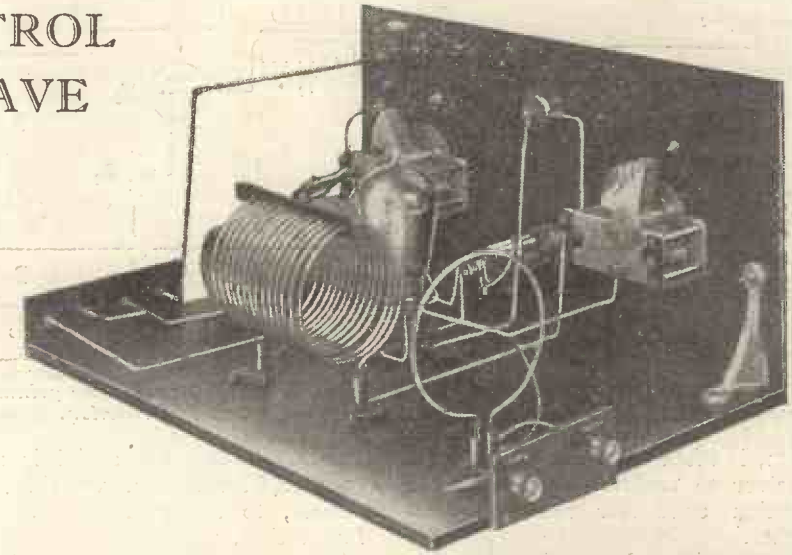


A considerable part of the time spent in designing a portable set should be devoted to the placing of the components in the minimum space.

REACTION CONTROL AND SHORT-WAVE RECEPTION

By L. H. THOMAS.

One of the secrets of success in short-wave work lies in the provision of a suitable method of reaction control.



ANYONE who has constructed a short-wave receiver to his own design has probably found out, before he has been operating the set for long, that certain methods of controlling reaction, though possibly quite satisfactory (or not noticeably unsatisfactory) on the broadcast frequencies, are quite unsuitable for use at the "ultra-high" frequencies.

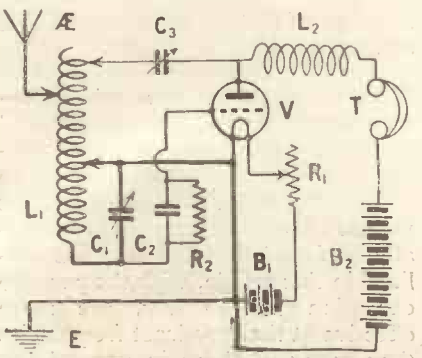


Fig. 1.—A common form of the Reinartz circuit re-drawn to show how the position of the reaction condenser gives rise to hand-capacity troubles.

A Popular Circuit

Probably the circuit most used for short-wave reception is our friend the "Reinartz," of which a form is shown in Fig. 1. Here the reaction control is effected by a variable condenser connected between the anode of the detector valve and a point on the inductance; in fact, it may be said that, roughly speaking, one side is connected to the anode and the other to the aerial. Put in this form, one disadvantage is obvious, namely, that neither set of plates is earthed, and therefore the value of the condenser cannot be altered without somewhat severe hand-capacity effects.

An Improved Form

Fortunately there is a simple remedy for this, the circuit being modified so that, instead of one inductance coil, there are two, with the reaction condenser between them, one side of it then being at earth potential. Incidentally, the writer prefers this arrangement for another reason, namely, that the two coils may be arranged so that the coupling between them is variable.

Removing "Dead Spots"

This is quite an advantage in cases where "dead spots" are present on the ordinary capacity control. Fig. 2 shows the modified circuit, and the coils may be of the interchangeable variety (this not necessarily implying that the standard plug and socket should be used).

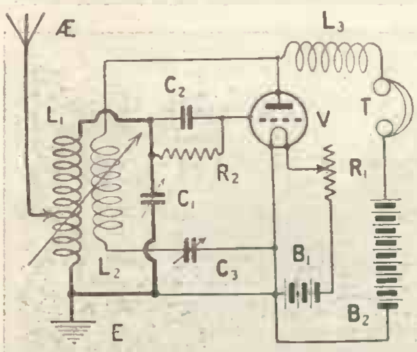


Fig. 2.—By using an entirely separate winding, one side of the reaction condenser can be placed at earth potential.

Aerial Coupling

In this case it will generally be found best to attach the aerial to some point on the grid coil, as, if it is kept at its former position on the anode coil, and the L.T. battery is earthed as usual, the reaction condenser is in the aerial circuit, and an alteration of its value will cause a change in frequency, which is altogether undesirable.

By-pass Control

Another good method, rather similar in its practical operation, is shown in the circuit of Fig. 4. Here, instead of having the usual fixed by-pass condenser across the primary of the L.F. transformer, we have a variable condenser of about .0005 μF capacity. This gives a very fine control of the degree of reaction, and does not alter the tuning of the receiver in the least. The difficulty arises, however, that when this circuit is employed with only one valve, the telephones then being in the position now occupied by the L.F. transformer primary,

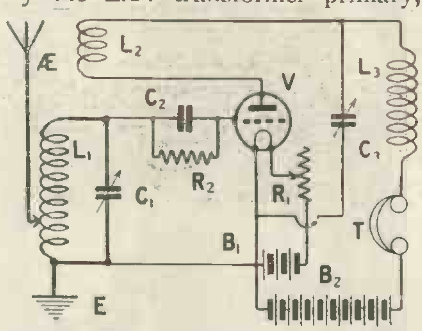


Fig. 3.—In this scheme the coupling between L1 and L2 is fixed, a "throttle" method of reaction control being obtained by means of C3. If body capacity effects are troublesome a condenser of about ·001 μF across the telephones may be desirable.

the capacity of the cords, together with the capacity to earth, through the body of the operator wearing

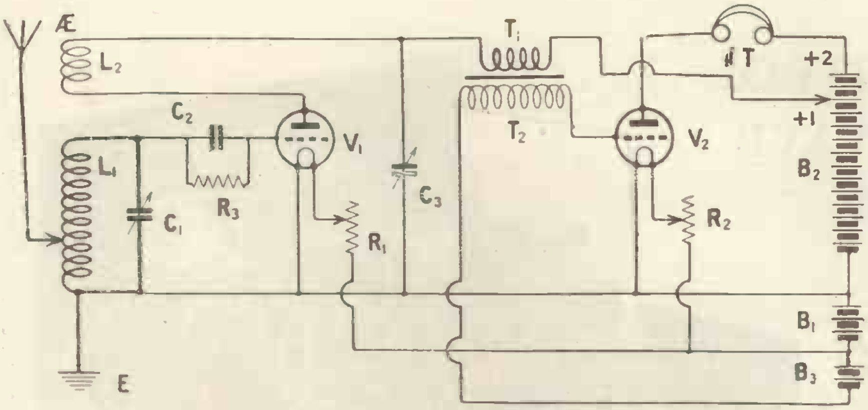


Fig. 4.—A variable by-pass condenser across the L.F. transformer primary will serve to give a very smooth fine adjustment of reaction.

them, is often sufficient to cause the receiver to oscillate even with the reaction condenser removed altogether.

Use of a Choke

This trouble is best overcome by inserting a radio-frequency choke of suitable size (which is best determined by experiment) between the 'phones and the connection to the reaction condenser, the circuit now being as shown in Fig. 3. The condenser may alternatively be connected directly across the radio-frequency choke itself, and a fixed by-pass condenser across the telephones.

An Effective Method

Fig. 5 shows a method of reaction control often employed by the writer. Here the aerial is auto-coupled, through a variable condenser, to the grid circuit. It is found that, with a suitable number of turns between the aerial and earth, the set will stop oscillating before the series aerial condenser is "all in," on account of the increase in the effect of the aerial damping. Also, the value of the condenser will be fairly small, and changes in its value will generally be found to have little effect upon the frequency of the grid circuit.

An Objection

Now it may appear that both sides of this condenser are "live," and that hand-capacity troubles would be present to a great extent. This is not so, however, for the actual working capacity is usually so small—and yet quite enough to cause the set to work efficiently—that one may even touch the aerial terminal without perceptibly altering the note of a signal that is being received.

Actually, the writer employs a .0002 μF low-loss square law condenser for this purpose, and it is generally set so that the scale reading is about 45 deg.

The greatest argument against criticisms of so small a coupling condenser is the excellent signal

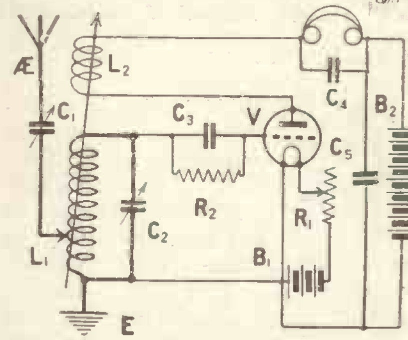


Fig. 5.—Here the fine adjustment of reaction is obtained by varying C1.

strength of distant stations with this arrangement!

