THE "ECKERSLEY" THREE—1/- BLUEPRINT FREE

MODERN WIRELESS

DOUBLE CHRISTMAS NUMBER

1/6

Vol. XII. No. 36.
DEC. 1929

SPECIAL CONTRIBUTIONS
in this issue by
Sir OLIVER LODGE, F.R.S.
Sir AMBROSE FLEMING, F.R.S.
Capt. P. P. ECKERSLEY, M.I.E.E.
G. V. DOWDING, Grad.I.E.E.
R. E. JEFFREY
G. P. KENDALL, B.Sc.
Etc., etc., etc.

RADIO CONSULTANT-IN-CHIEF CAPT. P. P. ECKERSLEY M.I.E.E.

Pages 693-700 are missing.

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Edited by NORMAN EDWARDS.
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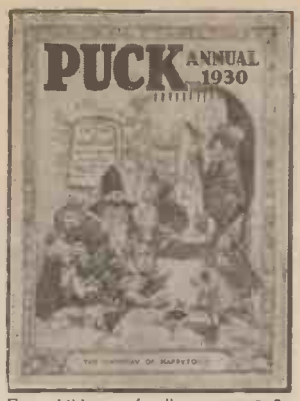

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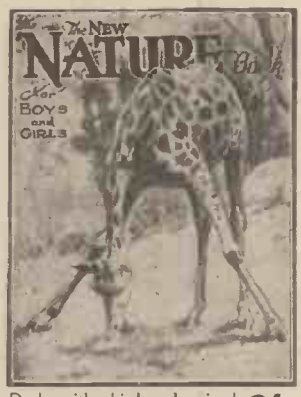

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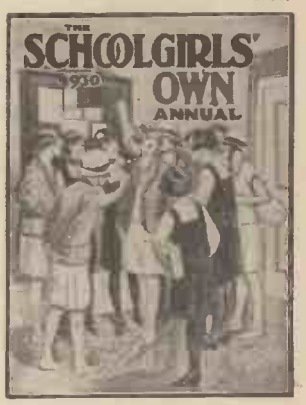

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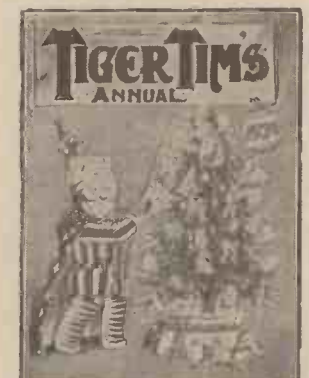

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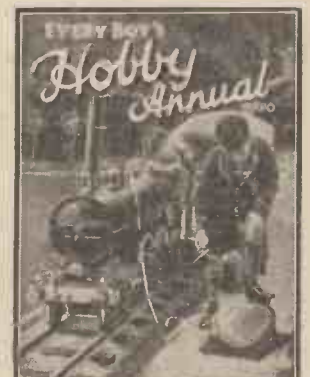

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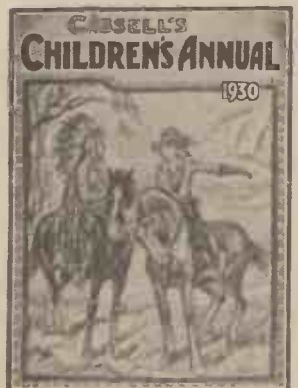

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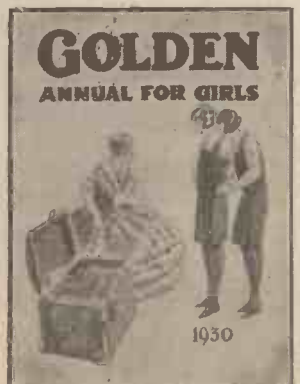

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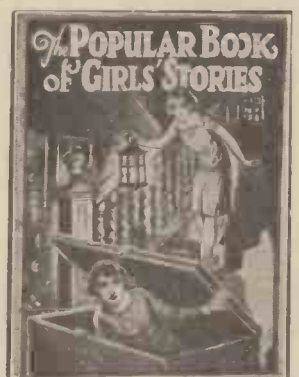

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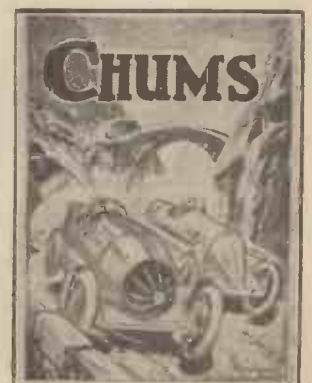

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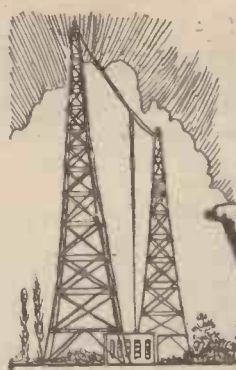


MODERN WIRELESS

Vol. XII. No. 36. December, 1929.

Our Star Set—Other "M.W." Research Designs—Those Twin Programmes—The Ban is Lifted.

Our Star Set

THE Star Set which we describe in this issue of MODERN WIRELESS is THE "ECKERSLEY" THREE.

This receiver has been specially built as a presentation set to our Consultant-in-Chief, Captain P. P. Eckersley. Readers can guess without much difficulty that, in designing a presentation set of this nature, the Research Department went "all out" in an endeavour to achieve something really first-class.

And on test the "ECKERSLEY" THREE has undoubtedly proved itself a first-class three-valve receiver. If we had any qualms about it we should certainly not present it to our Radio Consultant-in-Chief. But Mr. Kendall, of the Research Department, has been putting it through a series of exhaustive tests during the last few weeks, and it has emerged with flying colours.

Readers who build it will find that it provides a special combination of sensitive and selective long-range loud-speaker results. Examine the wiring diagram and the general layout, and you will see that it has many interesting features. In short, it strikes quite a new note in modern radio receiver design.

A blue print of this receiver is also given away in this issue, and we feel confident that readers who build it will have a really star set, of which they may well be proud.

Other "M.W." Research Designs

AMONG other sets in this issue is the "DUO-TUNE" ONE. This is a highly efficient wave-change single-valve set, which uses only three ordinary plug-in coils (instead of the usual four or five) as a special coil unit.

The "M.W." STANDARD A.C. UNIT is a mains unit intended for use with any MODERN WIRELESS set. It gives both L.T. and H.T. at standardised voltages, and takes the guesswork out of mains-operated sets.

The A.C. "BROOKMAN'S" is an all-from-the-mains version of the famous "Brookman's" Three. It retains the extraordinary selectivity and excellent quality of the original design; while the "TWIN-FRAME" FOUR is a very fine transportable set, with built-in frame aerial and loud speaker. Space for batteries or mains unit is allowed.

You can put this set down anywhere with the certainty of having plenty of programmes available. An ingenious and efficient wave-change scheme of switching is embodied. This is one of the Research Department's best productions.

Those Twin Programmes

ALTHOUGH there has been a good deal of pretty fierce criticism in the newspapers about the new Brookman's Park station, as was to be expected the complaints are now falling off as more and more listeners adapt their sets to new conditions.

The new 2 L O is certainly a very powerful station, but on the whole it may be said to be a great improvement on the old Oxford Street transmitter and, so far, a successful realisation of Captain Eckersley's Regional Scheme.

Some views have been expressed in the newspapers and elsewhere as to the possibility of much confusion when the Brookman's Park's second transmitter begins broadcasting an alternative programme. This criticism has arisen because some critics are of the opinion that the wave-length separation between the two transmissions is not sufficient.

However, supposing when the alternative programme is broadcast the wave-length separation is found not to be sufficient, it is pretty obvious that the B.B.C. will not have its first Regional station classed as a failure for that reason. That the wave-length separation will be increased is a foregone conclusion, if the present allocation is found insufficient.

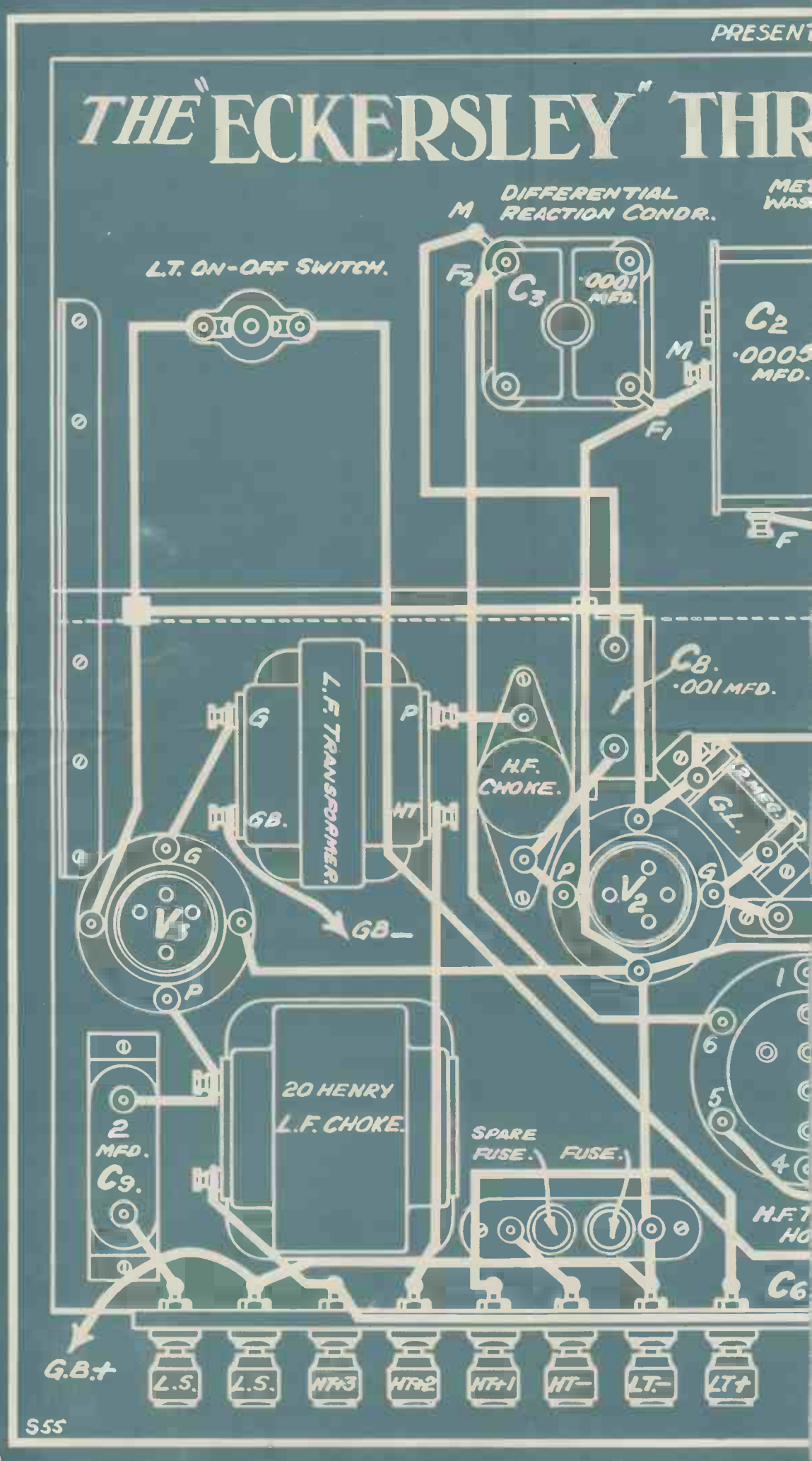
The best thing to do in a case like this is to wait and see. Criticising a chicken before it is hatched from its egg is always futile.

The Ban is Lifted

THE ban put on the admission of the B.B.C.'s dramatic critic to theatrical "first nights," by the West-End Theatre Managers' Association, has been lifted—and very quickly, too!

Recently, in sending theatre tickets to the Press, managers requested that the tickets should be used for "legitimate journalistic purposes and not for broadcasting," but such childishness could not be carried on for long.

Anyone has a right to express an opinion of something which is intended for public amusement—or boredom. That is the very reason why the B.B.C. is criticised from all quarters. "You pays yer money . . ." But if you can't take your choice, you *are* entitled to criticise what you have paid for!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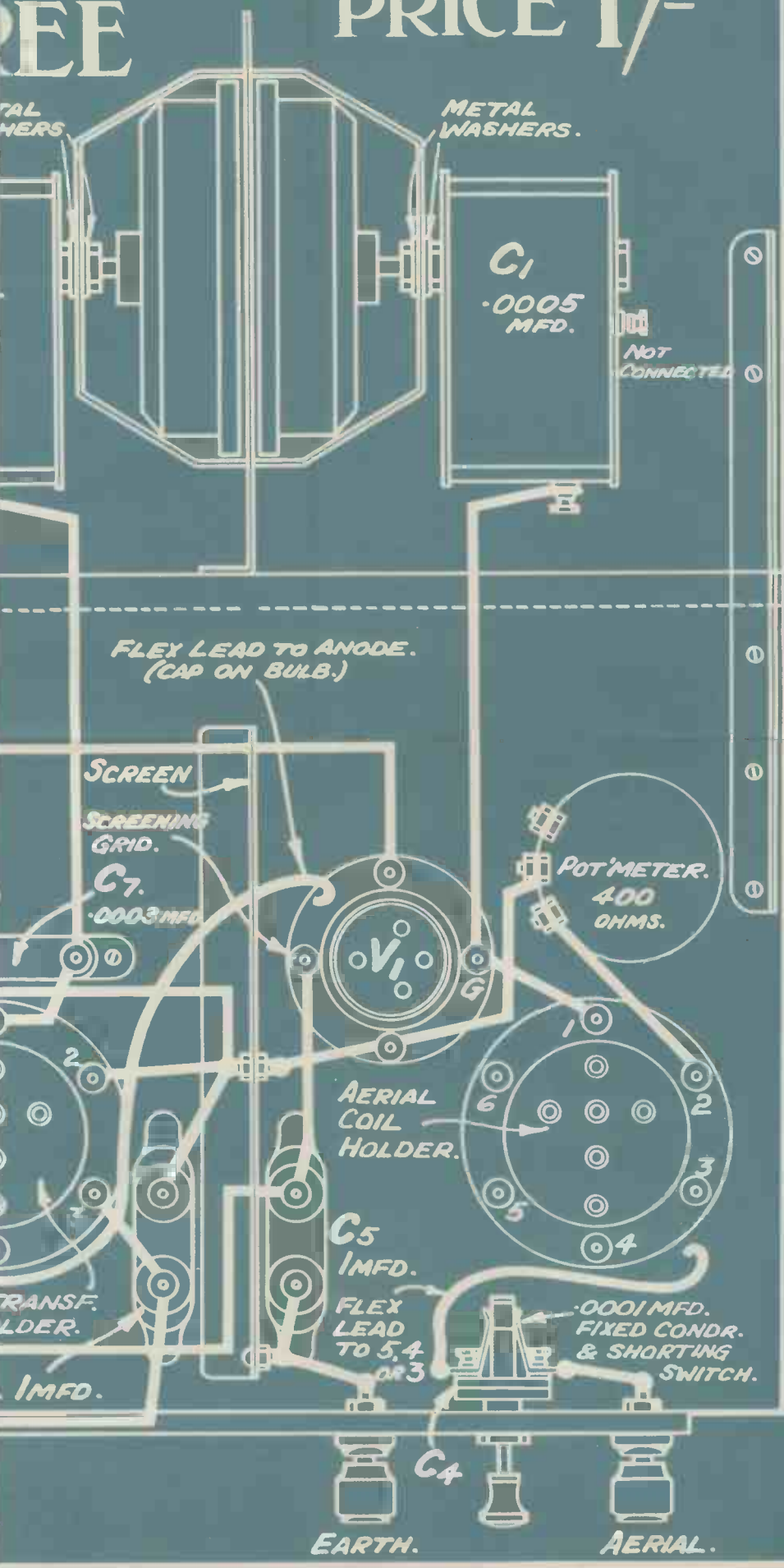


The "Eckersley"

This is a presentation set—designed and built as a compliment to our Radio Consultant-in-Chief, Captain P. P. Eckersley. Without doubt it is the finest three-valver ever described in "M.W.," and is worthy in every way of the distinguished name with which it has been christened.

IN the "Eckersley" Three we are presenting to our readers a set design upon which a great deal of thought and careful planning has been expended. It is a dual-purpose receiver of a decidedly unusual type, which we think will appeal to a very large number of constructors.

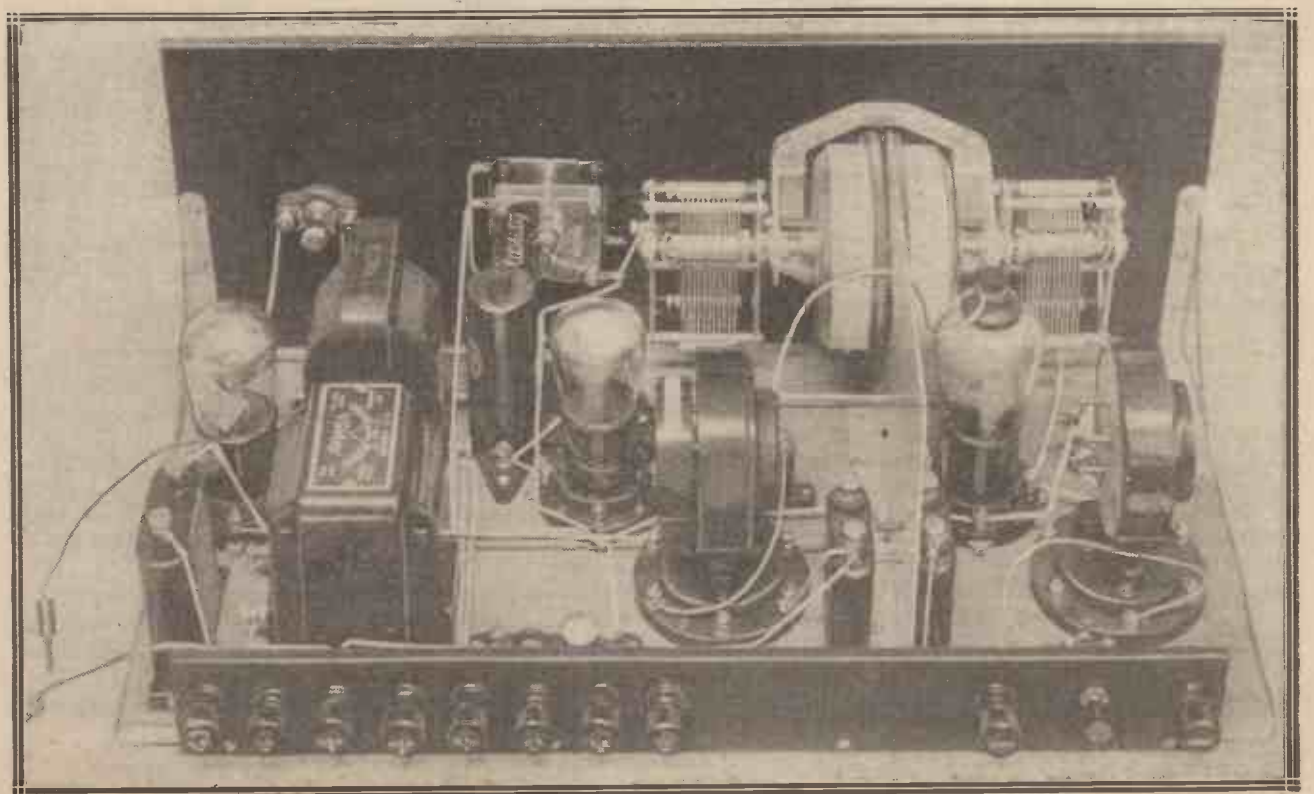
We do not propose to say very much about its special merits just yet, but would rather leave you to form your own opinion after we have explained what we have tried to do. Now, sets in the past have been for the most part divided into two main classes. In the first we find the majority of receivers of the larger type, this division including designs for highly sensitive and selective sets with all their details worked out to enable them to put up the best possible performance on long-distance work.

The Virtues of Both Types

The second division includes the much smaller number of large sets designed expressly to give the finest possible quality of reproduction, usually with only a secondary regard to high selectivity and sensitivity.

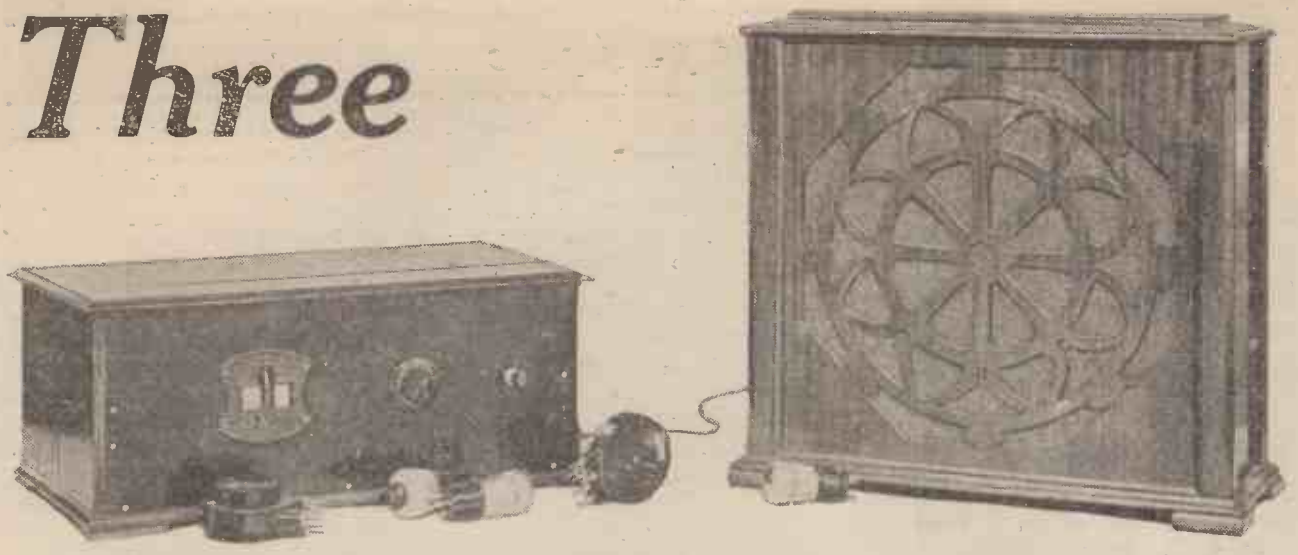
As a rule, a set designed expressly for the highest sensitivity and selectivity for long-range work is not quite ideal for giving the best possible quality on the local programmes, while, on the other hand, a receiver specially designed for the highest possible quality of reproduction does not generally shine when called upon to bring in foreign stations with both good volume and freedom from interference.

It has generally been assumed that it is scarcely possible to combine both characteristics in one receiver, and it was because we did not consider that this assumption was fully justified that we set to work to produce the "Eckersley" Three. In it we hope to show you that it *is* possible to design a receiver which can have either characteristic at



Note how the coils are placed so that the screen intercepts and cuts off their stray fields. The little knob between the aerial and earth terminals controls the series aerial condenser.

Three



will, a type of design which we believe is destined to receive a considerable amount of attention in the near future.

We believe that this definite separation of receivers into high-sensitivity, high-selectivity, long-range outfits on the one hand, and more flatly-tuned high-quality local sets on the other hand, will tend to disappear as time goes on. There is an undoubted tendency to regard high-quality reproduction of the local station as the main justification for any receiver, with an occasional search for distant stations as a mere diversion, and so there is bound to come a demand for just such dual-purpose receivers as the "Eckersley" Three.

Ideal for General Purposes

For this first example of the combined-function receiver we have chosen the deservedly popular three-valve combination consisting of a screened-grid H.F. stage, followed by a rectifier with optional reaction, and one transformer-coupled low-frequency stage, since experience has shown that such a combination has proved a close approximation to the ideal general-purpose outfit in our readers' hands. Probably in the future we shall be giving other examples showing the application of this same dual-purpose principle in sets of the larger type. This depends very much upon whether our readers indicate that they agree with us that such receivers represent a real step forward in design.

After first picking up your station by running both drums together, a little trimming up on each will give you the exact settings.

A Combination, Not a Compromise

As we go over the general details of the "Eckersley" Three you will see how this dual-purpose idea has been worked out. You will note in passing that the set is not in any sense a compromise, and that nothing has been sacrificed in the way of long-distance efficiency in order to incorporate the special features which make it also a local "purity" receiver. These latter features are exceedingly simple, and in so far as they affect the long-range properties of the receiver are of a nature which may be described as adjustable, so that they can be put out of action

COMPONENTS YOU WILL NEED

1 Panel, 18 in. × 7 in. (Resiston, "Kay-Ray," Paxolin, Goltone, Becol, Ripault, etc.).
1 Cabinet to fit, with baseboard 10 in. deep (Raymond, Cameo, Pickett, Gilbert, Lock, Osborne, etc.).
1 Double-drum condenser (Lotus, Cyldon, J.B., or similar type, in which the two driving drums come sufficiently close together to be revolved simultaneously with the operator's thumb).
1 ·0001-, ·00013-, or ·00015-mfd. differential reaction condenser (Utility, Ready Radio, Pye, Lissen, Magnum, Lotus, Polar, Ormond, etc.).
1 L.T. on-off switch (Lissen, Benjamin, Lotus, Wearite, Igranic, Magnum, Raymond, Burton, Bulgin, etc.).
1 Pair small panel brackets.
2 6-pin coil holders (plain unscreened type). (Formo, Lewcos, Bowyer-Lowe, Magnum, Wearite, etc.)
3 Sprung valve holders (Lotus, W.B., Benjamin, Dario, Igranic, Wearite, Formo, Bowyer-Lowe, Pye, Precision, etc.).
1 200- or 400-ohm baseboard-mounting potentiometer (Igranic, Lissen, Ready Radio, etc.).
1 Combined series aerial condenser and switch unit (Wearite).
2 1-mfd. condensers (Dubilier, Lissen, Ferranti, T.C.C., Hydra, etc.).
1 2-mfd. condenser (Dubilier, Lissen, Ferranti, T.C.C., Hydra, etc.).
1 ·0003-mfd. fixed condenser (T.C.C., Mullard, Goltone, Dubilier, Igranic, Clarke, Lissen, etc.).
1 ·0001-mfd. fixed condenser (Lissen, etc.).
1 2-meg. grid leak and holder (Dubilier, Igranic, Ediswan, Lissen, Mullard, Carborundum, Loewe, etc.).
1 H.F. choke (Ready Radio, Lissen, R.I., Lewcos, Dubilier, Climax, Raymond, Keystone, Wearite, Varley, Colvern, Magnum, Lotus, etc.).
1 Low-ratio L.F. transformer (Lissen, Ferranti, R.I., Brown, Cossor, Lotus, Varley, Marconiphone, Mullard, Telsen, Philips, Igranic, etc.).
1 Output filter choke of about 20 henries (Varley, Igranic, Wearite, R.I., Pye, etc.).
1 H.T. fuse (Bulgin, Ready Radio, Magnum, etc.).
1 "M.W." standard screen, 7 in. × 6 in. (Ready Radio, Magnum, Wearite, Paroussi, Peto-Scott, etc.).
1 Terminal strip, 16 in. × 2 in.
10 Engraved or indicating terminals (Belling and Lee, Igranic, Eelex, Clix, Burton, etc.).
Wire, screws, flex, plugs, etc.

An Ideal Every-Purpose Receiver

when not required, i.e. when the set is being used for long-range work.

Let us begin with the system of tuning employed in the receiver. By "system of tuning," by the way, we mean the method of arranging the controls for the tuning of the two circuits employed, not the actual method of effecting variations of wave-length, this latter being by the usual scheme of tuning coils shunted by variable condensers. At first sight this question might seem a minor detail, but if you think it over you will realise that it is of considerable importance in the design of any set intended for purely domestic use on the local programmes.

Objections to Ganging

It is reasonable to expect that any receiver making claims to being a viously be to have single-dial operation, but this normally means ganged tuning, in the case of an H.F. stage.

Now, ganged tuning is all very well, and it is quite possible to apply it successfully to a single H.F. stage with the aid of certain modern developments, but it does undoubtedly complicate the design of the receiver somewhat with a slight increase in cost, and it makes the initial adjustments decidedly more difficult to make for the reader who has not had some previous experience with similar receivers.

Moreover, we believe that there is considerable prejudice amongst constructors against ganged tuning as such, based upon the difficulties and uncertainties of some of the earlier versions of the system. Consequently, we decided against it in the case of easy to work as ganged tuning, and requires no preliminary adjustment or balancing whatever.

An Excellent Solution

What we have done is to incorporate what is called a "double drum-drive" condenser, which is really two separate condensers with drum control for each section, the edges of the two drums being brought out through a single fitting on the front of the panel, so close together that they can both be run together by means of one thumb. It is thus possible to run both the drums together when changing over from one station to another, yet independent tuning of the two circuits is possible, so that no special complications in the way of balancing devices are needed.

In the "M.W." Research Laboratory : Capt. Eckersley examining one of the experimental receivers under construction. On the left is seen part of the A.C. power board, and to the right the D.C. battery-charging gear.

purity outfit for use on the local station will be operated by the non-technical members of the family for a good deal of its life, and so simplicity of tuning and changing over from the local station to 5 G B and so on becomes of decided importance. The ideal arrangement would ob-

the "Eckersley" Three, since we desire to appeal to even the reader of limited experience with this set, and also we desired it to be as simple and economical as possible to put together and operate successfully.

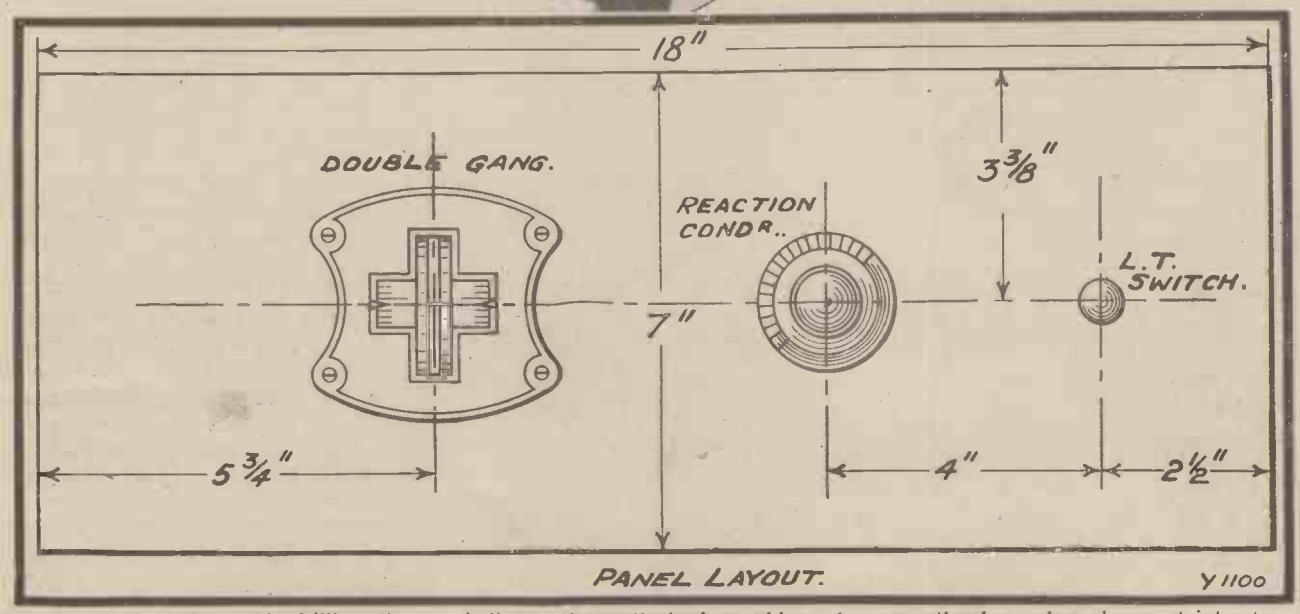
Instead, we have chosen a system of tuning which is very nearly as

This method of tuning is almost as convenient as the true one-dial system for the ordinary domestic user, since when the set is working on one of the local programmes it is quite a simple matter to change over to, say, 5 G B by running both dials together until the desired signals

are picked up, whereupon they can be more accurately tuned-in even by the non-technical operator by manipulating first one drum and then the other until the desired volume is obtained.

In the absence of special balancing devices the two circuits do not tune exactly alike over the whole tuning range, but they remain sufficiently well " in step " for the unskilled operator to be quite certain of picking up a strong signal by simply running the two drums together in going over from one station to another. This, after all, is the main thing to be provided for, since the real objection to a multi-dial set in such hands is the feeling of helplessness which is

Easy control, sensitivity and selectivity are main features of this set.



The panel view above this drilling diagram indicates the method of searching when once the drums have been got into step; both are run together with the thumb.

apt to assail an operator of this type when attempting to tune-in another station. So long as they are reasonably certain of finding another station quite quickly, the non-technical members of the family do not, as a rule, object to just a little fiddling to get the full strength when they have found the desired signal.

Convenient for Even the Expert

Incidentally, this method of tuning is one which even the more skilful operator should not treat disdainfully, because he will find it a real convenience in searching for foreign stations. Once the two dials have been got into step on any given station they usually remain quite closely together over a considerable part of the tuning range, so that searching becomes an exceedingly quick and simple process, with just a little " trimming up " on each drum when a signal has been found.

To secure the full possible benefits of this method of tuning there is just one point which you should look out for in choosing your double-drum condenser. Remember that you desire both drums to be capable of rotation simultaneously by running your thumb along the edges, and this means that the two driving edges must be sufficiently close together.

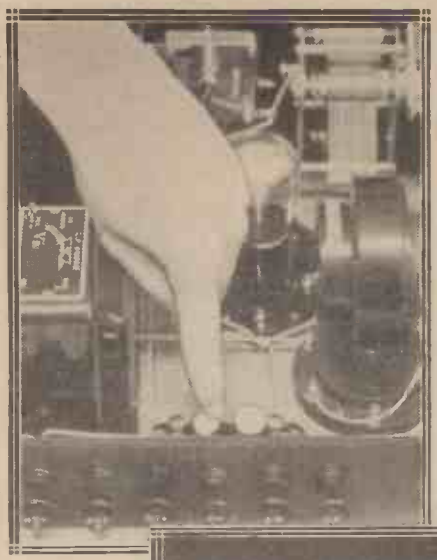
If they are placed, say, half an inch or more apart it means that you must use both thumbs, and so you lose to some extent the imitation single-control effect at which we have aimed. So far as the more skilful operator is concerned this is no drawback, but it is something of a sacrifice so far as the non-technical operator is concerned.

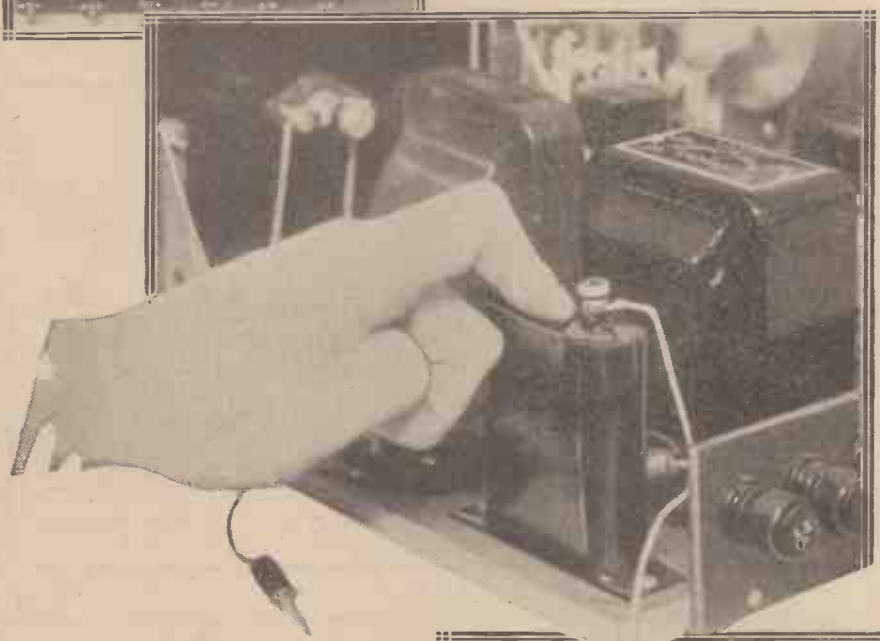
So far as the constructor and user is concerned this method of tuning appears to have only one drawback, and that is a purely constructional one consisting of the slight extra amount of work involved in mounting up one of these condensers on the panel.

Fitting the Condenser

Most of them require a square or oblong hole to be cut in the panel, a process which appears to alarm some set builders. We should like to assure such prospective builders that it is not nearly so difficult as it sounds, because the condenser makers provide you with a template which makes the cutting out of the hole very much easier, and if you employ one of the two methods which we shall suggest it is only a matter of just a little patience.

The first method is to mark out the desired hole, and then drill a series of





Above, the double fuse holder, with spare bulb. In the middle, the L.F. end, with the output filter. To the right, a general view of the set, with valves and coils removed, which you will find useful in checking up your layout.

quite small holes right round the outline so that the oblong piece of ebonite comes away and you can then file off the edges to exactly the desired shape. There is nothing very difficult about this process, but it does certainly call for a little patience and care to make a neat job.

Using a Fretsaw

A very much easier method which we strongly recommend is to purchase a small hand fretsaw and cut out the piece of ebonite with the aid of this tool. You then only require to drill a single hole at each of the corners of your outline, and the fretsaw will do the rest very easily. Just one practical tip: if you have not used a fretsaw on ebonite before, experiment on a small waste piece before you begin the job itself, and learn how to make a fairly straight cut, how much pressure to put upon the saw to avoid breakages, and so on.

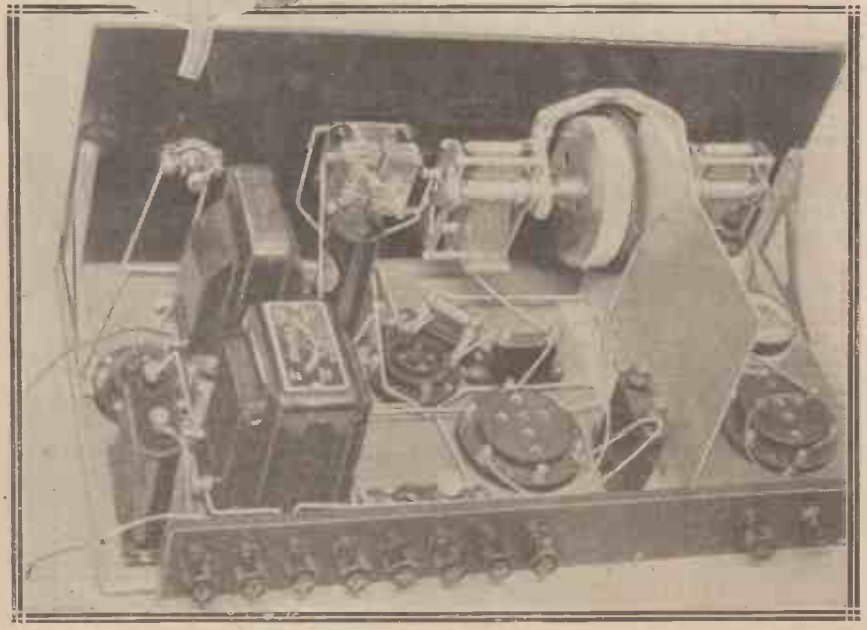
Striking a balance, we do not think that you will find this set requires any more work or is any more difficult to construct than other similar three-valvers, in spite of the fact that you have this rectangular hole to cut in the panel, because one of our objects in designing the set was to limit the number of controls upon the panel as severely as possible, and so there are actually very few holes to be drilled other than the one for the drum condenser.

Of course, if you still dislike the idea of cutting out this rectangular hole you will no doubt find that several of the advertisers in MODERN WIRELESS will supply panels for the "Eckersley" Three drilled and ready for the mounting of the parts. If you order one of these do not forget to specify the make of drum condenser which you are going to fit, so that you may be sure of having the correct hole cut in your panel.

So much for the method of tuning. This feature was one which was really decided upon because of its merits from the "local programme" point of view, but turns out to be advantageous also from the standpoint of the more skilful operator who searches for distant stations. Now let us look at those particular details which apply only to local station work.