Conclusions

Above all things it should be remembered that "swinging-coil" and variometer methods of controlling oscillation are not likely to meet with much success on short waves. Conversely, it will generally be found that the methods outlined in this article, with the possible exception of the last, are more effective at the broadcast frequencies than many of those in general use at the present day.

TESTING OF READERS' SETS DISCONTINUED

The Radio Press Laboratories will in future confine their activities principally to the development of new designs and inventions which will be published in our journals. The testing of readers' sets will cease until further notice.

This testing work, while applied to only a relatively small number of sets, is exceptionally costly, and it is felt that devoting extra space and staff to experimental and design work will be to the great advantage of our readers.

Sets, of course, will continue to be on view at our Bush House offices, and if the efficacy of any of our sets is ever challenged we shall continue to be happy to demonstrate the results at our Elstree laboratories.

A "sea-floor" broadcast was recently made from 3LO (Melbourne), in the course of which a diver descended in South Melbourne Harbour, his description of the things he saw being transmitted by the station.

THE BROADCASTING ENQUIRY

A brief summary appears below of the evidence given at the first day of the re-opening of the enquiry into the conduct of broadcasting.

THE Broadcasting Committee met again on January 20, the Earl of Crawford and Balcarres presiding.

The Radio Society of Great Britain had submitted a memorandum, and Sir Capel Holden appeared on their behalf.

The evidence stated that this essentially technical body was formed in 1913. Its present membership numbered 844, and included members in all parts of the world.

In addition there were 200 local and several foreign and colonial radio societies affiliated with it and numbering 10,000 members.

Claims of the R.S.G.B.

The society claimed to represent a small but very important section of the community, whose work was deserving of the utmost consideration.

The members of the society had done much valuable work, both previous to the inception of broadcasting and since. They were also responsible for the important developments which had taken place in short-wave transmission and reception.

Use of Broadcasting for Experimental Work

The members of the society used the broadcast transmission for experimental work in connection with the testing and design of new apparatus. The early work of the society had been influential in starting the present large industry which had been built up around this new means of entertainment.

Since the inception of broadcasting, some of the facilities previously enjoyed by the experimenter had been curtailed, and the erection of high-power stations, together with long and continuous programmes in large centres of population, had done much to detract from the usefulness of the work of the society's members.

Wish for Representation

Their memorandum proceeds to state: "While it is a fact that the first experimental broadcast service in this country was inaugurated at the instigation of the society, it is to be regretted that there was no opportunity for the society to be represented on the organisation which was subsequently formed to conduct regular broadcast transmissions.

"It is unfortunate that that section of the public—namely, the members of the society and of its affiliated organisations, which took the initiative in requesting the Postmaster-General to inaugurate a broadcast service—should have been unduly hampered in their work as a result of that request.

Admission to Advisory Committte

"It would seem to have been useful and possible for the society to have been represented on one or more of the advisory committees of the B.B.C. Although the society has, through its organisation, helped the company to make the service efficient, there have been instances when the B.B.C. has unnecessarily withheld valuable assistance which might have been given. Steps should be taken to ensure that, in whatever form broadcasting is controlled, the views and needs of the experimenter are given adequate consideration.

The B.B.C. Constitution

"The society, having regard to the future development of this new art, and the varied trade and public interests involved, desires to draw particular attention to the constitution of the B.B.C. The remarks to follow are in no way intended to cast any reflection on the manner in which the company have carried out their difficult task.

Anomalous Features

"The society considers that the following features of the constitution of the B.B.C. are anomalous:

"(1) That there is no representation on the directorate of the public, who supply all the revenue, all the costs of collection by the Post Office, and who have, in effect, supplied nearly the whole of the capital for building the stations.

"(2) That the directorate consists solely of representatives of manufacturing interests, which are thereby in a position to dominate the direction of wireless development in this country.

Difficulties of the Experimenter

"The society considers it highly undesirable that this state of affairs should continue indefinitely. The difficulty of the experimenter in the past has been the uncertainty existing regarding the times during which it has been possible to carry out tests free from all interference by the broadcasting service, and tests in connection therewith made outside the normal programme hours. It would be to the utmost advantage to the members of the society if definite silent periods, free from all B.B.C. transmissions, experimental or otherwise, could be guaranteed, and it is suggested that these silent periods should be fixed so as to fall in with the requirements of the members of the society and its affiliated organisations, particularly as it is they who would make most use of such silent periods."

Lord Blanesburgh's Enquiries

Lord Blanesburgh desired to be informed as to whether his view, that the R.S.G.B. desired to transmit as well as receive, was correct.

The witness replied that this was so.

Lord Blanesburgh: At the present moment, are there not large portions of the night in which the activities of the B.B.C. are not being exercised?

Sir C. Holden said that the B.B.C. occupied most of the night, so far as the usual meaning of that term was concerned. If they considered 2.0 a.m. to 6.0 a.m. as the night, then they were free.

Lord Blanesburgh: Is it not enough for you to have the ether free after midnight?

Sir C. Holden: Members of the society would like to have some time before midnight.

Lord Blanesburgh remarked that they would trespass upon the claims of a large number of the public, who desired to be entertained up to midnight.

The witness agreed.

Lord Blanesburgh asked if they

(Continued on page 672.)

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.

Ballasting Resistances

PROBABLY one of the most interesting developments recently made has been the evolution of ballast resistances for controlling the current in a circuit. In place of the usual rheostat or variable resistance which controls the flow of current, and enables variations to be made in accordance with any changes which take place in the voltage, it is possible to insert special ballast resistances or barretters, which maintain the current constant irrespective of minor fluctuations in the voltage.

Principle of Barretter

This principle of ballasting was adopted many years ago when the carbon arc was first evolved. This device possesses the peculiar property that as the voltage applied across it increases, the current flowing decreases. In order to maintain a stable state of affairs, it is therefore necessary to insert a certain amount of resistance in series with the arc. If the current increases, the voltage on the arc falls, but that on the resistance rises, and the total voltage across the whole combination can thus be adjusted to remain constant.

The development in question is an extension of this principle of ballasting. The resistance of ordinary metal increases as the temperature rises. This temperature effect is negligible with ordinary rheostats, which are designed to carry the current required without any considerable temperature rise. If, however, we pass a current through a comparatively fine filament of wire, then the wire will heat up to a considerable temperature, and any variation in current will produce an appreciable change in the temperature of the wire.

Temperature and Resistance

Let us assume that the voltage applied across this filament increases slightly. The current will also increase, and thus the temperature of the wire will rise. This increase in temperature will produce an increase in resistance which will tend to reduce the current once again. That is to say, the increase in current will not be as heavy as it would be if the temperature of the wire had remained constant.

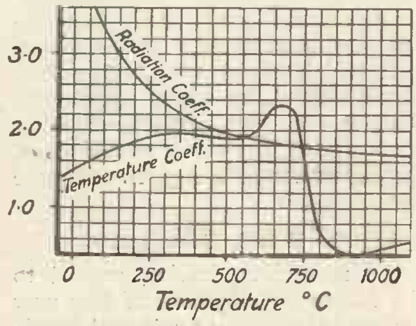


Fig. 1.—The relations governing the temperature and radiation coefficients in a system forming a "barretter."

Practical Use

This immediately suggests a method of controlling the current through a circuit. If it were possible to arrange that the increase in temperature of the wire produced sufficient increase in resistance to cut down the current to its original value, then we should have an arrangement which would pass an appreciably constant current irrespective of the voltage applied across it within the range over which this "ballasting action" took place.