Flattening the Tuning

First of all there is the question of getting rid of that extra sharpness of tuning which is so desirable a feature of the long-range set. For local work you really require to flatten out your tuning considerably to obtain the desirable even response to the various frequencies of the transmission, and in these days of the initiation of the regional scheme it is advisable that this flattening out should be under



Long-Distance Performance Assured

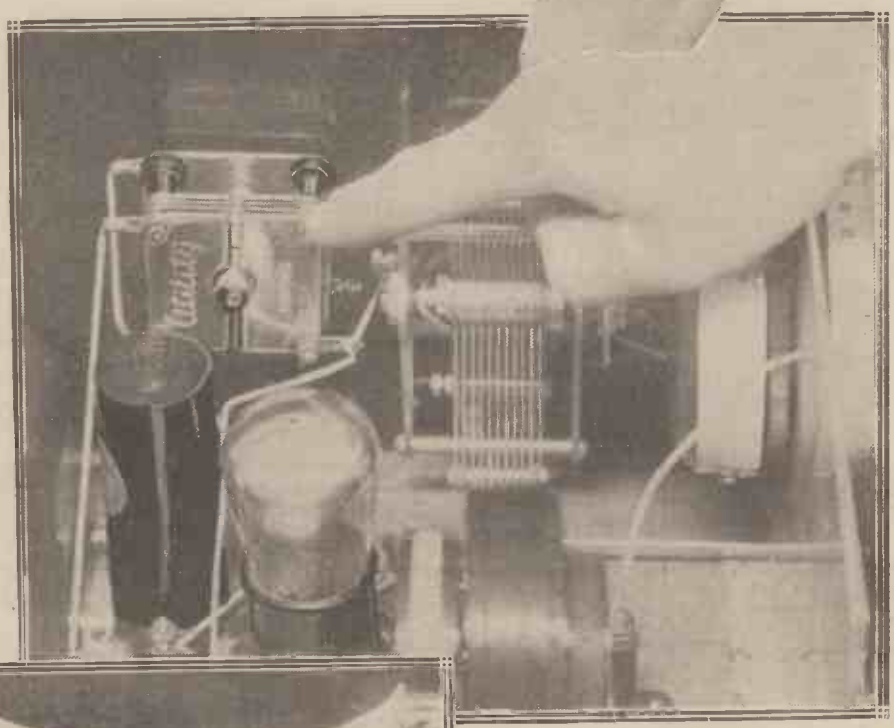
control. If it is more or less fixed and chances to be overdone, it is quite possible that there will not be sufficient selectivity to serve even for local programme purposes.

There is an obvious danger of going too far in this direction, but nevertheless a certain flattening out of the resonance peak of each circuit is extremely desirable to secure faithful response to all the different frequencies of the modulated carrier-wave. It is usually considered that too sharply-peaked a resonance curve for any circuit leads to an effect which is described as a cutting off of the more widely separated side-bands—that is to say, those conveying the higher notes of the scale.

Simple But Effective

Whatever the true explanation, the phenomenon is one which is quite well established in the sense that if the tuning is made too sharp, whether by means of reaction or some other device, one does obtain an undue preponderance of lower and middle register notes and an apparent reduction of the higher notes. Tuning circuits arranged to form what is called a "band-pass filter" provide a very satisfactory method of overcoming this difficulty, but without introducing such complications into a design much can be done by deliberately increasing the resistance of one or more of the circuits.

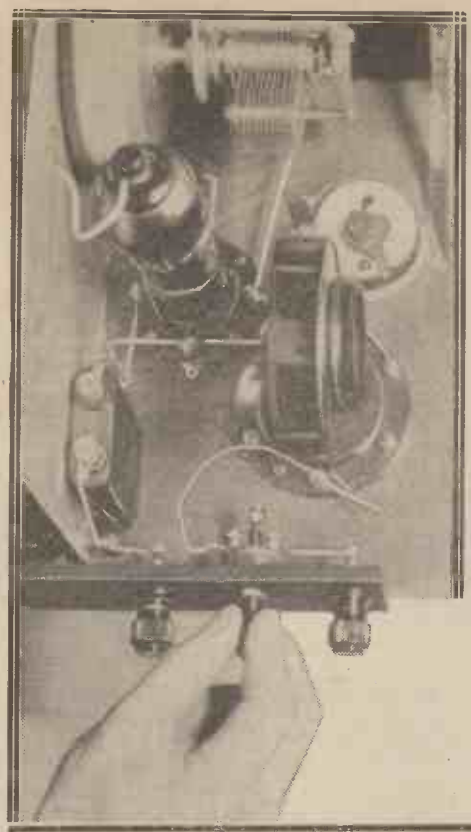
This expedient is the one we have chosen for the "Eckersley" Three, on account of its extreme simplicity and quite considerable effectiveness. In this particular receiver we have found that quite a good effect is obtained by increasing the resistance of only one of the tuned circuits, for reasons which will be apparent in a moment. The point is that the resonance curve of the second circuit is not unduly sharp, provided that reaction is kept at minimum, because



At the top, the control which does NOT upset your tuning (differential reaction condenser). Below and to the left, one of the main controls of selectivity—interchangeable primary windings of different sizes are available for the H.F. transformer.

the damping effect of the grid-leak type of detector appears to be sufficient for our purposes. All you have to do is to slack the reaction well back and you can then assume that the detector grid circuit is not unduly sharply tuned. For long-range work, of course, a little reaction is normally employed and you then get the sharply resonant condition necessary to give the high selectivity needed under modern conditions.

The circuit in which the extra damping is required is the grid circuit of the H.F. valve, since here we have no valve damping of any noticeable



merely does it enable us to flatten out the tuning and wipe out any slight inherent feedback effects, but it also acts as a very excellent volume control which can be supplemented by slight detuning in order to compensate for the difference in loudness between, for example, one of the regional transmissions and 5 G B.

The resistance we have used (sometimes called a losser) is actually a baseboard-mounting potentiometer, which can be of either 200 or 400 ohms, connected up as a plain variable resistance, i.e. with only two of its terminals wired into circuit. You will find this a very valuable and handy device for controlling the power of the local station, and it does not require frequent adjustment.

It can be set, as a rule, to one value and then further variations of volume effected by detuning a little. Thus with the resistance set to a suitable value you will probably find that you can tune-in 5 G B fully, and then for the stronger transmission of your local station reduce the volume still further by detuning as required.

For long-range work, of course, this "lossing" resistance should be cut out of circuit by moving the slider arm right round to the end at which minimum resistance is obtained.

Examine Your Potentiometer

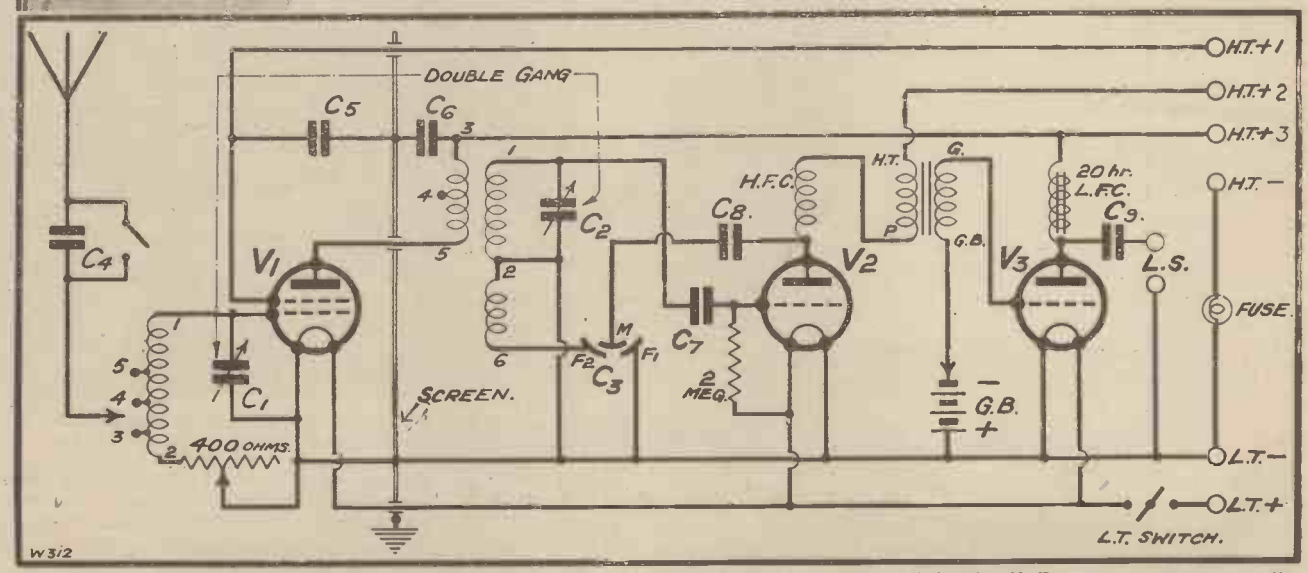
By the way, it is just as well to take a look at your potentiometer before you screw it down in place and see that when the arm is turned round to the end it does indeed cut out all the resistance, and does not leave two or three turns permanently in circuit. If you find that your potentiometer is of this latter type, just solder the last three or four turns together with some solder along the upper edge so that no turns are left in circuit when the arm is brought round.

Grid Leak or Anode Bend?

Now about the detector. It has been the convention for some time to use anode-bend rectification in super-quality receivers, but we decided against the use of this device in the "Eckersley" Three for the simple reason that its lower sensitivity makes it unsuitable for employment in a set of only moderate size.

Where we have only one low-frequency stage it is practically essential to use transformer coupling in order to obtain adequate volume on the more distant stations, and so we are practically compelled to use the cumulative grid rectification method of the normal type. Moreover, its higher sensitivity is most desirable for long-range work in a set of moderate size.

This is really the only compromise between super-quality and sensitivity which has been made in the "Eckersley" Three, and the more experienced reader will agree that it is not a very important matter. Actually, the difference between anode-bend rectification and a properly arranged grid-leak detector is not perceptible to the ear, except under very stringent test conditions of an unusually perfect type of loud speaker and a very keen ear.



In this circuit diagram you can follow the special arrangements which make the "Eckersley" Three both a high-quality local set and a sensitive long-range outfit. The photo above shows the control for the series condenser C_4.

extent, and we may on the contrary have a slight feedback effect due to stray couplings and capacities. The damping effect of the aerial has some influence on this circuit, of course, but in modern receivers this coupling is usually rather weak in order to obtain selectivity, and so may not do all we require.

The actual device we have used is a very simple one, and merely consists of the provision of a variable resistance in series with the first tuned circuit, which you will find serves the purpose admirably. Not

Excellent Quality and Simplified Tuning

Another feature of the set specially intended to promote perfect reproduction is the output filter for the last valve, a detail not often provided in three-valve receivers containing only one low-frequency stage. The assumption here is that since the "Eckersley" Three will often be used to obtain really high quality, quite a "large" valve will be employed in the last stage; for example, a super-power or one of those types taking from 15 to 20 milliamps H.T. current, such as the Cossor; and so an output filter circuit is very desirable to enable this valve to do its best.

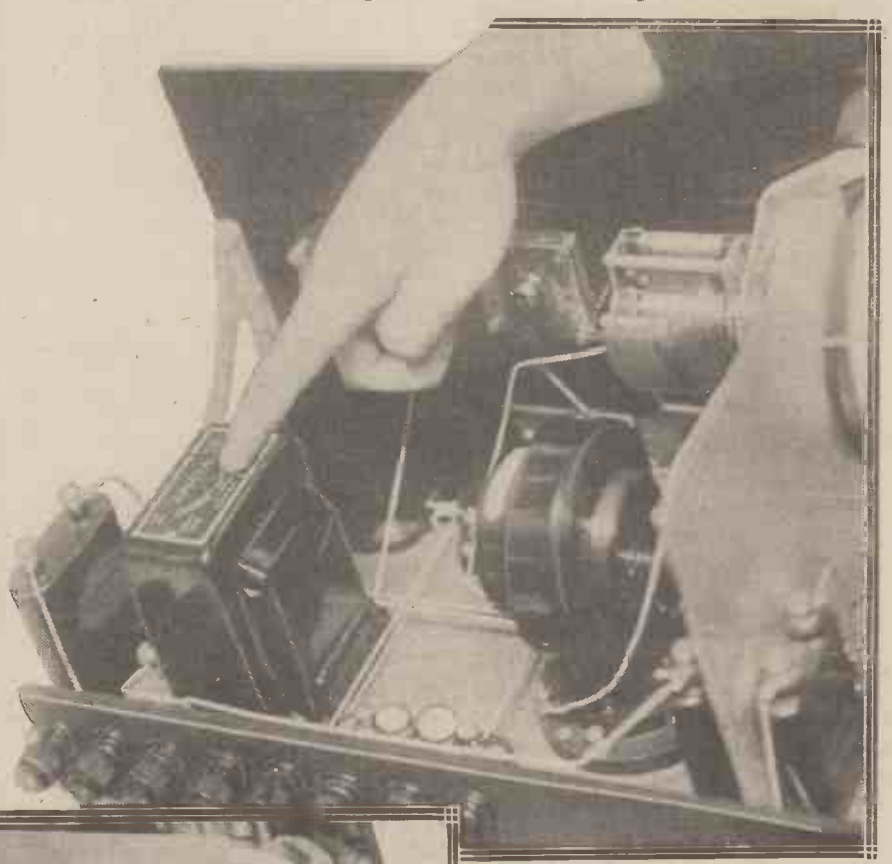
Saving the Volts

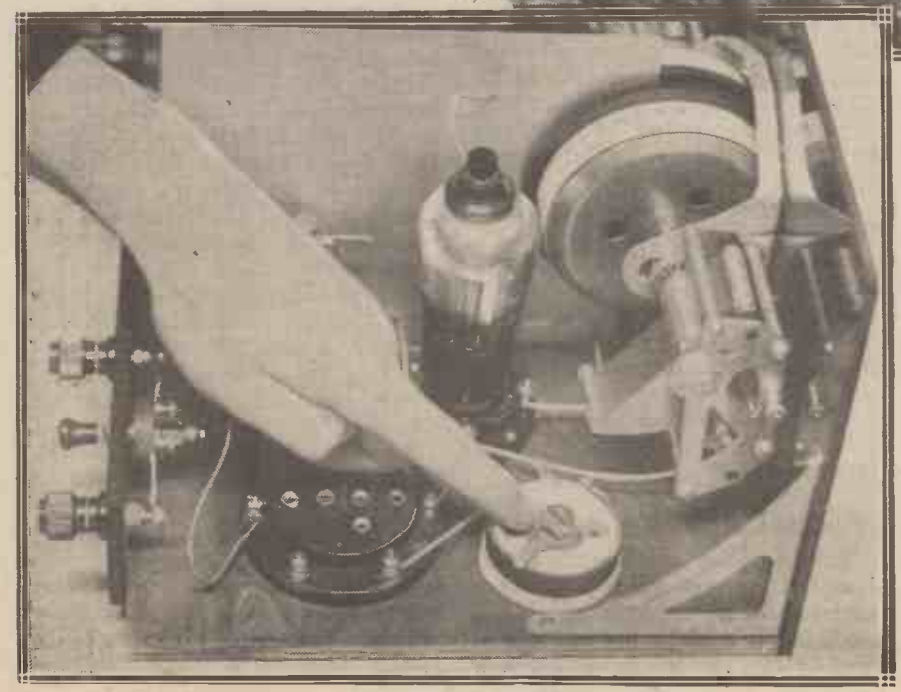
With a good output filter choke the voltage drop in the anode circuit becomes practically negligible, and so you may be pretty sure that all your precious H.T. voltage is actually getting to the anode of the valve. This is by no means the case when the loud speaker is connected straight in the anode circuit.

To take an example, suppose your valve is taking only 10 milliamps, and that your loud-speaker resistance is 2,000 ohms. The voltage drop across the speaker will now be 20 volts, and if you have, say, 140 volts H.T., only 120 volts will actually reach the anode of the valve, and you may wonder why it overloads more easily than you think it should.

Just one point about this filter. As you see it in the set it is correctly arranged for use with either batteries or an alternating current mains H.T. battery eliminator. For use on D.C. mains a slight modification is required to ensure safety and safeguard the operator against shocks from the loud-speaker terminals or leads.

You will note that one loud-speaker lead is wired to the L.T.— terminal. and this wire should be removed, Instead, wire this same loud-speaker terminal to one terminal of an additional 2-mfd. condenser, the remaining terminal of which should be wired to L.T.—. Connect grid bias + direct to L.T.—, instead of to one of the loud-speaker terminals as shown in the wiring diagram. This completes the modification.





Above, the output filter choke, where low D.C. resistance is to be desired. Below, the "losser" resistance which enables you to flatten out your tuning for the best quality on the local programmes.

Improving the Lower Register

By the by, if you are very keen to get the greatest possible amount of bass in your reproduction, you should really, when this alteration is made, increase the size of the condenser C_9 and your extra one to 4 mfd. each. The point is that you now have two condensers in series, and their resultant capacity will be only 2 mfd. if they are each of 4 mfd., and 2 mfd. is really about the smallest size desirable in the parallel limb of an output filter circuit.

Now let us take a look at the

receiver from the point of view of its long-range powers. The general arrangement of the circuit is one which the experienced reader will recognise as a particularly favourable one from the point of view of selectivity and sensitivity, the H.F. portion being arranged to take full advantage of the screened-grid valve in the simplest fashion.

The aerial and tuned secondary circuits are arranged so that a good degree of selectivity is obtainable when desired, by virtue of the use of an efficient type of coil and widely adjustable aerial coupling. We have provided a rather unusually wide

Our Chief Radio Consultant, greatly interested in the " Eckersley " Three.

degree of coupling adjustment at this point, as you will notice if you examine the circuit diagram. In the first place, there are three alternative tapping points on the coil itself.

Wide Control of Selectivity

These three tapping points give you quite a wide control and enable you to suit very different aerial conditions and selectivity requirements, but in addition to this control there is another in the form of an optional series condenser, giving you another and still higher range of selectivity adjustments.

Instead of providing the usual two alternative aerial terminals, one of which brings in a fixed series condenser, we have adopted the rather more convenient method of incorporating a very neat little component, recently placed on the market, which provides the necessary fixed condenser and a shorting switch all in one unit. Consequently, you have no need to fiddle round the back of the set, shifting the aerial lead from one terminal to another, but merely pull or push the knob on the switch according to whether the condenser is required out of circuit or in circuit.

The coupling of the high-frequency valve to the detector is done by means of an H.F. transformer, the particular type chosen being one with an interchangeable primary winding which can be adjusted as to size to suit all sorts of different conditions; in itself a very valuable feature in any circuit intended for general-purpose work.

H.F. Coupling Control

You have here a control of both selectivity and amplification. For example, by choosing a fairly large size of primary you obtain high amplification and only moderate selectivity, which is often a desirable state of things for obtaining powerful signals from, for example, 5 G B. Again, you can reduce the size of the primary and obtain distinctly higher selectivity at a slight sacrifice of amplification for the separation of weak distant stations from your more powerful local transmitter. As a rule, however, you will find it possible to decide upon one particular size of primary which gives good all-round results with moderate selectivity for the local programmes, and obtain your necessary high degree of selectivity for distant reception by bringing in the aerial series condenser C_4.

Next we come to a detail of great importance in a long-range set, namely, the system of reaction control. In the " Eckersley " Three we have incorporated the differential scheme which is now achieving a well-deserved measure of popularity. Some readers may not have examined the details of this scheme previously, so perhaps we may as well just explain very briefly how it functions.

Special Reaction Scheme

Instead of the usual reaction condenser of the type which is simply a miniature of an ordinary variable, a condenser is used having two sets of fixed plates arranged on opposite sides of the centre spindle. The usual single set of moving vanes can engage with either of these sets of fixed vanes to varying degrees.

How it is Used

To apply this system of reaction to the normal Reinartz type of reaction circuit the moving plates are connected to the anode of the detector valve, one set of fixed plates going to the upper end of the reaction winding and the other set of fixed plates is wired direct to the filament circuit. Then when the moving plates engage chiefly with the set of fixed plates which is wired to the filament, no reaction is obtained, but instead a plain high-frequency bypassing effect from the plate of the detector valve straight down to filament, with a consequent beneficial effect upon the sensitivity of the detector circuit.

When the moving plates are turned round to engage more with the set of fixed plates which are connected to the reaction winding, one begins to obtain a reaction effect in just the normal way.

Where the arrangement differs essentially from the older Reinartz system is in the fact that we have a practically constant H.F. bypass capacity from plate to filament of the detector valve, either straight through one set of fixed plates to the filament, or through the other set of fixed plates, and so via the reaction winding to filament.

And What it Does

In consequence, alterations of the tuning of the grid circuit resulting from adjustments of reaction are reduced very greatly, and indeed are brought down practically to vanishing point. This arrangement produces two extremely beneficial effects. In the first place there is always a certain H.F. bypass capacity from plate to filament of the detector, which improves both the sensitivity and the selectivity of the circuit, a point which will be familiar to those readers who have followed our recently introduced scheme of a direct plate-to-filament bypass in many of the receivers we have published lately which included capacity-controlled reaction of the normal type.

Secondly, and this is even more important, alterations of reaction no longer have a perceptible effect in upsetting the tuning of the detector grid circuit, and consequently the operation of tuning-in even a very weak signal becomes delightfully simple. You simply tune it in to the loudest point on both the dials, and

A Novel Receiver of Outstanding Merit

then turn to the reaction adjustment and secure the best setting here, and the operation is complete with no further fiddling and checking of the tuning adjustments.

Just one practical point concerning this reaction circuit before we proceed. Some types of differential reaction condensers are assembled with sheets of insulating material between the vanes, so as to eliminate the risk of short-circuiting due to the touching of one set of plates against the other, in consequence of any damage which the condenser may sustain. When a condenser of this type is used there is consequently no need to provide the usual fixed stopping condenser in the lead to the anode of the detector valve.

A Safety Point

The particular differential reaction condenser employed with the "Eckersley" Three, however, is of the ordinary air-dielectric type, and so we have provided the usual fixed condenser in the form of one marked C_8 on the diagram. If you happen to choose one of the differential condensers having an interleaving of thin sheets of insulating material, of course, you can omit this condenser and wire the moving plates straight to the anode of the detector valve.

The remainder of the circuit arrangements are of quite straightforward and normal types and need not detain us any longer. Let us turn now to the details of the practical assembly of the receiver. The general layout and assembly is of quite conventional type, but there are just one or two points to which we should like to direct your attention.

First of all, about the arrangement of the screening in the set. By careful positioning of the coils and components we have been able to secure the desired effect with quite a small amount of screening, actually only just the simplest of vertical partition screens separating the grid and anode circuits of the H.F. valve.

To enable this screen to do its job properly you must take a little care to duplicate fairly exactly the layout of the H.F. side, which you will see in the blue print and photographs, paying particular attention to the placing of the coil holders, both as to the actual spot they occupy on the baseboard and also in regard to the direction of the planes of the coils. Note carefully the arrangement of the coils in the original set, and see that you place your own at similar angles.

Observe, too, that the screen runs a little way in between the two drums of the dual condenser, and you will realise that the placing of this screen upon the baseboard must be done rather accurately in order to prevent the drums rubbing against it and producing an unpleasant noise in operation.

The Spare H.T. Fuse

The remainder of the layout and assembly you will find quite normal, but we should just explain a point about the safety fuse provided in the H.T. circuit. You will see that this appears to have two bulbs, and we would just explain that this is really an ordinary H.T. fuse of the single bulb type, with a separate holder for a spare fuse which can thus be kept ready for use when required. Just one little word of warning here: If the fuse blows, do not just put in the spare one without looking round to see what made the first one go!

Building the set is a very straightforward job of panel drilling, mounting up the parts thereon, laying out and screwing down those on the baseboard, and wiring up, but there are one or two points we should like to mention which will make the matter easier for you.

First of all, after you have mounted

Capt. P. P. Eckersley, M.I.E.E.—late Chief Engineer of the B.B.C.—with Mr. G. P. Kendall, B.Sc., in the "M.W." Research Laboratory.

all the parts on the panel and seen that they fit nicely, remove the differential reaction condenser and complete the wiring of the set as far as you can without it. Then, as the last operation, fit the differential reaction condenser once more and wire it up. You will find it rather easier to get at some of the connections with this condenser out of the way.

Earthing the Moving Plates

Next a point about the connections to the double-drum condenser. On the original model which we employed the moving spindles were common to all the metal work, consequently it was only necessary to make a single connection to one of the sets of moving plates, since the other set was also thereby automatically connected into circuit. If you employ some other make, examine it carefully and see whether the spindles are similarly common to the metal framework. If they are not you will need to add the following connection. Wire the moving plates of the section marked C_1 to any convenient point on the negative side of the low-tension circuit; for example, to a convenient point on the metal screen.

Material for Wiring

Now just one point about the wiring, and then we can leave you to get on with the job for yourself. For this receiver we should rather advise that a covered material be employed for the connections, such as bare wire and Systoflex sleeving, or one of the special covered materials like Glazite.

One of the three leads through the screen, by the way, is for the terminal on the top of the screened-grid valve, and you should be rather careful to take this through a hole in the screen in just about the position shown in the photograph in order to keep it well away from certain others. Just note in passing, also, that connections are actually made to the screen itself at two places—one near the middle of the screen and one near the rear edge. For this purpose you should use small screws and nuts passed through and tightly clamped in the perforations in the lower edge of the screen, such screws and nuts being usually provided along with the screen.

Now for some practical working data. The valves for the set should be one screened-grid, such as the Cossor 220 S.G., one H.F. type for the detector, and a power or super-power for the third. The choice in this case will depend in the usual way upon considerations of the strength of the signals you desire to handle without overloading and the current-supplying capacity of the H.T. source. For general work, with a bias in favour of long-range work, an ordinary power is perhaps to be preferred, on account of its slightly higher amplification. Where, however, your main interest is in super quality from the more powerful local transmission, a super-power should always be used, provided that you are able to provide the necessary amount of current.

Grid bias will naturally be adjusted to suit the particular power or super-power valve you are employing, a figure of somewhere about 6 or $7\frac{1}{2}$ volts being employed for the smaller valve, and anything up to perhaps 18 volts for the super type such as the Cossor 230 XP. Requirements here will vary according to the particular valve you employ, and so you should be guided by the makers' figures. The grid-bias battery, by the way, is intended to be placed in some of the special clips supplied by various firms, for attachment to the back of the cabinet inside, a suitable blank space being available near the middle of the cabinet.

High-Tension Voltages

The H.T. voltages should be these: H.T.+1 supplies the screening electrode of the valve and here you should try voltages between 60 and 80, until you find one which appears to give the best results, tests being made upon a fairly weak distant station for preference.

Terminal H.T.+2 supplies the detector valve, and here you can try the usual figures of perhaps 40 to 60 volts, seeking one which gives you the smoothest control of reaction. The terminal H.T.+3 supplies both the anode of the screened-grid valve and the power valve, and here from 120 volts upwards to perhaps 140 or 150, according to the rating of your valve and the capabilities of your H.T. supply, are indicated. On no account attempt to use a voltage of less than 120, because by so doing you will be cutting down the performance of your set very heavily.

Selectivity Adjustments

The general selectivity control you will have already understood from the description, and we will just explain briefly that the flex lead from one side of the condenser C_4 can be attached to the terminals 3, 4, or 5 on the first coil base, giving you thereby three different degrees of selectivity.

Capt. P. P. Eckersley listens with great interest to the receiver which was, as a compliment to our Chief Radio Consultant, named after him.

Setting a New Standard of Efficiency!

Large aerials will usually require the lower tapping to be used, and small aerials, including those of the indoor variety, the higher tapping. For general purposes you will find terminal No. 4 will give you a good all-round adjustment.

Using the Series Condenser

For higher selectivity still you will understand that the knob on the switch of the condenser C_4 should be pushed inwards, thereby bringing the series aerial condenser into action. Quite a good scheme, incidentally, is to place the flex lead on terminal 4 or 5 on the coil base, thus obtaining only a moderate degree of selectivity for local work, and then to get the necessary higher selectivity for distant working by bringing C_4 into action in the way described.

An important adjustment in this receiver is naturally that of the primary winding on the H.F. transformer. For general work on the lower broadcast band you will find that sizes P.6, P.8 and P.10 will cover most requirements. No. 8 is a good average adjustment, No. 6 gives you a definite increase in selectivity at a slight sacrifice of volume, while No. 10, although it usually increases volume again slightly above the No. 8 level, does not as a rule give you quite sufficient selectivity for cutting out a powerful local station.

The Coil Types

For the long waves you should try primaries Nos. P.14, P.16 and P.18, these giving roughly similar results on the longer waves to those quoted for the lower wave coils. By the by, we may as well state definitely, for the benefit of those who have not encountered these coils before, the actual types required in the set. They are the Lewcos "Super" type, and for the lower broadcast band you will require a C.A.C.5 for the aerial coil, and a C.S.P.5 for the H.F. transformer. For the long waves you want a C.A.C.20 for the aerial coil and a C.S.P.20 for the transformer.

Some Test Results

The use of the 400-ohm "lossing" resistance we have already dealt with at some length in the main description of this receiver, and we think you will understand by now exactly how it should be employed, without further description.

With the aid of the notes we have given you we think you will be able to go ahead and make good use of the receiver, and we trust that you will form as high an opinion of its powers as we did in our original tests on our own model. It gave a very excellent performance indeed, to which we should like to pay special tribute before we leave the set in your hands.

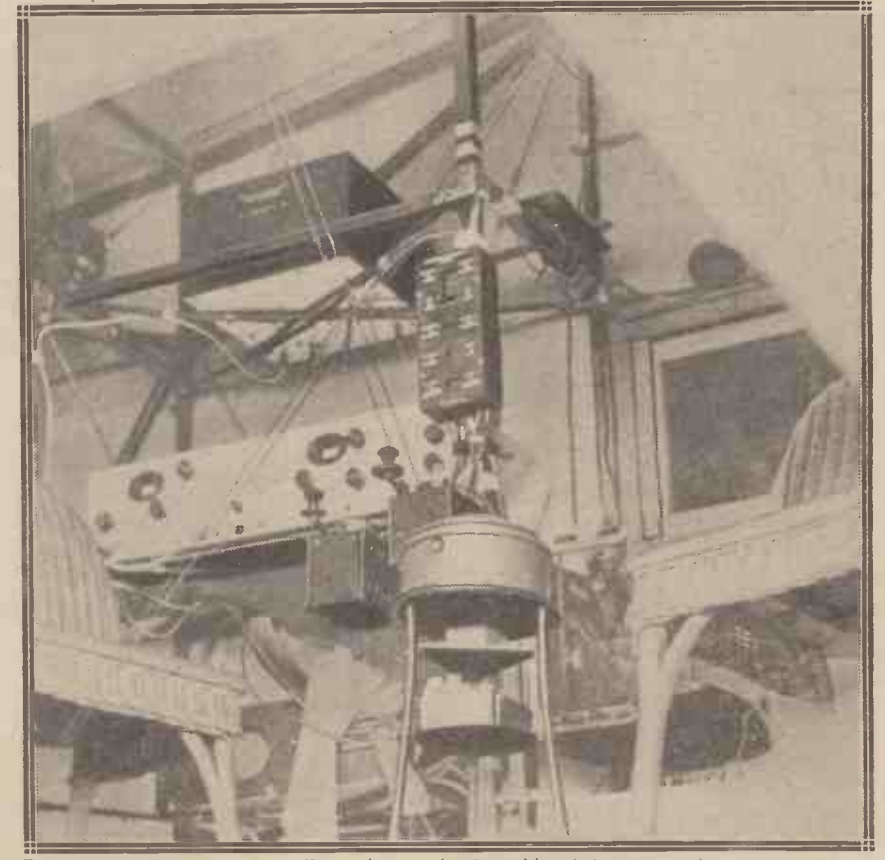
Selectivity was well above the average for a receiver of this type, and it should prove fully adequate for all normal requirements, with one exception, which we must mention. This is that no set of this type with only two tuned circuits can be expected to function successfully without the aid of a wave-trap in the very bad wipe-out area close round a local station, which is up to perhaps three or four miles in the case of an ordinary main station and perhaps seven miles in the case of the new regional transmitter at Brookman's Park. In these areas you really require a set with three tuned circuits, such as the "Brookman's" Three, or the "Olympia" Three, or else you should invoke the aid of one of the more efficient types of modern wave-traps.

Apart from this necessary qualification you can be confident that the set will give you a high degree of selectivity quite adequate for all normal requirements, and will set a standard of sensitivity up to the highest modern standard. On test it actually brought in a long string of foreign transmissions at very adequate loud-speaker volume when used on quite a normal outside aerial.

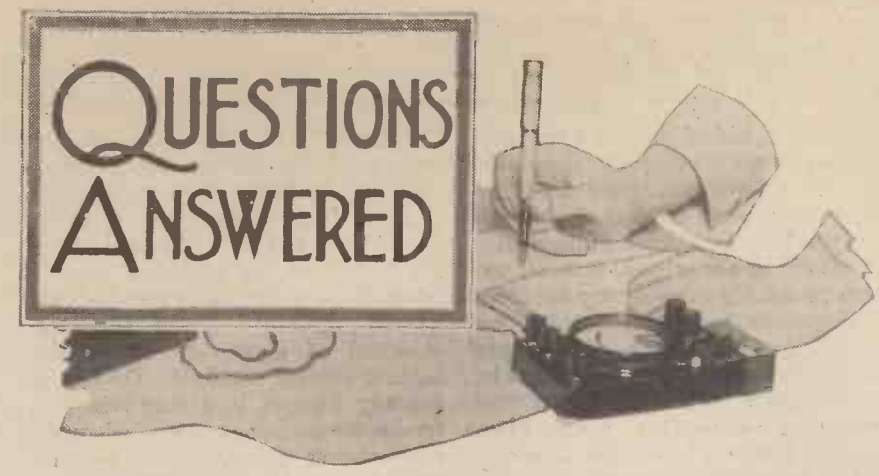
Even on an Indoor Aerial!

Tested on a good indoor aerial it even then managed to bring in quite a number of the more powerful Continentals at loud-speaker strength, and gave the impression that if a pentode valve were used in the last stage it could still be regarded as a thoroughly effective long-range outfit without the use of the second L.F. stage usually considered necessary when dealing with these adverse conditions.

HISTORIC AIR-LINER'S RADIO



This photograph shows the radio equipment in the cabin of the famous "Southern Cross." Note the two transmitting keys for sending Morse, which jut out in front of the metal panel.



A "Reedy" Effect

C. F. (Wolverhampton).—"I have a good balanced-armature type of cone loud speaker which is excellent on everything but piano transmissions. On these it has a reedy effect that sounds as though something is loose inside the cone. What can this be due to?"

Well, C. F., this effect could be caused by the overloading of the last valve in your amplifier, and this is very often more noticeable with instruments of the percussion type than with those of the string or reed type. Make sure that you are applying enough H.T. and grid bias to the last valve, and also that your amplifier is quite stable.

With regard to the speaker itself, see that the locking-collar which holds the driving rod in position is tight. Sometimes the effect may be caused by the resonance of one of the parts in the loud-speaker assembly. You might try wrapping a strip of very thin rubber round the driving rod. With some cone designs this is very helpful.

Of course, there is a possibility that the "reedy" effect may be due to the transmission itself.

An L.T. Problem

L. H. (Gillingham).—"How can a 25-volt house lighting supply (from storage batteries) be utilised to supply low-tension current to a four-valve set with 6-volt valves?"

Assuming that you wish to supply the filaments direct from the 25-volt supply, you will have to take a tapping through a suitable wall plug to the L.T. terminals on the set. Break the positive supply lead between the wall plug and the set, and insert a fuse which will blow when the current exceeds that taken by all the valve filaments by about a quarter of an ampere.

Then you will have to insert a fixed resistor in series with the L.T. positive lead to the filament. The value of this resistor will depend upon the total current taken by the valves. This you will be able to find out yourself from the maker's rating.

Let us suppose that it is $\frac{1}{2}$ amp. for the four valves. Then we have, from Ohm's law, the voltage to be dropped in the resistor, divided by the current, is equal to the resistance. That is, $\frac{19}{\cdot 5}$. This works out at 38 ohms, therefore your resistor will have to have a value of 38 ohms, and must be capable of carrying $\frac{1}{2}$ amp. without overheating.

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The MODERN WIRELESS Technical Queries Department is now in a position to give an unrivalled service. The aim of the department is to furnish really helpful advice in connection with any radio problem, theoretical or practical.

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A postcard will do: on receipt of this all the necessary literature will be sent to you, free and post free, immediately. This application will place you under no obligation whatever. Every reader of MODERN WIRELESS should have these details by him. An application form is included which will enable you to ask your questions so that we can deal with them expeditiously and with the minimum of delay. Having this form you will know exactly what information we require to have before us in order to solve your problems.

London readers please note: Inquiries should not be made in person at Fleetway House or Tallis House.

"Frying" Noises

L. S. T. (Newcastle).—"I have a three-valve set consisting of a detector and two L.F. stages. When the receiver is working there is a continual 'frying' noise, which disappears when the first L.F. valve is changed for another. Does this indicate a faulty valve?"

It is quite possible that your L.F. valve has developed D.C. leak, and we suggest that you return it to the makers for examination. At the same time, make quite sure that the valve base itself has not become covered with a layer of dust, thus producing a semi-conducting path between the valve pins.

Valves for Push-Pull

M. H. (Mottingham) wishes to know whether it is necessary to use similar valves in the output stage of a push-pull amplifier. If this is so, he asks whether it would not be better to employ matched valves.

Yes, M. H., it is certainly desirable to use similar valves, because you employ a common grid-bias value to each. The modern valve, however, is so well constructed that characteristic curves do not vary much these days. In any case, a slight variation will not make any difference, and it is therefore not necessary to have them specially matched.

Creeping with Wet Cells

C. R. (Luton).—"I have an H.T. battery of the Leclanché type, and I find that the sal-ammoniac solution creeps badly. Is there any method of preventing this?"

There is a special oil called Blancol which is sold for this purpose. A small quantity of the oil is poured upon the surface of the electrolyte, and is very helpful in reducing any tendency towards creeping.

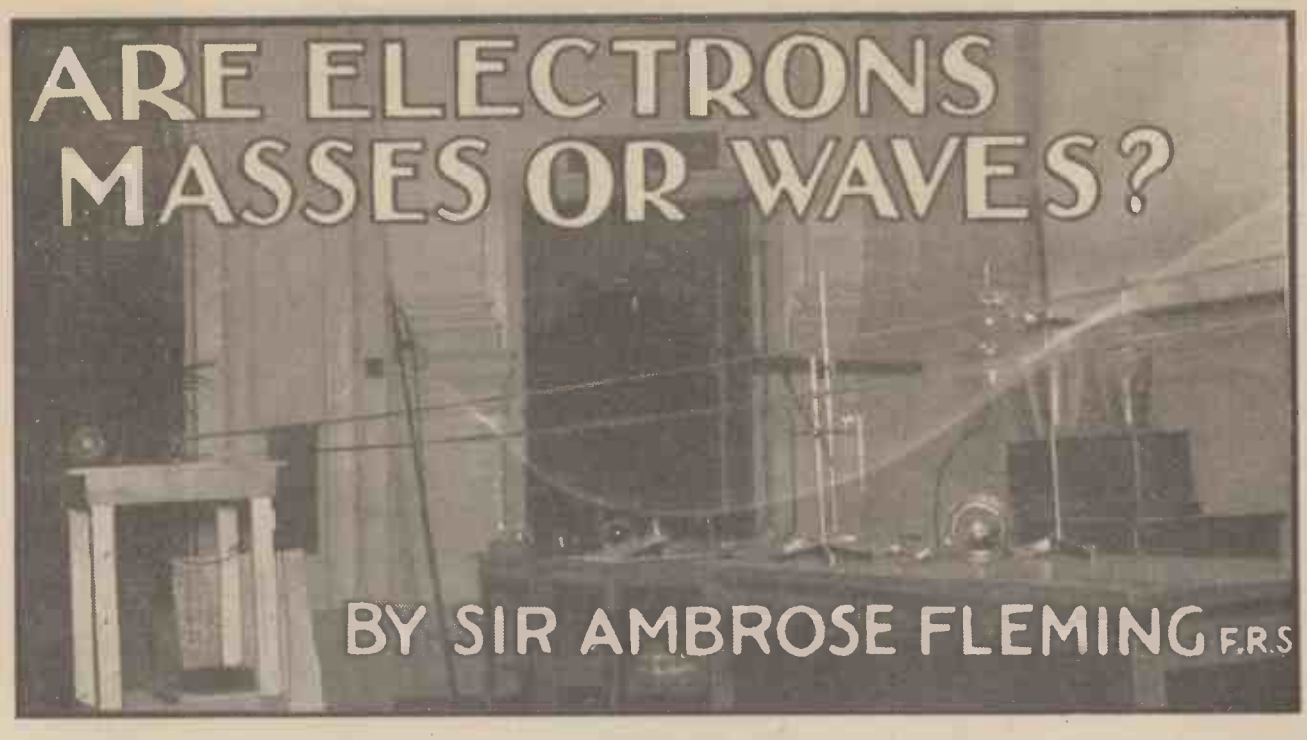
Interaction Between Aerials

R. W. and others.—"I am troubled with interference from my next-door neighbour. When he uses his set my signals frequently fade and become distorted. How can I remedy this?"

Cases of this kind cannot, as a rule, be cured by one party only, but the co-operation of both parties concerned is desirable. The trouble generally arises from the use of small sets which necessitate the use of a large amount of reaction, and, as a rule, the only certain cure is for both parties to build larger sets, preferably employing neutralised H.F. stages.

The only really certain cure is to separate the aerials to as great a distance as possible, and to refrain from using reaction even in such a way as to cause the set *almost* to oscillate. The use of a small condenser in series with each earth lead may help matters.

ARE ELECTRONS MASSES OR WAVES?



BY SIR AMBROSE FLEMING F.R.S

" The facts of science remain unaltered, but our explanations of them are in a continual state of flux," says the author of this absorbing article, in which he pulls down and rebuilds a well-accepted scientific theory of long standing.