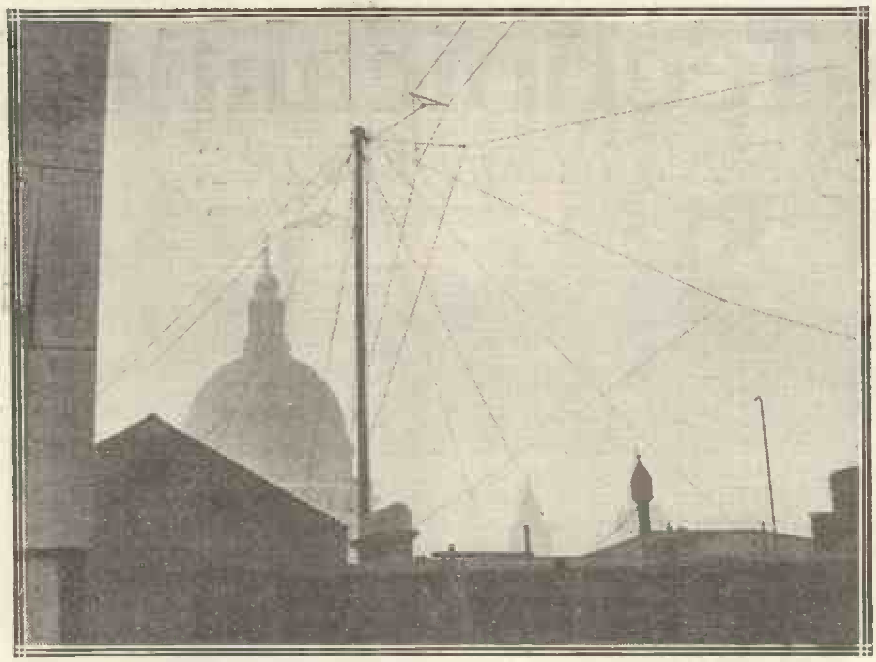
Unfortunately, however, it is not possible to obtain this effect quite as simply as it would appear. The actual change in resistance is usually insufficient to produce the necessary balancing action at reasonable temperature, and as soon as the temperature of the wire rises above a certain point the radiation of heat from the wire begins to increase very rapidly. This radiation of heat, of course, means that the wire does not increase in temperature as much as it should do, so that the increase in the resistance of the wire is limited and the ballasting action does not take place.

Iron Wire Suitable

Now it is found that iron wire possesses a temperature coefficient or rate of variation of resistance with temperature, which is of the right order to produce a ballasting action. The temperatures at which this action is most effective, however, are such as to produce appreciable radiation of heat, so that if this property is to be utilised, it is necessary to arrange for the heat radiation to be reduced to a considerable extent. This may be done by enclosing the iron filament in a glass tube which is filled with hydrogen gas at a reduced pressure.

Use of Hydrogen

The whole theory of ballast resistors has been discussed by H. A. Jones in the *General Electric Review* for May and September, 1925. In these articles he shows that the current through a filament of iron wire in an atmosphere of hydrogen will remain constant over a wide range of voltage, provided that the total heat loss by radiation increases at a slower rate than the resistance of the wire increases when the temperature is increased. Now the rate of increase of resistance with tem-



It is not generally realised that the various aerials on the roof of the G.P.O. are actually in constant use for the reception of traffic.

perature is the *temperature coefficient* of the particular material and depends simply upon the material and the temperature. For iron wire this coefficient increases slightly in a somewhat irregular manner, as the temperature of the wire rises, up to about 700 deg. Cent., after which it falls rapidly to low value.

Heat Radiation

The radiation of the heat of the filament, on the other hand, depends upon the temperature of the filament, and the temperature and pressure of the hydrogen atmosphere in which the filament is running. Fig. 1 shows the variation of the temperature coefficient and what may be termed the radiation coefficient of a system such as has just been described.

It will be observed that there is a particular portion where the curves cross, this portion being between the temperature range of 550 and 770 deg. Cent. This is the range over which ballast action can occur, for, as will be seen, the radiation coefficient over this range is smaller than the temperature coefficient.

Points in Design

The design of a ballast resistor, therefore, consists in so designing the length and diameter of the iron filament that it lies within this particular range of temperature when carrying the required current. A certain flexibility is permissible, but the conditions are really somewhat rigid. The current which is to be passed by the device determines the diameter of the wire which is to be employed. We may then choose the voltage at which we wish this ballasting action to commence, and this enables us to determine the length of the filament. For a given commencing voltage, however, and a given diameter of wire, the range of voltage over which ballast action is possible is fixed, and vice-versa, so that in this respect the design is rendered somewhat difficult.

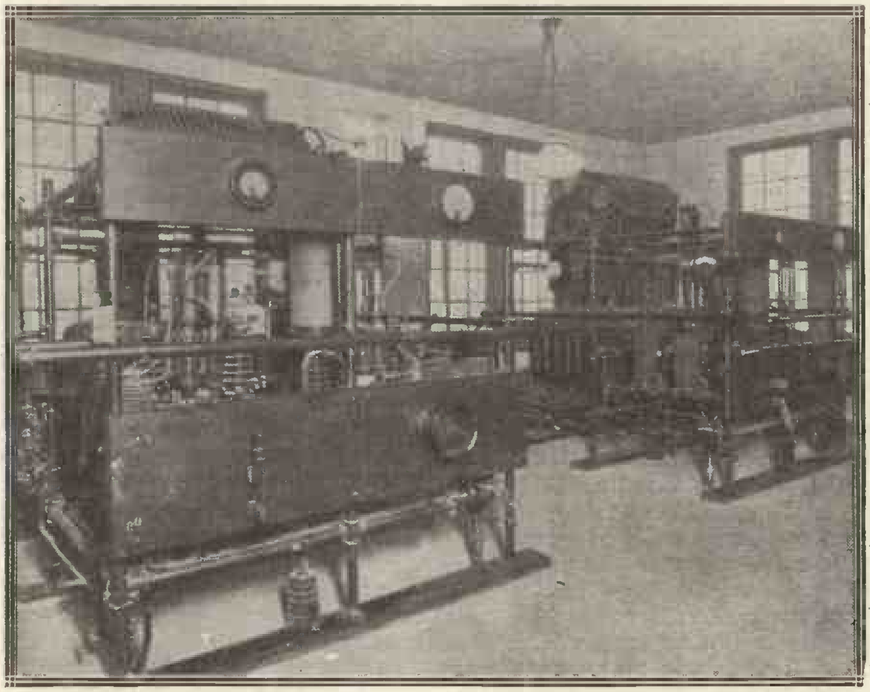
As practical examples of the order of the effects obtained, it may be mentioned that, using a single iron filament in a bulb filled with hydrogen at a pressure of 100 mm., ballasting action can be made to commence as low as 0.1 volt, but in this case the action only holds good over a voltage range of .05 of a volt. If the commencing voltage is 1 volt, then the voltage range over which the action holds good is 0.6 volts. As the commencing voltage is increased, so the length of the ballasting range is proportionately increased.

Substitutes for Rheostats

These ballast resistors have a considerable application to wireless as substitutes for the usual filament resistance. They can be made in such a manner that they will pass an approximately constant current irrespective of the voltage of the battery. This, of course, is a valuable asset, and one which possesses considerable advantages. In such cases what is required is a small commencing voltage and a large range for the ballasting action. This condition is not fulfilled in the examples given, but by suitable variations of gas pressure somewhat greater ranges are obtainable.

Practical Results

Some actual samples tested by the writer some time ago maintained a constant current of 0.3 amp. in a filament circuit over a range of 3 to 10 volts applied across the L.T. terminals.



The main oscillator panel at Bound Brook (WJZ) is duplicated, so that the breakdown risk is reduced.

Random Technicalities

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

IT is strange that with all the improvements in wireless receiving apparatus, both home-constructed and commercial, the average aerial one sees when travelling by train is as ugly, sloppy, and inefficient as ever. The first half-hour's run from any of the great London termini will reveal many delightful examples of how not to do it. One still sees a number of multi-wire aerials—sometimes as many as six parallel wires being used on 8 ft. or 10 ft. spreaders, supported not higher than 15 ft. or 20 ft. above the ground.

In the majority of such cases just as good results would be obtained with only two wires, supported at the same height, and much better results would be obtained with a single wire if taken from a chimney to a pole in the garden. I have even seen frame aerials supported at a great height above a building, with a single lead from the set to one end of the frame aerial winding, the user being apparently unaware of the principle of the working of such aerials.

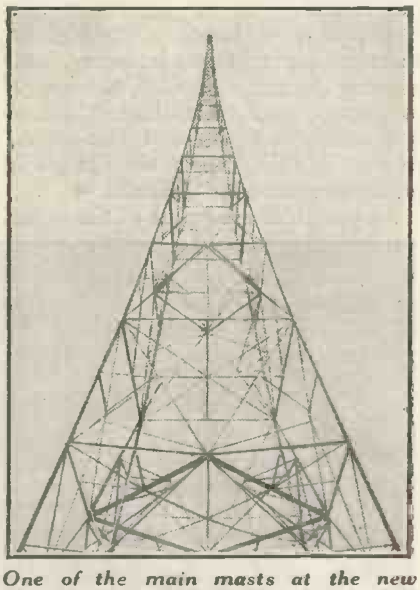
Aerial Height and Interference

I sometimes pass a perfectly appalling collection of sticks tied together with string and rearing itself to a dizzy height above the railway. I have not the slightest idea what kind of set the owner of such an aerial uses, but if it is a crystal receiver then the height of the aerial would probably give him excellent results. If he uses a multi-valve receiver he may be seriously troubled by interference from the local station.