ABOUT the end of the nineteenth century three discoveries were made which altered very greatly our concepts in physics and chemistry. Up to that time chemists and physicists had been content to think of atoms of matter as small, indivisible, ultimate fragments of substance carrying an electric charge, positive or negative.

Optical experiments had shown that light consists in some kind of undulation in a universal ether, and it was generally thought that the vibrations of atoms created these undulations in the ether just as tuning-forks in operation set up undulations in the air.

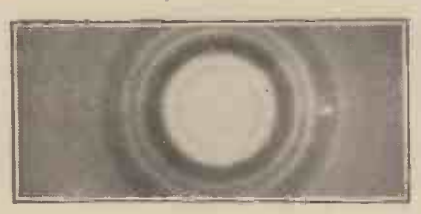


Fig. 1. Diffraction circles produced on a photographic plate by electrons which have passed through a very thin gold sheet. Taken by Professor G. P. Thomson of the University of Aberdeen.

The Third Type of Atom

Eminent physicists devised mechanical theories of the ether which enabled them to explain most optical phenomena. " But," as the late Professor Huxley once said, " the great and ever-recurring tragedy of science is that of a beautiful hypothesis killed by an ugly fact." One by one the hypotheses, which had seemed so attractive to nineteenth-century physicists, had to be abandoned in view of fresh and striking facts which killed them.

The first of these was the discovery of Sir J. J. Thomson that all chemical atoms could be made to yield up still smaller particles which were atoms of negative electricity, now called electrons; and from this was developed the new hypothesis that chemical atoms are congeries of electrons and protons, the latter being atoms of positive electricity.

The next important discovery was that, in addition to chemical atoms and electrical atoms, there is another kind of atom called an Action atom. The term Action is a technical term in dynamics and denotes twice the product of time and motional or kinetic energy. Kinetic energy is measured by the product of the mass of a body and half the square of its velocity.

Thus if a mass of 1 gram is moving with a velocity of 1 centimetre per second, its kinetic energy is one-half of a unit called an erg.

Its Action is the product of twice its kinetic energy and the time it lasts; so if it moves for a time reckoned

Prof. C. J. Davison and Dr. L. H. Gernier, whose research work is discussed by the author.

Not Merely a Charge of Electricity . . .

in seconds its action would be measured in erg-seconds. If its motion is not uniform, then we have to divide up the time into little intervals during each of which the motion is sensibly uniform, and then add up all the little products, or integrate them.

The discovery made by Professor Planck, of Berlin, was that, when dealing with the very small amounts of energy and very small time intervals connected with the motions of electrons in chemical atoms, we cannot have the Action expressed except in exact multiples of a small unit of Action which is equal to 6·5 divided by 10^{27} erg-second, and this is denoted by the letter h.

An Ingenious Theory

Planck's theory that Action is atomic in structure was arrived at by him in an attempt to explain the manner in which the energy is distributed between radiations of different wave-lengths in a beam of light and heat radiated by a black body. It was, however, applied by the Danish physicist, Niels Bohr, to explain the production of radiation by a chemical atom.

For this purpose he considered the simplest kind of atom—viz., a hydrogen atom supposed to consist of a single electron revolving in a circle round a single proton, like the moon round the earth. Bohr made an assumption, justified by its consequences, that the electron could not revolve round the proton at any distance, but only in certain orbits, called stationary orbits, in which it does not lose energy by revolving. The radii of these orbits are proportional to the squares of the natural numbers—viz., to 1, 4, 9, 16, 25, etc.

SEEN IN BERLIN

A German's method of symbolising radio, and which was shown at the Berlin Radio Exhibition.

Sir Ambrose Fleming and Sir. J. J. Thomson, two of the world's leading scientists.

Starting from the fact that the attraction between the electron and proton varies inversely as the square of their distance, we can easily find that the Action of the electron in its stationary orbits is represented by h, $2h$, $3h$, $4h$, etc.

The fact that Action cannot exist except in these integer multiples of h is the reason for the existence of these stationary orbits. Niels Bohr then showed that the planetary electron can make a jump from one orbit to another, and when it jumps from an outer to an inner orbit it releases or emits radiation of one single wave-length which appears in the spectrum as a single bright line. The wave-length, or, what comes to the same thing, the time period of the radiation, is determined by the rule that the difference of the energies of the atom in the two states, multiplied by this time, must be an integer multiple of Planck's atom of Action.

Affecting the Light Spectrum

Thus if an electron jumps from the $3h$ orbit to the $2h$ orbit, it gives out radiation which produces the red line in the hydrogen spectrum, and when it jumps from the $4h$ orbit to the $2h$ it creates the blue line.

If it jumps to the inmost, or h orbit, it creates spectral lines in the ultra-violet part of the spectrum, called the Lyman lines from their discoverer.

If, then, an electron is merely a little tiny ball, or mass, or atom of negative electricity, it is very difficult to understand how this sudden change of orbit can emit electromagnetic waves.

If we can imagine one of the outer satellites of Jupiter jumping to an inner orbit, it would hardly create waves. If, on the other hand, what we call an electron is in itself a system of waves, it is not so incomprehensible.

Now, strange to say, numerous facts have lately been discovered which seem to show that an electron can act sometimes like a set of waves.

The essential character of a wave is that it is a periodic change of some kind which is periodic in space as well as

Electrons Behave Like a Group of Waves

time. We are quite familiar with the fact that the two sets of waves—say, surface waves on water or compressional waves in air—if of the same wave-length, can destroy each other by the superposition of the crests or humps of one set coinciding with the hollows of the other set of waves. This destruction is called Interference.

There are optical effects, called Diffraction, in which two rays of light superimposed can produce darkness or neutralise each other. We know of no case in which masses of matter can nullify each other, because mass is essentially positive. Nevertheless, it has been found that, in connection with electrons, there are diffraction effects which show that they are, in some sense, waves as well as masses.

The Diffraction Circles

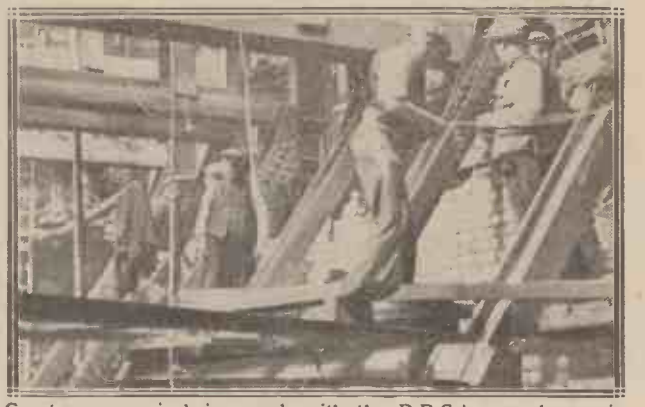
If we rule on glass with a diamond a set of parallel grooves very close, the interspaces act as little windows. If a beam of light of one colour is sent through on this grating, then on a screen on the other side we see a number of bright and dark bands on either side of the central line. These dark bands are caused by the interference of waves which have come through the little windows taken pair and pair.

If a glass plate is covered with a very thin layer of closely-placed opaque particles, then, if we look through it at a bright spot of monochromatic light, we should see it surrounded by bright and dark rings. This effect proves the wave nature of light.

An experimental radio beacon for airmen has been erected at Orfordness, Suffolk. It sends out regular signals on "continuous" and "interrupted" waves.

Now Professor G. P. Thomson, of Aberdeen, has discovered an exactly similar effect with a stream of electrons.

He projects a fine stream of electrons against a very thin sheet of gold, the atoms of which act like the opaque particles in the optical experiment. Then at a certain distance beyond this plate is put a photographic plate,



Great progress is being made with the B.B.C.'s new home in Langham Place. Here we see workmen building the steel and brick wall to hold up the road. There are to be three storeys of basement, the building itself being twelve storeys high.

the whole arrangement being in a high vacuum. When the plate is developed, a series of bright and dark rings are found on it, as shown in Fig. 1.

If a magnetic field is created crossing the path of these waves between the gold plate and the photographic plate, the ring system is shifted to one side, thus showing that the waves are in some way attached to the flying electrons.

Another similar diffraction effect with electrons has been investigated by Messrs. C. J. Davison and L. H. Gernier. If a beam of X-rays, which is known to be a wave motion, is reflected from a crystal surface, the regularly-arranged layers of molecules act like a grating, and the beam is well or badly reflected according to the angle of incidence.

A "Group of Waves"

Davison and Gernier tried the same kind of experiment with a beam of electrons reflected from the surface of a crystal of nickel. They found that, as the angle of incidence was gradually increased, the reflected beam exhibited periodic maximum and minimum values or intensities in such fashion as to show that the beam of electrons is not merely a succession of bombarding particles like bullets from a maxim gun, but acts like a procession of waves.

Hence it appears likely that we shall have to modify our idea of an electron and think of it, not merely as a small particle of negative electricity, but as a group of waves of some kind.

This new idea is now being worked out in a system of wave mechanics which will greatly modify our conceptions of atomic structure.

The facts of science remain unaltered, but our explanations of them are in a continual state of flux and hypotheses which are killed by certain facts, rise again, like a phœnix from its ashes, in another form.

Some interesting and, in cases, startling facts concerning the power used in different links of a broadcasting chain are dealt with

By D. YOUNG.

EVERY radio, electrical and mechanical operation is attended by a certain amount of power loss. In the driving of a motor-car there is an enormous wastage in heat in the friction of bearings and in other moving parts, in the friction between the wheels and the road surface, and in the overcoming of air resistance.

Wastage of this kind is what the perpetual-motion inventor endeavours to overcome and never does and probably never will.

Where There is Wastage

And you can never get back as much power from anything as you put in it. There will be more power expended in winding up a toy motor-car's spring than this "clock-work" will give out.

Probably there is not a reader of MODERN WIRELESS that is not perfectly well aware of the above elementary facts, but an examination of radio may reveal some less realised points of a similar sort of kind.

Radio transmitters are, as with anything modern demanding power, run as economically as possible, and yet many hundreds of watts are dissipated in doing nothing but make up for wastage mainly in overcoming resistance.

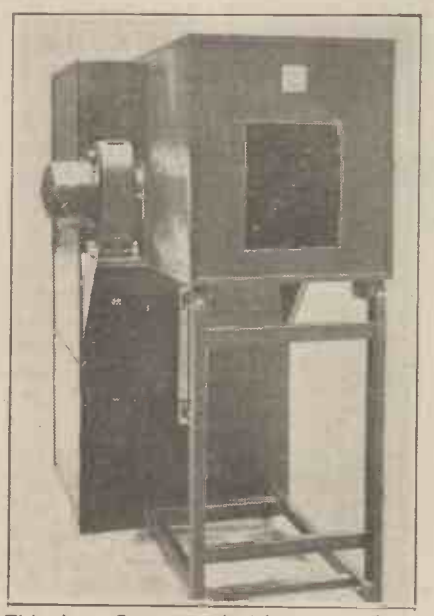
Really Low Resistance!

A station like 5XX of Daventry, which manages to develop an aerial power of from 15 to 20 kilowatts, will draw a power from the local power station of hundreds of kilowatts—enough, anyway, to supply a small town with all the electric lighting it wants.

What a potent factor resistance is can be explained by some sensational facts proved by scientists. The effect of quickly withdrawing a magnet from a closed ring of metal is to generate current in the metal ring, which, of course, makes a complete circuit.

But owing to the resistance of this circuit, current so generated will die away almost instantaneously. When metal is made extremely cold its resistance is considerably reduced. The experiment was tried on similar lines, but with a ring of lead immersed in a liquid gas; a gas frozen to a much lower temperature than that of liquid air.

When a magnet was quickly withdrawn a current of over three hundred amperes was generated and this current persisted for over half an hour! The metal was of such a low resistance that there was almost a negligible loss in overcoming it.



This is a German television transmitter. The difference between the illumination used at the transmission end and that which is present in the receiver is, in some television systems, almost the difference between an electric arc lamp and a glow-worm.

Radio Receiver Losses

Perhaps some day an inventor will discover a method of reducing the resistances of conductors to an equal degree without using liquid gases to do it. If such a day comes, electrical distribution will so greatly be facilitated and electrical apparatus will be able to be operated so efficiently that we shall all do a hundred and one things by electricity that would be reckoned as sheer luxuries at present.

In the radio receiver a great deal of power loss occurs. For instance, to reproduce speech at approximately its correct strength you need to develop a power of somewhere around about one quarter of a watt at the output of the set. In order to do this you use about three watts to light the filaments of your valves and some further three watts of H.T. battery power. Therefore there is a "wastage" of something in the neighbourhood of $5\frac{3}{4}$ watts. Over ninety-five per cent of the total power used is being employed merely to dissipate unwanted heat.

Direct Power Loss

Most of the above figures are very rough approximations, but the radio receiver that has a "power efficiency" of more than 10 per cent will be abnormally good.

(*Continued on page* 694.)

CHOOSING YOUR XMAS PRESENTS

This is an entirely practical article that will give gift seekers considerable assistance in their pleasant task. Details of the latest radio apparatus available are given together with an indication as to where the greatest bargains and most useful gear are to be found.

By G. V. DOWDING, Grad.I.E.E.

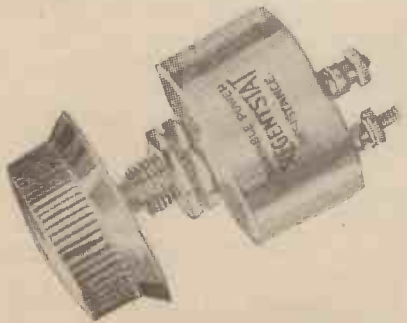
YOUR family may have a big percentage of maiden aunts living in country cottages, and another family circle may embrace a flock of bachelor uncles. Families are not arranged in standard patterns, and we can thank goodness for that.

But in view of the variety of make-ups of the hundreds of thousands of individual social circles it makes it difficult for me to discuss the selection of radio gifts, more particularly as there will be as wide a variation in financial strengths.

Something for Everyone

Radio gear is particularly suitable as Christmas presents in view of its entertainment possibilities. It is both a necessity and a luxury, and, therefore, overlaps both those classes of gifts which include purely domestic articles and expensive chocolates.

I endorse the claim, which is often made, that there is not a person of ten years of age or older in any house to whom something of a radio flavour could not be given. A decent-sized radio store answers practically all Christmas problems. Anyone with a little imagination can at once visualise a distribution of sets, accessories, components, subscriptions for "M.W.," etc., that would spread over the most varied family in a soft, warm wave of mutual pleasure and gratification.



An excellent present for a constructor: the "Regenstat" variable power resistance, made by the Regent Radio people.

It would, indeed, be somewhat impertinent on my part to suggest exactly what you should give to your friends and relatives. After all, half the fun of gift giving is the choosing of gifts.

Instead, let me tell you where I think is the best value for money in radio just now, and in which directions sufficient advance in design has been made during this last year or so to warrant you purchasing presents of a replacement nature.

That All Depends!

This is what I mean. Supposing you have an old friend who possesses a 1926 set with all its original accessories. Maybe he has been heard to express some discontent at the results it gives. Would a 1929-30 receiver give him a really worth-while improvement? Or, if you could not afford to give him a complete set, would a set of valves or something else within the scope of your pocket do the wonders that you might think essential for your present to prove a success?

That all depends! It will be necessary for us to examine such questions in detail in order to arrive at anything like passable answers.

First of all, however, let us look in perspective, as it were, at the radio market.

Portable sets are, in my opinion, the black sheep of the flock. Go very carefully if you are intent on the purchase of a portable either for yourself or for someone else.

Some seven or eight months ago there was a portable set boom, and all sorts of people rushed into the making of them and dozens of cheap makes were offered to the public.

Portable Sets

A large proportion of these sets were definitely "dud" as judged by modern standards, though they seemed to "get over" to some extent. Fortunately, the portable ramp is abating.

I must hasten to add that there were and are many excellent portables available for those who can discriminate between the good and bad in radio. And these were not all expensive instruments.

By the way, a battery-driven portable can be a very expensive set to maintain. If it has three or more valves its H.T. consumption may be more than the average dry battery can economically cope with.

If you are buying a portable this is the point you want to inquire very closely about, more especially if S.G. or pentode valves are employed.

Sets of an "all-electric" character are now to be obtained for all

What could make a better Christmas gift than a modern loud speaker? Here is the new W.B. cone speaker, which costs only 2 guineas.

The Day of Freak Prices for Freak Apparatus is Over

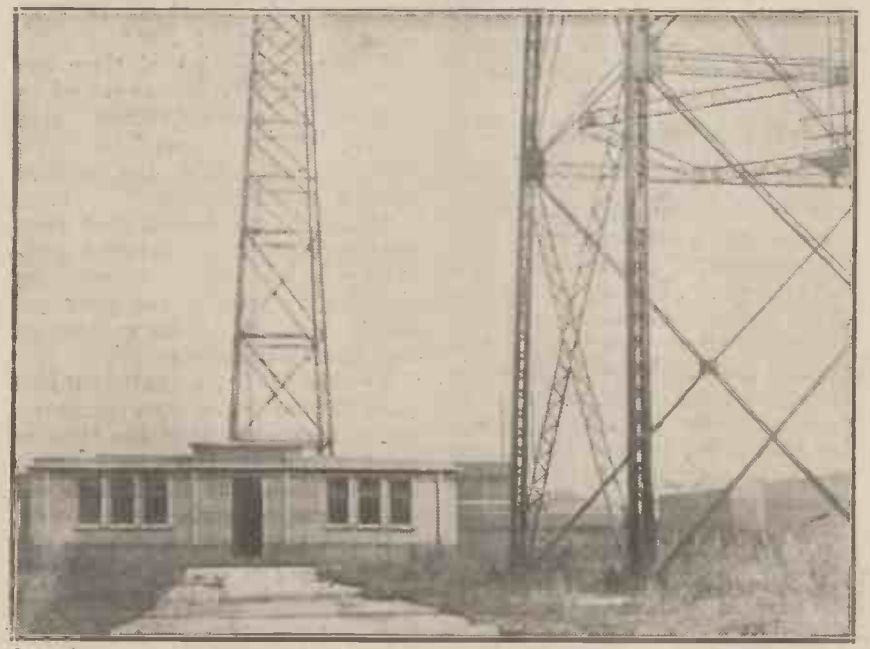
purposes and for practically all pockets. But don't get misled into acquiring one that is cheap, but has no credentials.

Your "all-mains" outfit must conform with the regulations of design drawn up by the Institution of Electrical Engineers before it can be regarded as a safe proposition.

One of the most satisfactory of all Christmas presents, and one that is more likely than any other to prove satisfactory, is a good loud speaker.

Loud speakers have improved out of all knowledge this last year or so, and it truly is remarkable what difference is caused by hooking a good modern speaker to an old radio outfit that hitherto has been coupled to an antiquated horn-type speaker.

THE PARISIAN PROGRAMME PROVIDER



One of the most popular of all Continental broadcasting stations is Radio Paris, which operates on 1,725 metres, with a power of 12 kw. C F R, as the station is called, frequently gives pleasant midday Sunday concerts. Above you see the station building and the feet of two of the great masts.

Valves may be dangerous presents. You might think that a set of new valves would work wonders with an old set. It is quite likely that the vastly improved amplification qualities of the new valves would cause the old set to howl with instability!

Why Not a Wave-trap?

It occurs to me that there are two items that should head the list of radio Christmas gifts this Christmas, both of which offer extraordinary value for money in view of their potentialities.

The first is the wave-trap or some other such device. With the new London station in operation there may be thousands of people who have lost their foreign stations merely because they have not troubled to discover or acquire something to cut out the new regional. Maybe many even now do not know it can be done.

A wave-trap in such a case would prove most acceptable.

Radio-Gramophones

The other item is the pick-up, the link between the radio set and the gramophone.

The first pick-ups were pretty "dud" and seldom gave you record reproduction equal to that possible with a gramophone of moderately good design. Now, however, there are a number of really excellent pick-ups on the market at reasonable prices. Any one of these will bring out bass and treble notes you never suspected for your favourite records.

Give someone who has a good modern radio receiver and any old kind of gramophone one of the better-known makes of pick-ups, and you will make an acquaintance a friend for life and a friend more devoted than ever.

I am not quite so favourably inclined to the radio-gramophone in general. I refer to the combined wireless set and electric gramophone. Here again we have much that is bad, even if we have a number of really excellent instruments from which to choose.

If You Are Wise . . .

Honestly, and with my hand on my heart, I can say that the present advertisers in "M.W." are offering instruments of the latter type.

The best class of advertiser is attracted by "M.W." and no other class is encouraged.

Therefore, you will be wise if you confine your choice, particularly of portable, mains, or radio-gram sets to the makes advertised in "M.W."

This year's L.F. transformers are definitely superior products, offering very big returns for their prices. If you know anyone who is still using a transformer of '23 or '24 vintage, buy him one of the new ones. It will make a most acceptable present.

There are loud speakers in the shops from a guinea upwards that are better than one would have ever expected loud speakers in mass production to be. The gap between the expensive moving-class type and the speaker within the purchasing power of the average listener is narrowing.

Batteries are as good as ever and as cheap as they are ever likely to be. H.T. and L.T. varieties are consistently good and are eminently safe purchases.

Don't Take Risks

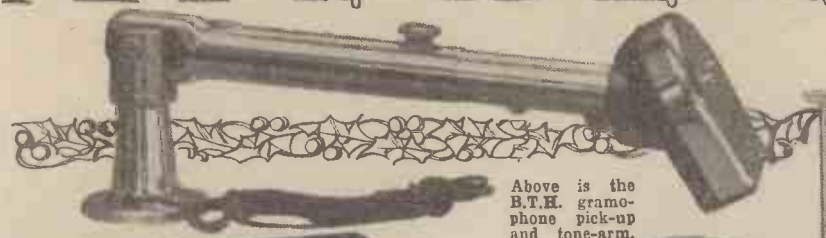
Telephone receivers are, in general, not superior to those available two or three years ago, but are decidedly cheaper. They are not so much in demand these days.

Summarising, I can safely say that radio sets, accessories, and components, with few exceptions, now seem to have reached stability in quality and prices, and that the day of freak prices for freak apparatus is over.

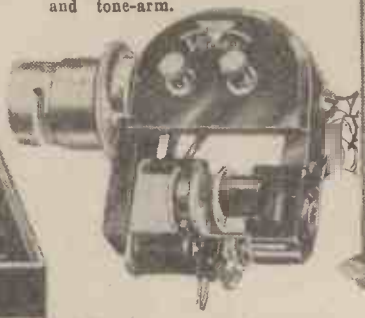
Radio gear is now, for the most part, produced sanely and sold at fair figures. The Philistine is perfectly safe in a radio store providing he keeps his eye on the names of reputable manufacturers.

Before you go a-buying glance at the list of advertisers on the last page of this issue of "M.W." Stick to the products of these people and you can't go wrong. If you take something that is unbranded, then you accept the risk of disappointment, for a radio gift that doesn't work well or doesn't work at all is but a gift for the dustman!

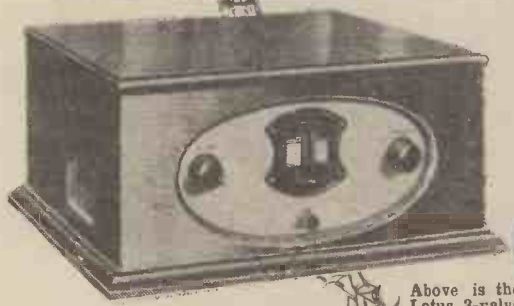
XMAS RADIO GIFTS



Above is the B.T.H. gramophone pick-up and tone-arm.



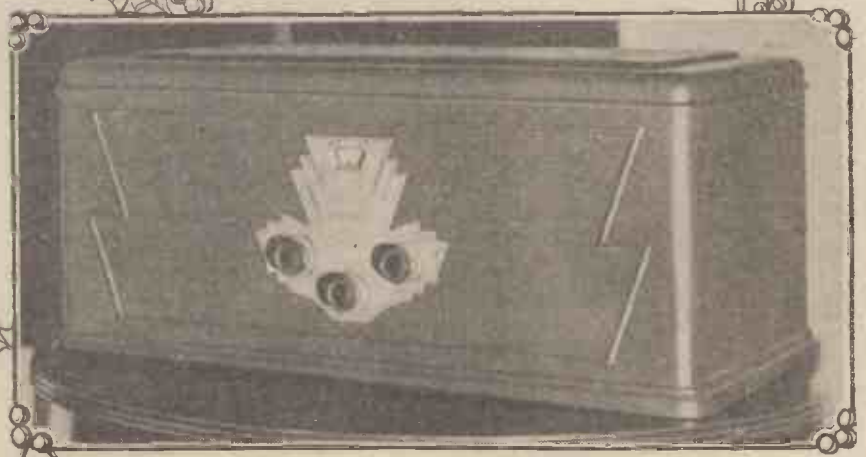
To the right is an Amplion Lion loud speaker. Above, the famous Varley pick-up; and, left, an accessory that needs no further description.



Above is the Lotus 3-valve S.G.P. receiver, an efficient and inexpensive piece of apparatus.

The Brown L.F. transformer, Bowyer-Lowe neut. condensers and the very latest Cossor "Melody Maker" receiver are included in this group of apparatus suitable for radio Xmas gifts.

A Lissen radio-gramophone instrument would make a first-class present.



On this and the following three pages is a varied selection of radio apparatus particularly suitable for present-giving purposes. The photos and the advertisement pages in this issue of "M.W." constitute a complete radio market from which you can choose reliable gear at reasonable prices.

To the left is an attractive Ward and Goldstone D.C. charger, and, above, one of the excellent Ekco mains units.

This is the Ferranti dynamic loud-speaker unit.

Here is the R.I all-electric transportable receiver, the only set made that can use its loud-speaker leads as an aerial.

Here is another selection of radio devices of most varied appeal. To the left is the well-known Blue Spot loud-speaker unit and, in the centre, "Susie," as the Ready Radio Selectivity Unit is called. On the right is one of the senior members of the famous Celestion family of loud speakers, the "Celestrola."

The Formo L.F. transformer.

To the right is the novel and effective Donotone loud speaker, and on the left is the artistic G.E.C. "Stork" plaque type.

Here is the very well-known Magnavox dynamic loud-speaker unit which is handled by the Rothermel Corporation. Farther over is the Telsen L.F. transformer.

Below is a Lewcos "Q" coil and absorption wave-trap.

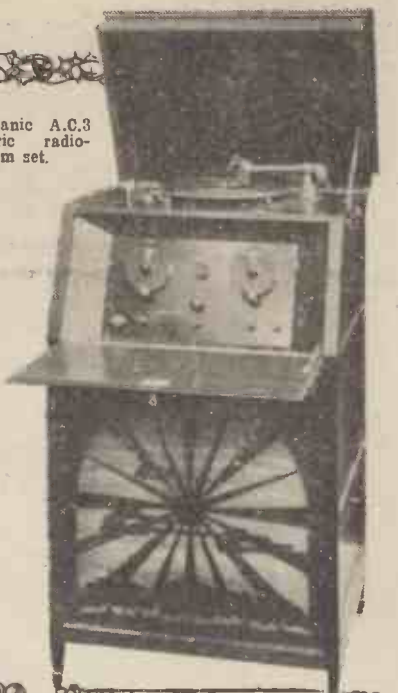
In this immediate group are the Wright and Weaire "Titan" coil, the Falk, Stadelmann and Co., Ltd., "Puravox" loud speaker, and the Burne-Jones Magnum Transportable Five receiver.

This is the "Master" cabinet due to the Carrington Mfg. Co., Ltd., and to its left can be seen one of the Westinghouse H.T. type metal rectifiers. Farther over is one of the fine productions of E. Paroussi.

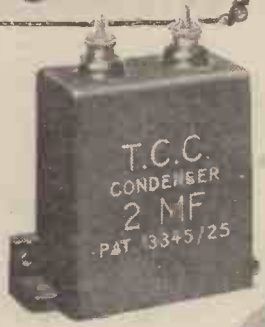
Could any assembly of articles have a wider appeal than this? Here, as on the other pages, there are sets, components and accessories suitable for all people, purposes and pockets. Everything of a radio appeal from components for home-constructors to complete receivers of the highest possible class can be found in one or other of these pages of photographs. Although the arrangement of the photos may be artistically haphazard, the selection of apparatus for this supplement was very carefully carried out in order to preserve the necessary balance between the various types of accessories and sets.

An Ediswan component of distinction.

The Igranic A.C.3 all-electric radio-gram set.

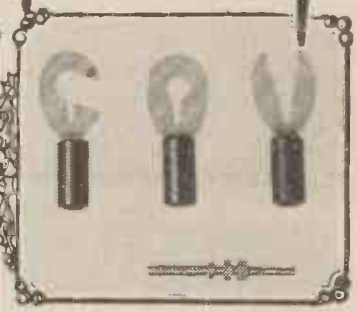


Above is a J.B. neutralising condenser, and, left, a Peto-Scott H.F. choke.

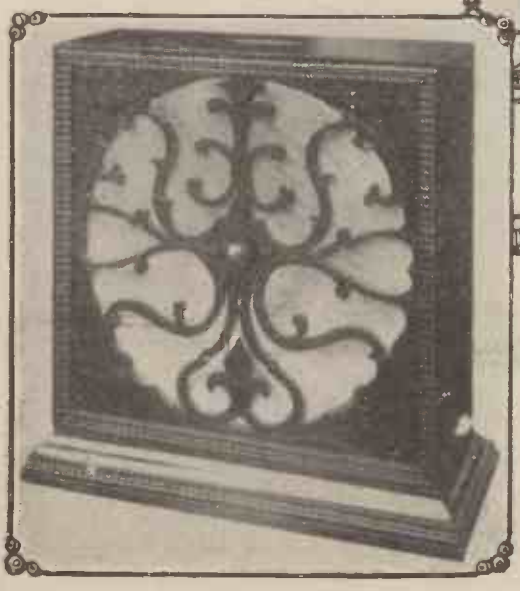


Here we have one of those fine Pickett's cabinets and a very well-known make of fixed condenser.

The above reliable accessory needs no further description, while the Belling-Lee devices to the right will be familiar to most readers.



Here are some of the novel and very useful Lectro-Linx terminals.



To the right is a Gambrell radio-gram outfit of an "all-in" character.

On the left is one of the several fine M.P.A. loud speakers that are available.

The sizes of these photos of pieces of apparatus are not in proportion, and the spaces devoted to them are not in any way indicative of their relative importance. The haphazard selection of dependable and representative items is arranged in an artistic ensemble for your guidance in choosing gifts.

RESONANCE IN CIRCUITS

A chat of a theoretical nature, but one that is none the less practical value nor interesting for that.

By A. J. BOYINGTON.

ALTHOUGH the principle of resonance has a wider application in wireless practice than the average amateur realises, the term is to many just another piece of scientific nomenclature, vaguely defined and imperfectly understood. Yet even the simple process we call "tuning-in" is based upon this principle, and whoever twirls a condenser dial in search of etheric entertainment calls it into service.

What "Tuning-In" Is

"Tuning-in" a station—as the reader will be aware—really consists of adjusting the values of inductance and capacity in the tuning circuit of the receiver so that the circuit becomes "resonant" at the frequency of the carrier-wave transmitted from the station.

When this condition of affinity has been achieved, the modulations of the carrier-wave—produced by the impression of the transmitted speech or music upon it—will create the maximum possible changes of potential at the input terminals of the receiver and, consequently, the strongest signals at the output end.

A short digression at this point may serve to illustrate the phenomenon of resonance a little more clearly. Imagine a pendulum, or, more simply, a weight suspended at the end of a length of string. If the weight be tapped lightly it will commence to swing rhythmically to and fro, and if the tap is timed to occur when the weight is at the end of its swing the weight will soon be swinging backward and forward with quite a large amplitude.

Should, however, the propellant taps be timed erratically, or with any other frequency than the correct one, the weight will continue to swing backward and forward—but the amplitude of the swing will not build up to any appreciable extent. If, indeed, you have ever observed one child giving another a ride upon a swing you have been watching a familiar demonstration of the principle of resonance. It has its counterpart in wireless thus:

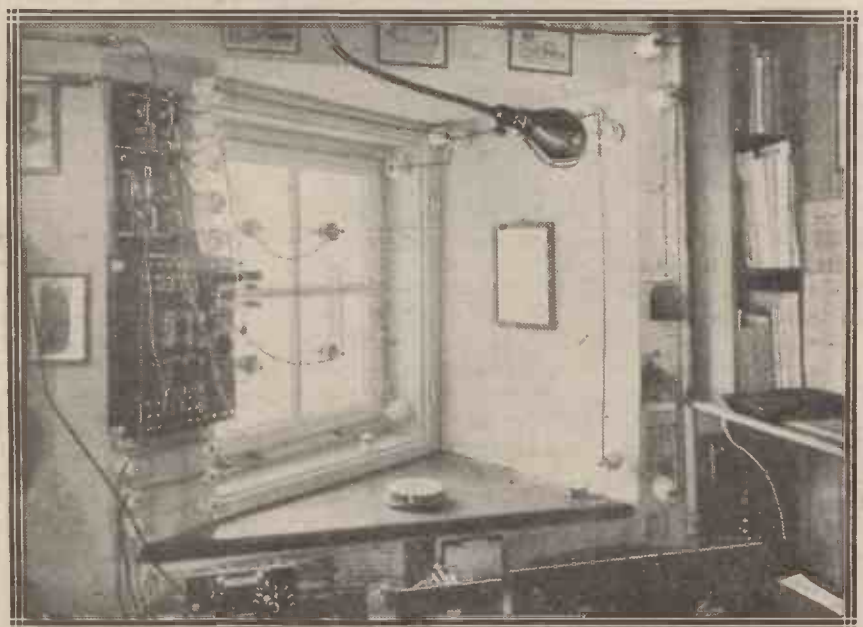
The Oscillating Circuit

When an alternating potential or voltage is applied to a pure inductance in parallel with a condenser of the correct value, the energy released by the condenser as it discharges is entirely used up by the inductance to build up a magnetic field. Alternately, as this field collapses the released energy is entirely used up in recharging the condenser. Therefore, if the relationship between the values of the inductance and capacity is correct for the particular frequency of the applied potential, and if there is absolutely no resistance in the circuit, no energy will flow either into or out of the circuit.

It would seem that, having once got the pendulum swinging at a sufficiently wide angle, we might abandon the initial tapping and leave it to swing for ever, since there appears to be sufficient energy stored up as it swings from the highest point in its path on one side to carry it over to a corresponding point on

(*Continued on page 690.*)

SUCCESSFUL SWISS STATION



Some of the receiving gear at Zuoz College, Switzerland, where many long-distance feats have been carried out.

The Speed of Radio Waves

In this fascinating article Sir Oliver Lodge gives "M.W." readers a peep behind the scenes in the Cavendish Laboratory, which is world-famed for the scientific discoveries made there. He tells just how, by means of photographic plates, and in collaboration with Sir Richard Glazebrook, he was able experimentally to verify an important theory about the speed of radio waves.

NOWADAYS it is well known—though it was by no means well known when early experiments were conducted—that whenever electric oscillations occur the ether is perturbed, and that electro-magnetic waves are produced, which are supposed to travel out with the velocity of light.

Theory Completely Proved

This fact was predicted by G. F. FitzGerald mathematically on the basis of Clerk Maxwell's theory, and was experimentally verified by Hertz, and indeed by the writer also. But Hertz did it better and more completely, and moreover gave a very complete explanation of the detailed process by which the waves were emitted.

The discovery was made public by FitzGerald at the British Association Meeting in Bath in the year 1888, before anything like wireless communication was thought of, and before there was any proper means of detecting the waves.

Hertz could only detect them by the surgings which they produced in properly attuned receiving circuits, those surgings being demonstrated by the overflow or spark which they caused. The surprising thing was that the waves were strong enough to produce sparks, even when the receiver was separated by a fair distance from the emitter. And thus Clerk Maxwell's theory was qualitatively verified.

Theory stated that if any such electro-magnetic waves were produced they must travel through space with the velocity of light; and it is now universally assumed that wireless waves do travel with the velocity of light.

This relic, on view in a Berlin Radio Museum, shows Braun's transmitter, which dates from 1904. Note the huge coil standing beside the table.

But even advanced experimenters may sometimes wonder whether this is exactly true, and whether any experimental proof has been given that the velocity of electric waves, of the considerable length used in wireless practice, really do travel at the same rate as the utterly minute waves which are able to affect the eye.

Velocity Never Properly Measured

The velocity of light has been measured with great accuracy; but I am not aware that the velocity of wireless waves has ever been really measured at all. Being waves in the ether, it is natural to assume that, whether long or short, they all go at the same rate, just as sound waves do in air. The rate of transmission of bass notes and treble notes must be the same, otherwise, as Sir Isaac Newton said, we could not listen to the music of a band at a distance. There would be hopeless confusion if the notes travelled at different rates.

Obtaining Proof

Still we ought not to be content with the mere assumption that the same will be true for ether waves, and we may properly ask what proof has been given that electric oscillations of a few hundred or a few thousand a second emit waves which travel at the same speed as those of optical frequency, which in the case of yellow light are 500 million-million per second, and for all colours have to be expressed in hundreds of millions of millions.

The proof was really given by the present writer and Sir Richard Glazebrook working in collaboration in the Cavendish Laboratory in the last century. The method was to generate oscillations with high voltage, such as would cause sparks in a circuit containing a great capacity, made of interleaved glass plates and tinfoil, and a great coil of wire of about four henries inductance.

The rate of oscillation could be calculated for such a circuit on Maxwell's principles, in accordance with the theory first formulated by Lord Kelvin so long ago as the year 1853. He it was that worked out the rate of oscillation as dependent on capacity and inductance; though the term "inductance" was never then used; it was invented later.

Kelvin (then Professor William Thomson) called the

By Sir Oliver Lodge, F.R.S.

one "electro-static capacity," and the other "electro-dynamic capacity." That which he called electro-dynamic capacity was afterwards called self-induction by Clerk Maxwell, and much later was called inductance by Heaviside.

It is a magnetic phenomenon, due to the magnetic qualities of a current, as opposed to the purely electric phenomenon of charge. The oscillations are due to the interaction of magnetism and electricity; and so are the waves, which Hertz found were emitted by the oscillations. Hence the waves are called electro-magnetic. Linear aerials collect the one form of oscillation. Frame aerials collect the other—the magnetic—kind of oscillation.

An Ingenious Method

But although the complete theory had been given, there had been no verification. The rate of oscillation had been calculated, but not observed. Glazebrook and I proceeded to observe it, on the supposition that the velocity of light was involved. To do this we photographed the spark on a rapidly revolving photographic plate. The plate revolved in its own plane at a carefully measured rate of about 60 revolutions per second.

The spark was focused on the plate, not at the middle but near the edge, so that if it were drawn out it would form a circular band instead of a sharp line; and if the spark were an oscillating one the band would be beaded, that is to say, would consist of smears of light separated by minute intervals of darkness.

The plate so obtained when developed could be subsequently micrometrically examined and measured; and from the recorded image of the oscillations, knowing the rate of revolution of the plate, the rate of vibration could be accurately checked. The whole investigation is published in a volume of contributions by a number of different writers, as a Memorial to Sir George Stokes, one of the leading mathematical physicists of the last century—the teacher one might say of both Kelvin and Maxwell, as well as of the rest of the smaller fry.

It was published by the Cambridge University Press in the year 1899; but it is presumably not well known, and this article may serve to call attention to it.

Maxwell's Theory Proved

The result may be expressed thus: Lay off a length corresponding to the magnetic units of inductance in the coil employed; for on the magnetic system of measure inductance is a length. End to end with this line lay off another length as a continuation of the first, to correspond with the electric measure of the capacity of the condenser employed; for on the electric system of units capacity is a length.

Having got those two lengths end to end, draw a semi-circle upon them; so that the two lengths together form a diameter. Then from the junction of the two lengths draw a perpendicular to meet the semi-circle. Measure the length of that perpendicular. With that length as radius let a wheel be constructed, or rather imagined to be constructed, with that length as any one of the spokes. In other words, take a wheel with that length as radius.

A recent portrait of Sir Oliver Lodge.

We now suppose that wheel to be employed like the wheel of a locomotive running along a line of rails, or on a flat surface, so that its rate of revolution shall correspond with the observed rate of oscillation as measured from the spark-record on the photographic plate.

Maxwell's theory says that the rate at which that wheel would travel along as it rolls like a coach wheel would be the velocity of the waves emitted. The size of the wheel was known, the rate of revolution was known—both known from the conditions of the circuit.

The question then is, at what rate that wheel would advance; for that would be the velocity of the waves. Was it the velocity of light? It was.

What we actually did was to assume that it would travel forward with the velocity of light, and on that supposition calculated how fast a wheel of that size would have to revolve. Did the rate of revolution correspond exactly with the rate of electric oscillation?

Exact Correspondence Achieved

The answer given by experiment, that is, by measuring up a great number of the spark records on a number of revolving plates, was that it did correspond. The correspondence was exact; the theory was verified; the proof was established that electric waves of great length, corresponding to comparatively slow oscillations, travelled

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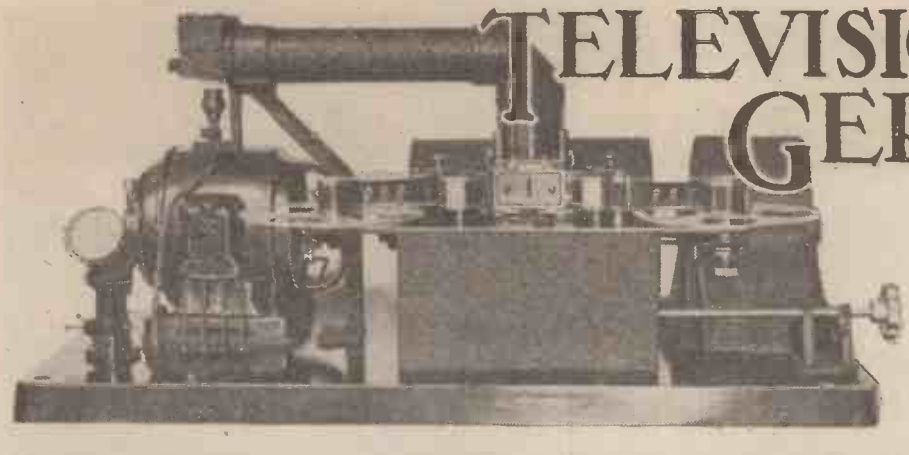


TELEVISION IN GERMANY

The position to-day, outlined in an interview with the head of German broadcasting.

By Our Special Correspondent.

THE most important part of the annual German wireless exhibition was that devoted to television, and the German authorities expect some actual result from this part of the exhibition. That is to say, it depends on public opinion after having seen the different systems in actual use if television will be experimentally introduced into Germany or not.

The Official View

The head of German broadcasting, the Commissioner of the German Reichspost for Broadcasting, Secretary of State Dr. Ing. Bredow, was kind enough to give me his views on the possible introduction of television in its present state into Germany. If the public wants television now in Germany it will get it. First of all, *not* as actual television, but as telecinema, as the technical perfection of actual television is, at the present moment, not so great that it would warrant its introduction to the satisfaction of the public.

Staatssekretär Dr. Bredow went on to say that he had waited with the introduction of broadcasting as a service into Germany till he was sure that the greater number of listeners would get real enjoyment out of it and not mere technical entertainment. Dr. Bredow pointed out that the listening public in America, and also in Britain, although he was not so well acquainted with conditions there, were far more technically inclined than the German listener.

Actual Entertainment Essential

He drew my attention to the number of periodicals more or less solely devoted to self-construction of listening, or rather receiving, apparatus in the U.S.A. and in Britain, and to the very much smaller number with less space devoted to the same subject in Germany. Thus the German listener had to be provided with actual entertainment and not with a technical toy when broadcasting was first introduced, and the same with television. The technical perfection of the existing systems will have to be greater before television can be safely introduced into Germany.

It is for this reason that the technical department of the German P.O. has fitted a special television laboratory and is earnestly working on the perfection of things at the transmitting end. Bredow hopes to be able to get the different competing companies to agree to the German P.O. transmitting by means of the standard apparatus developed by that department and leaving the companies a free hand as to the selling of receivers.

As Bredow very rightly pointed out, the television companies will make

Dr. Bredow, the Chief of German broadcasting.

their money by selling receivers and not by the selling of transmitters. It is generally considered probable in Germany that the first definite transmissions of telecinema on a regular basis, even though it be at first called experimental, will take place at a very early date. The standardised system developed by the German P.O. will most probably be used. A standard system is necessary, as it is also necessary that the receiving apparatus be able to reproduce this standard transmission to prevent technical development making the further use of old apparatus completely impossible.

In Laboratory Stage

In spite of this rather optimistic report as regards telecinema, the actual television available does not yet warrant more than laboratory transmissions such as are being carried out daily in Germany, mostly according to the P.O. standard system and Von Mihaly's system. The general public are so used to the very excellent reproduction in illustrated papers and in the cinema itself that, once the newness has worn off, it will hardly ever turn to its television receiver except, of course, if it were possible to televise large scenes such as football matches, etc.

Small theatre scenes are much better either in the theatre or in the cinema, especially as there are no two wave-lengths internationally available for the simultaneous broadcasting of speech and picture. I think this embodies pretty well the official standpoint in Germany expressed to me by Dr. Bredow and by officials of the technical department of the German P.O.

At Berlin Exhibition

At the German radio exhibition two firms exhibited commercially-made small telecinema receiving sets. The German Telehor Fernschau Co., System von Mihaly, the first of whose apparatus will be manufactured by the well-known German firm of Kramolin, Berlin; and the German Fernseh Co., a quarter of which belongs to the Baird International Television Co., Ltd., also exhibited apparatus closely resembling the British Baird Company's small receiver.

(*Continued on page* 692.)

The A.C. "BROOKMAN'S"

A very interesting example of an all-mains outfit produced by the conversion of that popular set, the "Brookman's" Three, for use with the standard "M.W." A.C. power unit.

By the "M.W." RESEARCH DEPT.

WHAT is the proper way to construct a completely mains-driven receiver? Opinion seems to be divided on the point, and there are two main ways of arranging such an outfit.

In the method which is most often seen, the receiving and power circuits are all built into one large instrument, so that we have the receiving circuit proper and the mains power supply devices all housed inside a single cabinet. While this system of construction has many obvious advantages, and results in a very workmanlike outfit, it has in our opinion certain definite drawbacks which make it unsuitable for quite general adoption.

In the first place, it makes the construction of such a receiver really rather a large job, and one calculated to frighten off anyone save the more experienced constructor.

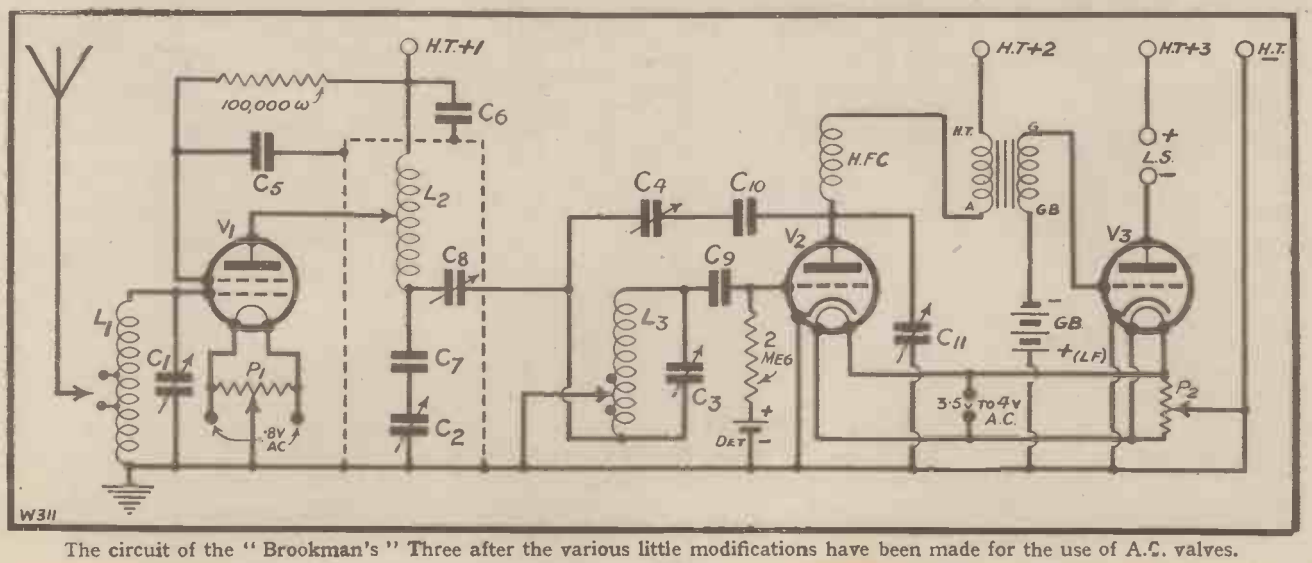
Moreover, this system is very apt to make the receiving equipment very large and cumbersome, because when one is producing a design for the home-constructor one cannot proceed in the same way as the commercial designer, who has only to think of construction under factory conditions. So long as one is compelled to stick more or less to the simple panel and baseboard system of construction, it is not possible to secure much compactness in such a design without making it exceedingly difficult to construct.

An Attractive Alternative

Another drawback of the all-enclosed system of construction which we regard as more serious still is that such an instrument represents a very considerable outlay in components and time, the whole of which must be scrapped, or, at any rate, pulled to pieces, when the owner decides that he wants to build a new and perhaps more powerful outfit.

Now, we do not wish to give the impression that we are condemning out of hand this method of assembling an all-mains equipment, because that is far from our intention. Such single unit outfits undoubtedly fill one particular need, and have their own particular sphere of usefulness, but the point which we wish to make is that they do not meet every need, and we consider that from the home-constructor's point of view there is another type which really deserves to be given considerably more attention than it usually receives.

Let us, therefore, take a look at this alternative system of construction. The idea, briefly, is this: you build your receiver very much like a battery equipment, merely making such small changes in its current supply circuits as may be necessary to make it suitable for mains working, and then you add to this an entirely separate and self-contained power unit, which can be connected up to the set exactly like an equipment of



The circuit of the "Brookman's" Three after the various little modifications have been made for the use of A.C. valves.

batteries. This power unit can be placed at some little distance from the receiving circuit proper, and so you automatically get over certain difficulties which usually call for screening in a single-unit type of all-mains receiver.

An important advantage of this double-unit system is that you can construct your power unit first of all, and use the H.T. portions of it for supplying your present receiver, and then at your leisure build the special set to work with it, which will, in the end, give you complete all-mains operation.

COMPONENTS REQUIRED

- 1 Panel, 18 in. × 7 in. (Becol, Resiston, Ripault, Trelleborg, Ebonart, "Kay-Ray," Goltone, Paxolin, Keystone, etc.).
- 1 Cabinet, with baseboard 10 in. deep (Raymond, Camco, Lock, Gilbert, Pickett, Bond, Caxton, Artcraft, etc.).
- 3 ·0005-mfd. variable condensers (Lotus, J.B., Lissen, Gecophone, Pye, Burton, Raymond, Utility, Bowyer-Lowe, Formo, Cyldon, Ormond, or other good make of moderate dimensions).
- 3 Slow-motion dials, if condensers not of slow-motion type (Igranic, Formo, J.B., Utility, Brownie, Lissen, Lotus, Ormond, etc.).
- 1 ·0001-mfd. or ·00015-mfd. reaction condenser (Bowyer-Lowe, J.B., Lotus, Lissen, Formo, Ormond, Magnum, Burton, Dubilier, Raymond, Cyldon, Polar, Utility, etc.).
- 3 Single-coil sockets (Wearite, Ready Radio, Lotus, Raymond, Igranic, etc.).
- 2 1-mfd. condensers (T.C.C., Lissen, Dubilier, Ferranti, Hydra, etc.).
- 1 ·01-mfd. fixed condenser (T.C.C., Dubilier, Goltone, Lissen, Clarke, Mullard, Igranic, Magnum, etc.).
- 1 ·001-mfd. fixed condenser (Lissen, etc.).
- 1 ·0003-mfd. fixed condenser (Dubilier, etc.).
- 2 Baseboard-mounting potentiometers, 200 or 400 ohms (Igranic, Lissen, Ready Radio, Sovereign, etc.).
- 1 Neutralising condenser (Magnum, Peto Scott, Bulgin, etc.).
- 1 H.F. choke (Varley, Dubilier, Lissen, Cosmos, Igranic, Raymond, Climax, Bowyer-Lowe, Magnum, Wearite, Precision, Ormond, Colvern, R.I., Lewcos, etc.).
- 1 2-meg. grid leak and holder (Lissen, Dubilier, Ediswan, Igranic, Cosmos, Mullard, Pye, Loewe, etc.).
- 1 100,000-ohm resistance and holder (Cosmos, R.I., Lissen, Igranic, Ediswan, Dubilier, Ferranti, Varley, Precision, etc.). (See text.)
- 1 Low-ratio L.F. transformer ("Hypermu," Lissen, Brown, Ferranti, Varley, Cossor, Marconiphone, Telsen, Igranic, Philips, Mullard, etc.).
- 1 ·0001-mfd. or ·0003-mfd. compression-type adjustable condenser (Formo or similar type).
- 1 Special screening box (Magnum, Paroussi, Ready Radio, Wearite, etc.).
- 2 5-pin valve holders (Lotus, W.B., Wearite, Formo, etc.).
- 1 Ordinary sprung valve holder.
- 1 Terminal strip, 16 in. × 2 in.
- 12 Terminals (Eelex, Burton, Belling and Lee, Igranic, Clix, etc.).

Flex, wire, G.B. plugs (Clix, Lisenin, Eelex, Burton, etc.). Screws, etc.

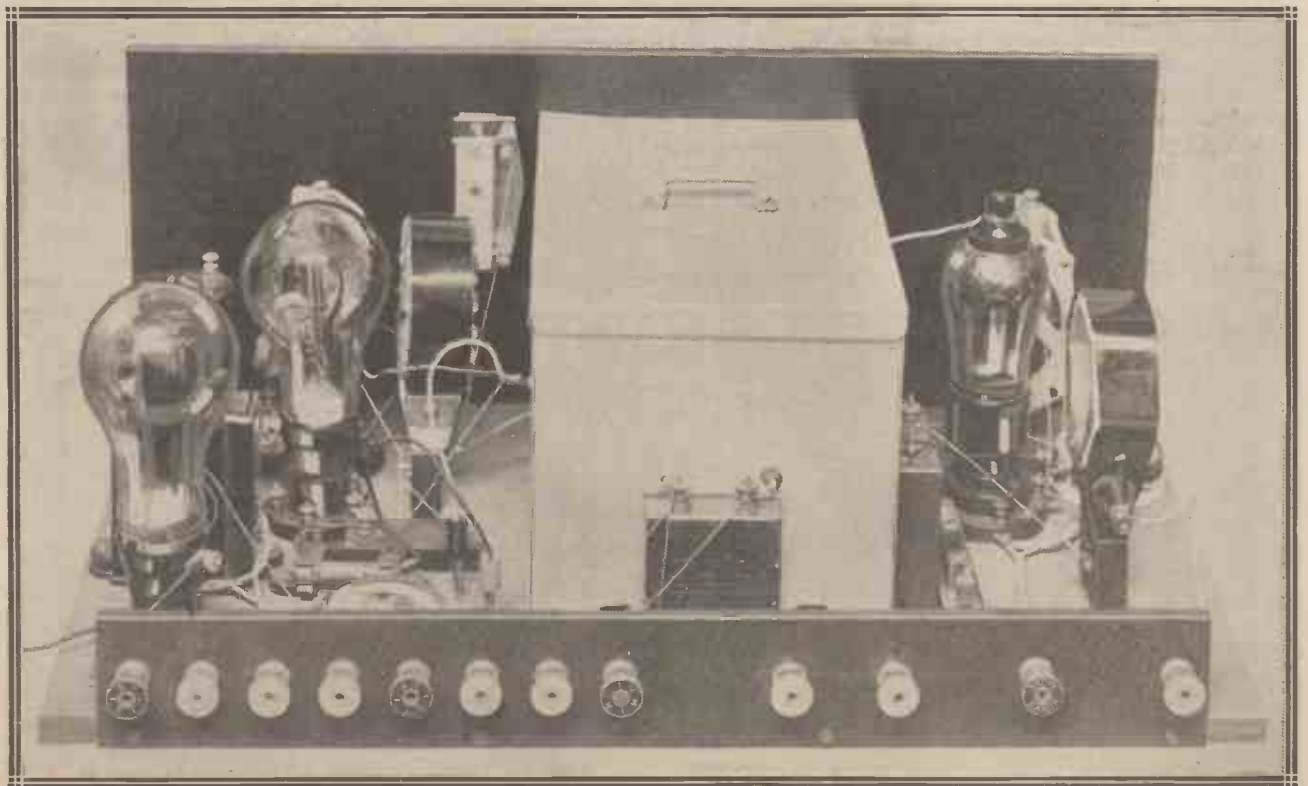
The Cabinet Question

Another factor which we believe is playing a considerable part in making this type of all-mains equipment more popular is its easy applicability to the more modern type of radio cabinet. We notice that the older type of simple "American" cabinet, which makes the receiving set merely a sort of box which has to be placed upon a table, is going out of favour to some extent, and is being replaced by the larger and more elaborate cabinet which is really a piece of furniture, housing both the receiving set in a suitable compartment, and also the loud speaker and batteries in another compartment.

This method of housing a wireless equipment has much to commend it, and really converts an installation into something in the nature of a musical instrument, of whose appearance even the domestic authorities may be expected to approve.

Unit System Advantages

The two-unit system of construction has an obvious advantage here, since the receiving set proper remains of moderate dimensions, and so can



Two extra terminals are required for the ·8-volt A.C. supply to the screened-grid-valve filament, and these are mounted just to the left of the earth terminal.

be expected to fit easily into the set compartment of such a cabinet, and the power unit goes quite neatly out of sight in the lower compartment.

This is rather an important point, because an all-mains receiver of the type in which the power circuits are built into the set itself is apt to be a good deal too large for fitting into even the largest of these cabinets, and even if you succeeded in compressing it to the required dimensions you would simply find that the lower compartment of your cabinet was being wasted, with the exception of carrying the loud-speaker unit.

A General Conversion Guide

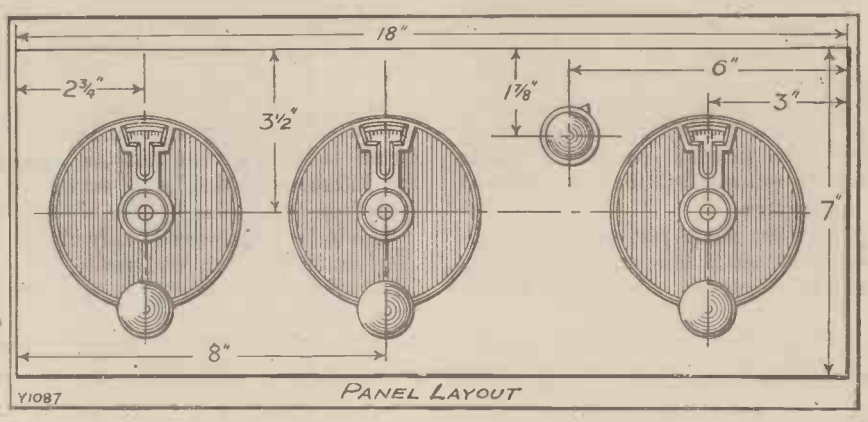
In this short article we are attempting to give you not merely a design for one such all-mains equipment of the two-unit type, but also to indicate the general method by which they may be assembled, in hopes that you will be able after reading these notes to consider the conversion of existing receivers to the same arrangement.

We shall be giving actual practical details for an example of such an equipment, but the method described will be as general as possible, and you will very likely find that they can be taken as a guide to the conversion of even your present set.

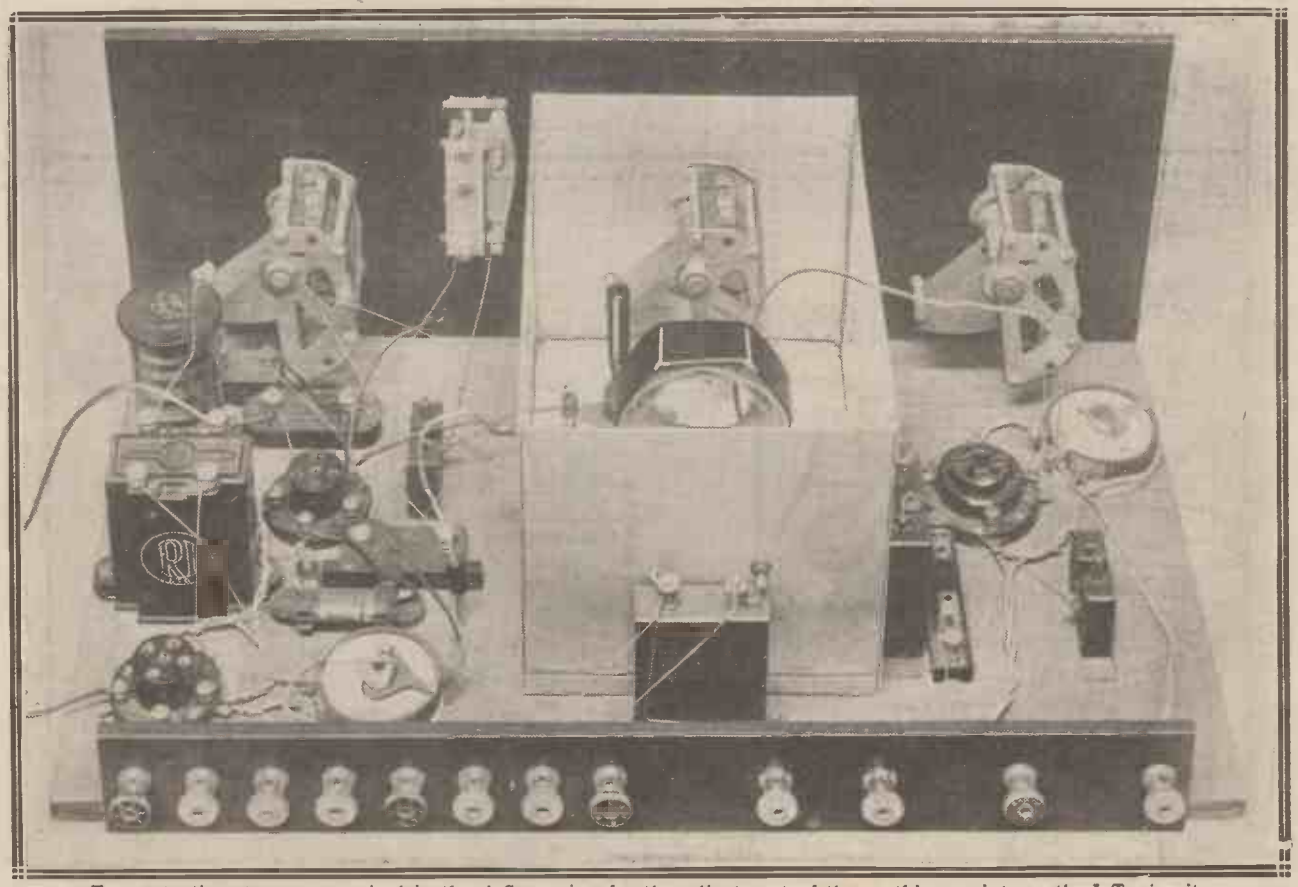
First of all, there is the question of the power unit, and in this connection we would refer you to the design for an A.C. instrument described elsewhere in this journal. This will form the basis of our suggestion for your conversion, since this instrument was specially designed to be as adaptable and universal in its applications as possible. It gives you the necessary supply of H.T. voltage at various pressures, and also a supply of L.T. alternating current at two different voltages for running the different types of mains valves.

This power unit, then, will form the basis of our discussion, and now we can turn to the question of the conversion of the receiving set. As an example, we have taken a particularly efficient recent design for a three-valver, and worked out the slight alterations and modifications necessary to convert it for all-mains working, so that you can if you like take this article as a design for a complete all-mains outfit, in conjunction with the one describing the mains unit in question.

The set we have chosen is the "Brookman's" Three, which we regard as one of the best three-valve receivers we have ever presented to our readers, with the extraordinary



PANEL LAYOUT



Two potentiometers are required in the A.C. version for the adjustment of the earthing points on the L.T. circuits.

selectivity and excellent quality of reproduction conferred by its special arrangement of tuning circuits, and its very fine performance as a long-range set.

It is one of the very few receivers we know which has sufficient selectivity to cope easily with the conditions to be expected when the second regional transmitter starts work at Brookman's Park. We believe that it will do so without an effort, and will not require the aid of a wave-trap even on the northern side of London. Such extra aids should only be needed in the absolute swamp-out area within a few miles of the station.

Now let us see just what has to be done to make this set an all-mains outfit. First of all, about valves. By making a very careful choice from among the mains types available we have been able to enhance the already fine performance of the set quite considerably, because certain of theA.C. mains valves have definitely better characteristics than the equivalent battery types.

The H.F. Stage

For the H.F. stage we have chosen a screened-grid valve of the directly-heated "Point 8" type, which has a filament taking ·8 amp. of A.C. at ·8 volt. This valve we found better suited to our present purpose than the indirectly-heated A.C. screened-grid type.

This latter has a considerably higher amplification factor, and really calls for special circuits to employ it to the best advantage. Moreover, rather elaborate precautions are needed to ensure an adequate factor of safety as regards stability, and so we decided against it in this case, remembering that our object is to describe general methods of conversion which can be applied to almost any set.

The first step, then, is to remove the filament wiring to the H.F. valve socket, and instead wire the filament terminals of this socket with twisted flex leads to a new pair of terminals on the back strip. This new pair of terminals is then to be connected to the ·8-volt pair of A.C. output terminals at the back of the power unit. (The centre-tap terminal on the power unit is not used in the present case.)

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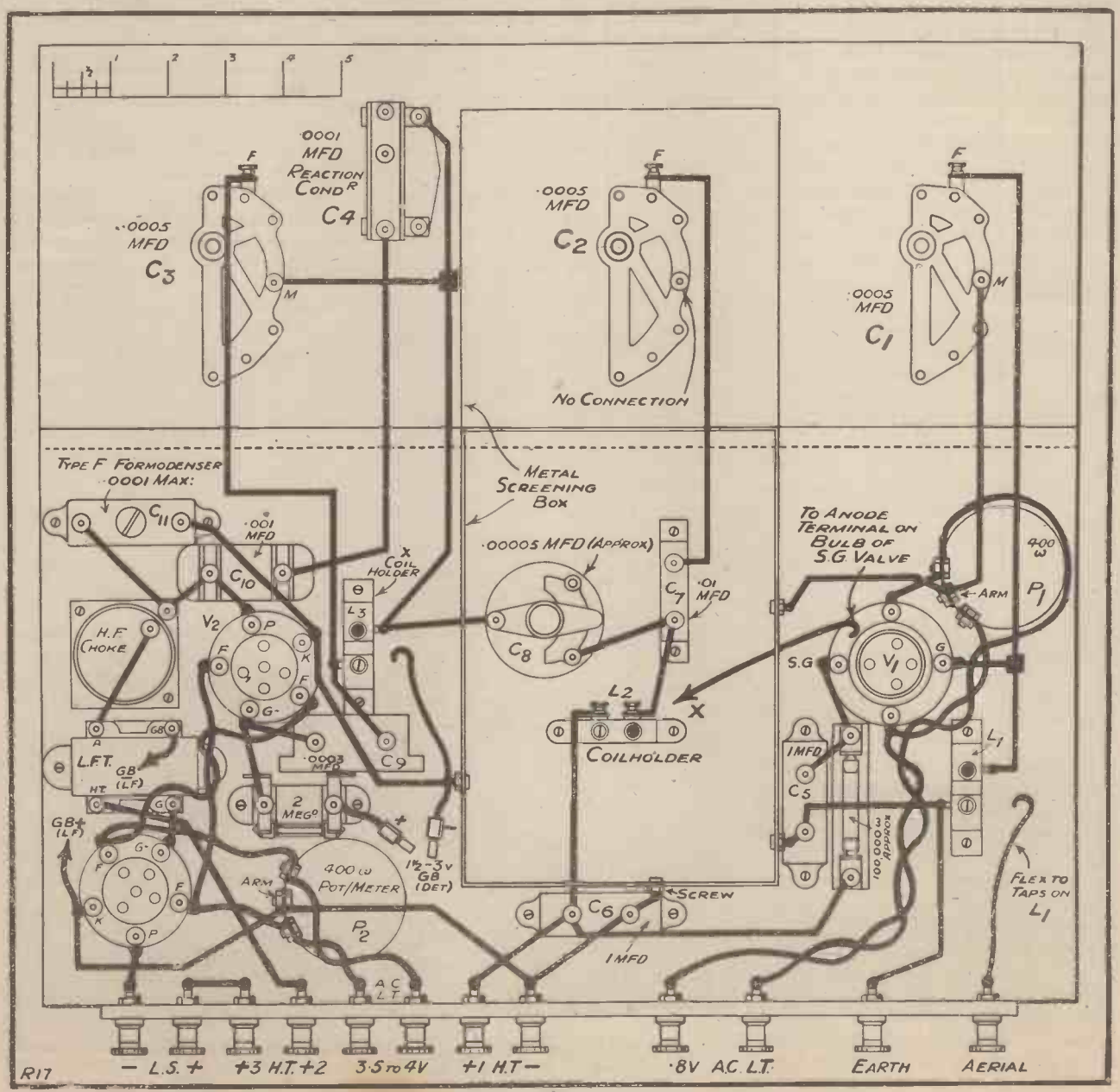


SEVEN RADIO CHRISTMASSES

BY CAPT: P.P.ECKERSLEY M.I.E.E.

In this interesting and seasonal article our Chief Radio Consultant chats about the early days of broadcasting and reviews the progress made in the past six years. Finally he expresses his beliefs and hopes for the future.

CHRISTMAS, 1923! Christmas, 1929!—six years while one has seen broadcasting grow from an impetuous youth to what one might describe as an old young man of the world; well-dressed, gentlemanly, formula-seeking, self-assured, and, at times, a little irritatingly patronising towards enthusiasm.

I liked broadcasting better, I must confess, when it had all the crudities of enthusiasm, when a thousand letters poured in to praise or blame an innovation. Many disagree with me, believing that such is the responsibility of the broadcasting authority that it must never commit the *faux pas* of seeming to want to indicate a definite line of thought, and must never descend to the vulgarities of publicity, drum beating, and an expressed desire to please.

The Good Old Days

Perhaps then I shall be blamed in raking up a past best left to be covered by the oblivion of the crowded years that separate now and then. Perhaps it is mere hedonism that drives me to recapture the fever that possessed us all in those days; but maybe there are some who in the leisure and goodwill of Christmas will like to read of Christmas, 1923, as I remember it.

It all centred round what we called American relays. In those days "short" waves were astonishing all but the pioneers in their ability to penetrate to every part of the globe and give signals of amazing clarity considering the long leagues they had to travel. KDKA, an American station worked by the research engineers of the Westinghouse Company in Pittsburg, was using a wavelength of the order of 60 metres, and, at times, and with luck, could be heard in this country.

Capt. A. G. D. West, who did valuable pioneer work in the rebroadcasting of the programmes of distant stations.

So Capt. A. G. D. West (another of those who have forsaken the B.B.C. and gone into the commercial world) rigged up a receiver down at Biggin Hill and spent much of his working and waking hours (synonymous in those days) in rigging up a special receiver to pick up KDKA, and sent what he got down a line to Savoy Hill, where it was distributed by our then new S.B. system to a listening country.

That First Relay!

Patient work, a little luck, and the Gods that control the Heaviside Layer, conspired, around Christmas, 1923, to give us faint encouragement of success. Rushing in where angels feared to tread, we started to relay our results. Sitting in an armchair in my house, I had my private telephone connected in parallel with America. My loud speaker (*quel horreur!*) told me what we were receiving, and I explained what was happening "over the top" of America.

You must imagine a noise like a hail storm on the corrugated iron roof of a resonant shanty and, like dim figures seen through a mist, the occasional shadowy emergence of music. Was it a brass, military, jazz, or sideband? Or did we hear a piano? Was that a human voice or an American one? I guessed my vague guesses and superimposed over the mélange of music, messages, Morse, and atmospherics my microphone-distorted

It is a Far Cry From Christmas, 1923. . .

voice gave all who listened the benefit of my "guestination."

And when it was all over and West and I discussed with suppressed delight at our initial success new circuits, new aerials, the telephone tinkled and congratulations poured in from all over England. Scotch voices, Midland voices, North Country voices, Londoners, all pouring their excitement into my flattered ear, till a head less likely to be swelled than mine might have been excused for making room for the idea that we, not the Heaviside Layer, were responsible for the marvel.

A Romantic Beginning

And next morning we were "news." Newspapers splashed the story only to the limit set by the dimensions of their broadsheets, reporters were ringing up, letters were pouring in. Never mind that, as an entertainment, it lacked the clarity one normally associated with wireless broadcasting, never mind that one had to insist that it meant no more than itself and many and difficult were the problems to be overcome, it was romance and a beginning, it indicated the *possibility* of an intercontinental link, if it did nothing else.

As I was then, I am still, second to none in my enthusiasm for the ultimate consummation of a world network interlinking every local station, American, European, Asiatic, British. I find that the indications of a possible beginning were taken by too many as the basis of finality.

A year or so later than the time of which I write, an agitation began that we should set up, at once, a system of "Empire Broadcasting"; that is to say, as a result of experiments with waves of the order of 15 to 30 metres, people were encouraged to believe that we might immediately spend the hundred or so thousands of pounds required to set up an Empire interlink so that British programmes might be heard throughout the Empire. I had the unenviable task of pouring cold water upon the idea because I believed, and still believe, that it is better to be surer of our ground than we were at that time (about two years ago).

Here is a photo which will take the old-timer back to earlier and, in many ways, more exciting days. It shows the receiving apparatus that was once installed at Biggin Hill, and on which were received the very earliest transatlantic programmes that were picked-up by the B.B.C. for re-broadcasting.

There are, it seems to me, two problems in this regard: the interlinking of continents so that anyone's local station can re-radiate an overseas programme, and the furnishing of a service to the "lonely listener" who finds himself in the wilds too far away from any ordinary broadcasting station to hear a programme clearly.

The former problem must be solved experimentally before money is found for the necessary stations, the latter problem is to a large extent solved in the maintenance of our short-wave station 5 S W. But we are very near a solution of the former problem, and moves will, I think, soon be made to set up a true inter-continental link. It would have been rash to have rushed in two years ago, it will be wrong if some move is not soon made to set up a permanent system.

The researches made by the Marconi Company and ourselves at Terling reveal that it is possible on occasions to receive startlingly clear and interesting broadcasts from America; the success of the Marconi-Mathieu beam system of multiplex shows that it is perfectly practicable to telephone to any part of the world where facilities exist.

Amazing Potentialities

It is a question whether when, thanks to the patient work of many experimenters in the past six years, we have such a system, in what way it will best be used. My own opinion is that music, being universal and suffering to some extent in its transmission over very long distances, will never be relayed from one continent to another via the short-wave link.

Here is the orchestra at the K D K A station. At Christmas, 1923, a little luck and a lot of patience and hard work resulted in the retransmission by the B.B.C. of "a noise like a hail storm on a corrugated roof . . . with the occasional shadowy emergence of music." Nevertheless, it was a triumphant step in the development of our broadcasting system.

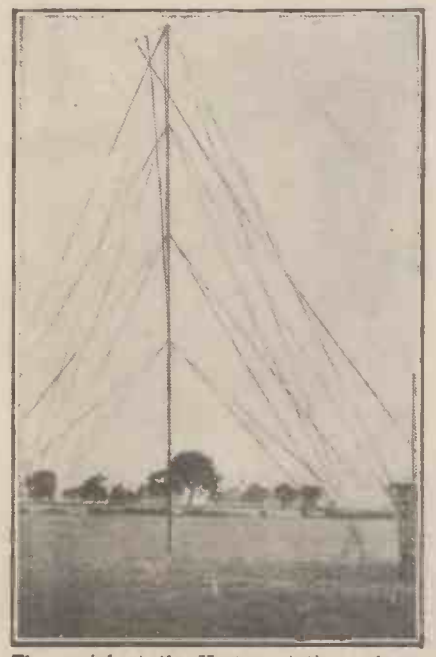
But events of world-wide importance will certainly be so relayed. One has felt, for instance, the amazing potentialities of the link when one has listened with thrilled attention to the American commentators describing the arrival of the Graf Zeppelin at Lakehurst, or picked up every word spoken by the Prime Minister when New York welcomed him as the envoy of world peace to America.

Nation Bound to Nation

It is just in these sort of events that the world link will come in and bind nation to nation in ever securer bonds of understanding. The lonely listener will enjoy his occasional broadcasts from a station like 5 S W always; it is a question whether the interlinking of continents cannot be achieved by hiring a channel from the postal authorities when occasion demands, just as we do to-day with the wire network in Britain and Europe.

The True Xmas Spirit

So few will be the occasions when events take place worthy in their intrinsic interest and importance of world-wide dissemination, that this might indeed be a possible method of achieving an ideal; it remains to be seen in terms of actual trial whether this will indeed be possible.



The aerial at the Keston station, where the B.B.C. used to check transmissions and pick up distant programmes for rebroadcasting. Keston has now closed down, and Tatsfield has taken over this work.

It's a far cry from Christmas, 1923, when we first relayed America, to this Christmas, 1929. We have now a far greater possibility of hearing. Might we perhaps not once more capture the old spirit of enthusiasm, and in doing so remake for the first time in 2,000 years the true spirit of Christmas "Peace on earth, good will towards men"? It only requires a voice to articulate what all believe—that peace must endure or civilisation perish.

PRACTICAL HINTS FOR LISTENERS

Every new owner of a valve set should get the B.B.C.'s useful little booklet on oscillation, which is obtainable free of charge upon application at any broadcasting station, or 2, Savoy Hill, London, W.C.2.

* * *

Keep your switch contacts clean, for crackles, scratching noises and poor reception are all liable to be caused by dirty switches.

* * *

Never attempt to run a lead-in wire (even although it is insulated) through a metal grille, as sometimes fitted over a doorway for ventilation, because if you do this a large proportion of the incoming signal strength may leak away through the insulation to earth.

* * *

One of the great advantages of R.C. coupling is its compactness. Resistances can be placed side by side without fear of interaction such as would arise with transformers.

Do not run an aerial wire close to a wall or a ceiling for a greater distance that is absolutely necessary.

* * *

The liquid in an accumulator should always be kept at the level recommended by the makers, which is generally at least a quarter of an inch above the top of the plates.

* * *

It is not safe to assume that a set will not interfere with your neighbours because it is a one-valver, for as a matter of fact it is very often the one-valve set which causes so much interference with other people's programmes.

* * *

Keep the "Earth" Clean

If the earth lead is taken to a water-pipe it is essential that this is cleaned properly and that no paint is allowed to remain on the pipe before the clip is placed on it.

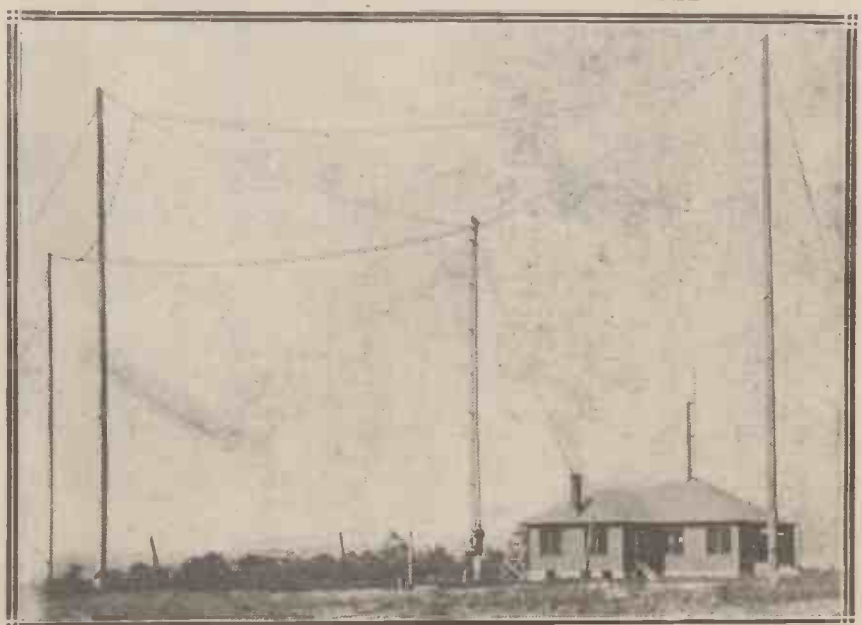
* * *

Back numbers of "M.W." which are not out of print can be obtained from the Amalgamated Press, Ltd., Back No. Dept., Bear Alley, Farringdon Street, London, E.C.4, price 1s. 3d. post free. (Double number 1s. 10d.)

* * *

If your 'phones or loud speaker have become demagnetised or insensitive, do not throw them away, for they can often be put right for a few shillings by the makers or by firms specialising in this class of work.

THESE ARE ROMANTIC AERIALS



The aerials of the famous American short-waver K D K A were among the first to provide real programmes for short-wave fans. The station is still going strong and doing real good work, although there are hundreds of other short-wavers these days.

The "Twin-Frame"

Here is an extremely attractive all-enclosed receiver of excellent performance, which puts all the accessories out of sight, yet provides room for full-sized batteries and frame-aerial windings of high efficiency.

Designed and described by the "M.W." Research Department.

THE sudden popularity achieved by the so-called portable set last season was rather puzzling to many observers, for at first sight this type of receiver appears to possess so many drawbacks.