I am by no means an advocate of high aerials in all cases. Provided one has a sensitive set, better results from distant stations can often be obtained by using a low aerial. Different aerials have different degrees of selectivity, and often a particular circuit gets credit for a selectivity which in the main is dependent on the particular aerial with which it is used.

Ill-treatment of Accumulators

Users of the dull emitter valve which consumes only 60 to 70 milliamperes do not often realise that the low filament consumption may lead them to discharge a four-volt accumulator far below a safe point without any noticeable decrease in signal strength. Such valves will work effectively with down to about 2.8 volts, and the average four-volt accumulator will give current at this voltage, when the flow of a heavier current would immediately bring the voltage far below this point.



One of the main masts at the new WJZ station. This supports the aerial used for the lower-frequency transmissions. The great height of the mast is well conveyed by this view.

Ruinous Treatment

In any case, no accumulator manufacturer likes to think of his cells being discharged below 1.8 volts per cell, as long experience has shown him that this is the way to ruin an accumulator quicker than by almost any other methods. The position is made worse by the fact that a 4-volt accumulator discharged to, say, 2.8 volts will, after being left for a short time, temporarily come back in voltage to a higher figure, thus again tempting the user to discharge it still further.

A Wise Policy

Personally I have long since adopted the only safe way in using accumulators, *i.e.*, to adjust the filament resistances on the valve in use, so that at two volts per cell the correct current is passing. Directly the valve starts to dim, instead of readjusting the filament resistances, I take the batteries off and recharge them. The additional discharge period obtainable with an accumulator after the first drop has taken place is so small that it is not worth worrying about, and one can make perfectly sure of keeping the cell in first-class condition over long periods if this method is adopted.

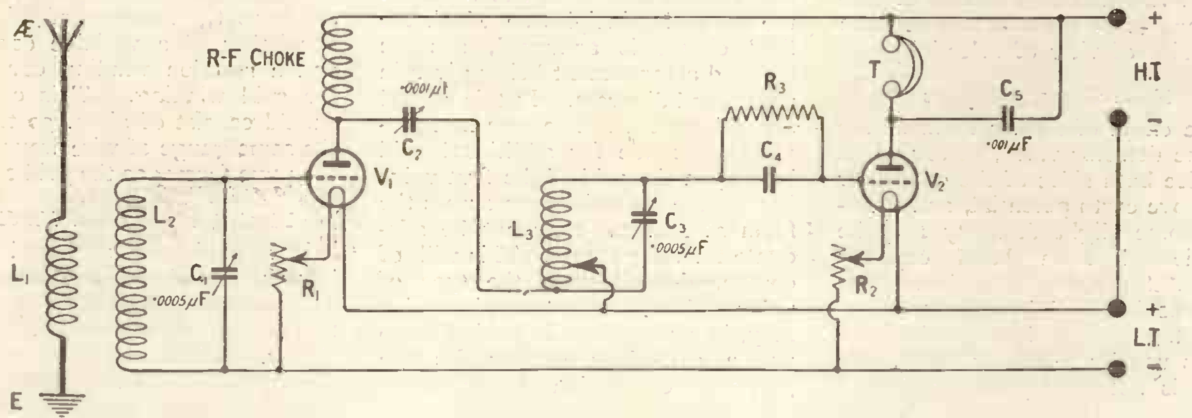
For the reasons given above there is much to be said for using valves designed for the exact voltage of an accumulator, *i.e.*, two, four or six volts. There are a number of two- and four-volt valves available, and these can be used in a set without filament resistances of any kind.

JOTTINGS BY THE WAY

It has been decided that in future the feature 'Jottings by the Way' will appear in alternate issues of "Wireless Weekly."

Circuits for the Experimenter

NO. 2.—A TWO-VALVE CIRCUIT WITH "PARALLEL FEED" COUPLING.



NEUTRODYNE circuits are becoming so popular nowadays that other methods of securing stable high-frequency amplification are apt to be rather neglected. A particularly effective and successful scheme of H.F. inter-valve coupling, however, which does not employ any method of neutrodyne control, is that which incorporates a method of "parallel feed" from the anode circuit of the one valve to the grid circuit of the next.

"Parallel Feed"

In this scheme the anode circuit of the H.F. valve contains a choke coil, while from the anode of the valve itself a lead is taken through a stopping condenser to a coupling winding, and so to the filament circuit, a certain proportion of the radio frequency component of the anode current taking this parallel path. A form of this type of coupling was employed by Mr. D. J. S. Hartt in the construction of two receivers, which he has called the "DX Four" and the "DX Five," published in recent issues of *Modern Wireless*, and these have proved very successful.

In Mr. Hartt's sets the parallel path from the anode to the filament circuit of the high-frequency valve consisted of a fixed condenser and a small winding which constituted the primary of a transformer, the secondary of this transformer being connected across the grid and filament of the succeeding valve in the ordinary way.

An Auto-Coupling Method

In this week's circuit a simple form of this type of coupling is shown, no separate primary winding being indicated, but instead auto-coupling is used. Upon examination of the first diagram, it will be seen that a small variable condenser of .0001 μF capacity, indicated by C2, is provided to act as a stopping condenser between the anode of the high-frequency valve and the portion of the coil which serves for auto-coupling purposes, and the function of this condenser calls for a word of explanation.

> **CIRCUIT NO. 2.**
> **SPECIAL FEATURES**
>
> 1. **Stability without Neutrodyning.**
> 2. **A Simply-made Intervalve Coupling Unit.**
> 3. **Reduced Grid Damping in the Detector Circuit.**
> 4. **Smooth Reaction Control.**
> 5. **Adjustable Degree of Selectivity.**

Adjustment of Natural Reaction

Primarily, of course, it serves to prevent a short circuit of the high-tension battery, and, secondly, it serves to adjust the tendency to oscillate of the first valve. When this condenser is small, the first valve will be found to be perfectly stable, while as it is increased in capacity it will be found that with certain types of valves self-oscillation will set in. It is therefore of some slight advantage to use a variable condenser here, but a fixed one can probably be substituted with quite good effect as soon as an approximately correct value has been found to suit the particular lay-out and valves which are being employed. Small adjustment of the natural reaction effect can then be made by variations of the high-tension value applied to the first valve.

Coupling Details

The auto-coupling arrangement will be seen to be produced by the connection of the lead from the anode of the high-frequency valve to the lower end of the grid circuit of the rectifying valve, a lead from the filament circuit being taken to a tapping point upon this coil. In this way the amount of the winding included in the parallel anode path of the first valve can be varied at will and so the degree of coupling can be adjusted.

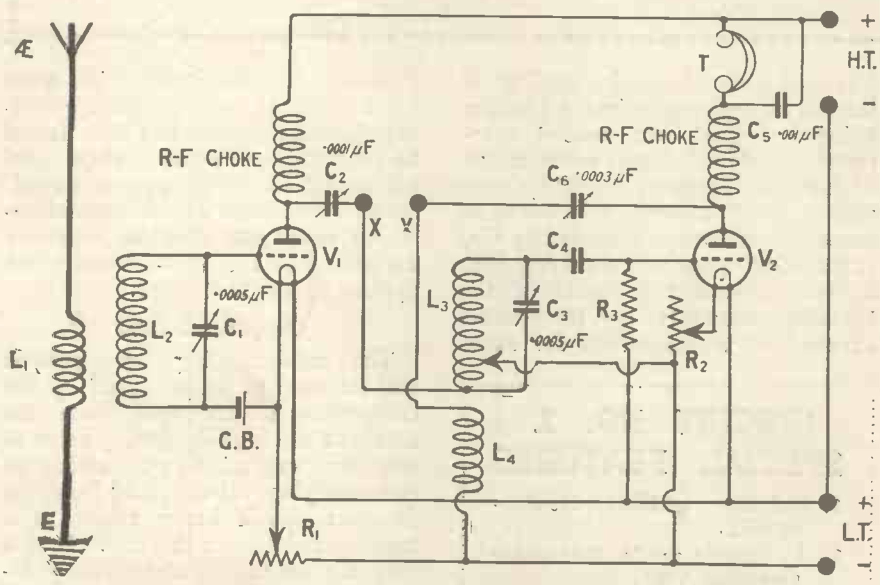
It will be found that there is definitely a best value for this coupling, from the point of view of signal strength and selectivity. The larger the number of coupling turns the greater the signal strength within certain limits, but the lower the selectivity.

Grid Damping

The effect of this particular method of auto-coupling is to place the detector valve across only a part of the tuned grid circuit, the portion included between grid and filament being that between the upper end of the inductance L3 and the tapping point from the filament circuit. In this way the amount of damping imposed upon this circuit by the grid current of the detector valve is reduced, and improved selectivity results, with only a very slight loss of signal strength. (This point was dealt with in a recent article in *Wireless Weekly* by Mr. Kendall, and it will be remembered that it was shown that this scheme of connections is of decided benefit from the point of view of selectivity.)