An Interesting Tendency

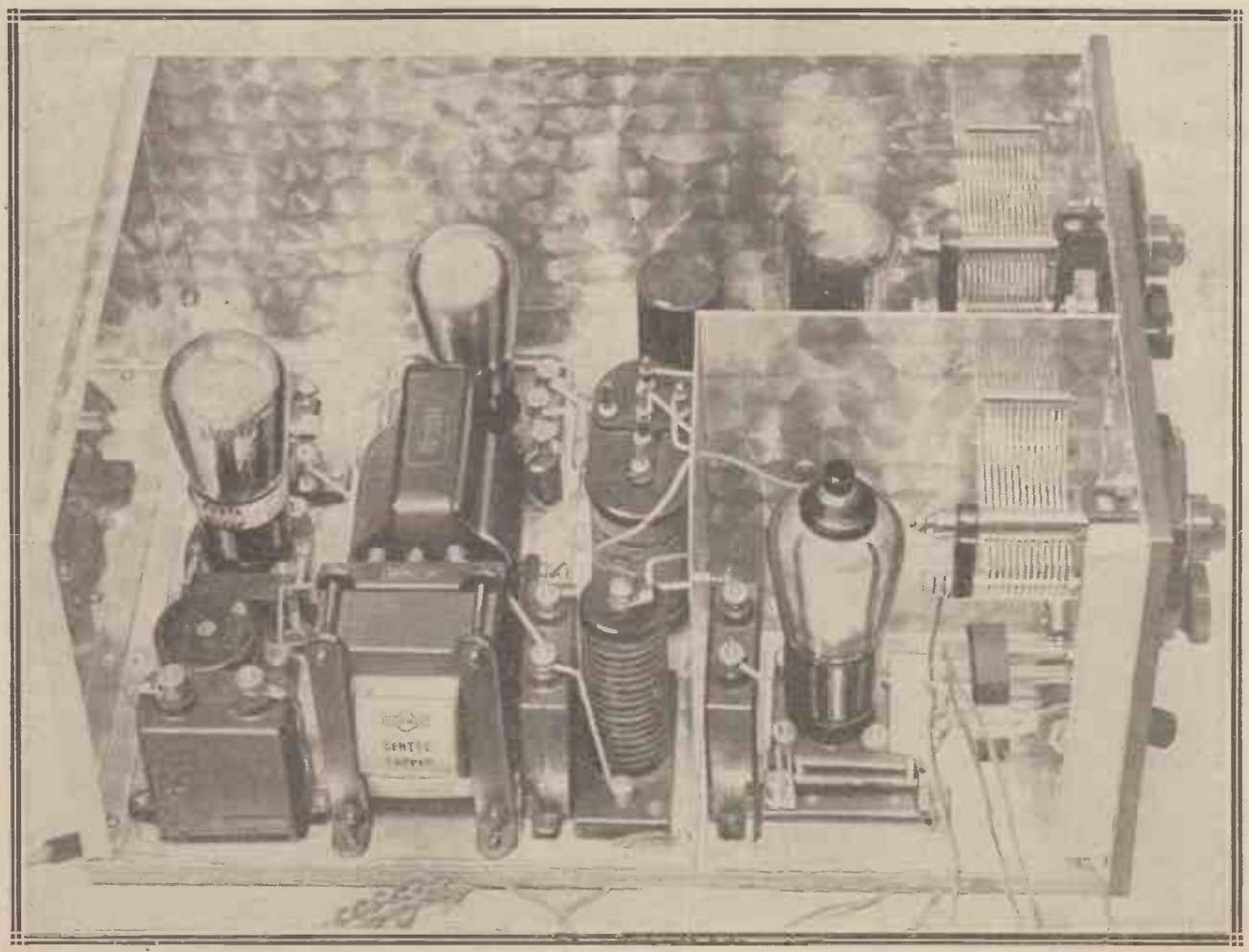
Working upon a small and usually very inefficient frame aerial it cannot possess anything like the performance of a set employing an equal number of valves upon an outside aerial, quality sometimes suffers to some extent as a result of the use of a comparatively small and inexpensive cone speaker movement, and so on through a long list of drawbacks, as compared with the more normal type of outside aerial receiver. Notwithstanding all this, the portable set has indeed achieved a very considerable measure of popularity, and although that popularity now seems to be slightly on the wane, in comparison with other types, there is reason to believe that it indicates a definite tendency in public taste.

It seems very unlikely that it was really the feature of actual portability which attracted so many people to this type of set, because you so very rarely hear of one being taken out on a picnic expedition or otherwise used in the way in which its name seems to invite. The attractiveness of the type seems to lie far more in the fact that here we have a wireless installation which is entirely self-contained, with no trailing wires, unsightly batteries, or troublesome aerial and earth arrangements.

Anywhere in the House

This in itself is obviously a very potent attraction, and then we have in addition the fact that, in spite of the considerable weight of most specimens, they are still sufficiently portable to be carried quite easily from room to room, and so used exactly wherever it is desired to listen at the moment.

These are obviously weighty points, and ones which may justifiably influence anyone considering the



In this general view the set is seen complete except for the fitting of the screening cover and the special screening cap on the S.G. valve. The latter is to be connected, by the by, to the moving plate terminal of the nearest variable condenser.

Four

Pleasing but unobtrusive appearance characterise this fine receiver.

purchase of a receiver for ordinary domestic use.

The slight decline in the popularity of portables which has followed this season is again natural enough if our supposition that the previous boom was really based upon their convenience as a normal domestic receiver rather than as a true portable outfit. The fact is that from this point of view they possess not merely the drawbacks which we have already mentioned, but also the further serious one that in very many cases they do not provide sufficient space for anything but a comparatively small dry battery H.T. unit, which will only run the receiver for a comparatively short time before it requires renewal. (It is only fair to add that this difficulty is now being overcome in many cases by the provision of a small mains unit.)

A Very Successful Design

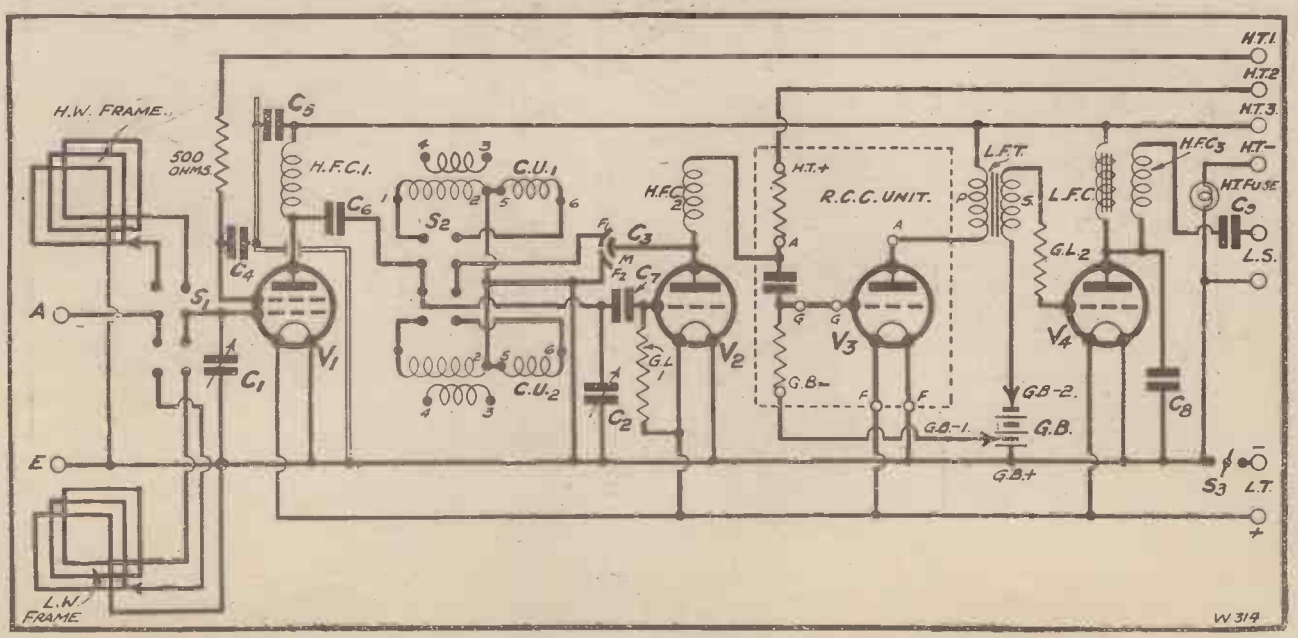
Now there is an obvious moral for the set designer in all this, and we have been wondering whether it would not be possible to produce a design which would go a long way towards combining the advantages which attracted so many people in the ordinary portable set with those of the normal receiver, that is to say, normal quality reproduction, and the better performance which would follow from the use of a more efficient frame aerial, with, of course, also the removal of the difficulty about battery sizes which we have mentioned.

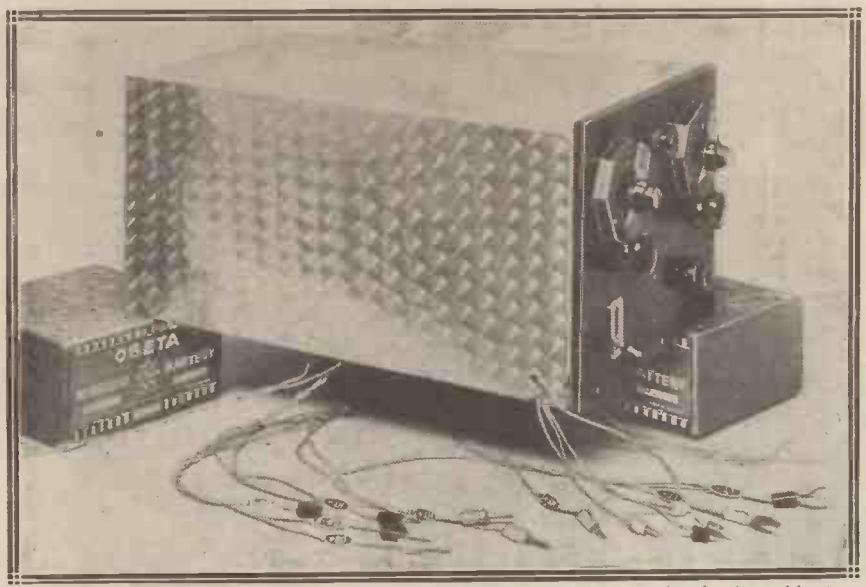
If it could be done, the result would obviously be an extremely attractive set, and we decided to try. The "Twin-Frame" Four is the result, and we feel that we have gone quite a long way towards achieving our object in this set. We ourselves are extremely pleased with it in every way, and we feel pretty confident that we know what our readers' verdict will be.

Its tests show that it conforms to a decidedly high standard of performance, although it incorporates only four valves. Even on its first tests, which took place in a badly-screened building in the City, it proved capable of giving exceptionally powerful signals from 5 G B without the use of reaction, and later tests under normal conditions showed that it is capable of giving really adequate loud-speaker results from quite a number of foreign stations when operated with just a little care.

Excellent Selectivity

Selectivity is well above the average level expected of portable receivers, since not merely have we the benefit to be derived from the frame aerial, but there is also another tuned circuit in the receiver, and the net effect is to provide really high selectivity adequate for any situation. The set should cut out Brookman's Park, for example, almost anywhere with ease, provided that you are more than perhaps three or four miles from the station.





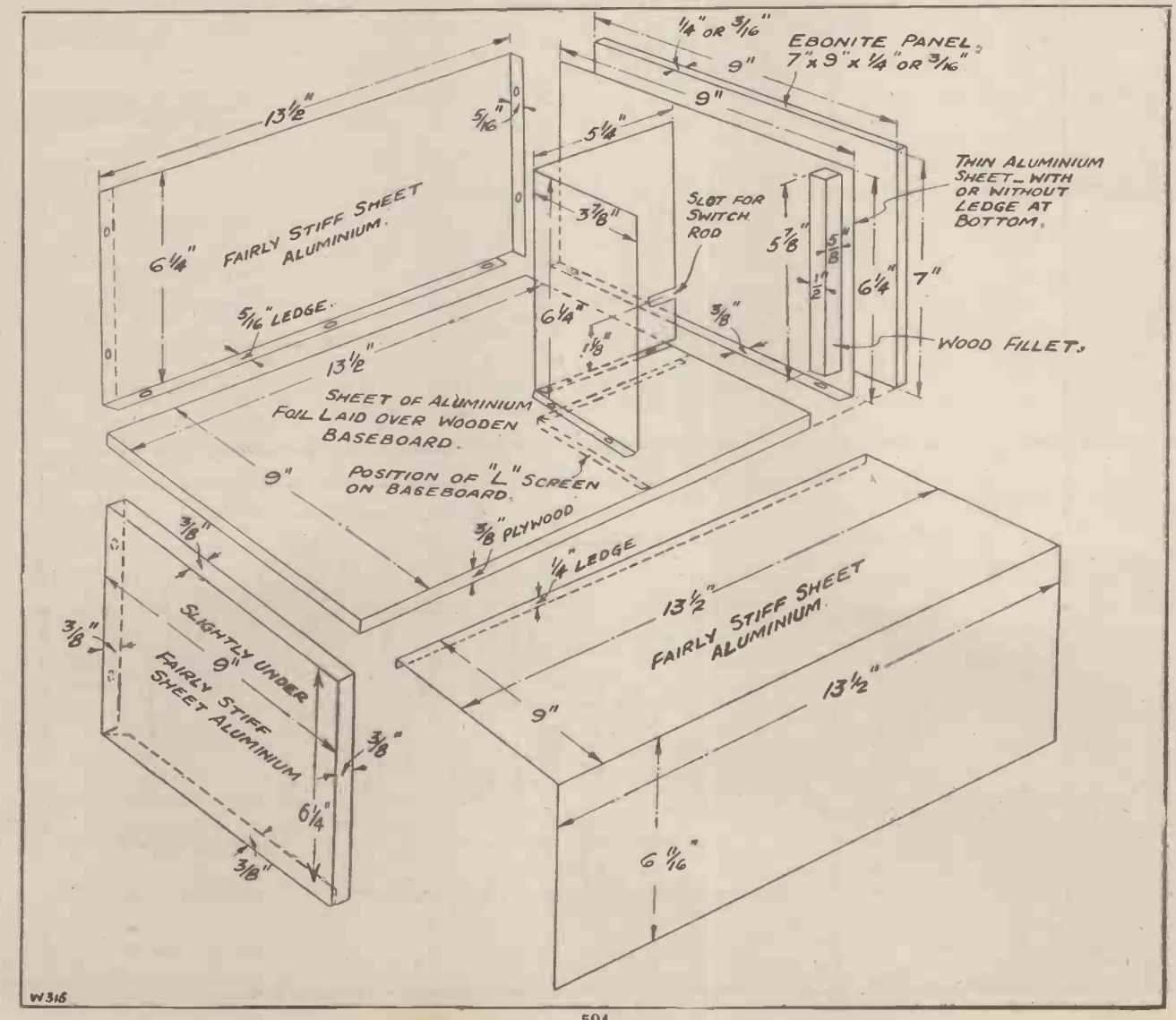
The complete receiver portion with screens in place ready for insertion in the cabinet.

This rather outstanding performance arises chiefly from two special features of the set. In the first place we have sacrificed some portion of the portability idea and provided rather a larger cabinet, and consequently space for a larger and more efficient frame-aerial winding. Secondly, we decided that readers of MODERN WIRELESS do not demand such ultra simplicity of tuning as is usually considered necessary in commercial self-contained sets, and so we have used a fully-tuned H.F. inter-valve coupling, with a corresponding gain in amplification.

Portability Limitations

Mention of this question of the actual degree of portability, by the way, reminds us that we should explain that we have not thought it necessary to achieve so much compactness as characterises the commercial portable receiver. We have definitely sacrificed the idea of true portability, since we do not consider that this is one of the main attractions of this type of receiver.

It seemed to us in producing this design that it would be sufficient to make it sufficiently compact to enable



Ample Room for Large Batteries

it to be carried from one room to another with no great difficulty, bearing in mind that it is entirely self-contained and there are no trailing leads. Accordingly, we have had a rather large size of cabinet made for it, actually measuring about 12 in. wide across the front, roughly 16 in. deep from back to front, and about 20 in. high.

Battery and Loud-Speaker Spaces

In such a cabinet as this there is room to wind quite an efficient frame aerial, which can moreover be spaced out a little from the receiving set itself, and so gain still further in efficiency. A cabinet of such a size as this, you will see, permits quite large-sized batteries to be used if desired, and so gets over one of the great objections to the ordinary type of portable. Moreover, we have made provision on the front fret to allow room for quite a variety of different types of "chassis" loud-speaker units, and by choosing one of those which you know to be capable of giving good results you can be confident that this outfit will give you very good quality indeed.

So much for the general ideas underlying the design of the "Twin-Frame" Four. Now let us explain as briefly as may be how it is assembled. The essence of the outfit is the use of a cabinet of a rather unusual shape, specially worked out to provide convenient accommodation for both set and accessories and to allow for the fact that a frame-aerial set requires to be turned in various directions to pick up the desired signals.

Efficient Frame Windings

Another special point taken care of in this cabinet design, as we have seen, is the provision of more efficient frame-aerial arrangements than are usual in such cases. Not merely are the frames of larger dimensions than is normal in a set of the all-enclosed type, but they are also better spaced-out from the set itself.

True, they approach moderately close to the metal screening across the top, but this is much less harmful than the more usual method of placing the frame windings right round the outside of both set and loud speaker. All that happens in the present system is a slight reduction in the pick-up powers of the frame windings. There is practically no chance of the much more objectionable, but nevertheless quite common, defect of direct interaction between the frame and the receiving circuits.

Despite the slight screening effect of the metal casing of the set the pick-up properties of the frames remain decidedly good. On actual test we found no perceptible difference between the signal obtained with the windings in their normal position and with them removed to a distance of a couple of feet, so the damping effect of the metal is evidently negligible.

By the way, you may have noticed that we have mentioned "frames" in the plural; there are actually two separate windings, one for normal waves and one for long waves, arranged on either side of the cabinet. More about this later.

The top portion of the cabinet houses the set proper, which slides in from the front, the small panel being enclosed behind a couple of little doors. Immediately below these doors is the fret behind which the loud-speaker assembly is to be mounted. There is a good deal of space available here, and it is suggested that you should fit one of the complete chassis assemblies of which there is now a very wide range upon the market. The only limitation here is that the overall width of the chassis must not exceed 12 in.

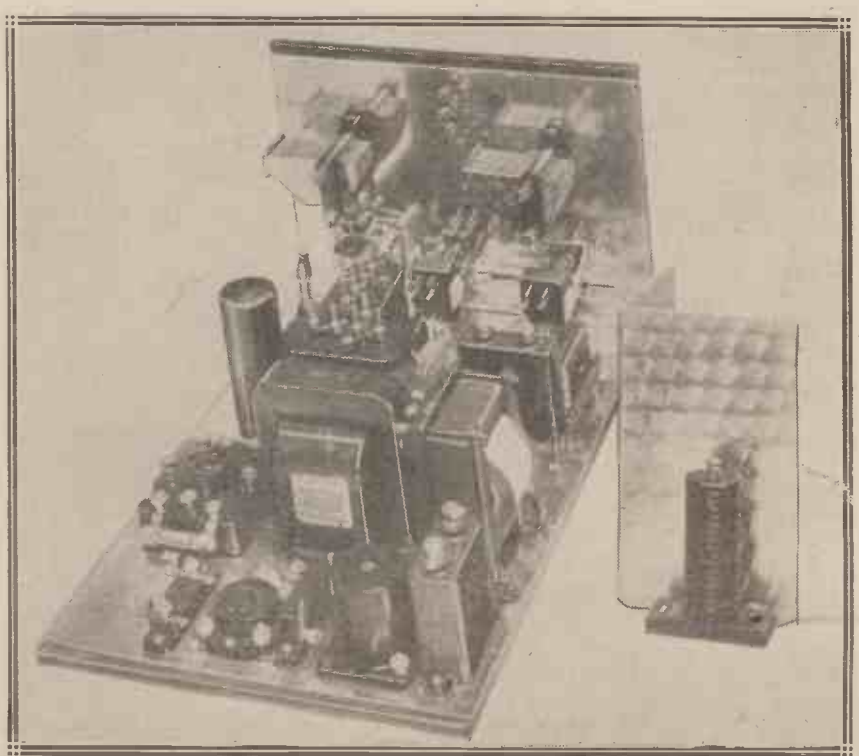
The lower portion of the cabinet provides ample space for H.T., L.T., and G.B. batteries, or even for a small mains unit if desired. As a matter of fact, we propose to describe a simple mains H.T. unit to work with this set in a very early issue (next month, if possible, otherwise in the February number).

Orienting the Set

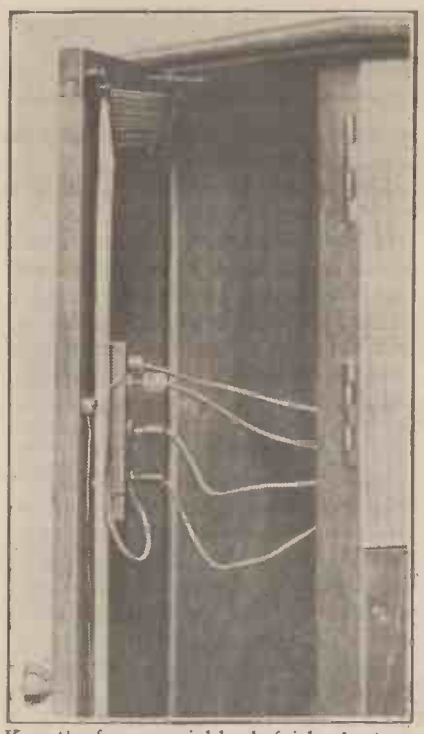
The two main sides of the cabinet take the form of doors upon which the two frame windings are placed. Looking at the set from the front, the left-hand door carries the high-wave frame, the low-wave one being on the right-hand door.

Since the set must be rotated to the direction of maximum strength for any particular station, provision must be made for turning it to various angles. It is therefore suggested that you should fix to the underside of the cabinet a turn-table, such as the one specially produced for portable sets by Messrs. Ormond.

You will not find, by the way, that you will need to turn the set through a very wide angle to get the best results from any given station, so the



In building the set the last operation before wiring up is the attachment of the partition screen and the parallel-feed H.F. choke.



Keep the frame-aerial leads fairly short so that they shall not trail when the doors are closed.

loud speaker can always remain more or less facing out into the room.

Now about the set proper. It is built on a comparatively small panel carrying just the operating controls, and a narrow deep baseboard. Rather complete screening is provided, since we found that the comparatively high sensitivity of the receiver made this desirable.

How it is Screened

The upper surface of the baseboard is covered with a sheet of aluminium foil fastened down initially with a few small round-headed brass screws, and later held down at a greater number of points by the securing screws of the various components, which pass through it into the wood beneath. The panel is also backed with a thin sheet of aluminium (or copper, of course), and it is to be noted that one side of each tuning condenser and the on-off switch makes contact therewith.

The reaction condenser MUST be insulated from it, and a convenient way of doing this is to cut out a fair-sized hole in the metal, so that the condenser is mounted directly on the panel. Such a hole (it can be square) is easily cut out with strong scissors or a pair of tinman's "snips."

Stiffer screens form a complete cover for the set, and one of these is permanently fixed in place. This is the one which forms one side and the back of the complete box. The other is detachable, and this provides the remaining side and the top. You will be able to see quite clearly in the photos and diagrams how this detachable piece fits on, noting particularly the wooden fillet screwed to the back of the panel to provide a locating surface for it.

Inside the set is another screen forming a partition of L-shape, screwed down upon the baseboard. This, too, will be quite clear upon an inspection of the special diagram provided.

How Many Dials?

By the by, do not be deterred by the apparent complication of all the metalwork in this set. You can obtain all the screens cut and ready for fitting from the usual suppliers, and then it is merely a matter of screwing them down in place, really a very simple matter and only a slight addition to the amount of work involved in building the set. We do not suggest this design as a suitable one for the absolute beginner, of course, but no one who has had a little experience should have any real difficulty in making it.

There is nothing very special about the circuit of the receiver, although it is a very unusual combination for a frame-aerial set. In such instruments the usual practice is to aim at single-dial tuning, and so any H.F. stage or stages must be of the aperiodic type. On thinking things over we came to the conclusion that readers of "M.W." do not really require a set to be so extra simple to operate, and so we decided that two dials would be permissible, so long as the tuning of, at any rate, one of them was not unduly critical.

There is, of course, the question of the ordinary domestic user, who cannot be expected to search with two dials. We believe that this difficulty is not a serious one, since it is after all an easy matter just to record the dial settings for the few stations to which the non-technical members of the family are likely to listen.

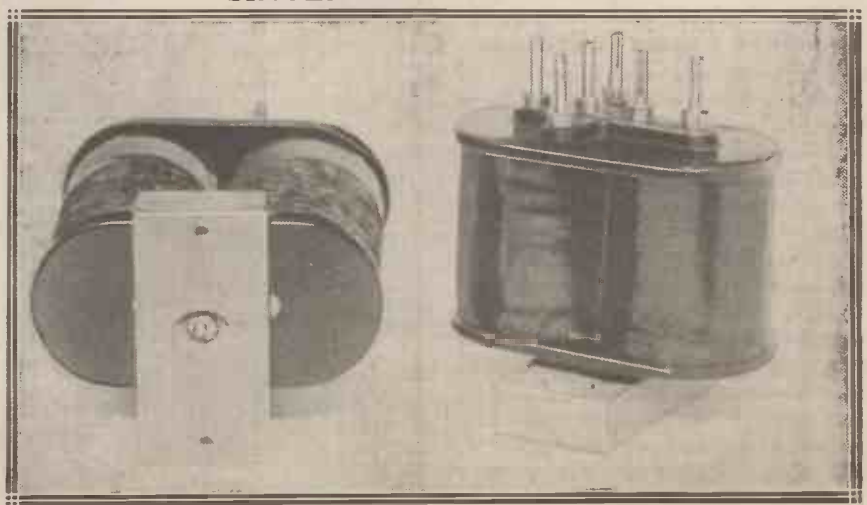
Accordingly we have provided a tuned H.F. stage of a very simple type, with a consequent gain in selectivity and magnification. Selectivity, as a matter of fact, is extraordinarily good, and you will require to learn the trick of running the two dials in step before you will pick up even 5 G B. This is not to say that the set is difficult to operate, of course, because after all there are only two dials, and it is a simple matter to get them in step on the local and then run them together.

How the Circuit is Arranged

The circuit is actually this: two frame aerials are provided, with a double-pole change-over switch to change from one wave-band to the other, and these constitute the tuned grid circuit of the screened-grid H.F. valve. Coupling this valve to the detector there is a simple form of parallel-feed circuit, with the feed lead going to the upper end of the tuned grid circuit of th edetector valve.

This arrangement prevents the tuning from being unduly sharp, yet in conjunction with a frame aerial gives very ample selectivity. It is also rather helpful in reducing battery coupling effects, so that we have not found it necessary to provide any special anti-coupling devices, apart from the resistance and bypass

SIMPLE BUT EFFECTIVE



The coils are mounted on pieces of wood by removing their knobs and using an ordinary nut on the threaded spindle which then projects. The connecting leads are soldered direct to the pins.

High Efficiency and Handsome Appearance

condenser in the lead to the screening electrode of the H.F. valve, and, of course, the output filter for the loud speaker.

Wave-change switching is provided here also, with a complete change-over from one coil unit to another. This switch, by the way, is "ganged" with the first one, so that a single knob controls both. (Be careful in ordering this switch with its fittings to specify the set for which it is intended.)

Building the Set

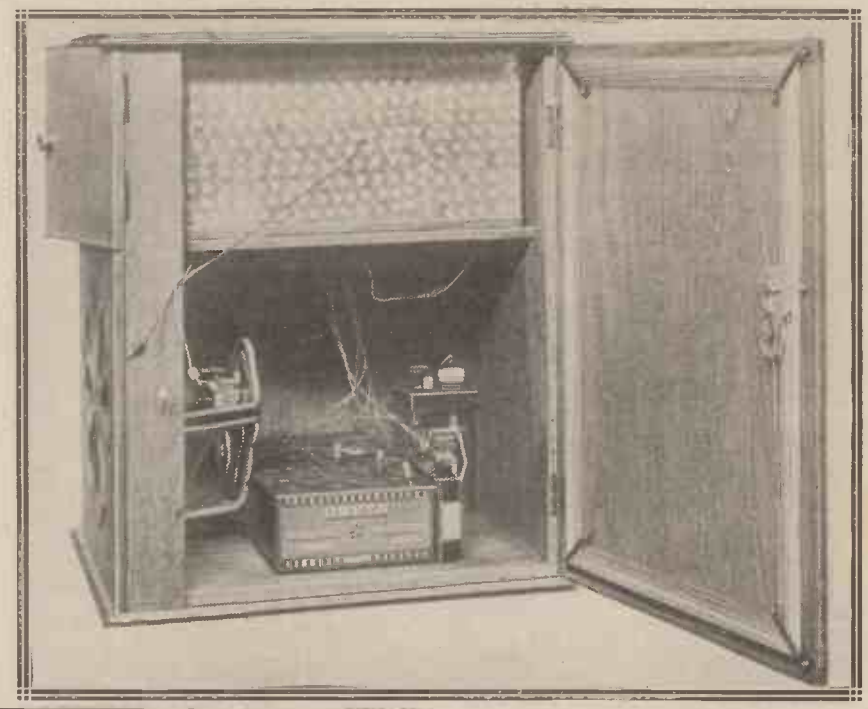
The L.F. side of the set is of quite a normal "R.C. and transformer" type, except that rather elaborate precautions have been taken to deal with wandering H.F. currents and keep them out of the loud-speaker leads.

Now we had better proceed to business and give you such constructional hints as may be needed, since such a set as this calls for rather more detailed instructions than one of the normal type. First of all, the panel is to be drilled and fitted with its back screen. This latter, of course, is held in place by the components mounted thereon.

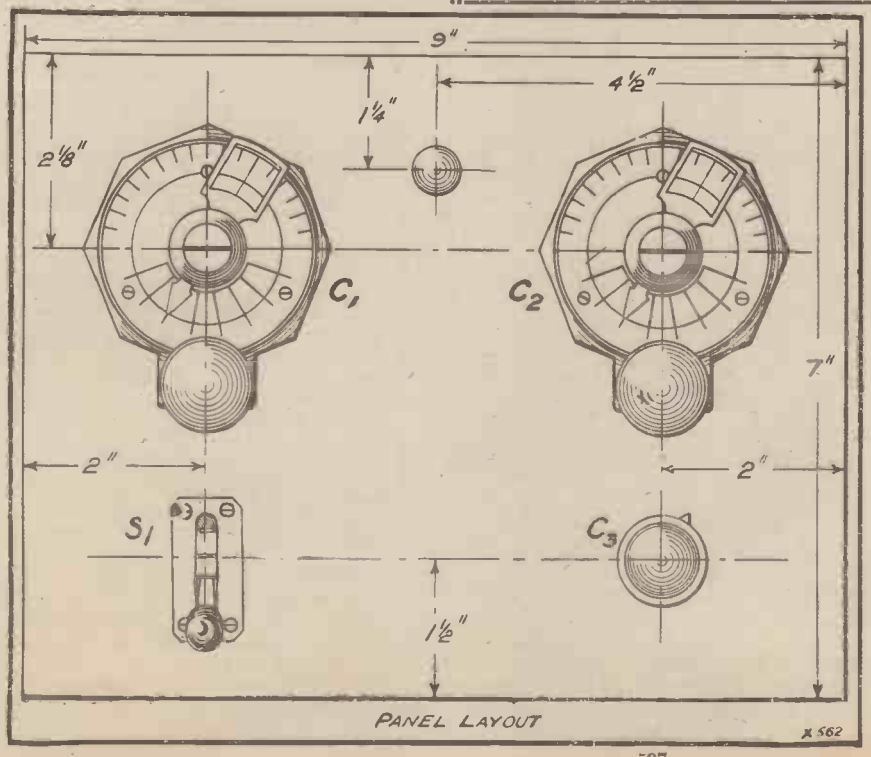
Note that the variable condenser spindles and one side of the on-off switch "earth" on to this screen. If you chance to use a switch of the entirely insulated type the valves will not switch on, in which case wire the free side of the switch (see wiring diagram) to the moving vanes of the condenser C_2. If, on the other hand, you find the switch does not turn the set off, just take the single lead shown to the other terminal of the switch.

Next mount the panel up to the baseboard and proceed to fix down the aluminium foil on the latter, after which you proceed with the layout and mount up all the components. Before you do so, however, go carefully over all the photos and their captions, since several special points are made clear therein. By the way, see that the screen on the back of the panel makes contact with the aluminium foil on the baseboard.

Now there are some important points about the wiring. First, note



A study of this view will clear up many points about the frame and battery arrangements.

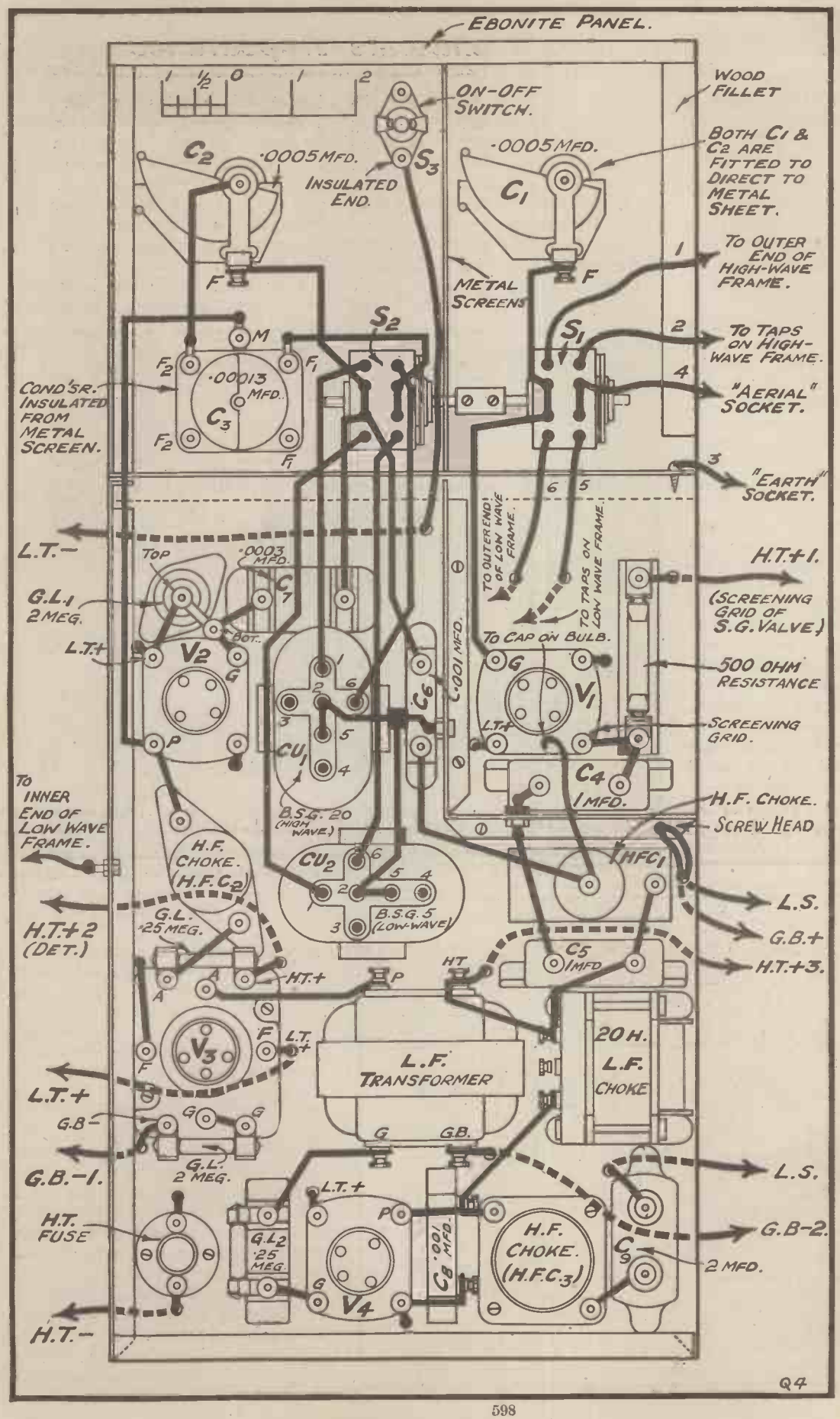


that from one filament terminal of each valve socket an insulated wire goes down through a hole in the baseboard, and is marked L.T.+ on the wiring diagram. All these are joined together under the baseboard and from the one from V_3 a flex lead (carrying a spade tag on the end) goes down to the accumulator.

Connections to the Screening

The other filament terminal of each valve holder is connected to the metal sheet which covers the baseboard. A convenient method is to put a small brass round-head screw in the baseboard beside each socket and solder a wire to its head, the other end of this wire going to the filament terminal in question.

Connection is made to the screening system at three other points in addition to these: First to the head of a screw in the baseboard behind



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the left-hand edge of the panel (left hand looking at the set from the front), next to a screw holding down a screen near H.F.C.$_1$, and thirdly to a metal screw and nut in the middle of one of the outer screens. Lettering on the diagram will make clear the purpose of all these connections.

Screening the H.F. Valve

Now about an important detail which completes the screening arrangements in the set. You will see that one of the photographs shows a sort of nightcap on the screened-grid valve. This device we found necessary in the original set to ensure complete stability under all conditions.

It appeared that without this little screening cap an undesirable amount of capacitative feed-back took place between the plate of the valve through the glass bulb to certain wires and objects in the grid circuit.

Essential in Compact Sets

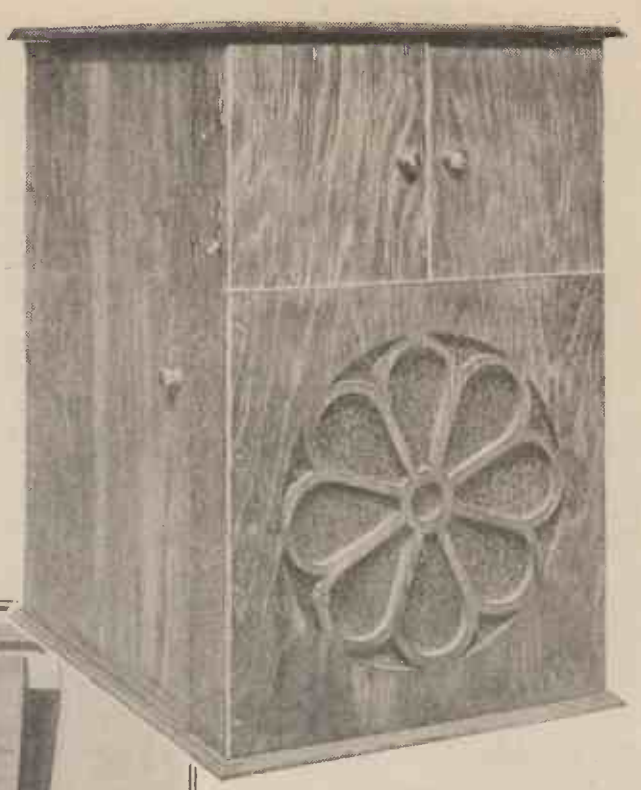
This kind of thing is of common occurrence in such closely-packed designs as this, and due care must be taken to render them harmless. So far as the rest of the circuit is concerned, this has been done by means of a

combination of actual screening and judicious layout, but a different method had to be adopted in the case of the S.G. valve.

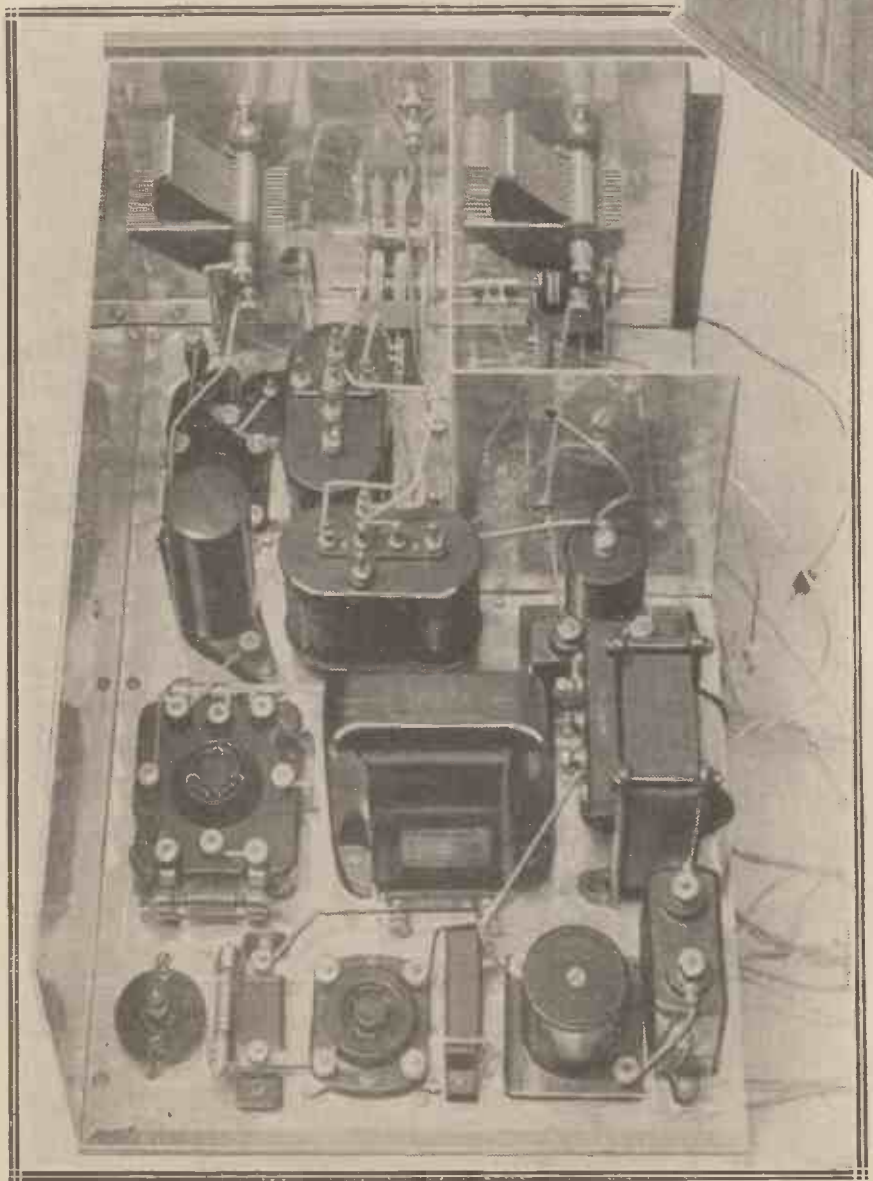
The ideal solution of the problem is no doubt to mount the valve through a hole in a screen, but space does not permit of its adoption in the case of a specially compact design like this. Instead we have adopted the "nightcap" scheme, which turns out to be perfectly effective.

Making the Valve Screen

This little extra screen is cut from copper foil with a pair of scissors and bent round into a tubular shape to fit the bulb of the valve. A touch of solder completes it, and it is slipped over the valve in the way you see. Its exact dimensions are not important, and the photo really gives you all the data you need.



The completed receiver has a very imposing appearance, and it gives results well in keeping with its good looks.



The receiver finished, ready for the fitting of the remaining portions of the screening system. Note how the "ganged" switches are arranged.

By the way, this screening sleeve requires to be earthed. An easy way of arranging to do so is the one we adopted ourselves, and which you may be able to see in the photo. The copper foil is cut so that a long strip projects from the upper edge of the sleeve, forming a lug which can be gripped under the "moving plates'" terminal of the variable condenser which tunes the frame circuit.

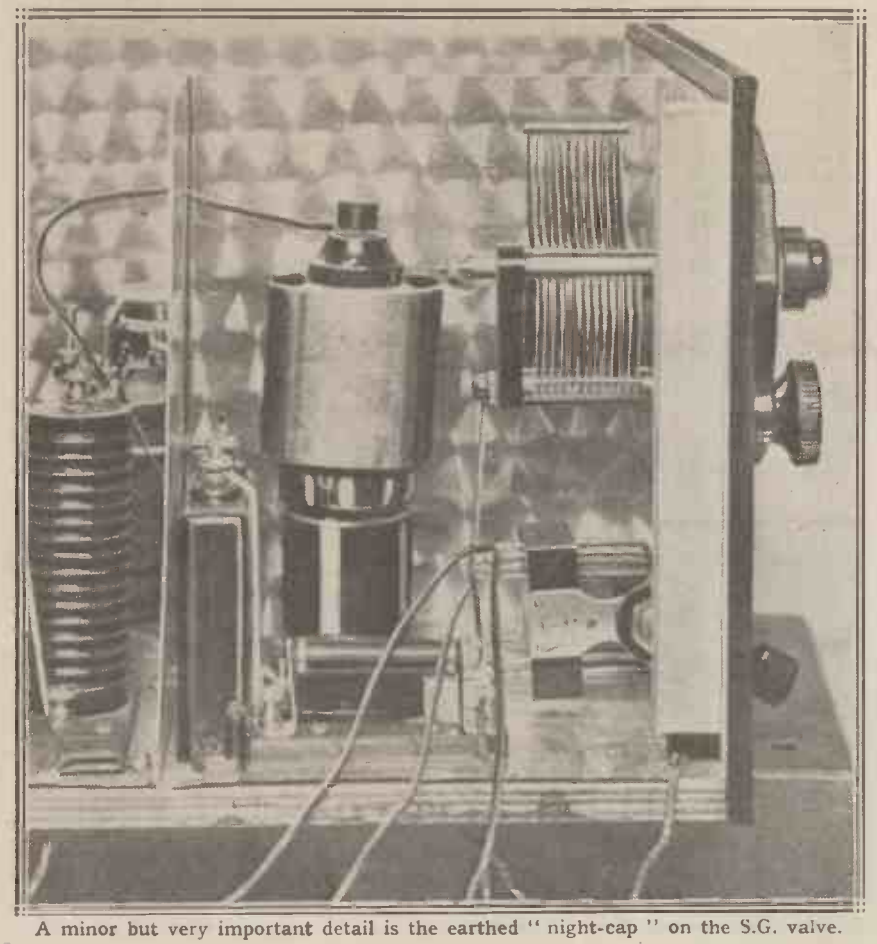
This arrangement also serves to hold the sleeve in position, although it is as well also to bend the upper edge inwards, here and there, so that it rests on the shoulders of the valve bulb and cannot drop down too far. Rather a makeshift scheme, but an effective and simple one none the less.

Valves to Use

Now, about valves for use in the "Twin-Frame" Four. It is assumed that two-volters will be used, and these are the correct types: One upright type S.G. screened-grid valve for the H.F. stage, such as the Cossor 220 S.G., one H.F. type (impedance 20,000 to 30,000 ohms) for the detector, another for the first L.F. stage (an L.F. type is also suitable here, and is rather preferable in some cases), and a power type for the last socket.

The H.T. voltages are just the normal ones, i.e. somewhere about

An Ideal Drawing-Room Receiver



A minor but very important detail is the earthed " night-cap " on the S.G. valve.

60 volts on H.T.+ 2, some 60 to 80 volts on H.T. + 1, and 120 volts on H.T. +3.

The frame-aerial windings are carried in some special moulded corner-pieces, these fittings each having ten slots.

More than ten turns are required, of course, so more than one turn is put into each slot. The low-wave frame consists of a total of 14 turns, and these are arranged with 1 turn in the first four slots (beginning at the inside and working outwards), and 2 turns in each of the others.

The long-wave frame has 48 turns, with 4 turns per slot in the inner two slots and 5 in each of the others.

On each door a strip carrying three sockets for the appropriate frame connections are mounted. The ends of each frame go to the outer sockets, and the middle one is connected to the 3rd turn (counting outwards from the inner end) on the low-wave winding, and to the 10th turn in the case of the long-wave one.

In addition, two more sockets are mounted on the left-hand door for ordinary aerial and earth, if desired. Besides the connections you can see on the diagram, the E socket is wired to the " inner end " socket of the high-wave frame aerial, and no plug is inserted in the latter.

COMPONENTS REQUIRED

1 Special cabinet (Osborn).
1 Baseboard, 9×13½ in.
1 Panel, 7×9 in. (Becol, Goltone, Resiston, " Kay-Ray," Paxolin, Trelleborg, Ripault, etc.).
1 Set of screens (see text) (Paroussi, Ready Radio, Wearite, Magnum, etc.).
2 ·0005-mfd. variable condensers (Formo or other small type).
2 Small vernier dials (Ormond, Formo, Brownie, etc.). (In ordering these be careful to specify that they are to fit ¼-in. spindles.)
1 L.T. switch (Benjamin, Lotus, Igranic, Lissen, Bulgin, Burton, Raymond, Ready Radio, Ormond, Junit, Wearite, Magnum, etc.).
1 Differential reaction condenser, ·0001, ·00013 or ·00015 mfd. (Lotus, Ready Radio, Lissen, Utility, Pye, Ormond, Magnum, Polar, etc.).
2 Double-pole change-over switches with special " ganging " attachment (Wearite).
3 Sprung valve holders (Benjamin, Lotus, Pye, W.B., Igranic, Precision, Formo, Bowyer-Lowe, Wearite, Dario, Magnum, Marconiphone, Keystone, etc.).
1 Combined valve holder and R.C. unit, with ·25-meg. anode resistance and 2-meg. leak (Dubilier).
1 B.S.G.5 coil and 1 B.S.G.20 (Lewcos).
1 H.F. choke for parallel-feed circuit (Lewcos, or other good make occupying small baseboard space).
1 H.F. choke for reaction circuit (Lissen, Varley, Lotus, Ready Radio, Climax, R.I., Dubilier, Raymond, Bowyer-Lowe, Igranic, Lewcos, Colvern, Magnum, etc.).
1 H.F. choke for L.F. output circuit (Dubilier, or other good make).
1 L.F. choke (Magnum, or other compact type).
1 H.T. fuse (Magnum, Bulgin, Ready Radio, etc.).
1 De-coupling resistance, 500 or 600 ohms or thereabouts (Ready Radio, Bulgin, Wearite, etc.).
2 1-mfd. condensers (T.C.C., Lissen, Hydra, Mullard, Ferranti, etc.).
1 2-mfd. condenser (Dubilier, etc.).
1 ·0003- and 2 ·001-mfd. fixed condensers (·001-mfd. to be of edgewise type) (Dubilier, T.C.C., Lissen, Goltone, Clarke, Mullard, Igranic, etc.).
1 2-meg. grid leak with vertical holder (Dubilier).
1 ·25-meg. grid leak and holder (Dubilier, Ediswan, Igranic, Lissen, Mullard, etc.).
1 Low-ratio L.F. transformer (Lissen, Varley, Ferranti, Brown, R.I., Cossor, Marconiphone, Telsen, Lotus, Mullard, Philips, etc.).
Materials for frame aerials : 8 special corner pieces to carry windings (Bulgin), 8 small sockets (Clix or similar type), 4 oz. No. 26 D.S.C. wire (low-wave frame), and 6 oz. No. 30 D.S.C. (long-wave).
2 Spade tags for L.T. leads, 4 H.T. plugs, 3 G.B. plugs, 5 plugs for connections to frame sockets, 2 ditto for connections to " Aerial " and " Earth " sockets (these latter should be of small G.B. type so that similar plugs on ends of aerial and earth leads can be plugged into same sockets from outside of cabinet when it is desired to use outdoor aerial). (Clix large plugs and Eelex small ones used in original.)
Set of indicating tablets or labels for battery leads (Collett).

A NEW OUTLOOK ON RADIO

ARE WE GOING ROUND IN A CIRCLE?

It is interesting to note that although radio is a young science there is, nevertheless, a constant tendency to resuscitate ideas that have previously been thrown aside as old-fashioned or obsolete. This peculiarity in radio engineering is discussed below in an interesting manner.

By SEXTON O'CONNOR.

A CERTAIN school of philosophy holds that progress does not follow what may be called a straight-line law, but rather tends to go round and round in cycles. Civilisations arise and flourish up to a certain point, and then disappear and are forgotten—to be followed in due course by others.

Something of the same idea lies at the root of the well-known saying that there is "nothing new under the sun." From some points of view it might be thought that radio is about the last thing on earth to which this could be applied. And yet one cannot fail to perceive a certain tendency in modern wireless practice to resuscitate ideas that have previously been thrown on one side as old-fashioned and obsolete.

Inventors Who Look Back

One of the most striking illustrations is perhaps to be seen in the revival of short-wave signalling. Hertz manipulated waves of the order of only a few metres in his laboratory at the very birth of wireless. Later on, when Marconi first tackled the problem of signalling over long distances by means of wireless waves, he found it necessary to use high aerials having large capacity and inductance. In this way he was able to pour a greater amount of energy into the ether, and so to cover long distances.

At the same time this meant that his aerials were tuned to wavelengths of the order of some thousands of metres. In fact, the development of commercial wireless was for many years almost entirely concerned with long-wave working. Apart from a few pioneers, no one had any use for or interest in the shorter waves.

Then new methods of generating and handling very high-frequency energy were discovered, and the so-called Beam system of directional transmission was developed. This proved so successful in practice that, for the first time, commercial wireless signalling began seriously to threaten the position of the cable companies.

The two industries, cable and wireless, have now been merged into a common interest, but it took a long time for inventors to look back and exploit what those who followed Hertz had thrown contemptuously aside as of no value.

Taking another point of view, the new Regional scheme is to some extent a throwback to the state of affairs which existed when broadcasting was

ONE OF THE LATEST RADIO COMPASSES

Examining the direction-finder on board the "Discovery," which was "open" to visitors just before she set off on her latest cruise.

"Nothing New Under the Sun"

first introduced. Then there were but a few isolated stations, each serving as wide an area as possible.

This was followed by the gradual establishment of a regular network of subordinate and relay stations dotted here and there over the country, and imparting a certain amount of local atmosphere to the programmes. Now we are aiming to go back to the use of only five stations, to serve the whole country.

Amazing Ups and Downs

As a side issue it is not without interest to note the *volte-face* that has taken place in the early relations between wireless and the gramophone industry. The introduction of broadcasting was at first generally expected to deal a death blow to the gramophone.

A REAL LUXURY RECEIVER

The largest receiver at the Radio Exhibition this year was the double turntable M P.A. radio-gram set shown above, costing 270 guineas.

There is no need to dwell on this mistake. One does not whip a dead horse. Instead of disappearing, the gramophone industry found an amazingly successful new lease of life, and is now more flourishing than ever.

Another curious turn of the wheel is evidenced by the recent revival in the use of high-frequency amplification. All modern sets comprise at least one, and generally two, H.F. stages. Yet not long ago it was the fashion to decry the high-frequency valve as of no value.

At one time, owing to inefficient tuning coils and high damping losses, a single stage of H.F. amplification added practically nothing either to the range or selectivity of a set. Also, owing to the difficulty of stabilisation, it was a troublesome matter to handle two stages of H.F. amplification when used in cascade. And so listeners grew tired of the H.F. amplifier, and, figuratively speaking, pitched it overboard.

Nowadays quite a different view is taken. It is beginning to be realised that H.F. amplification is the only sure solution to the problem of selectivity. Not only that, but the H.F. side is actually threatening to displace L.F. amplification, for the reason that amplification applied before the detector valve leads to much less distortion than amplification applied afterwards. Present indications are that the set of the future will comprise three or four H.F. valves followed by a detector and one pentode stage for loud-speaker work.

However this may be, the fact remains that what was thrown on one side in contempt a few years ago has again sprung into favour, owing to later improvements and a more enlightened point of view.

The revival in H.F. leads one quite naturally to notice the equally remarkable falling-off in the use of reaction. In most up-to-date sets fitted with ganged H.F. stages there is usually no deliberate back-coupling.

This is an amazing contrast with the days of Captain Eckersley's "Don't do it" campaign, and his efforts to prevent the ether from being made hideous by the persistent "knob twiddler."

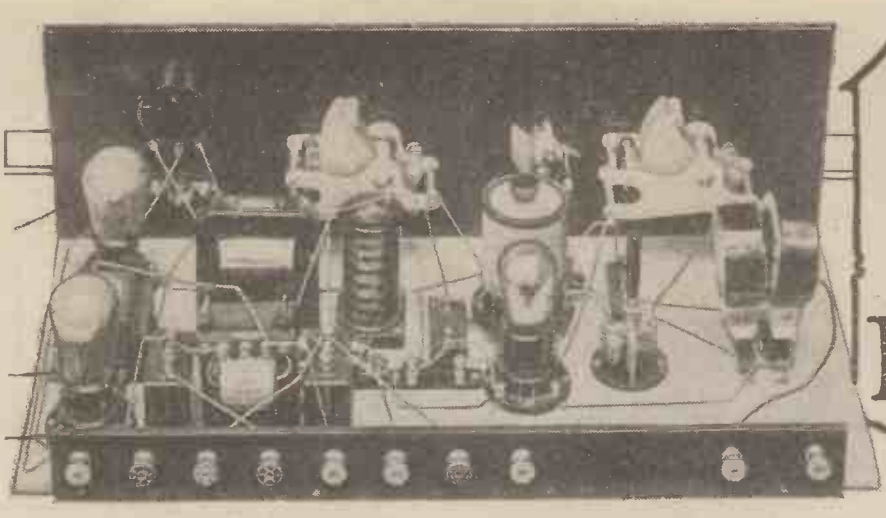
Transformer Transformation!

Again, take valve couplings. The first coupled valves were linked together by a transformer. Then came a variety of resistance, tuned-anode, and choke-capacity circuits, all of which, no doubt, had their advantages. At the same time they have defects, too, and the present tendency in set design is to revert to the transformer.

It has the undoubted advantage of giving a decided voltage step-up, and has now been freed from its original "resonance" defects. In fact, with modern improvements in design, and particularly the avoidance of saturation difficulties, the transformer coupling is fast outstripping its later rivals in efficiency and all-round performance, both on the high- and low-frequency sides.

There are still hopes of a crystal revival. In one sense the quartz crystal has carved out quite a new and special field for itself as a piezo oscillator. But, apart from this, one can remember the sudden flush of interest that was aroused in the ordinary oxide or crystal rectifier when Lossev and Round discovered that it could (sometimes) be made to amplify the received signals.

Owing to certain difficulties, and to a drastic drop in the price of valves, this interest has waned for the time. But it is quite on the cards that the despised crystal may yet develop new and unsuspected qualities and again take first place in the affections of the broadcast listener. This would be "ringing the changes" with a vengeance.



BAND PASS FILTERS

The band-pass filter is a device which appears to offer important advantages, both from the point of view of higher selectivity and from that of quality of reproduction. An interesting general explanation of the special circuits required is given in this article.

By G. P. KENDALL, B.Sc.

WHAT is a band-pass filter, anyway? A natural enough enquiry on reading the title of this article, but before I try to answer it let me tell you something about the gadget in question: it looks very much like becoming the "very latest" which no fashionable constructor will be able to afford to be without.

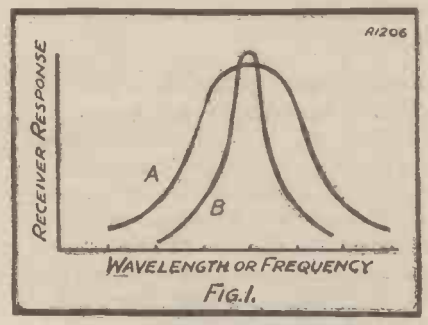


FIG. 1.

Not so long ago most people had only heard of it in a vague sort of way, if at all, but of late we have all been hearing more and more frequent references to the band-pass filter, which must have made us suspect that it was becoming important. Very possibly it will become decidedly important, but I wonder if MODERN WIRELESS readers realise that it is already in use in certain of the designs presented to them? It may come as something of a surprise, but it is actually a fact that I made use of a form of band-pass filter in designing those highly selective sets, the "Kuttemout" Three, the "Brookman's" Three and the "Olympia" Three.

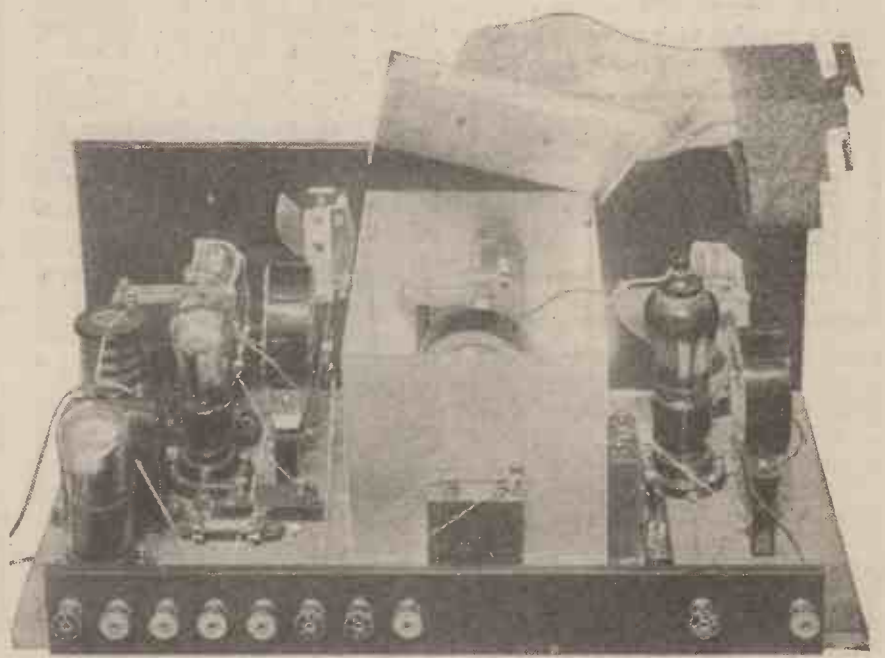
Why They Are Used

Now the object of using a band-pass filter is two-fold. First, it gives us a more effective kind of selectivity than we can obtain with the same number of circuits arranged in the more normal fashion, and, secondly, it leads to improved quality of reproduction, other things being equal. Before we can see how these effects are produced we must just run over a few elementary facts about the behaviour of tuned circuits to refresh our memories.

First of all take the case of a simple receiver containing just one tuned circuit. This will have what is called a resonance curve something like the one sketched at "A" in Fig. 1. This curve shows that the receiver responds more strongly to the particular frequency or wavelength to which it happens to be tuned, and that the response falls off fairly rapidly to all other frequencies on either side of the resonant one. The curve is not very sharply peaked, the actual sharpness of the peak naturally depending upon the constants of the circuit, and it possesses rather spreading "skirts," which explains why it is that a strong station will still come in, although considerably off tune.

Cascaded Tuned Circuits

In curve B of Fig. 1 I have indicated the sort of resonance curve obtained from a receiver of the more selective type, such as one with two tuned circuits coupled together by means of a valve. The type of circuit I had in



The "Brookman's" Three incorporated a form of band-pass filter in the intervalve coupling circuits. (This set was described in detail in the September issue.)

mind here is that with one H.F. stage having a tuned grid circuit and some sort of tuned anode or tuned H.F. transformer coupling to the detector valve. You will see that this is considerably more sharply peaked, and that the skirts of the curve are much narrower.

You can see clearly the effect of adding more tuned circuits on these lines, by going from one H.F. stage to two, and so having three circuits.

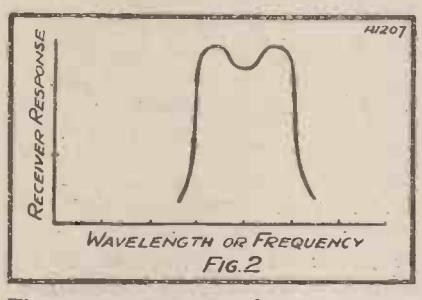


FIG. 2

The resonance curve becomes more sharply peaked, it falls away more steeply on either side of the true tuning point, and the skirts of the curve become less pronounced.

This method of getting high selectivity is a good and practical one in many ways, and has been almost universally used in the past. Nevertheless, it is not by any means the ideal method, and the modern tendency towards the cleaning up of every little detail of a wireless receiver has led to the exploration of other schemes.

Effect on Quality

The main objection to this almost standard method of obtaining selectivity by means of cascaded tuned circuits coupled with valves is on the score of quality of reproduction. As

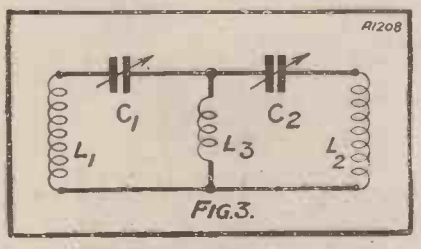


FIG. 3.

our resonance peak becomes sharper and sharper we find that the receiver tends to respond only to a very narrow band of frequencies, and even to that band it does not respond evenly, for obvious reasons connected with the sharpness of the actual peak itself. Now, for perfect reproduction of broadcasting, we require that our receiver shall respond not only to the main carrier of the station being received, but also equally well to the slightly different frequencies of the side-bands produced by the modulation.

This is a rather difficult condition to satisfy in practice. With the ordinary scheme of cascaded tuned circuits we are very apt to get far too sharply peaked a resonance curve if we arrange our circuits to be reasonably free from the spreading skirts of the resonance curve. The actual sharpness of the peak depends very largely upon the H.F. resistance of each circuit, and by avoiding the use of coils of too high a quality it is possible to secure a reasonably good compromise, but we are still some little way from the ideal.

A Double-Peaked Curve

The modern tendency in the direction of the perfecting of every detail of our circuits is making us somewhat impatient with these limitations, and it is here that the band-pass filter promises to be of considerable assistance. There is nothing very involved or difficult to understand about these band-pass filters, since they are really in essence just two or more tuned circuits coupled together by means of some other device than a valve.

For example, they can be coupled together in the well-known magnetic fashion which used to be so popular in old-fashioned crystal sets. Probably the reader is aware that when two circuits are arranged in this way with very weak coupling we normally get a resonance curve very much like that of one of the circuits, but considerably more sharply peaked and less spreading.

If, now, we tighten the coupling between the two circuits we begin to get a double-humped resonance curve, with a dip in the middle of what would otherwise be the single peak. The sharpness and extent of this dip naturally depends upon the tightness of coupling between the circuits, and we can, if this factor is controllable, get all sorts of different curves.

Approaching the Ideal Curve

This is really what we do in the band-pass filter, and by proportioning things nicely we can get a resonance curve which approaches very closely to the ideal state of things, which would be a flat-topped affair with a very sharp falling away on either side to prevent interference by stations on neighbouring wavelengths. A glance at Fig. 2, wherein I have sketched roughly the resonance curve of a typical filter, will help you to understand this. You will note that the top of the curve is comparatively flat, if we disregard the small dip in the middle (which would not actually be audible), and its skirts are considerably less pronounced than those of any ordinary arrangement of one or two tuned circuits.

The effect of such a resonance curve on reproduction is distinctly

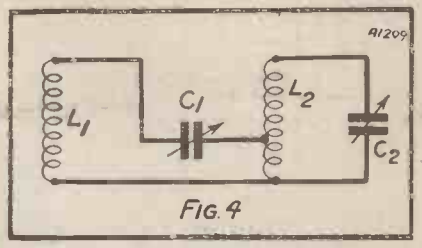


FIG. 4

perceptible under suitable conditions of a really high quality amplifier and a loud speaker capable of showing up the finer differences. We are now getting a more uniform response to all the different side-band frequencies, and more particularly we get a more adequate response to the higher notes. (These are represented by the side-band frequencies furthest removed from the main carrier frequency, and they are normally attenuated to a considerable extent because of the sharpness of the resonance peak of our tuned circuit.)

Both Quality and Selectivity

In the earlier types of high quality receivers an attempt was made to limit this tendency by using moderately high resistance tuning circuits, great care being taken to avoid reaction feedback which might sharpen the resonance curve peak and so on. The band-pass filter system

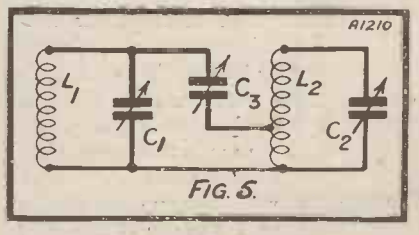


FIG. 5.

of tuning, however, gives us the desired effect, and at the same time a degree of selectivity which is very difficult to obtain in any normal scheme where the tuning circuits are not of very low H.F. resistance.

The essence of the idea, you will see, is to use two or more tuned circuits coupled together in such a way that we get a resonance curve which tends to be double-humped, thereby getting an approximation to the ideal flat-topped curve, which enables us to secure more uniform response to all the different frequencies which must be treated uniformly to get perfect reproduction of a broadcast transmission.

Improving Quality and Selectivity

In practice there are quite a number of ways of arranging a band-pass filter, and Fig. 3 shows the essential features of one of the simplest of these methods. Here we have two main tuned circuits, one composed of the coil L_1 and the variable condenser C_1, and the other of coil L_2 and condenser C_2.

Coupling Methods

The two circuits are coupled together by means of the small inductance L_3, which is common to both, and so produces the desired coupling effcte. By adjusting the size of this inductance we can get various types of double-humped curves, the larger inductances tightening the coupling, and increasing the separation and pronounced nature of the two peaks.

adjustable, and so in the "Kuttemout" Three the Fig. 5 arrangement was used, in which the small variable capacity C_3 gives us the desired control.

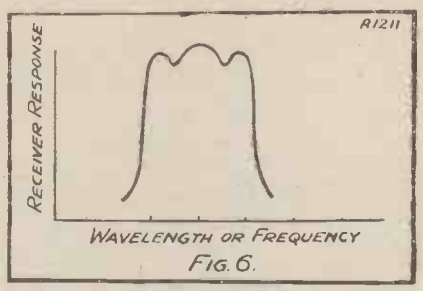


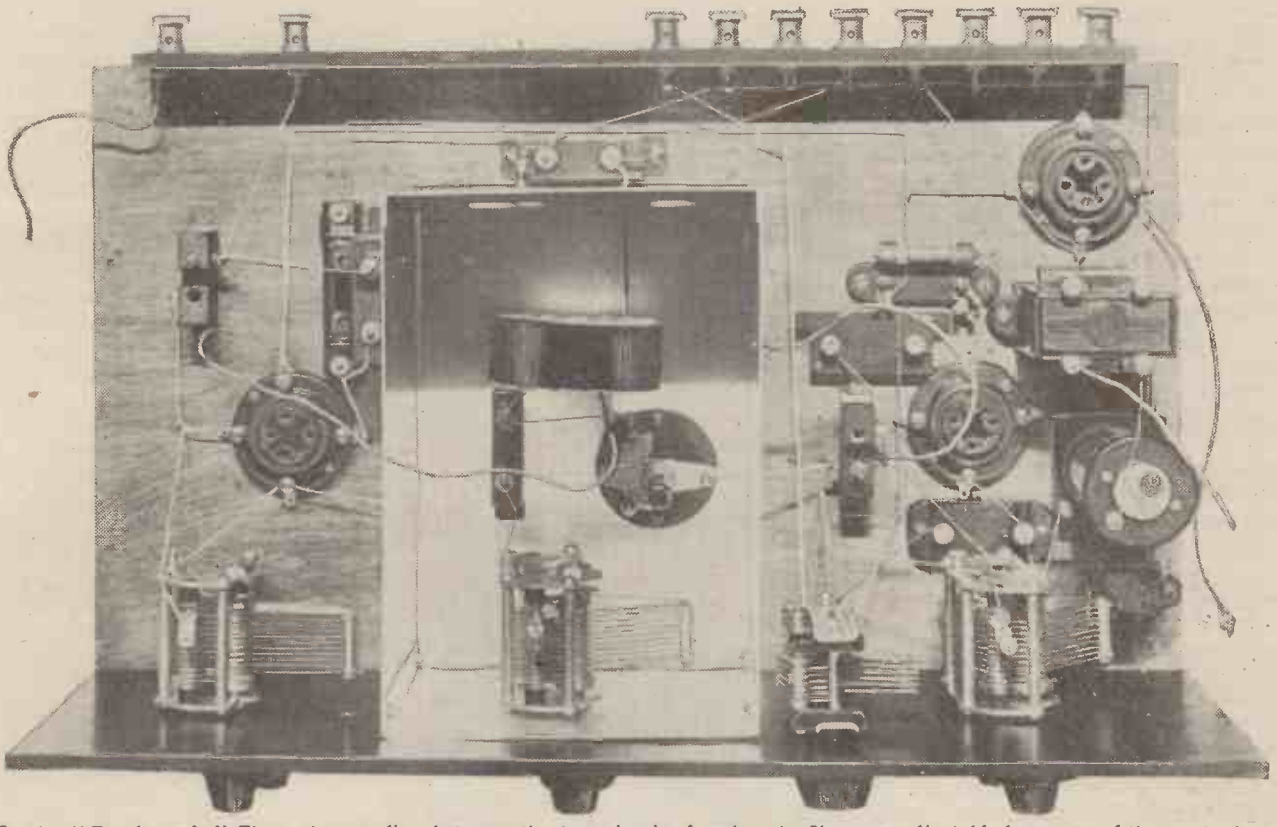
FIG. 6.

In the set in question, C_3 was actually a small neutrodyne type of condenser, and with the particular capacity chosen a distinct broadening and flattening of the peak of the resonance curve was obtained when this condenser was set to maximum. By reducing it somewhat the double-humped effect tended to disappear and the resonance curve became fairly sharply peaked, giving an extraordinary degree of selectivity, but, of course, at the sacrifice of the special merit of the band-pass filter in the direction of improved reproduction.

Flattening the Curved Top

In conclusion, I should just like to mention an interesting point relating to a still further improvement of the resonance curve from the point of view of uniform response to all the frequencies of the carrier wave. This concerns a method of lifting up slightly the normal dip in the middle of the band-pass filter double peak. This effect can be achieved by incorporating in the receiver a third quite independent tuned circuit, which adds to the overall response of the receiver a normal sharply-peaked resonance curve. By seeing that this circuit does not tune too sharply as the result of very low H.F. resistance it can be made to lift up the middle of the resonance curve to the desired degree, and so we get a remarkably close approximation to our ideal flat-topped arrangement. (See Fig. 6.)

This was actually done in the "Brookman's" Three and the "Olympia" Three, by means of the tuned grid circuit of the H.F- stage.



In the "Brookman's" Three the coupling between the two circuits forming the filter was adjustable by means of the neutrodyne type condenser inside the screening box.

In a simpler form of circuit, such as that of the "Kuttemout" Three, the separate coupling inductance L_3 can be dispensed with and the circuit arranged so that a small portion of one of the coils is common to both circuits, as in Fig. 4. This circuit is quite a practical one, but in actual use it is convenient to have the coupling effect between the two circuits

How to

THE FIRST OF A SERIES OF ARTICLES OF INTEREST TO THOSE OF OUR READERS WHO ARE THINKING OF WRITING RADIO PLAYS.

Mr. R. E. Jeffrey directing a radio play at 2LO.

EVERY day life is full of interest. As the days pass it may seem that they get rather overcrowded with interest. It is a matter for congratulation that one of the great attributes of the human mind is adaptability. The new interest of to-day, full of new colours and appeals, is the commonplace of to-morrow. The wonder of receiving words by the human voice, almost any sort of words in any form, of a few years ago has to-day changed, by the amazing adaptability of the mind, to the critical analysis of how those words are spoken, the quality of the composition, and the form, artistic or otherwise, in which they are placed.

Thus in a few years wireless transmission of words has in the minds of the people been changed from a mechanical wonder into an analytical study of what the art of radio drama at present is, or may develop to be.

What is Required

These articles are not intended or designed to form an artistic frame in which to place arresting pictures.

They are written to give interested readers, and, we hope, writers, some rudimentary information on the general question of material, methods, types, etc., of writing and of construction which it is necessary for the author to know before setting out on what is not an easy task—writing plays for radio transmission.

Those who have been listening during to the past years to radio drama have been present at the accouchement of an art which when full-grown will be able to make its voice as influential as almost any of those which have echoed through the world; for radio drama is an art—let there be no doubt about that. And the would-be radio dramatic author must study it with that consideration in mind.

Definite Plot Essential

If this branch of dramatic art receives the application of minds with a flair for creation, it should result in the contribution of much more technique to the art than at present has been discovered.

The aspiring writer must approach the work after having conceived in his own mind a definite idea of the form of the art to which he is applying himself. The words will be the colours of his pictures, but the sketch lines with which they are to be enclosed must first be well defined. This single form, or alternative forms, will be best discovered by carefully listening to examples of drama broadcast from time to time—study being given to their deficiencies, which may be many—lack of form, superficiality, clumsiness, obviousness, and others which may strike the student listener.

To condense the foregoing the author must find a form which satisfies him as being particularly and

The author must find a form which satisfies him as being particularly and almost exclusively suitable for transmission by sound. Broadcasting a story from 2LO.

Write Radio Drama

By R. E. JEFFREY,
Late Dramatic Producer and B.B.C. Programme Research Director.

almost exclusively suitable for transmission by sound.

On the other hand, an extensive knowledge of form cannot atone for poverty of ideas. As words are the only means of holding the attention of the listener, they must at all times be reinforced by a cementing idea which shall create and hold interest.

In a word, radio dramatists must have something to say and be able to say it in a manner suitable for radio.

The First Necessity

Perhaps it would be well to say here that those who have little or no talent for writing should not expect to succeed as radio dramatists. From the number of ill-written attempts the B.B.C. receive it would seem that this point is not understood. The first necessity of an aspiring writer of plays is to be able to write, and write moderately, naturally, and well. This observation may appear trite, but experience informs us that it is regrettably necessary.

Many more observations on these essential points may be written, but it will be sufficient in this initial article to give just a general idea of what is wanted.

The radio dramatist must have something to say. He must have an idea. That idea must in its essence be dramatic. It must be capable of dramatic development. In this respect there is no difference between the radio play and the stage play. It must get somewhere. This cannot be stressed overmuch.

A Good Idea

The technique of the stage play is to-day very different from what it was in the time of Sophocles, but the essence of the matter is the same. All the great dramatists, from Grecian times down to the present day, owe their greatness primarily to the fact that they had something to express of beauty, of greatness, of eternal significance. The form of it was largely dependent on the theatrical conditions of the time—a form, which, within the well-defined limits of all theatrical art, was yet susceptible of great modification to accommodate the development of the idea.

This, then, is the first essential—a good idea.

Then it must be asked, has this idea, good in itself, the germ of drama? Is there in it the essence of conflict which can naturally and credibly develop to its inevitable climax? If so, we have the beginnings of a play.

The aspiring writer must have an idea that is worth while, the ability to express it—and a sense of dramatic sequence. Frank Vosper and Aubrey Mather in the "Combined Maze."

In writing for the stage, the dramatist has, of course, to consider whether his idea is capable of being wrought out in a stage setting. He might conceivably have to abandon many a good idea because of the limitations of theatrical conditions. This does not apply in the same way to radio drama. Although the medium of radio imposes its own limitations which are obvious ones, it offers a much wider scope to the selection of ideas. Its very limitations are an advantage; for the lack of all that is actually visual offers a stronger appeal to the imagination. Much that on the stage would be crude and unreal can by radio be made credible and convincing.

Must be Clearly Expressed

Assuming, then, that the radio-dramatist has an idea worthy and suitable for casting into form as a radio play, what else remains?

The second general point is that he must be able to express the idea in a manner suitable for radio.

Detailed discussion of what seem to be the most suitable forms for radio must be left for later articles. Here we can only suggest what is necessary in a general way.

Although a good idea is the essence of the thing, unless that idea can be expressed clearly and dramatically the idea might just as well be left to sleep in the brain of its author. This is where the art of the drama becomes necessary.

The dramatist must be able to write good dialogue.

In Good Dialogue

This doesn't mean that the dialogue need be literary. That will depend on the subject and its treatment. Some of the most poignantly dramatic moments in a play are often achieved by a phrase which has neither literary quality nor yet grammatical form; but the phrase is always germane to the character uttering it and to the dramatic situation at the moment.

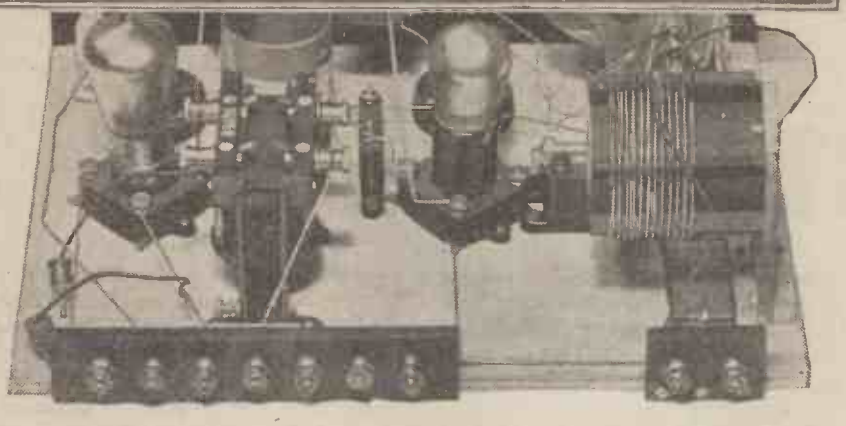
But, in a general way, the writer should be able to write English. This is not always the case with those who submit radio plays. They forget that the idea has to be *expressed*, and the power to write English in the form of convincing dialogue is indispensable.

Note the word "convincing."

It is not enough to have a

(*Continued on page* 695.)

ON THE SHORT WAVES



Notes of Interest on Short-Wave Receivers and Reception.
By W.L.S.

WHAT is the most popular type of short-wave receiver in general use? I often ask this question, both privately and in print, and I have never yet received a satisfactory reply. I suppose this is natural, for, to quote a very hackneyed phrase, "circumstances alter cases," and there may be occasions on which one's own ideal undergoes a change. I am making no confessions about mine at the moment, but I must say that my own ideas about short-wavers have changed very little during the last three years.

One reader, by the way, is using for short-wave broadcast work a *five-valve* set, using two screened-grid stages (both tuned), detector, and push-pull output! Some noise, I should imagine! But tell me, H. G. A., how on earth do you manage the two S.G. stages? I think I had better resign from my seat and give you the position of "short-wave wizard."

Improved Quality

I am very fond of two S.G. stages, the first being untuned and merely acting as an "aerial coupling valve," the second being tuned and neutralised if necessary; but two tuned stages is far more than I should care to handle.

It is really wonderful how the all-round quality of short-wave broadcast has improved since 1927. I have a big gramophone amplifier and a moving-coil speaker that I usually use for no other purpose than that for which it was designed, but on nights when W2XAF is coming across well I can couple up with this amplifier the output from my short-waver, and the reproduction on the M.C. is nothing that one would be ashamed of from 2LO.