Hand Capacity Effects

The effect of such a filament tap for the detector valve, of course, is to raise both sides of the condenser C3 above earth potential, and therefore some slight difficulty may be experienced from hand capacity effects. Since, however, the number of turns included between the filament tap and the lower end of the coil is usually relatively small, this effect is not very pronounced, and



The circuit in a more detailed form. The points X and Y can sometimes be connected together and the special reaction winding L4 omitted. The more elaborate arrangement, is, however, to be preferred in most cases.

does not in practice give rise to any noticeable trouble.

As regards the practical details of the circuit, the coils L1 and L2 constituting the "tight-coupled" primary and the tuned secondary may be of the ordinary plug-in variety, the usual small size being indicated for L1. The radio frequency choke should be equivalent to a No. 200 or larger plug-in coil, and the reader is referred to details given elsewhere in this issue on the construction of chokes if he wishes to make this for himself.

Coil Details

The coil L3 is the only critical component in the circuit, and for this 50 turns of No. 32 double silk-covered wire on a 3 in. tube are suggested, tappings being taken at the 5th, 10th, 15th and 20th turns from the lower end, connection being made to these points at will with the filament tap shown.

The circuit given at the head of this section is intended to illustrate the general principles on which the final circuit is arranged, a more detailed arrangement being given in the second diagram. In this second arrangement it will be seen that provision is made for additional grid bias upon the grid of the first valve in case the potential drop across the filament rheostat may not be adequate for the purpose. This will, of course, depend upon the type of valve and the filament supply, and it may, in some cases, be preferable to use a grid bias battery for the purpose, connection being made direct to the negative end of the filament instead of to L.T. negative.

Reaction Schemes

It will be seen that the position of the grid leak has been altered, and, further, that provision has been made for the use of reaction upon the grid circuit of the detector valve. This particular arrangement is a particularly beneficial alteration, and will be found to yield a real improvement in signal strength and selectivity.

Reaction into the grid circuit of the detector valve is particularly beneficial, since the effect of the detector grid current upon the damping of this circuit is always fairly considerable. The most satisfactory method of obtaining reaction has been found in the case of this circuit to be the method usually associated with the Reinartz circuit, namely, the insertion of another radio frequency choke in the anode circuit of the detector valve, and the provision of a shunt path from the anode to the filament of this valve consisting of a variable condenser and a reaction winding coupled to the grid winding. This coil (L4) should consist of about 30 turns of the same gauge of wire wound upon the same former as the grid coil.

Placing of Reaction Winding

It is preferably arranged at the lower potential end, as shown in the diagram, to reduce its effect upon the tuning adjustments of the grid circuit. If it is found that there are objectionable hand capacity effects upon the reaction condenser C6 when it is connected as shown, it should be placed in the usual alternative position between the other end of the reaction winding and the filament circuit, the position which it occupies in the diagram being thereupon short-circuited.

Whether this will be necessary will, of course, depend very largely upon the design of the condenser itself, and from the point of view of simplicity in wiring-up it is often most convenient to place it where it is shown in the diagram.

Alternative Reaction Scheme

Another scheme for producing reaction which has proved decidedly erratic in practice, but which it may be interesting to try, is to omit the reaction winding L4 altogether and instead to join the points X and Y directly. This method is not particularly satisfactory from the point of view of operation, being tricky to work, and with some valves producing very objectionable overlap effects, but it has the merit of simplicity, and is therefore worth trying. A possible objection to its use is that it does not give the desirable independence of reaction and intervalve coupling control.

"CAUSES OF LOUD-SPEAKER DISTORTION."

It is regretted that exigencies of space once more necessitate the holding over for a week of the continuation of the article in the issue of January 13 on "The Causes of Loud-Speaker Distortion."

It is hoped to include this article in an early issue.

THE TRANSATLANTIC TESTS

The transatlantic broadcasting tests have now commenced, and the latest revised schedules appear below.

SINCE the publication in the last issue of *Wireless Weekly* of the time-table arranged for the British and Continental stations in the Broadcasting Tests, certain alterations in and additions to the schedule have been announced. The revised schedule will be found in the table on this page.

Attention is drawn to the fact that Birmingham and Glasgow are to transmit on January 29, and that Radio Toulouse has been withdrawn from the Tests.

American Schedules

The time schedules arranged for the stations on the other side of the Atlantic—that is, stations in Canada, the U.S.A., Mexico, and Cuba—are similar between the dates January 25 and 28 inclusive (reckoning in Greenwich mean time). On these nights all stations will transmit their special programmes from 3 to 4 a.m., G.M.T., keeping silent for the period 4—5 a.m., while the British and Continental stations are working.

Special Programmes

For January 29 and 30 special schedules have been arranged. For January 29 America will be divided into zones in an east and west direction, separate times for transmission being allotted to each zone. All times are given in G.M.T.

Eastern time zone and Cuban stations operate from 4 to 4.15 a.m.

Central time zone stations operate from 4.15 to 4.30 a.m.

Mountain time zone stations operate from 4.30 to 4.45 a.m.

Pacific time zone stations operate from 4.45 to 5 a.m.

In this schedule the stations in Iowa, North and South Dakota, Nebraska, and Kansas will work with the Mountain time zone stations, although actually they belong to the Central time zone.

Second Series of Schedules

For the tests on January 30 a north and south division of the country will be observed, and the transmissions will take place as follows:—

Canadian stations operate from 4 to 4.15 a.m.

U.S.A. stations, northern section, operate from 4.15 to 4.30 a.m.

U.S.A. stations, southern section, operate from 4.30 to 4.45 a.m.

Cuban, Mexican, and Central American stations operate from 4.45 to 5 a.m.

In this schedule the northern U.S.A. section will consist of all states north of and including Oregon, Idaho, Wyoming, South Dakota, Minnesota, Illinois, Indiana, Ohio, Pennsylvania, and Delaware. The southern section will consist of all states south of and including California, Nevada, Utah, Colorado, Nebraska, Iowa, Missouri, Kentucky, West Virginia, Maryland, district of Columbia and Virginia.

Reports

All listeners who hear any of the transmissions from America are invited to send in reports on their reception, addressing them to "Tests Editor, Radio Press, Ltd., Bush House, Strand, W.C.2." It is requested that reports be submitted as soon as possible after each night of the transmissions.

In order to facilitate the classification of reports, it is further requested that listeners draw up their reports as far as possible on the lines indicated in last week's issue of *Wireless Weekly*.

Stations.	Wave-length in metres.	Fre-quency in kilo-cycles.	Date (January).						Remarks.
			25.	26.	27.	28.	29.	30.	
			Time a.m. G.M.T.						
GREAT BRITAIN:									
London	363.5	825	4–5	—	—	—	—	—	
Bournemouth ..	387	775	4–5	—	—	—	—	—	
Cardiff	353	850	—	—	4–5	—	—	—	
Glasgow	422	711	—	—	—	—	4–5	—	
Birmingham ..	479	626	—	—	—	—	4–5	—	
Aberdeen	496	605	—	—	4–5	—	—	—	
Daventry	1,600	188	4–5	—	4–5	—	—	—	
CONTINENTAL:									
Vienna	530	566	—	4–5	—	4–5	4–5	4–5	
Munich	485	619	—	4–5	—	4–5	4–5	—	
Stuttgart	450	667	—	4–5	—	4–5	4–5	—	
Breslau	416	721	—	—	—	4–5	—	—	
Munster	410	732	—	4–5	—	—	4–5	—	
Hamburg	392.5	764	—	4–5	—	4–5	4–5	—	
Madrid	373	804	—	4–5	—	4–5	4–5	—	
Prague	368	815	—	4–5	—	4–5	4–5	4–5	
Brussels	263	1,141	—	4–5	—	—	—	4–5	

CORRESPONDENCE

"ATMOSPHERICS"

SIR,—Dr. Robinson's articles on "The Nature and Sources of Atmospherics" have been of great interest to us dwellers in a region of constant static, and it is to be hoped he will continue to give us information as to the result of research. Meanwhile we do not all agree as to the cause and origin of static. Mr Stanley McClatchie writes in your issue of December 23 last, ". . . static is usually a quite localised affair." This is certainly true of places on the Spanish Mediterranean coast.

In a letter of mine you were pleased to publish in your issue of April 15, 1925, I said ". . . the local weather seems to be the dominating factor. A storm in the English Channel or the Bay of Biscay does not affect our reception of Bournemouth, but a local barometric depression may make it impossible to hear anything from anywhere."

My later experience confirms the foregoing, and, moreover, I think I have even narrowed it down a little; there is no doubt that while barometric variation may be reflected, as a general rule (but not invariably) in a wireless receiver by noise, the meteorological variation that is most constantly followed by a change in ratio of static to signals is that of relative humidity. I have no opportunity of observing this hour by hour, but I am inclined to believe that, at any rate in this locality, the curve of ratio of perception of signals would follow fairly closely the curve of variation in relative humidity.