Real "DX" Stuff

Fairly high-frequency fading does not improve matters, but apart from that the transmission is crystal clear, with very little background, and the bass notes are obviously not interfered with by their collisions with the Heaviside layer.

The real "DX" stuff is coming in again, and by the time these notes appear we should be in the thick of winter conditions again. Two or three Philippine Islands amateurs are coming across well on 40 metres nearly every afternoon, and I am anxiously trying to hook K1XR, the broadcasting station in Manila which works, I believe, mostly on 48·8 metres, although it has been heard in this country in the region of 31 metres, which is naturally a much easier wave on which to receive it; and HS1PJ, Bangkok, Siam, is another fish worth catching.

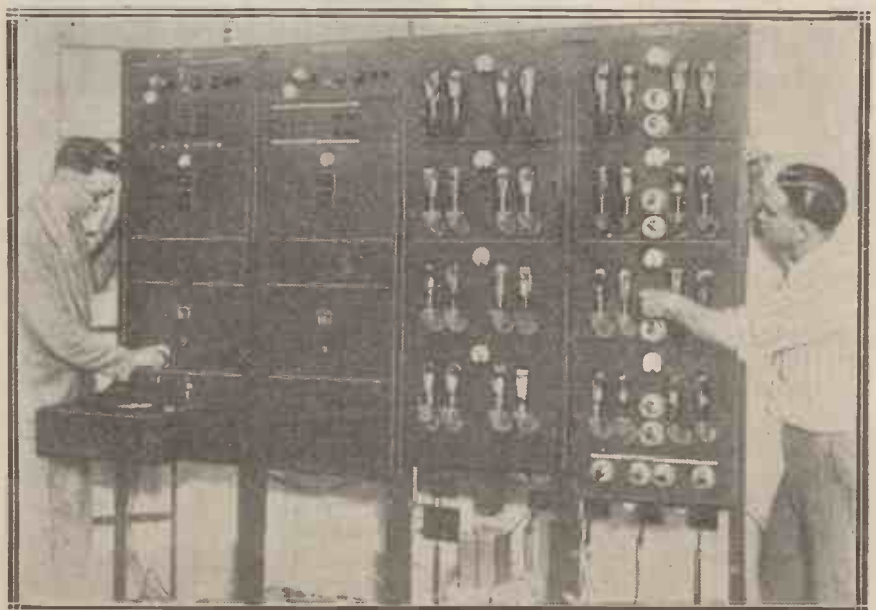
"All-Metal" Short Wavers

On the 20-metre amateur band the Antipodes transmitters continue to come through well in the early mornings, but this wave is not very useful in the late evenings now; there usually seems to be a fairly complete fade-out.

I believe I have commented previously on my failure to get an "all-metal" short-waver going satisfactorily. This time I have not gone in for a metal box, but have used a metal panel and an aluminium "chassis" instead of a baseboard, and have had no trouble at all with capacity effects or any other undesirables.

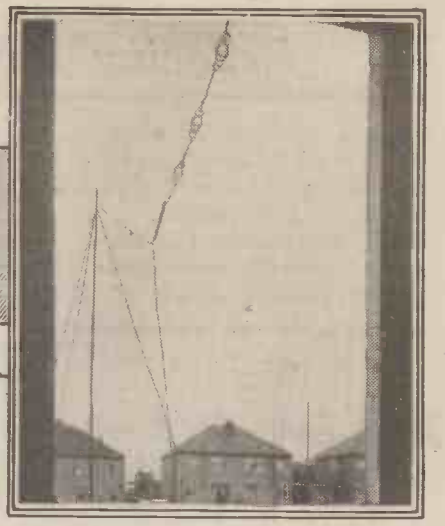
Several readers have reproached me for not giving more attention to capacity effects, which seem to bother them unduly; but, as I have explained, I never meet them myself unless I take precautions to avoid them, when they inevitably arrive, with most interesting effects!

A SUPER-SET FOR SCHOOLS



Said to be the finest school radio outfit in the world, this unique installation is fitted in a new school on Long Island, U.S.A. Not only can distant stations be tuned-in, but the headmaster can speak to any class-room or department.

Separating the Aerial



Some novel aerial schemes designed to eliminate direct leads-in and to reduce static and lightning hazard are described

By G. V. DOWDING, Grad.I.E.E.

A PROPERLY arranged outside aerial is a lightning protector; providing a lightning arrestor and/or an earthing switch is fitted, the aerial conducts all dangerous atmospheric charges direct to earth. This fact should be universally known by now, but there are still a few

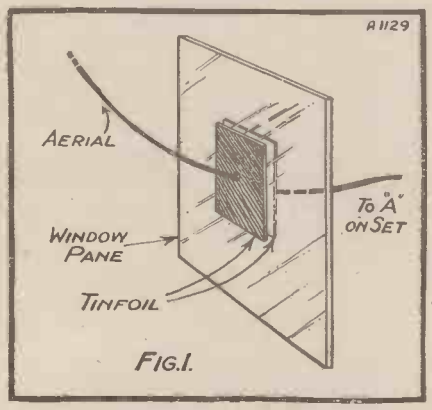


FIG. 1.

people who fear that lead-in wires into a house bring the possibility of trouble indoors.

Again, there are people who dislike the idea of having to bore holes through window frames or arrange other such means of entry. Many years ago there was a method of avoiding this which achieved some popularity. The scheme was to make the connection between the outside aerial and the set indoors a capacity one: a condenser being formed by pasting tinfoil on each of the two sides of a window pane.

An Unsightly Scheme

The outside foil was connected to the aerial and the inside one to the aerial terminal of the set. This is shown in Fig. 1. There is nothing against it technically; indeed, a series condenser is frequently advised in ordinary installations. The arrangement suffers from the disadvantage that a rather large area of tinfoil is needed in order to achieve the necessary capacity, as though glass has a high dielectric constant, that used for domestic window frames is rather thick, and large sheets of tinfoil stuck on a window exclude light and look unsightly.

A Better Method

There is another way of coupling the aerial through a window which is perhaps less known. As a matter of fact, I think I was the first to suggest it some six or more years ago. Recently I added a slight refinement which makes it much more effective, so much so indeed that there may be readers of "M.W." who can find a real use for it.

The coupling is an inductive one. The aerial goes straight through a coil to a direct earth outside the house.


"The earth lead needs no special insulation."

Across the coil a lightning arrestor is connected for the protection merely of the coil. This coil is coupled through the window pane to another coil which acts as the aerial tuning coil of the set.

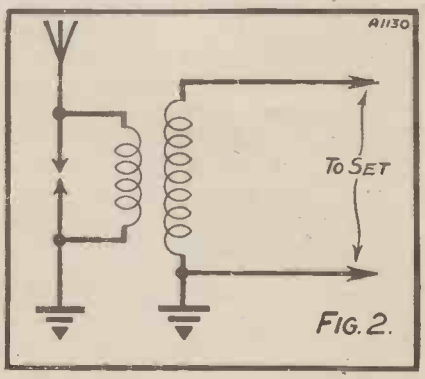


FIG. 2.

A water-pipe earth is used indoors for stability purposes. If a mains unit of any kind is employed, or the receiver itself is mains driven, the water-pipe connection is unnecessary, as the set will find its stabilising earth in the mains themselves.

Practical Details

The two coils are of the solenoid type; the aerial, or outside one, consists of 55 turns of No. 24 gauge wire wound on a former of about 2 in. diameter. The coil is mounted in a small weather-proof wooden box, one side of which is open. The arrangement is rather sketchily shown in Fig. 3. The small box is screwed to the window frame and putty is plastered round the edges in contact with the glass. The whole is then well painted.

The earth lead needs no special insulation, so that it passes straight through a small hole bored in the wood down to a plate buried in the ground beneath. The aerial wire, on the

Reducing Statics by Underground Tuning

other hand, needs careful insulation, so this is carried through an ebonite bushed hole which is well shellaced after the wire is in position.

The lightning arrestor is mounted on a small piece of ebonite inside the box, and consists merely of two

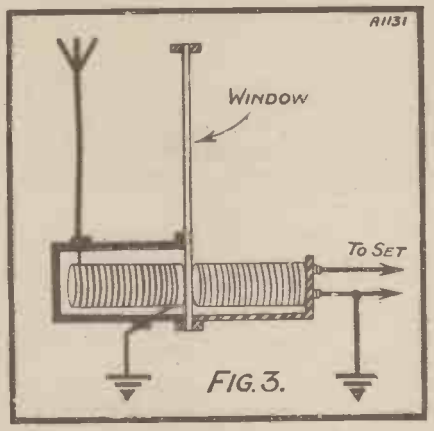


FIG. 3.

pieces of brass, one pointed, separated from each other only by the thickness of a piece of paper. Enough slack is allowed in the aerial and earth in order to permit the window to be opened.

There is, of course, no need for weather protection with the inside coil. This is another solenoid coil wound in accordance with the wave-band over which it is desired to receive. In the normal course of events it is necessary to have at least two coils: one for the 2 L O, 5 G B and so on band, and another for the 5 X X area.

The Best Coupling

In the arrangement I have fixed up at home, the two coils each have two pins and these slide into sockets on the window-frame holder. This holder swivels so that a varying degree of coupling between the two coils can be obtained and an adjustment of selectivity made possible. The best coupling is obtained when the two coils are in line, their ends being as close together as the glass will permit. The windings in each case continue close to the ends of the formers that are in proximity.

Very little difference is noticed between the signal strength received with this inductively-coupled aerial and when a direct aerial connection is used. One has, of course, to remember that the leads coming from the inside coil have to be well separated and be as short as possible. They cannot wander around the room or even across the room—the set must be near the window. The coil will no doubt be in the grid circuit of the first valve, and its leads can cause interaction troubles unless carefully disposed.

Another scheme, the real purpose of which is to endeavour to reduce the interference with reception caused by atmospherics, is the tuned earth illustrated in Fig. 4. This necessitates a connection from outside to indoors, but entirely disposes with the ordinary extended aerial.

A Tuned Earth

I described the main principles of this idea at about the same time as I did the inductive lead-in. In its present form it is now being exploited very successfully in the United States. It must not be confused with ordinary buried aerials, for these are merely extended antenna laid in troughs in the ground.

The tuned earth consists of a metal box about the size of an ordinary biscuit tin having a wooden top and buried about 3 ft. in the ground. From the box, and projecting about


A down lead terminating in a lead-in which goes directly through the window frame.

a foot above ground, runs a wooden tube some 2 in. in external diameter with ½ in. bore. Both this tube and the box are heavily protected with damp-proof anti-corrosive paint.

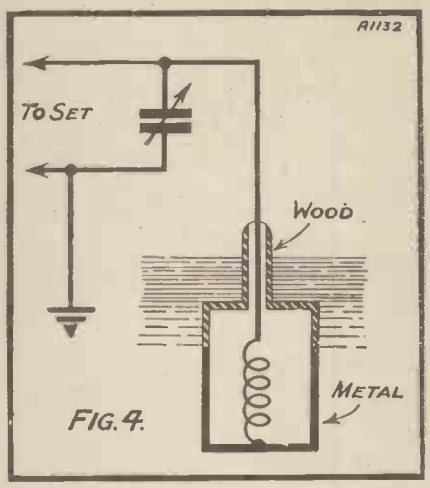


FIG. 4.

In the centre of the box is a coil wound to dimensions necessary to cover the wave-lengths required. One end of this coil is connected to the metal box. From the other end of the coil a lead runs up through the wooden tube to an ordinary aerial lead-in tube, and so on to the aerial terminal of the set.

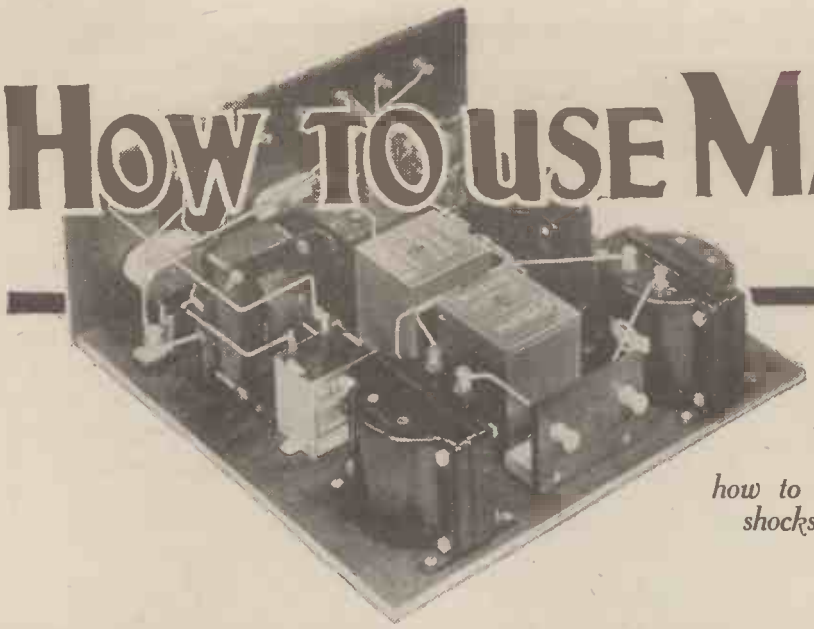
Very Selective

The earth terminal of the set is joined to a water-pipe earth inside the house, or, in the case of a set using the mains for H.T. or L.T., the earth can be found in the power line. As you will see, the coil which is buried in the box can act both as the aerial and the aerial tuning coil. Alternatively, it can be connected by a series condenser to a coil in the set itself. By this means a very high degree of selectivity can be achieved.

The pick-up qualities of this tuned earth are exceptionally good.

I am not going to claim that this tuned earth cures static, although it does seem to reduce them considerably, and there is by no means a proportional reduction in the signal strength of distant stations. The disadvantage of the scheme, the one which makes it rather unsuitable for use in this country, although it has great popularity in the States, is that you can only cover the one wave-band with the one outfit. Two each with a suitable coil would be needed in order to cope with our unfortunate double-band working.

HOW TO USE MAINS UNITS



Every owner or prospective user of a mains unit, whatever its character, should read this article. It tells you how to operate mains devices without getting shocks or doing damage to the apparatus.

By H. A. R. BAXTER.

IT is not wise for the newcomer to radio to experiment with mains devices. Some elementary knowledge of electricity should first be acquired. Commercial mains units and mains sets, at least those due to reputable manufacturers, are as harmless as any domestic electrical appliance, such as a vacuum cleaner, or an electric iron, providing the instructions for use are carried out.

It is a different matter altogether when the amateur starts to connect all sorts of home-made apparatus to the mains. It is then that certain facts in connection with the distribution of power must be known.

There are two distinct types of supply, these are A.C. and D.C.; A.C. (alternating current) is in some ways safer and, in other ways, more dangerous to handle. Its greater safety is to be found in the fact that the current is seldom led direct to its destination. Invariably, a transformer is interposed, and the primary of this is fed from the mains connection via the light or power socket. (See Fig. 1.)

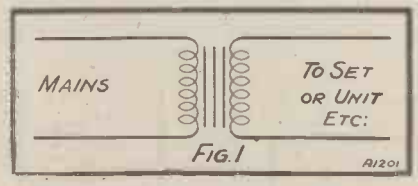
The Higher Voltage

This, in a certain way, isolates the distribution lines from anything to which the secondary of the transformer is connected, but alternating current is more physically harmful, and if what is known as a step-up transformer is employed to increase voltages it is possible to get very nasty "packets" indeed.

It should be noted that alternating current reaches a voltage much greater than its rating. For instance, 210 volts A.C. touches a maximum pressure of about 300 volts. Alternating current, as its name suggests, flows first in one direction and then in the other, and it rises to a maximum and falls to zero in each case.

Systems of Distribution

The complete operation of rising to maximum, falling from maximum to zero in the one direction and then rising to maximum and falling again to zero in the other direction, is known as a cycle. With a 50-cycle supply there are fifty complete reversals per second.

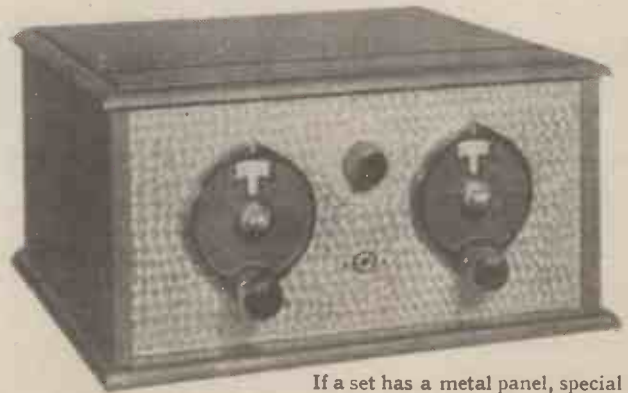


The effective voltage is 70 per cent of the maximum, and it is this that is given as the rating; so do not forget that if you have the A.C. mains you are up against a voltage much greater than that which is inscribed on your electric light bulbs and other devices. This greater voltage will not be taken into account in the ordinary working of domestic electrical apparatus, except in that these devices will have to be designed with greater safety factors than is necessary for D.C.

You may often have seen the terms "single phase," "double phase," and "three phase," as applied to A.C. mains, but these terms are of more interest to the engineer than to the household user of electricity. They refer to systems of distribution. Single-phase working is the generating and distributing of a single alternating current, as described above. In double-phase working two currents of the same voltage, but out of phase—that is to say, the one is rising to maximum in the one direction before the other—are generated, and pass out for distribution.

Vitally Important Point

In the case of three-phase there are three currents of the same voltage, but all out of phase with each other, developed for distribution in a rather complex manner. But, as we have said, you do not have to worry about this.



If a set has a metal panel, special precautions must be taken before a mains unit is used. Remember, it is possible for the whole panel to be "live."

With D.C. mains the point of vital importance is that one of the power wires is almost sure to be earthed. Having seen the electrician fix the wires and take every precaution against these coming into contact with anything, it may strike you as curious that one of the wires should be earthed. But this is almost sure to be the

case and may cause complications unless you are aware of it.

Also, it may be either of the wires, and not necessarily the negative one, as shown in Fig. 2. With this negative power wire earthed it means that you short the mains completely if the positive wire happens to come into contact with anything else that is earthed. For instance, it might so happen that the positive wire brushed a water pipe or a gas pipe, and the result would be the same as if you brushed the positive wire against the negative.

Causing a Conflagration

At best a fuse would go; at worst, a red-hot wire would cause a conflagration of minor or major character. We have said that it might be either the negative or positive wire that is earthed. The cause of this is to be found in what is known as the three-wire distribution system, which is almost universally adopted where there are D.C. supplies.

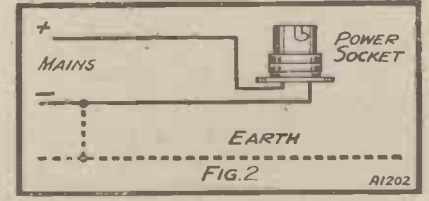
The purpose of the three-wire system is to enable the economical distribution of two voltages to be carried out. The high voltage, which will be double that of the low, will be used for driving power machinery in factories, and for operating tramcar systems and so on, while the low voltage will be fed to houses for domestic purposes.

A very simple plan of a three-wire scheme is shown in Fig. 3. There are three output mains wires from the power station, and these are known as the negative, positive and neutral. The full voltage of the supply will exist between the negative and positive leads, and the lower one between either of these and the neutral. The neutral wire is almost invariably earthed.

On the Other Side

The houses in one road of a district might be served with the neutral and positive wires, as at A in Fig. 3. The voltage difference between these will be 200 volts if the full voltage of the mains is 400, and the neutral becomes the negative connection.

The houses in another area (it might be only the other side of the



same street) could be served with the negative and neutral feed, and, in this case, the neutral would become the positive connection, and this is, of course, earthed.

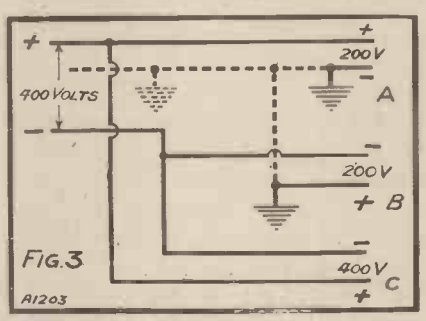
The point "C," with 400 volts, gives the full pressure of the supply, such as may be needed by tramcars and so on, as we have before mentioned.

Because of the almost invariable earthing of the negative H.T. and L.T. in radio sets, it has become something of a legend that negative is always taken to earth, but this is very much not the case when applied to the mains. The three-wire system is rather difficult for the non-technical man to grasp, but he may find it easier if we apply it to a simple battery arrangement such as is shown in Fig. 4.

The battery symbols indicate that there are six cells joined in series, and if these were accumulator cells the total voltage across them would be 12 volts. Now, supposing a wire were joined to the point connecting the third and fourth cells. There would be a voltage difference of 6 between this wire and either of the other two wires shown in Fig. 4, and the middle wire would be 6 volts positive to the negative connection.

A "Neutral" Point

But also that central connection would be 6 volts negative to the positive connection, or, which is exactly the same thing, the positive



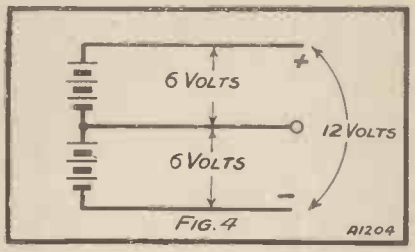
connection is 6 volts positive to the central connection and 12 volts to the negative connection.

Thus the central tapping can be either negative or positive. It is positive in relation to the one end of the battery and negative in relation to the other. This you will see is obvious, in that the wire is connected to the positive of the third cell from the bottom and the negative of the third cell from the top, these two points being joined together.

Prevention is Better . . .

However, you do not get three wires coming into your house unless you have special permission for the use of the full voltage of the local supply station. You have only got two wires, and the point to remember is that either one of these may be earthed. And unless you know for certain which one is so connected and carry out your experiments accordingly, there are precautions you must adopt to prevent accidents happening.

The vital thing to remember is that your radio set has an earth connection, and that if you connect a mains unit to it, either L.T. or H.T., or both, you must remove the direct earth connection on your set or you



may cause wires to go red-hot, fuses to blow, and other things to happen.

The best thing to do is to discard the earth connection altogether, for it is quite unnecessary if you use a mains unit of either the L.T. or H.T. variety. In that the mains are earthed, or at least one of the wires is, a further connection to the ground is quite unnecessary. Indeed, it is liable to introduce hum.

If for any abnormal reason you find that an earth to the set is necessary, then the connection must be made via a fixed condenser; that is to say, you take a 1-mfd. or a 2-mfd. condenser and join one of its terminals to the earth terminal of the set. The earth lead is then taken to the other terminal of the fixed condenser.

Series Earth Condenser

It is necessary for a fixed condenser used in such a way to be capable of withstanding the full voltage of the mains, the ordinary low-voltage variety will not prove sufficiently robust. A condenser of the type used in mains units for smoothing, with a working voltage of double that of the mains rating, is the sort of thing you want. But even after having dispensed with the ordinary earth connection, or having arranged a series condenser as described, you have by no means obtained safety.

In the ordinary way, one does not worry about the various things that are connected to earth through a radio set. The result is that you may find in your outfit all sorts of screening wires and components that, far from

"... And a Nasty Shock it Might Prove!"

being adequately insulated, are not catered for at all in this respect.

You have an earthed main, this is assuming that you are using a mains device, coming via various resistances and so on, into the set, and, what is much more important, you have another very "live" main. It is this last that you have got tenderly to nurture. Supposing it happens to be the negative main that is earthed. In this case there is not much to worry about, because it will go to L.T.— and the normally grounded parts of the set, but supposing the negative main is the unearthed connection, then it is a very different story.

Something Worth Missing!

If you look at the theoretical diagram of any set you will find that the negative L.T. or H.T. point is joined to a whole hoard of things, such as coils, transformers, and so on.

As your negative main is very "live," all these points are at the full voltage of the mains potential above earth.

If you were standing on a fairly conductive floor, or if you happened to be resting your hand against a-not-too-good-insulator of a wall or touching something else that was even more directly earthed, and then with the other hand touched a coil or transformer winding, or anything else that was joined metallically to the earthed side of the set, you would get the full voltage of the mains passing through your body, and a nasty shock it might prove.

This indicates that you should not touch the interior of the set or any of its terminals or metallic parts while the mains are switched on. In all probability the aerial will be metallically connected to the L.T.— H.T.— points via the windings of a coil, and in this case the aerial itself becomes merely an extension of that live mains connection, and sparks would fly if it swayed against a drain-pipe, or scraped against a wet wall.

To prevent this happening a fixed condenser can be joined in series, close to the set or inside the set, in the same sort of way as the one described for the earth.

Don't Forget the Fuses

When you use the mains for either H.T. or L.T., do not forget the claims of fuses. A fuse of the correct proportions and in the right place can save a lot of trouble. If the total current you are going to extract from the mains is, say, a quarter of an ampere, put a fuse in series with each

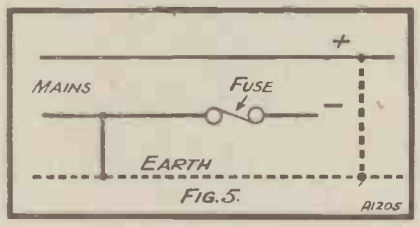


FIG. 5.

of the mains leads which will blow at nothing greater than, say, a third of an ampere. Do not make the mistake of using only the one fuse. We have said enough about mains, we hope, for you to have firmly grasped the idea that it might so happen that you inserted the fuse in a wire which happened to be grounded. Obviously this would do nothing to prevent damage arising through the other wire short-circuiting to earth.

As you can see in Fig. 5, a fuse would be quite ineffective in a negative power wire if this negative wire were already earthed and then the positive wire were accidentally taken to earth. If there were also a fuse in the positive wire, this would come into operation.

The same sort of thing applies to switches. It is quite a common practice to use single-way switches which break only the one wire; but then it might so happen that this one wire were the earth connection, and in this event the live connection would still be carrying the full potential above earth to any of the points to which it was connected.

The Golden Rule

Therefore, complete switching can only be obtained by withdrawing the plug or using a switch of the double-pole type. But whatever the scheme is, and whatever the switching used, the golden rule in mains working is never to make any adjustment of any kind while the apparatus is connected in any way to the mains unless it is absolutely vital.

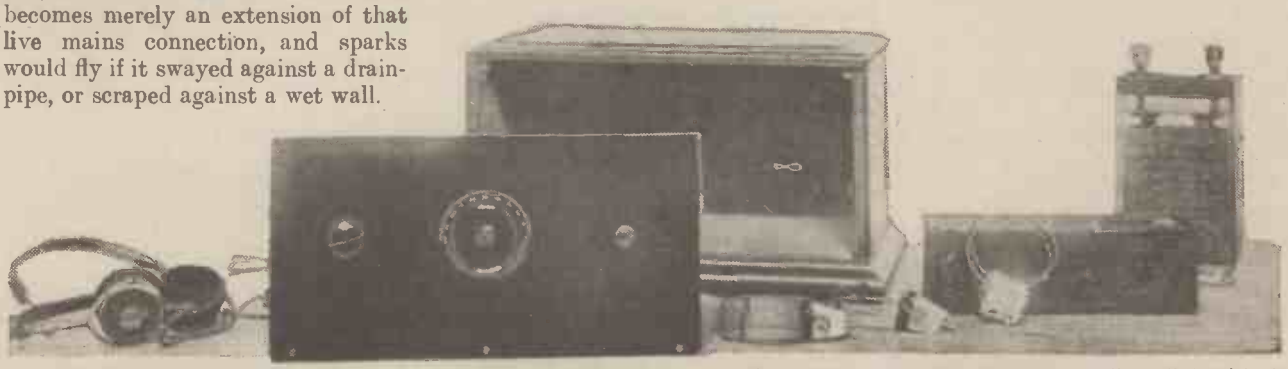
And if in any vital circumstance it is necessary to make an adjustment, don't forget that rubber gloves cost only about one shilling per pair.

These gloves are sold by Woolworth's stores for domestic use, but are made of good rubber, thin enough to permit perfect freedom of action. But even when wearing rubber gloves such adjustments should be made very carefully lest any dangerous short-circuiting be caused.

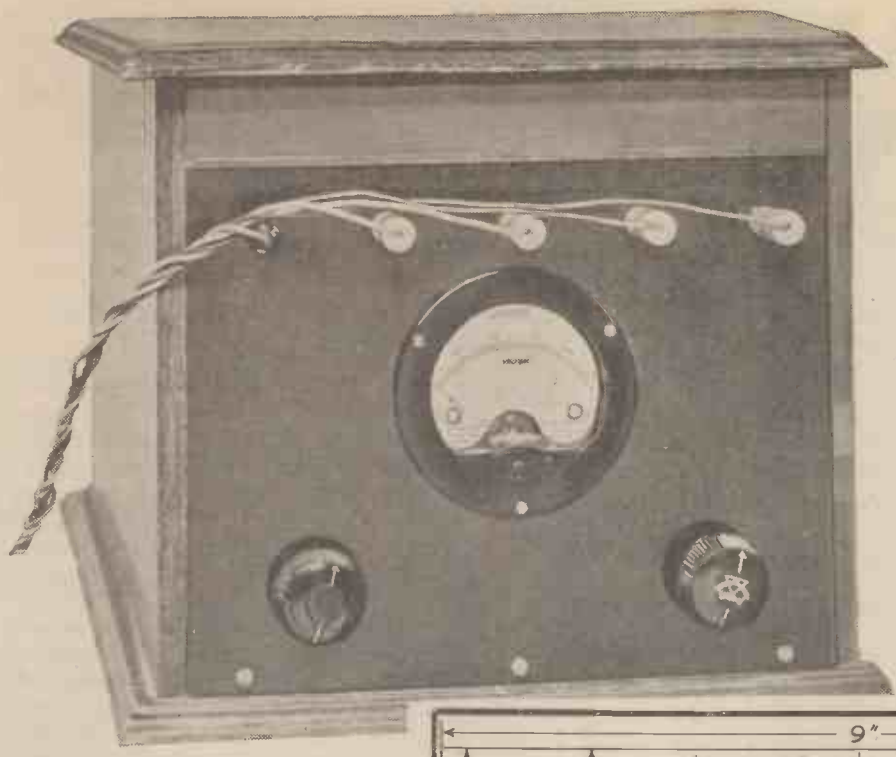
Our Last Word

You can, of course, handle the tuning controls of the set quite freely providing the various precautions against leakage are taken and that the metal parts of variable condensers, and so on, do not come into contact with the fingers.

And our last word on the subject for the time being will be—unless all the foregoing is well and truly understood, and perhaps a little more besides, treat the mains with great circumspection — if you deal with them at all.

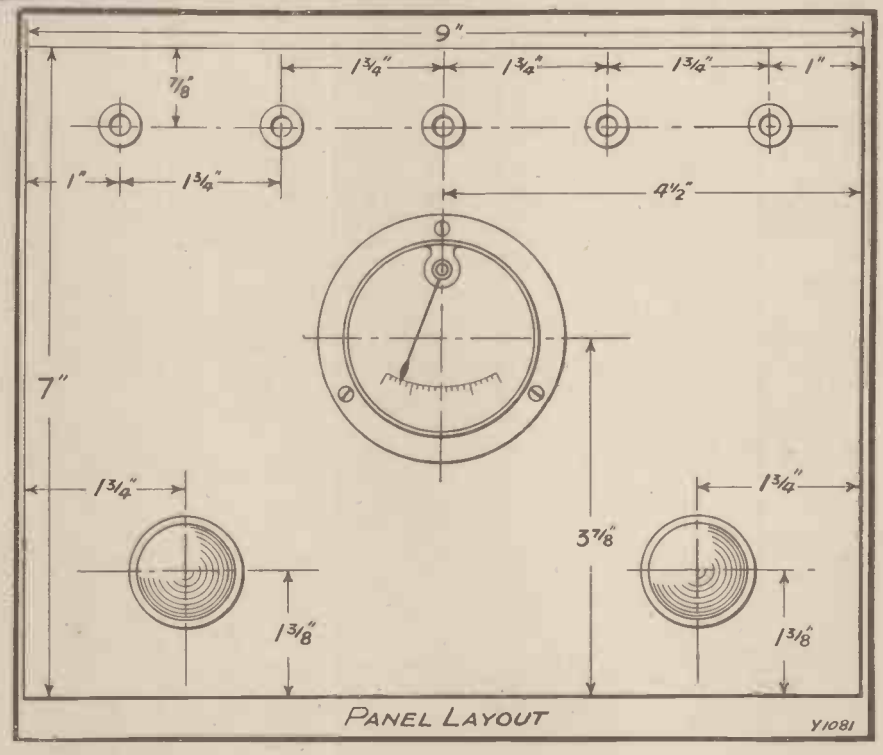


A battery-operated receiver is a completely self-contained installation. A mains outfit, on the other hand, has a direct link with the power station and its almost limitless energy.



Designed and described by the "M.W." Research and Construction Dept.

This Unit is universal in its application and you can use it with any of this season's sets. It is a an invaluable device and gives standardised L.T. and H.T. outputs safely with adequate current reserve and with freedom from hum.



LAST month we presented to our readers a design for a D.C. mains H.T. unit with a scheme for standardised voltages which we believe will go a long way towards removing the last difficulties in the way of the use of the mains for H.T. supply. This month comes the turn of those readers who have an alternating supply, for whom we have prepared a very similar standardised-voltage unit.

Just as in the case of the D.C. unit, we have a combination of three special features in this unit, and since no doubt many readers will be interested in the present design who will not have studied the previous one, we had perhaps better explain just what these points are. First of all we have endeavoured to make the unit as universal in its applications as possible, and pains have been taken to make it entirely suitable for use with practically any of this season's MODERN WIRELESS set designs.

In Constant Use

As a matter of fact, this unit can be depended upon to work well with practically any set, whether of this year's series or not. We mention its special suitability for this season's designs simply because here we have a positive check, the unit being kept in constant use in the "M.W." research laboratory, and all our new set designs are tested upon it, just as they are upon the corresponding standardised D.C. unit.

If any special peculiarities are noted in the behaviour of a set when operated in this way, due note will be made of the fact in the article describing the set, and in the absence of any such note it can be taken that each set will work with these two units when connected up in just the standard fashion.

Our second requirement was unusually thorough and perfect smoothing and effective anti-motor-boating precautions. These two requirements seem at the present time to be of greater importance than ever before, because modern requirements in realistic reproduction make even the slightest hum a most undesirable defect, and, further, because high-sensitivity receivers demand that considerable care be taken if motor-boating is not to occur when they are run from a mains unit.

Our third aim in producing this standardised design was to remove the element of guesswork in regard to working voltages which appears to be one of the few obstacles still

The "M.W." Standard A.C. Unit

remaining in the way of the average man's use of the mains for his high-tension current supply. Those with experience of mains working will not need to be told that this difficulty of determining the exact voltages which are being obtained from the various terminals of a mains unit is quite a real one, because in most designs the exact voltages vary considerably according to the load, and very few people possess accurate very high resistance voltmeters to permit the exact figures to be obtained by measurement.

Eliminating Guesswork

General rules can usually be given for the use of any particular H.T. unit, so that the operator has some idea where he is, but, nevertheless, he is never entirely sure just what he is getting. Consequently the usual procedure is to adjust the various voltages until the set appears to be working correctly, and hope that the best setting has really been found. It is this element of guesswork and uncertainty that we have set out to remove in the design under discussion, and we have achieved our end in a manner which the reader will, we think, find an unusually interesting one.

So far the main features of the A.C. version of our standard unit correspond exactly to those of the D.C. unit, but it has in addition a rather useful feature which could not be provided on the D.C. unit. By choosing a suitable power transformer we have been able to provide not merely for the necessary H.T. output at different voltages, but also for the supply of low-tension alternating current at two different voltages for the running of the various types of A.C. valves.

COMPONENTS REQUIRED.

- 1 Panel, 9 in. × 7 in. (Paxolin, Ripault, Becol, Goltone, Trelleborg, Resiston, etc.).
- 1 Cabinet, with baseboard 14 in. deep (Camco, Osborn, Raymond, Lock, Gilbert, etc.).
- 5 Safety connectors (Belling & Lee) for panel.
- 1 0–150 panel voltmeter (Ferranti, Sifam, Weston, Goltone, etc.).
- 1 50,000-ohm wire-wound power potentiometer (Varley).
- 1 5,000-ohm wire-wound power potentiometer (Varley), used as plain resistance.
- 1 Power transformer (Marconiphone type "L").
- 2 Smoothing chokes, about 20 henries, resistance not more than about 300 ohms (R.I., Wearite, Varley, etc.).
- 1 15,000-ohm potential divider (Igranic).
- 1 Sprung valve holder (W.B., Dario, Lotus, Benjamin, Precision, Pye, Bowyer-Lowe, Igranic, Wearite, Burndept, etc.).
- 5 2-mfd. condensers, working voltage not less than 200, and preferably 250 (Dubilier, Hydra, Lissen, T.C.C., Ferranti, Mullard, etc.).
- 1 4-mfd. condenser (Dubilier, Lissen, Mullard, Ferranti, Hydra, T.C.C., etc.).
- 1 Terminal strip, about 9 in. × 2 in.
- 5 Terminals (Eelex, Igranic, Burton, Clix, Belling & Lee, etc.).
- 2 Battery type plugs (Clix, Lisenin, Eelex, etc.).
- Length of flex and adapter for mains connection, wire, screws, sleeving, etc.

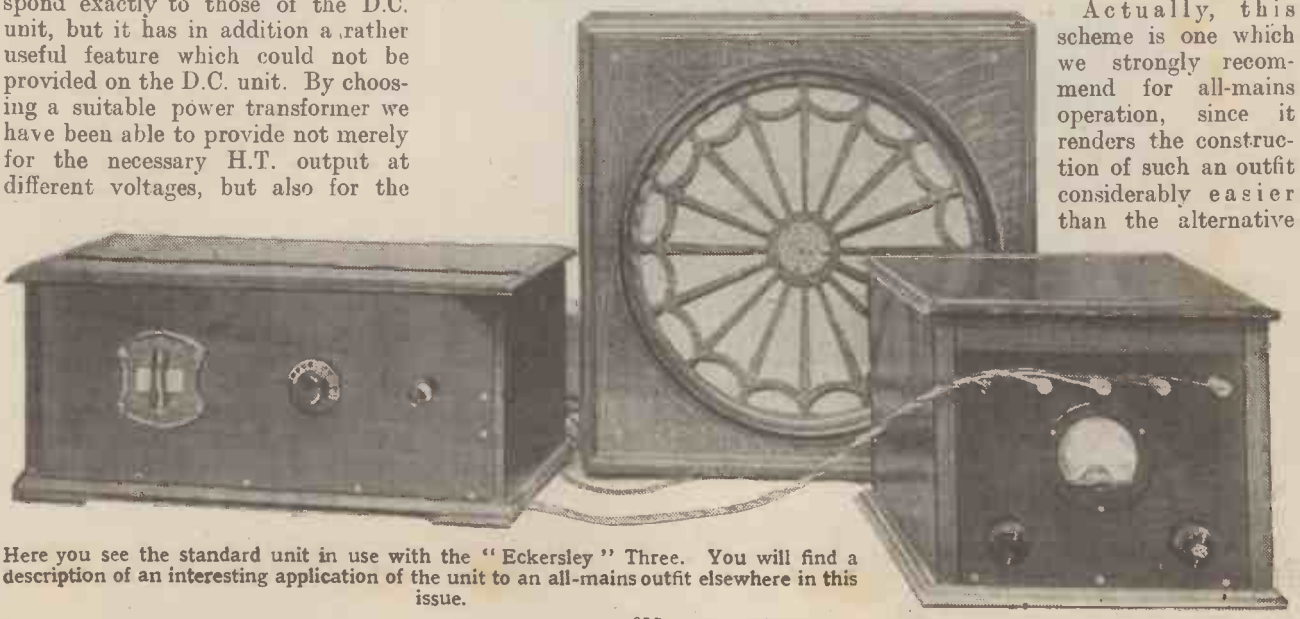
At the back of the unit you will see a terminal strip which carries five terminals, two of which give a supply of alternating current at 3·5 to 4 volts, the other three providing a supply at ·8 of a volt between the two outside terminals, the middle one being the centre-tap of the winding which gives this supply.

From these terminals a supply of current can be obtained sufficient for running two indirectly-heated A.C. valves and three of the directly-heated ·8-volt ·8-ampere type. By choosing a suitable combination of directly- and indirectly-heated valves, therefore, quite a large set can be supplied.

L.T. Supply Also

The unit consequently gives not merely a complete supply of H.T. voltages adequate for the operation of even a big set, but also the necessary current for all-mains operation with the various types of special A.C. valves. By fitting such valves in almost any design and adding this unit you can change over to all-mains operation in a very simple and easy fashion, an example of such a conversion being given elsewhere in this issue.

Actually, this scheme is one which we strongly recommend for all-mains operation, since it renders the construction of such an outfit considerably easier than the alternative



Here you see the standard unit in use with the "Eckersley" Three. You will find a description of an interesting application of the unit to an all-mains outfit elsewhere in this issue.

method of building everything into one cabinet containing both the receiver portion and the power circuits. Moreover, if you put together an outfit on these lines with a more or less normal set and the separate H.T. and L.T. A.C. unit you get considerably greater flexibility, in that it is quite an easy matter to build a new set when you feel that your present one has become inadequate, your separate power unit remaining unaltered whenever you do so.