I suggest that this may be explained by the existence in the atmosphere of innumerable particles of earthly or meteoric dust, each, or some, at the same or a different potential to earth. With variations in atmospheric pressure and temperature, leading to an approximation to dew-point, each particle receives its covering of condensed moisture, and may either change its potential or lose its mobility, or both. This change in potential or mobility may have the effect of diminishing the constant impinging on the aerial of myriads of electrically charged particles. Hence in winter atmospherics are less troublesome, and hence also a frame aerial, protected from physical contact, affords considerable freedom.

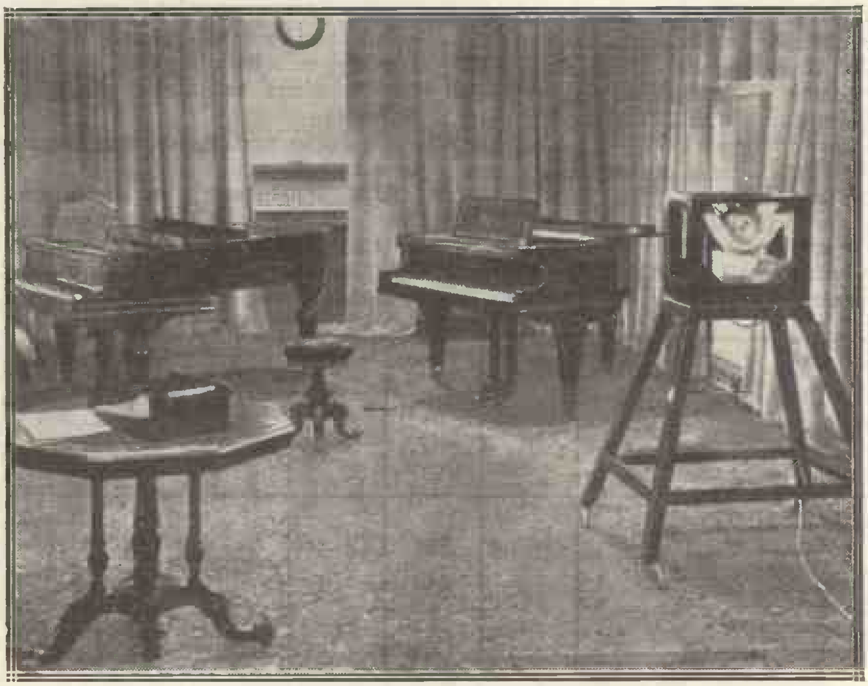
Unfortunately, I have to confess that all this is guesswork, as I have not the time to devote to constant observations and experiments. Unfortunately, also, my idea would seem to be in conflict with Major Robinson's dictum, that "atmospherics come on occasions from very different directions . . ." unless in this he refers only to the "crash" variety due to distant storms. On the other hand, my idea is not incompatible with the theory of a "cold front," since any approach to dew-point will change the effect.

Granting the state of humidity to be a factor, as it undoubtedly is here, an alternative theory is that electrical disturbances find their way more easily to earth before reaching the aerial, when moisture in the air is near condensation point, and screening surroundings are damp.

Reverting to the question of locality, my experience agrees with that of your correspondent, Mr. McClatchie. I have had nearly noiseless reception 100 miles west of this place, and at Carthagena, 30 miles east, reception is also much better than here.

No one need go to Timbuctoo to study atmospherics! We can produce a very interesting variety here in Europe. But as an old "Coaster" myself, I would invite contributions to this discussion from listeners in West Africa, where the *harmattan* at certain seasons fills the atmosphere with a perceptible mist of impalpable dust from the Sahara. Mr. Guy C. Beddington, who knows what static can be like in the Mediterranean, once suggested the Sahara as a contributory cause. This theory of dust does not at first sight appear to account for Alpine influence, but mountaineers know there is an almost constant stream of particles from a high mountain ridge to leeward, often visible as a thin cloud of earth or snow-dust, which may conceivably become ionised.

It might be thought that a constant stream of particles would produce a



The Dublin station (2RN) is now being heard with considerable regularity in this country. This view of the studio indicates that the microphone used is of the type so extensively employed by the B.B.C.

"hiss" rather than a "grinder," but what I have in my mind is the condenser effect in the aerial and its surroundings. In any case it would be very interesting to know whether in West Africa the static is fiercer or not during the *harmattan* season.—Yours faithfully,

GEORGE L. BOAG.

Aguilas (Murcia), Spain.

CHEMICAL RECTIFIERS

SIR,—With reference to the difficulties experienced by your readers with chemical rectifiers, perhaps the following information after three months' very successful use may be of help.

Solution.—½ lb. commercial phosphate of soda in 1 gallon rainwater is amply strong enough. Pure sodium phosphate would be better, but it cannot be had here. The soda salt is much cheaper than the ammonia salt. If phosphate is not available, bicarbonate will do.

Plates.—Two aluminium plates 12 in. × 2¾ in. × ⅛ in. thick, one lead plate 14 in. × 2¾ in. × 1/16 in., plates separated ⅜ in. to ½ in. between each, the lead being central. With sodium phosphate the aluminium plates remain clean, but with use the lead plate becomes coated with a chocolate-coloured skin which must be removed from time to time with a piece of file card.

Transformer.—I have a French make transformer, primary 110 volts 50 cycles, secondary with middle tapping giving twice 12 volts at 3 amperes.

Mounting.—I drilled the plates at the top to take terminals and large washers to receive spade terminals and flexible leads. With two spacing pieces of ebonite top and bottom I placed and wedged the aluminium plates with thin wood wedges and slid the lead plate into the central groove, kinking the edges near the top to prevent it falling through and to have the edges of the three plates in line at the bottom.

Knotting the two strings and passing them through a screw-eye in a board above, one can regulate the immersion and current output by hooking the knot on to one of a series of nails in the board.

Circuit.—The central tapping goes through the ammeter to six 50-amp.-hour accumulators arranged in two banks of three in series. The positive plates must be connected to the middle tapping of the transformer and the negative plates to the lead plate in the phosphate solution.

Results obtained are very satisfactory even on a local supply where voltage regulation of the mains may be said to be non-existent. I charge regularly at 1½ amps. as indicated about five hours per day for a bright emitter 4-valve set which gives me all B.B.C. main stations, Rome, Berne, Toulouse, Madrid and Stoke (relay) on loud-speaker, and works for long periods.

When the solution, at first clear, becomes very milky and the amps. fall off, it is time to renew.

I shall be glad to give any further information direct if required.—Yours faithfully,

A. TAYLOR.

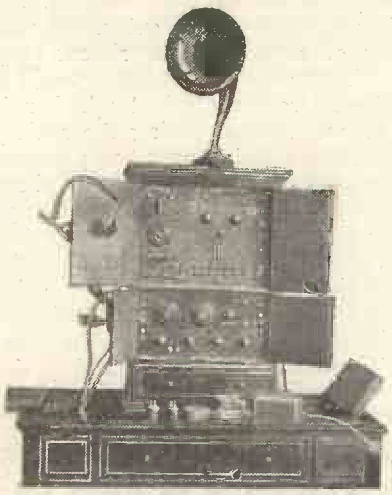
Rolleville, Seine Inférieure, France.

P.S.—Postage to France is 2½d. Excess postage is very heavy!

A SUPERHET QUERY

SIR,—A few weeks ago I constructed a 6-valve Superheterodyne receiver, utilising the tropadyne principle and having two stages of intermediate frequency amplification. I used Silver Marshall transformers for the intermediate stages of amplification, of the type described in *Wireless Weekly* for December 2, 1925.

I have been getting quite good results with the receiver on the broadcast band



The handsome receiver constructed by Mr. H. R. Ward from Radio Press designs.

of frequencies, but I am not quite satisfied with the intermediate stages. My trouble has been concerned mainly with finding the best type of valve to use, and I should much appreciate the views of any of your readers who have had similar experiences.

With the first valves tried amplification seemed quite good, and the selectivity of the receiver was sufficient to enable me to receive Manchester without interference from London (I am seven miles from 2LO). Being anxious to try experiments, I substituted small power valves for these valves. Results were much inferior, both selectivity and amplification suffering from the change.

My next experiment was to try some valves of a special H.F. type. These gave very much better amplification, but selectivity was decidedly *poorer* than with the first valves tried! It was no longer possible to hear Manchester through London's transmission. Bournemouth could be brought in, but always with a "background" of London. The amplification factor of these latter valves is given by the makers as 16, with an impedance of 35,000 ohms. The first valves tried have an amplification factor of 8, with an impedance of 40,000 ohms.

I must confess myself puzzled at the phenomena observed. Is it possible that the poor selectivity with the last series of valves tried is due to increased grid current? Your views and those of your readers on the subject would be welcomed.—Yours faithfully,

P. R. WILSON.

Wimbledon, S.W.19.

A READER'S SET

SIR,—I made the set in the enclosed photograph from various designs in your Radio Press series, and am really delighted with same. I might add that I have also built and used your "Family Four" described by Mr. Harris in Envelope No. 2, and some of the crystal circuits described in *The Wireless Constructor*.

The main set is the "Transatlantic Four," described by Mr. Harris in *Modern Wireless* for November, 1924, which you will see at the bottom of the cabinet. Above, on the left-hand side, is the "Fool-Proof Crystal Set," from *The Wireless Constructor*, January, 1925, and designed by Mr. Harris also. This is connected by a D.P.D.T. switch to a "Two-Valve Power Amplifier," as described by John Underdown in *Modern Wireless*, December, 1924, and this is also connected by the other throw of the switch to the "Transatlantic," so that by cutting out with the switch provided I am able to use as a five-valve with two L.F. stages.

In the small cupboard let in the top of the supporting cabinet is an "A.B.C. Wave Trap" (Radio Press Envelope No. 6, by G. P. Kendall, B.Sc.), which may be used if desired. This panel also contains the plugs for connecting to the accumulator at the base; on the right-hand side is the H.T. battery.

Wishing you every success.—Yours faithfully,

HORACE R. WARD.

Coventry.

RECEPTION IN INDIA

SIR,—I wish to report on the reception of Daventry in India on a four-valve home-constructed set which was described by Mr. Harris in Radio Press Envelope No. 2 ("Family Four").

Almost every night I spend an hour or two endeavouring to sort Daventry out from the Russian spark stations. The latter are almost always working and are very strong here, but although some very good musical items are often obtained, speech is as a rule a little too distorted to follow. However, last Thursday night (December 24) I was surprised to hear the strength of Daventry's carrier, and on tuning him in received an excellent programme. The best items received were as follows: 0012 hours (I.S.T.), "All Alone" (orchestra); 0030 hours (I.S.T.), seven o'clock, Big Ben; 0031 hours (I.S.T.), weather forecast and news; 0145 hours (I.S.T.), Christmas carols (choir).—Yours faithfully,

R. J. DRUDGE-COATES.

Rawalpindi, India.

THE BROADCASTING ENQUIRY

(Continued from page 663)

desired to be given a transmission by the B.B.C., for test purposes, other than they at present got?

Sir C. Holden: Yes, something in the way of signals other than the programme.

Questioned by Capt. Ian Frazer, M.P., the witness said it would be a great advantage if periods were fixed in advance during which there would be no broadcasting, experimental or otherwise.

Earl Crawford desired to be informed if, as they were interfered with by the B.B.C. transmissions, the members would not interfere with each other?

Sir C. Holden agreed that this was possible.

Capt. I. Frazer thought that more co-operation with the B.B.C. would meet many requirements, as, for instance, when many stations closed before midnight. He also questioned the witness whether they desired to be represented on an advisory body or actually on the administrative committee of the B.B.C. The witness considered they should be represented actually on the administrative committee.

Mr. G. Marcuse, who was allowed to interpose at this point, stated to Capt. Frazer that close co-operation existed with the B.B.C., but he thought it might be closer.

The Silent Hour

He mentioned that the R.S.G.B. had applied for a silent hour or half-hour, between the times of 6.30 p.m. and 7.30 p.m., twice a week. This had been refused.

Earl Crawford asked if there was any qualification for membership?

Sir C. Holden said there was not, but that this was a future possibility.

Earl Crawford said he took the view that the chief grievance was lack of scope for experiment.

Witness agreed.

Earl Crawford asked whether it was not natural, seeing the society represented only about 800 persons, that the concession of a silent period between 6.30 p.m. and 7.30 p.m. was refused?

Sir C. Holden thought that the experiments would be in the interests of the progress of the science.

The Chairman thought they desired probably the most important hour or half-hour in the whole day's programme. Why was this particular time desired?

Mr. Maurice Child said that signals from New Zealand were only audible at this period.

The Chairman said this showed the New Zealand experimenters were prepared to work at 6.0 a.m. We could do likewise.

Asked as to whether it was a fact that the B.B.C. encouraged experiment and experimented constantly themselves, the witness stated he had no information.

Lord Rayleigh said perhaps he could give some information on this point. The B.B.C. had specially transmitted outside their normal programme hours to aid Prof. Appleton in a series of experiments.

Lord Blanesburgh asked if they could not work early in the morning or, say, 9.0 a.m. to 9.30 a.m.?

The witness said members had other matters to attend to, and, besides that, they obtained better results during the night.

Lord Blanesburgh here showed satisfaction at eliciting the information that it was desired to interrupt the programmes merely to suit the personal convenience of members of the society.

J. O. C. (DUBLIN) has constructed a Supersonic-heterodyne receiver with separate oscillator, and can only hear his local station faintly. Turning out the oscillator valve on its filament resistance does not materially affect results. He asks where to look for the fault.

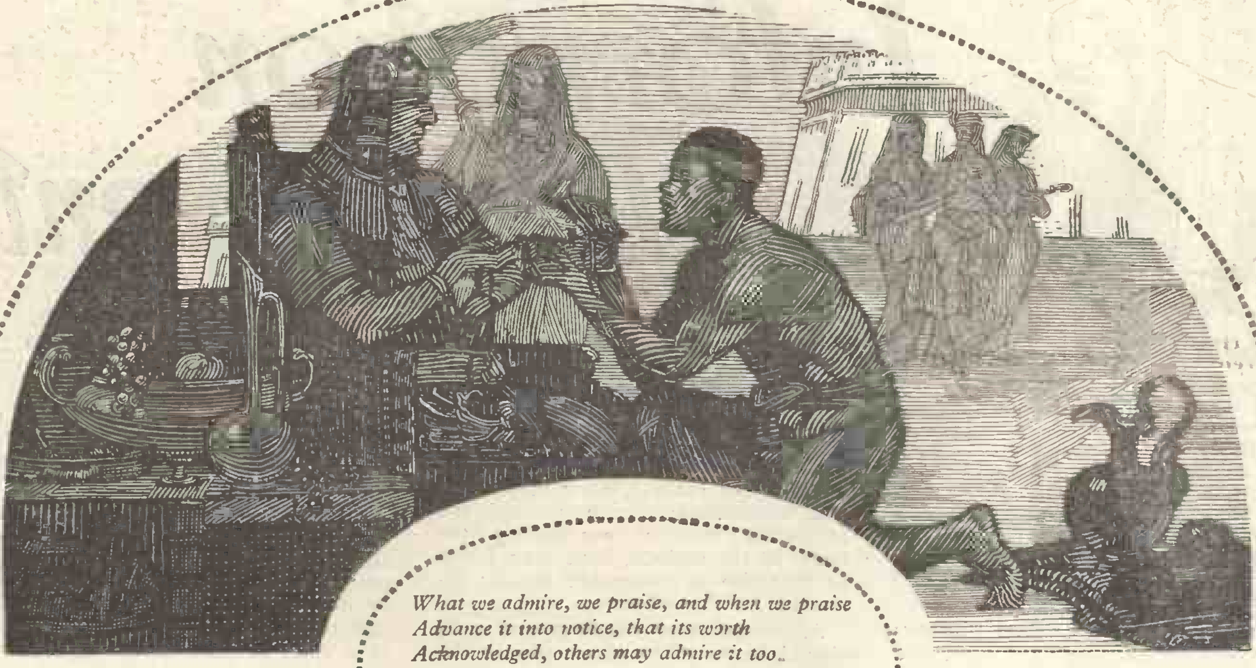
Faults in super-heterodyne receivers are extremely puzzling in nature, and the observed symptoms often seem to implicate any part of the set but the component which is actually responsible for the trouble. Our correspondent has reversed the connections to the plate coil of the oscillator valve, so obviously the fault is not due to wrong connections here.

From the symptoms given a definite diagnosis cannot be put forward, but we would advise that attention be paid to the valve sockets, since in practice poor connections therein, through the insulating material overlapping the metal of the sockets, have been found to give rise to somewhat similar behaviour to that observed.

All transformer windings and coils should be tested for continuity by the well-known telephones and dry cell method, whilst any component which can be substituted by some other known to be working effectively, should be so replaced. For further hints the reader is referred to "Faults in Supersonic-heterodyne Receivers" in the December, 1925, issue of *Modern Wireless*.

M. C. (BRIGHTON) asks what is meant by "hand capacity effects" and how to minimise them.

By hand capacity effects is meant the alteration in tuning of the set when the hand of the operator is brought near to a condenser, an inductance coil, or any other conducting part of the receiving apparatus which is connected to a point of more or less high potential. The capacity to earth, or even the isolated capacity of the operator's body, is responsible for the trouble, which is most noticeable, as a rule, with sets employing high frequency amplifiers or in receivers intended for short-wave work. Screening the condensers by means of thin metal plates secured to the underside of the panel



What we admire, we praise, and when we praise
Advance it into notice, that its worth
Acknowledged, others may admire it too.

COWPER

"That its worth acknowledged . . . . ."

JUST how strong is the wireless public's loyalty to the Wuncell Dull Emitter is demonstrated by the fact that the year just passed was easily the most successful in the history of the Cossor Valve.

A very large proportion of Wuncell users are those who first became acquainted with the peculiar merits of Cossor Valves through the original P.1—the most popular Bright Emitter ever placed upon the British market.

During the past two and a half years the public have had ample opportunity to test out the Cossor Valve under every possible condition. Invariably they have found it supersensitive to a degree, productive of a beautiful fullness of tone and exceptionally trustworthy. They have proved that the arched filament combined with the electron-retaining hood-shaped Grid and Anode is responsible for a standard of efficiency which cannot be duplicated by any other make of Valve. Consequently once they have chosen their valves, Cossor users are not to be weaned from them.

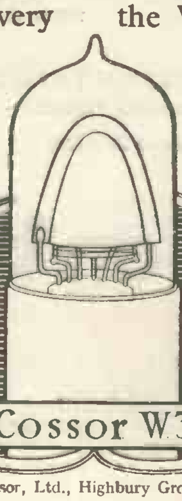
Month by month this circle of enthusiasts is widened by those discerning men who are desirous of obtaining the finest possible valve service. With the Wuncell they are realising that the working costs of a Valve Set are reduced to a level never before believed possible.

For 2-volt Accumulators.

W.1.	For Detector and L.F. use Consumption: ·3 amps.	14/-
W.2.	(With red top) For H.F. use Consumption: ·3 amps.	14/-
W.3.	The Loud Speaker Valve Consumption: ·5 amps.	18/6

For 2, 4 or 6 Volts.

W.R.1.	Similar to W.1, but with special resistance which can be short-circuited when not required	16/-
W.R.2.	Similar to W.2, but with resistance as above	16/-



Cossor Cossor W3 **Valves**

A. C. Cossor, Ltd., Highbury Grove, N.5

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and connected to the earth terminal of the receiver, or in some cases by merely reversing the leads to the condenser, will often effect some improvement. It is mostly in the adjustment of variable condensers that the trouble makes itself felt, and when it is found impossible by the means previously mentioned satisfactorily to work the receiver, it is advisable that long extension handles be fitted.

H. J. P. (STAFFORD) wishes to construct a selective 2-valve set for working two pairs of telephones and states that the house lighting electric supply is of alternating current at 220 volts, and that alternating current power lines pass near to his house. He asks whether a reflex receiver would be suitable for his purpose.

Situated as is our correspondent, we would not advise that any reflex receiver be employed, since such sets are prone to be affected by induction from alternating current mains, which often gives rise to an objectionable "humming" in the telephones. A straight set, preferably with an inductively coupled aerial circuit, is to be preferred, and for a suitable design we would refer our reader to the November, 1924, issue of *Modern Wireless*, in which a "Double-circuit Neutrodyne Receiver" is described.

F. P. (WORTHING) has constructed the 2-H.F. and detector receiver described by Mr. Rattee in "WIRELESS WEEKLY," Vol. 6, Number 9, and can only obtain stable working by dimming one of the H.F. valves on its respective filament resistance. He states that he is certain of all his components excepting the double condenser, which bears no name, but appears to be well made.

It would appear likely from the symptoms given that the double condenser is responsible for our correspondent's difficulty, and we would suggest that this be changed for one of the type used in the original design. In practice it is found with certain double condensers, generally nameless, that the two sets of plates are placed too close together, which results in uncontrollable oscillation being experienced.

W. C. (BOGNOR) asks us to refer him to a back number of "WIRELESS WEEKLY" in which a suitable wavetrap for separating Radio-Paris and Daventry is described.

A type D wavetrap, which serves admirably for this purpose, is described in *Wireless Weekly*, Vol. 4, No. 15, for August 13, 1924.

M. W. (GRANTHAM) asks us how to alter the smoothing unit described by Dr. Robinson in the January, 1926, issue of "MODERN WIRELESS," in order to obtain 60, 100, and 200 volts from his 200 volt direct current mains.

The unit mentioned is not suitable for the voltages specified, since it should be realised that of necessity a certain voltage must be dropped across the smoothing valve, usually of between 60 and 70 volts, which at once makes it impossible to obtain the 200 volt tapping.

L. W. M. (NEW BARNET) states that with his "All-Concert de Luxe" receiver he cannot obtain results at all comparable with those given by Mr. Harris, in Radio Press Envelope No. 4. He submits a sketch of his aerial, which is shown to be 20 ft. high at one end and 15 ft. at the other, whilst on either side and only 5 ft. away in one case, two other aerials are erected.

We are by no means surprised that our correspondent has been unable to duplicate Mr. Harris's results on the All-Concert de Luxe receiver, employing the aerial and earth system of which he sends us the sketch, since the average height of the aerial is but little above 15 ft., and it is seriously screened by the other aerials which are near it and above it in height. Under the circumstances, therefore, we can only suggest that the height of the aerial be increased, especially at the lead-in end, and that experiments be tried with alternative earth connections, in order to determine whether this part of the system can also be improved.

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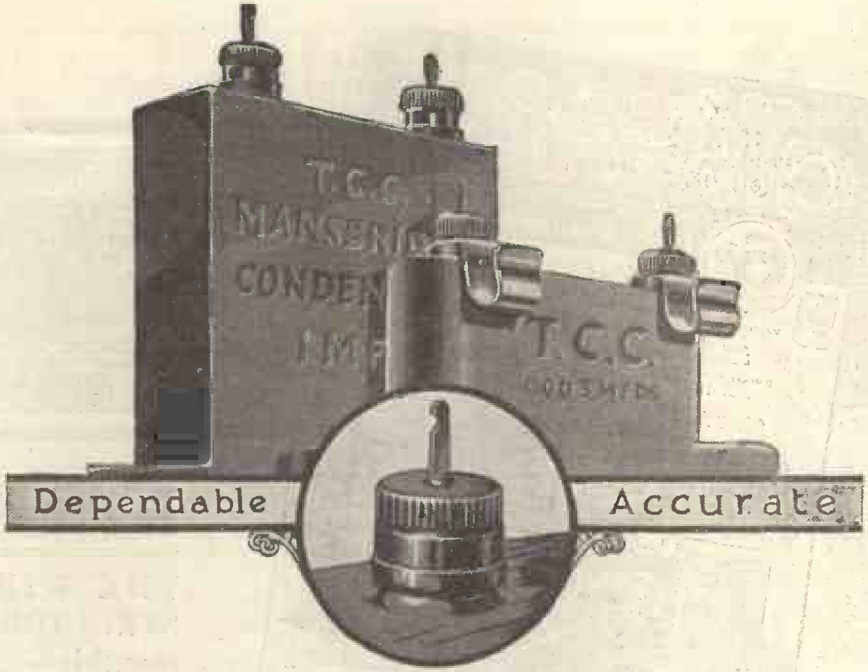

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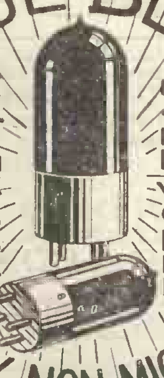

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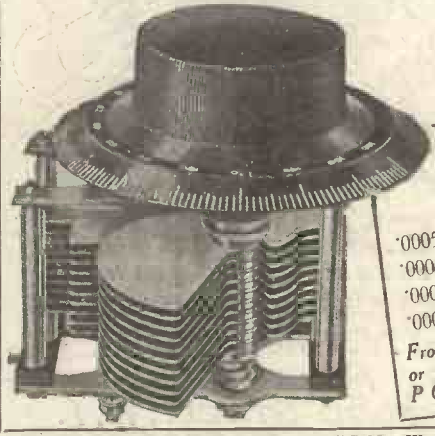

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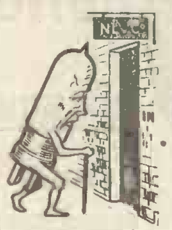

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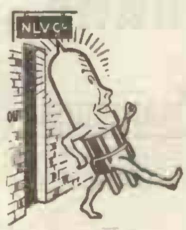

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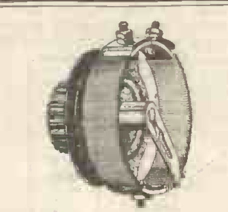

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