The Power Transformer

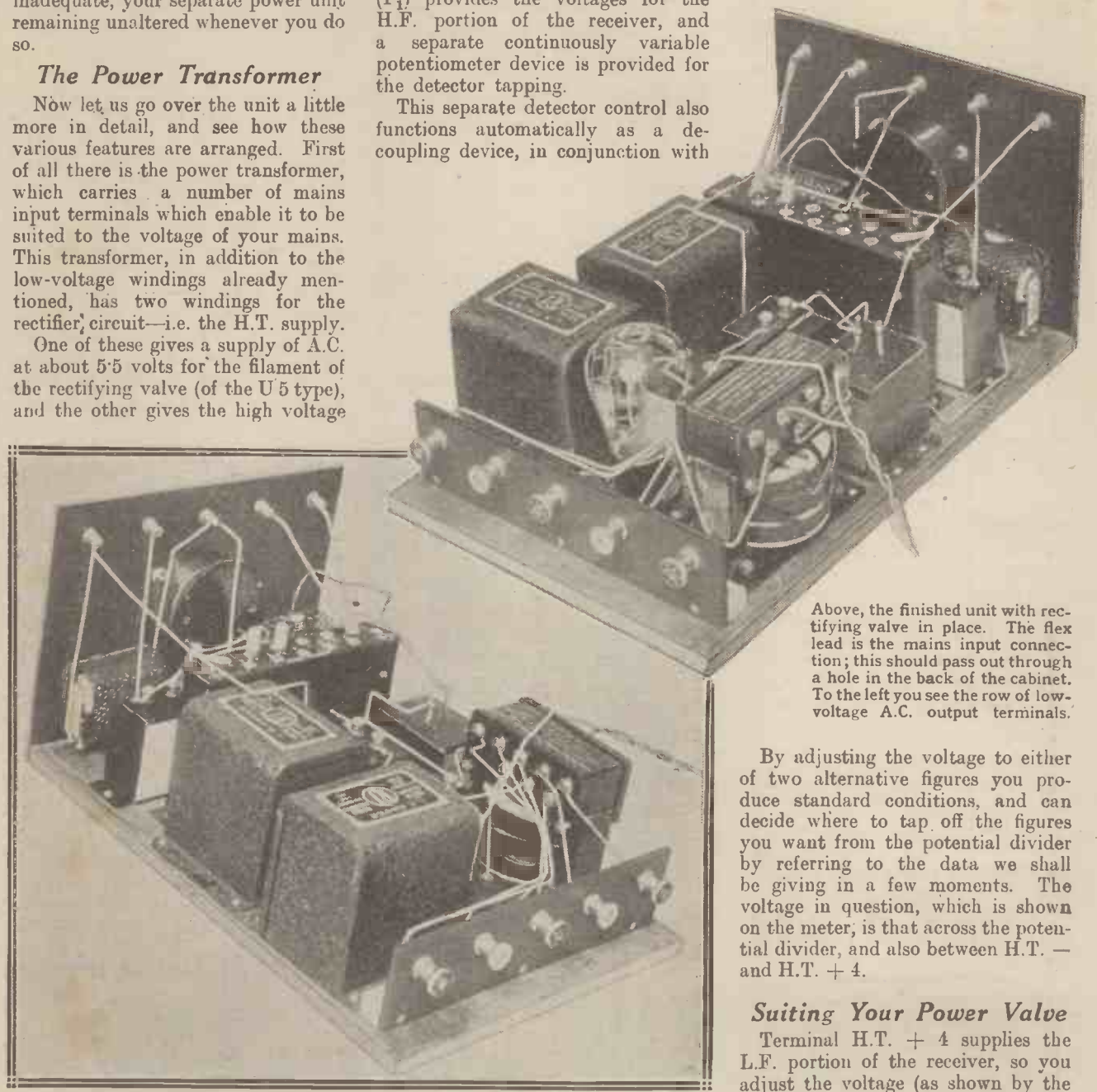
Now let us go over the unit a little more in detail, and see how these various features are arranged. First of all there is the power transformer, which carries a number of mains input terminals which enable it to be suited to the voltage of your mains. This transformer, in addition to the low-voltage windings already mentioned, has two windings for the rectifier circuit—i.e. the H.T. supply.

One of these gives a supply of A.C. at about 5·5 volts for the filament of the rectifying valve (of the U 5 type), and the other gives the high voltage current which becomes the H.T. supply after rectification and smoothing. Both these windings are provided with a centre-tap, that on the filament winding constituting the positive side of the H.T. circuit, and the one on the other forming the negative.

On the output side of the rectifier circuit there follows a very thorough smoothing filter which ensures a very quiet and hum-free output from the H.T. terminals, and then we come to the special anti-motor-boating and voltage-adjusting devices. So far as the prevention of motor-boating is concerned the arrangements are very simple. A tapped potential divider (P_1) provides the voltages for the H.F. portion of the receiver, and a separate continuously variable potentiometer device is provided for the detector tapping.

This separate detector control also functions automatically as a decoupling device, in conjunction with the bypass condenser C_5. In the great majority of cases this provision will be ample to ensure stability.

Now about the standardised output voltages. The arrangement is exceedingly simple, but we think you will find it very effective and convenient. It has certainly proved itself to be so in our own very considerable use of the unit. The idea is this: The voltage across the potential divider is adjustable by means of a master resistance R_1, and is indicated by the voltmeter on the panel, which, for this purpose, need not be of the expensive high-resistance type (it is permanently in circuit).



Above, the finished unit with rectifying valve in place. The flex lead is the mains input connection; this should pass out through a hole in the back of the cabinet. To the left you see the row of low-voltage A.C. output terminals.

By adjusting the voltage to either of two alternative figures you produce standard conditions, and can decide where to tap off the figures you want from the potential divider by referring to the data we shall be giving in a few moments. The voltage in question, which is shown on the meter, is that across the potential divider, and also between H.T. — and H.T. + 4.

Suiting Your Power Valve

Terminal H.T. + 4 supplies the L.F. portion of the receiver, so you adjust the voltage (as shown by the meter when the unit is actually running the set) to a figure to suit your power valve. The maximum available is a trifle under 140 volts, which suits many power and super-power valves admirably.

If your last valve is rated to stand up to this voltage, therefore, simply

Excellent Smoothing and Standardised Voltages

set R_1 to give you the maximum reading on the meter. The adjustment of the voltages for the H.F. portion of the set is then to be carried out as follows: Terminal H.T. + 3 is intended for the anode supply of the H.F. valve or valves, and the required 120 to 130 volts will be obtained by placing the plug connected by a flex lead to the inner side of this terminal in the No. 9 socket on the potential divider.

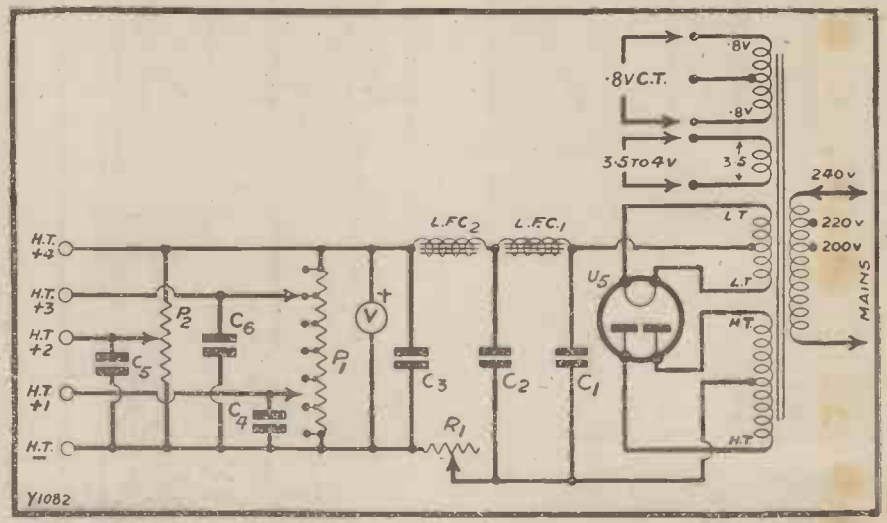
Terminal H.T. + 2 is intended to supply the screening-grid voltage for S.G. valves, and the requisite 60 to 80 will be found by placing the plug appropriate to this terminal in the 6, 7, or 8 socket on the potential divider. Screened-grid valves vary in their requirements here, so try the plug in each socket in turn, and note which gives the best volume, preferably using a fairly weak signal for testing.

The Detector Adjustments

The detector valve is to be run from the H.T. + 1 terminal, and here you have a "continuously variable" type of control giving a wide variation of voltage. The usual range will be between a mid-way position and minimum—i.e. with the knob turned fully to the left.

This means an actual range of from zero to about 70 volts, and you do not need to know the exact voltage you are getting, since all you have to do here is to adjust for the smoothest possible reaction control, and it is no help to know what the figure really is.

Another series of adjustments is called for when the power valve is only rated to take 120 volts, as is often the case with valves of the "smaller" type. In such circumstances set R_1 so that the voltmeter reads 120 when the set is actually working, and place the H.T. + 4 plug in the No. 10 socket. The plug from H.T. + 2 will now go in the 7, 8, or 9 sockets, with adjustment as before. The detector control will be obtained in just the same way as in the previous case, of course.



There, you should now have gained an idea of the way this unit can be employed, and will be able to follow quite easily the article appearing elsewhere on the conversion of the "Brookman's" Three into an all-mains outfit with its aid.

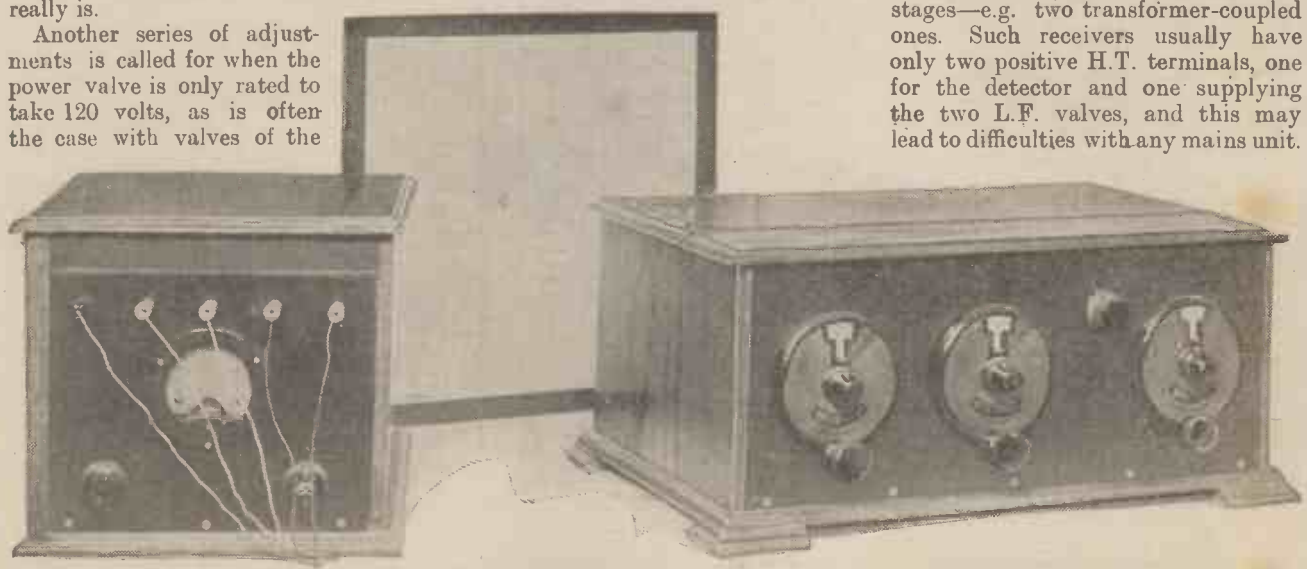
Now for some miscellaneous hints about the use of the unit with various types of sets. Really, there is only one type about which you should be warned, but since we are raising the question we may as well go into it thoroughly.

First, then, about sets of the detector and L.F. type, which obviously require only two positive H.T. taps. Here you should run the L.F. valve from H.T. + 4 in just the usual way, and the detector from H.T + 2.

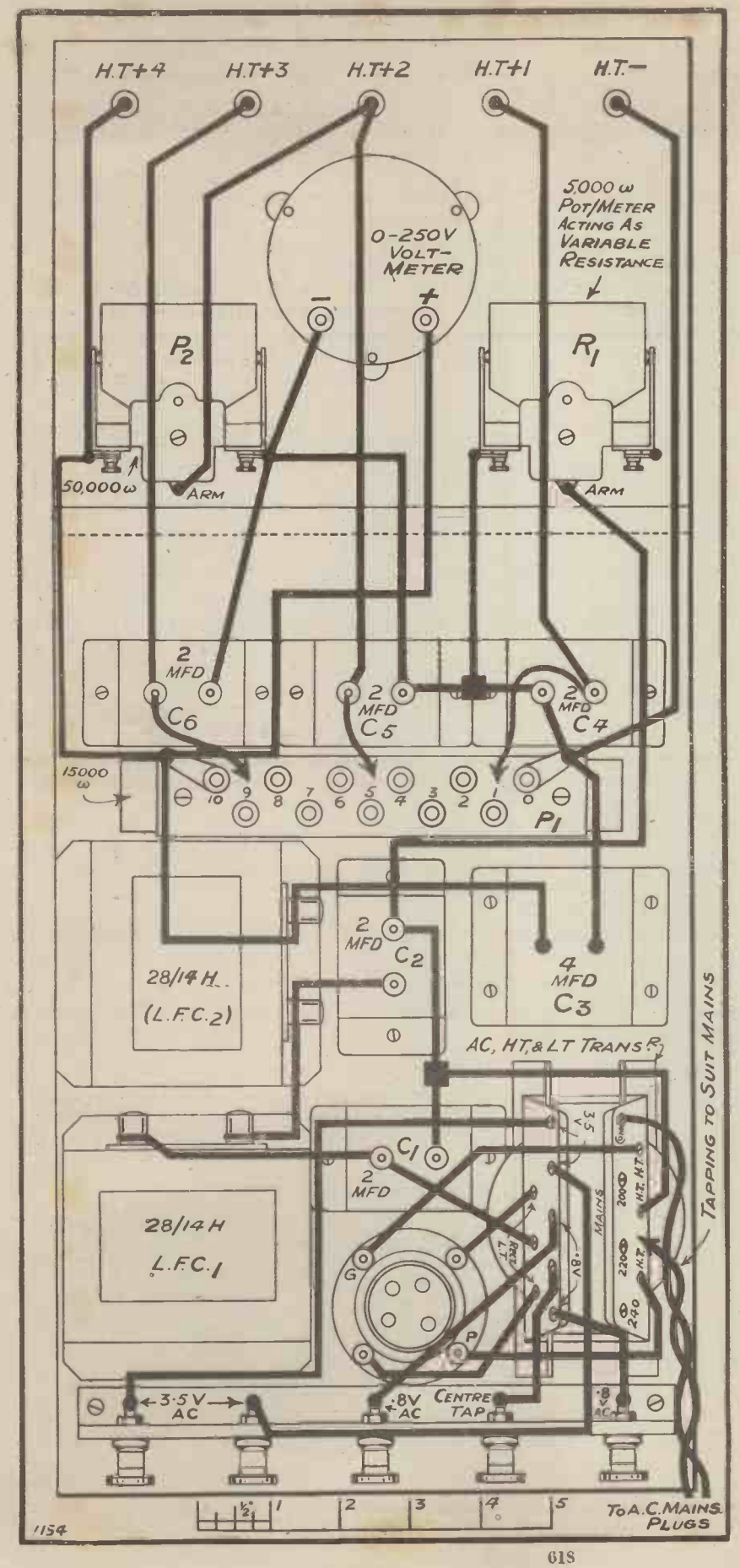
We mention this case in passing merely because you might think of running the detector from H.T. + 1. This is not advised, because although it would be successful in many cases there are others in which it would be likely to set up motor-boating.

Preventing Motor-Boating

A more important case is that of the three-valve receiver consisting of a detector and two powerful L.F. stages—e.g. two transformer-coupled ones. Such receivers usually have only two positive H.T. terminals, one for the detector and one supplying the two L.F. valves, and this may lead to difficulties with any mains unit.



This view of the unit with the "Olympia" Three serves to emphasise a little point about the H.T. leads. A much neater appearance results if you make up these leads into a twisted cable such as you see in the photo on the first page of this article



It is usually desirable in such cases to break into the wiring of the receiver and take out a separate H.T. supply lead for the first L.F. valve. This valve should then be run from H.T.+3 on the mains unit, the plug appropriate thereto being placed in the No. 8 or 9 socket of the tapped potential divider.

In this way the supplies for the two L.F. stages are separated a little, and probably all will be well. It is much to be desired, of course, that an output filter be used in such a set to ensure stability, as well as safety, when it is worked with a mains unit.

When Coupling is Harmless

With normal four-valve sets it is usually quite safe to run both L.F. stages from H.T.+4, since the L.F. side of such a receiver is not as a rule so powerful and consequently is more stable. Moreover, a set of this size generally incorporates an output filter. It is conceivable, however, that some receivers of this type may tend to motor-boat under such conditions, and relief can often be obtained by taking out a separate H.T. lead for the first L.F. valve as before.

This extra H.T. terminal on the set can then be run from H.T.+3 on the mains unit, which is already being used for the H.F. valve. Coupling between these two stages is not as a rule dangerous.

POINTS FOR CONSTRUCTORS

When plug and jack contacts have been in use a long time they should be examined occasionally for specks of dust, dirt, etc. These may lower the efficiency of the component, which may give rise to crackling if its contacts are not cleaned and scraped occasionally.

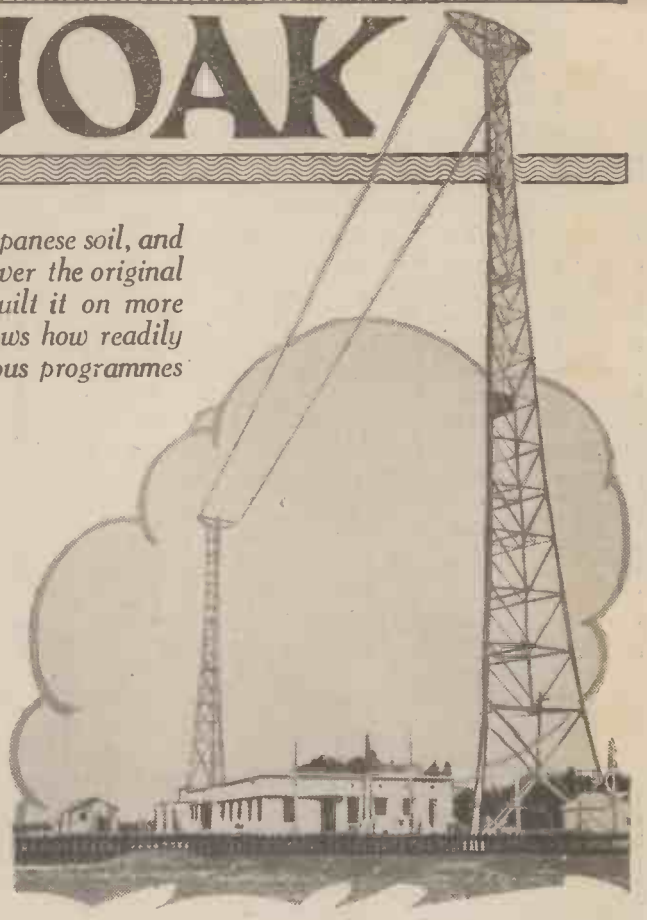
* * *

Remember that celluloid as used for coil formers, etc., is very inflammable, so that great care should be taken if any of this material is lying on a work-bench when soldering.

* * *

On some L.F. transformers it is the practice to provide an extra terminal by means of which the metal case of the instrument may be connected to earth, but there is no need to connect this up if perfect results are obtainable without such a connection.

A NEW JOAK



The germ of broadcasting has been firmly planted in Japanese soil, and recently an official Broadcasting Bureau has taken over the original broadcasting station at Tokyo (J O A K) and has rebuilt it on more modern and Western lines. This interesting article shows how readily Japan is taking to the new science, and how the various programmes are arranged and carried out.

From Our Special Correspondent.

Do you happen to know what "Sumo" is? No, it is not the name of a new proprietary article, or a term expressing an ancient form of worship. "Sumo" is a peculiar game much favoured by the Japanese. It is a mixture of wrestling, ju-jitsu, and boxing. A "Sumo" match is an event of great interest in the Land of the Rising Sun. In fact, the adherents of the game are as multitudinous as are our own football "fans."

Now, when wireless broadcasting was first started in Japan by that pioneer station, J O A K, of Tokyo, its inception attracted some interest. The average Japanese, however, wasn't over-enthusiastic about the new development; the main reason, perhaps, being that the early programmes transmitted were rather of the cut-and-dried variety.

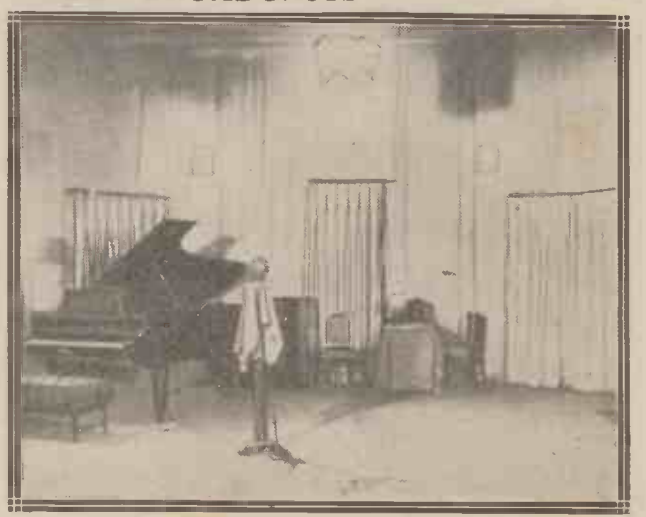
An Up-to-date Station

But the germ of broadcasting had been firmly planted in Japanese soil, and when, ultimately, an official Japanese Broadcasting Bureau got to work on the peculiar and local problems of popular broadcasting in that country, developments soon began to arise.

One of the first plans of this Broadcasting Bureau, or *Chuo Hosokyoku*, as it is called, was the rebuilding of the existing station at Tokyo on a larger and more organised scale. European methods of popular broadcasting were to be introduced, and the whole of the programme placed upon a new basis.

Last year the newly-erected station at Tokyo was opened, and its inception constituted a very definite step forward in the progress of Eastern radio. The studios of the new Japanese station, J O A K, are, as one would expect, situated in the heart of the Japanese capital, Tokyo, but the transmitting equipment proper is located

FOR "OUTSIDE" AND "INSIDE" BROADCASTS



On the left we see the experimental staff at work on the control of outside broadcasts, while on the right is a photo of the main studio at Tokyo.

A Very Definite Step Forward in Japanese Radio

at Shingo-mura, a district some ten or eleven miles north of the city.

Here the 200-ft. twin lattice masts tower above the countryside, and mark the progress of Japanese radio in no uncertain manner. The station has a power of 10 kw., and its normal wave-length is 375 metres—figures which, I think you will agree, constitute very suitable ones for operating popular broadcast transmissions over a fairly wide-stretched territory.

To come back to "Sumo," however. The new J O A K station, fulfilling its policy of effecting a maximum number of outside broadcasts, immediately began to tackle the question of broadcasting this national form of sport. The "Sumo" contests are held periodically at the Tokyo *Kokugikwan*, which is, of course, a local stadium of much repute.

Wrestling and Baseball

It is from this pavilion that the "Sumo" games have been broadcast with all the efficient technique of the most perfect outside-broadcast in this country. Before the contestants enter the ring the announcer broadcasts particulars of the event in the approved English fashion. During the actual contests he gives a running commentary on the match, ending up with a declaration of the winner.

In the Tokyo Stadium before a wrestling match. Note the announcer in the foreground broadcasting the preliminary details.

Outside-broadcasts of the above nature have "taken on" wonderfully well in Japan, no doubt owing to the great love of sport which the Japanese people, as a whole, possesses.

Another new activity of the recent J O A K station is the broadcasting of the national baseball matches.

The main transmitting hall at the Tokyo station.

For this purpose a whole crew of announcers is requisitioned. They take their places in a carefully-wired-off enclosure on the edge of the field, each announcer being provided with a separate microphone. On the top of the enclosure is erected a large microphone for the purpose of picking up the sounds of the game, and, no doubt, the cheers (and groans) of the spectators.

Within the broadcasting enclosure, as one may well imagine, a hive of industry exists. Each announcer is responsible for the "getting-over" of certain portions of the match. Thus a complete broadcast of the game is effected, and, with the aid of the superimposed sounds picked up by the large microphone on top of the enclosure, as realistic a transmission as possible is given to the listeners.

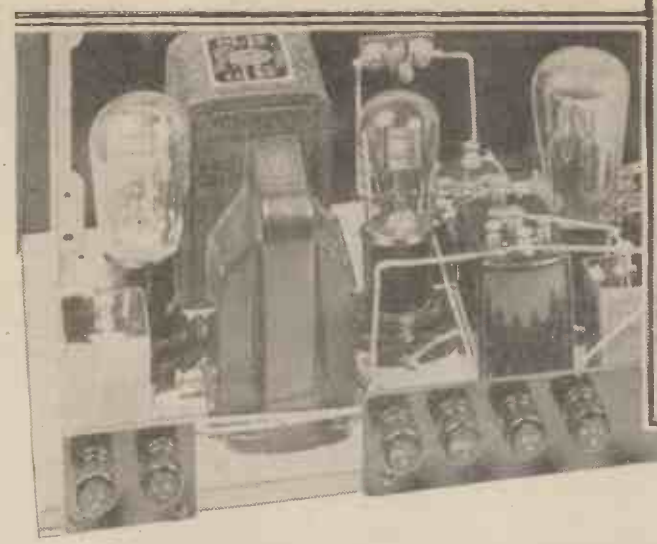
More Broadcasting on Sundays

J O A K's main studio is by no means an out-sized one, as far as modern studios go. It is capable of accommodating comfortably a decent-sized orchestra, in addition to a dozen or so artistes or performers. The studio is semi-draped only, in order that a certain degree of echo effect may be obtained in the transmissions.

The new transmitter is of the usual type, and calls for few words of description. It is situated in a specially-designed concrete hall, adjoining which are the various power plants used for supplying the current, in addition to several workshops and experimental rooms. The transmitting apparatus itself is of a modified Western Electric type, each section of the system being built into a separately-contained unit.

Quite apart from the large number of outside broadcasts which are made by the station authorities, the normal working day of the J O A K station is eight hours. On Sundays and special holidays ten or twelve hours of broadcasting are given.

The radio play is being developed, and from all accounts it bids fair to rival our English broadcasting product of that nature in popularity.



USES FOR SPARE CONDENSERS

A practical article telling how to get better results by using up those odd condensers—fixed or variable—that every experimenter accumulates from dismantled sets.

By E. L. FORTESCUE

MANY and varied are the uses of the condenser, and yet, strangely enough, nearly every listener has one or more of these useful pieces of apparatus lying idle about the house.

Many Possible Positions

Among the points across which fixed or semi-fixed condensers can be tried to see if they improve reception are (a) across the resistance in an R.C. unit (between P. and H.T. + terminals); (b) between the slider and end of a potentiometer; (c) across the grid condenser (when the added condenser is a small one); (d) across an existing by-pass condenser; (e) in the aerial or earth lead; (f) in series with the tuning condenser to reduce its tuning capacity for short-wave work; (g) from filament to plate of the detector valve; and many other places.

In the case of a fixed condenser of the "two 0's" range (·001, ·002, etc.), an obvious opportunity for use occurs in cases where your set has condenser-controlled reaction. Look at the wiring to this reaction condenser and you will find that (via the reaction coil) one set-of plates goes to the L.T. wiring, whilst the other set goes to the plate of the detector and to an H.F. choke.

"Safety First"

If the set is a modern one you *may* find that in addition to the reaction coil and reaction condenser there is a fixed condenser in this wiring between plate and filament, placed there to prevent shorting troubles. If so, well and good; but if not, you will be affording your set a valuable protection against future troubles by inserting your spare condenser in this part of the receiver.

All that is necessary is to mount it near the reaction coil (or reaction condenser), undo one of the leads to either of these, and put it on one terminal of your new condenser. Then carry on the wiring from the other side of this condenser to the point from which you took the lead, thus restoring the circuit as before, but with the condenser joined in series.

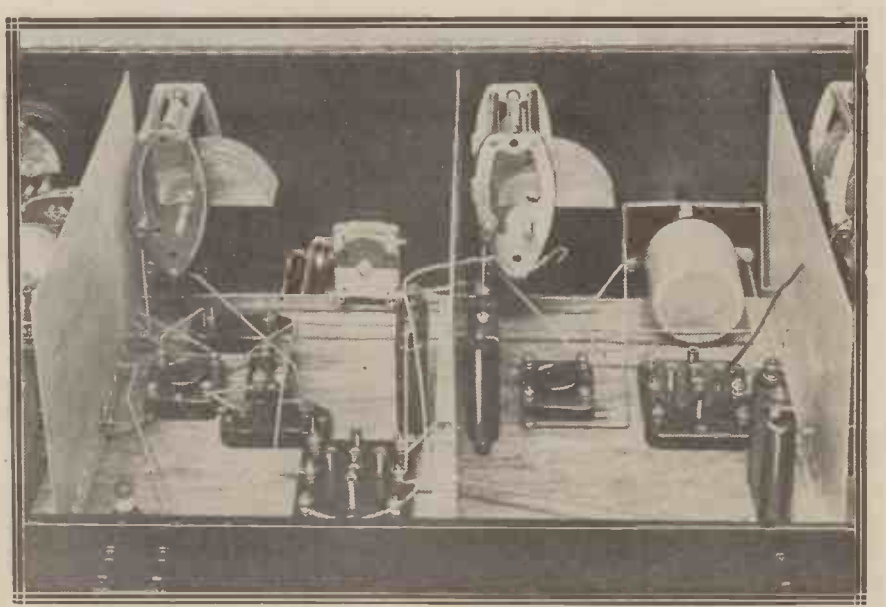
It is the work of only a few moments, but it may save you both expense and annoyance.

Very Easily Fitted

Even when a set includes a "safety" condenser in the reaction circuit, as described, a spare "compression-type" semi-variable condenser can often be of great assistance in improving reaction results. In this instance, simply connect one side of the added condenser to filament and its other side to plate of the detector valve. Readjust H.T. + to the detector so as to get good, snappy reaction, and then notice the effect on reaction control adjustment when the tuning condenser is towards the top of the scale.

Smooth Reaction Control

You will find, in all probability, that instead of the set going fairly suddenly into oscillation as the true reaction condenser is advanced a little way, it will be possible to adjust the extra semi-fixed condenser so that oscillation takes place only when the reaction condenser is "full on." This results in a great improvement in the ease of handling when long-distance work is attempted.



Some of the many uses of fixed condensers are illustrated in this view of a modern set. Note how the reaction condenser on the panel has a fixed condenser in series with it.

The L.S.D. of being

IT was stated in the public courts not very long ago that a certain entertainer was receiving from the B.B.C. about £150 per week. The very mention of such wealth was sufficient to cause at least nine out of ten amateur comedians to make up their young minds to reach the microphone at all costs. Indeed, I am told that some of them ordered their Rolls-Royce on the spot so that it might be delivered in time.

On the face of it, such a statement, considering the circumstances under which it was uttered, does undoubtedly convey the impression that a broadcasting comedian is a rich man. But it needs looking into. How many weeks, I wonder, did the £150 per week last? One, and only one, I should say.

All Kinds of Salaries

To understand the true value of such a figure a certain knowledge of other conditions is required. The B.B.C. pays all kinds of salaries, because it has to go out into the market and take prices as it finds them. The most expensive part of any programme is usually the peak hour or half-hour. An artiste who sings a couple of songs in a normal programme will not get £150 a week, but a sum equivalent to his earnings on the halls or concert-party platforms.

The biggest sums go to people like Sir Harry Lauder, who are relatively few, and able to name a figure and get it. Probably the next largest go to the "rota" artistes for the week. Listeners may have noticed that nearly every week there are certain names being repeated at stations all over the country. These are the week's stars. Their payment is in the neighbourhood of, but it would not be fair to say they are earning, that sum per week. Even if they are super-super-entertainers, the B.B.C. will not employ them more than once every six weeks, and more often the period between two such engagements is six months.

Some financial secrets revealed by one of Britain's most popular broadcasters.

In considering smaller engagements, such as a quarter of an hour on Thursday and ten minutes, say, on Saturday, a comedian, such as myself, has to bear a lot of points in mind. First of all, he has to watch his expenditure, of which I shall have something more to say in a moment, and to maintain a sufficient balance at the bank to meet it. Then he must watch his microphone appearances so that they do not become too numerous. The surest way to extinction is to weary the public.

"Just a Little More"

This is so self-evident an axiom for all entertainers that it may seem scarcely necessary to mention it, but I can assure my reader from my own experience that it is the easiest thing to forget. We artistes are all surrounded by friends who, from the best possible motives, persist in telling us how marvellous we are. Officials at Savoy Hill give us an encouraging word or two, and sometimes we read a kindly notice in the Press, all of which gives us, or, at any rate, tends to give us, swollen heads.

Often and often this well-meant flattery has made me simply bursting to go on again, but somewhere inside me a little voice has whispered, "No." My motto is always the same as that of a very well-known man in regard to eating. He said, "Always leave off when you feel you would like just a little more," and I try to leave the microphone when I have been moderately successful, so that the public "would like just a little more."

Looking for Ideas

A comedian can never afford to push his income up to the limit, because he is running the risk of shortening his professional life.

Another point is that of material. The lines and gags spoken before the microphone are all carefully thought out beforehand. Naturally, funny ideas come fairly readily or he would take up some other job, but there are times when he feels no more funny than anyone else, when, to use a nautical phrase, he is becalmed. There is no cure for this professional complaint. Everyone has to study his own mental make-up and try to discover a remedy.

"The biggest sums go to people like Sir Harry Lauder, who are relatively few, and able to name a figure and get it."

Funny

By LEONARD HENRY

I know one popular music-hall artiste who used to walk round the Zoo looking for ideas. There was another who went down into the country and called on his aunt who kept a small poultry farm; still another used to go for long country walks with his wife, carrying on for perhaps a whole hour before so much as opening his mouth—but when at length he did, it was usually with a first-class suggestion. For myself, I usually call on some friends and make merry with them so as to drive all worries out of my head. After an evening in their company, or in a bad case a week of evenings, ideas begin to trickle in again.

I suppose nearly every comedian keeps a joke book, in which he jots down gags, puns, twists, and thoughts for a humorous song or monologue. As a rule ideas come along in dozens, and as it is impossible to use anything like all of them at once the best thing to do is to put them "in store"

Everybody has to laugh with Leonard Henry—and here he tells where he gets his funny ideas.

A recent portrait of the author of this article.

The famous Roosters' Concert Party. Leonard Henry says: "An artiste who sings a couple of songs in a normal programme will not get £150 a week, but a sum equivalent to his earnings on concert party platforms."

"A Wireless Comedian Undoubtedly Earns Good Money"

for a mental rainy day. Unfortunately, a joke is not always funny; when one turns to the book the funniness has sometimes disappeared. What is humorous to-day often seems painfully childish to-morrow.

Now it must be remembered that every entertainer, no matter whether he is a comedian or straight actor, is a one-man concern. He has no machinery, and no "hands." Everything depends on his presence; when Leonard Henry is due to broadcast it must be Leonard Henry in the studio. I can never arrange things so that someone else does the donkey work while I sit back and count the profits.

Always a Personal Business

If I made my living making wireless sets it is conceivable that I should in time make myself into a company, build a factory and content myself with watching things, never soiling my hands again. If I contracted an illness the factory would still run, and there would probably be no falling off in income. But when Leonard Henry falls ill he stops earning, because he cannot employ anyone to do his work no matter how big he may become in his profession.

From this it follows that any comedian must study his health and spend more money on it than the average person. The slightest suspicion of a cold, not to mention the dread 'flu, means wrapping up, medical attention, medicine and what not. During the hot summer months as much time as possible must be spent at the seaside, or in the country, fortifying the system against the rigours of the coming winter.

All this costs money. My occasional hotels alone make quite a startling total. Then there are numerous items of petty cash incurred in order to keep bright and cheerful, abreast of the times and in touch with the latest trend of popular humour.

Little Chance to Save

A wireless comedian undoubtedly earns good money, and is not a poor man, but his income is not regular and his expenses are large. Not infrequently a case is brought to light of a former popular music-hall idol who has fallen on evil days, a man who once "topped the bill" regularly in the West End. The cause of his straightened circumstances is lack of income. No one, except that one-in-a-hundred super-artiste, can hope to keep up with his expenses unless he is earning fairly consistently. Once he falls by the way his capital will soon be eaten up, because he has never had a chance to save any appreciable amount.

I must not close on too mournful a note as that would convey an altogether wrong impression. Being a comedian is a glorious life. I would have no other. But—I shall never be a millionaire, and I doubt if I shall ever earn £150 per week *every* week.

BUCKLING BATTERY PLATES

An accumulator that has been allowed to sulphate to any extent is also extremely liable to a further disablement known as "buckling."

Taken by itself, sulphating, if it has not gone too far, is usually amenable to a little patient and persuasive treatment, but when this doubly complicated stage has set in the case becomes a rather hopeless one, and it usually means that the positive plates at least—if not the entire cell itself—will have to be "scrapped." Short-circuits are set up, the paste falls out of the grids.

Where buckling has set in to any appreciable degree it is advocated that the positive plates are at once replaced by others, or else that the affected cell or cells be put out of service altogether. But where sulphating is unaccompanied by buckling, or where the buckling is only slight, matters may be somewhat remedied.

Charge Very Slowly

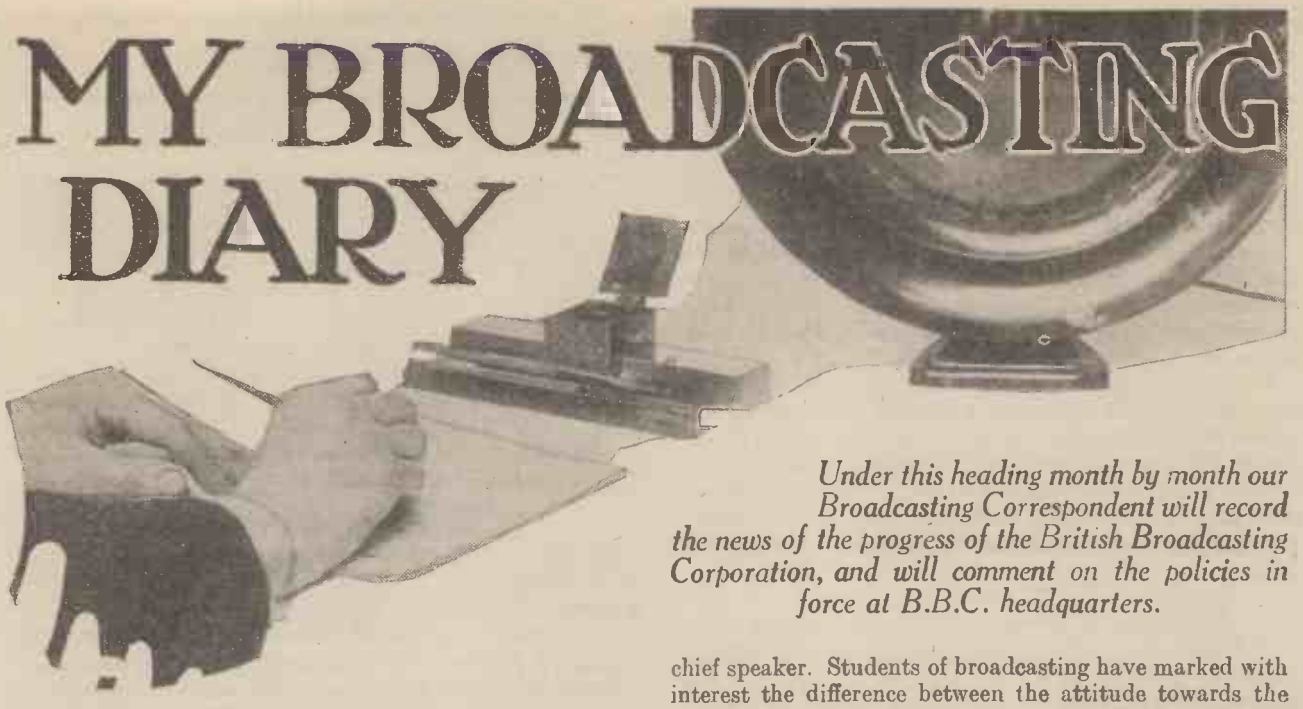
The faulty cell should be charged at approximately half its normal rate.

A sulphated cell placed on charge at normal rate almost inevitably buckles, so great care should be taken in this respect. Once on charge, the restoration of the cell to a healthy life is then very largely a mere matter of time. It is found that the electrolytic action of the charging current, which may be gradually increased as the treatment proceeds, slowly disintegrates the white, scaly deposit, until at length, after persistent application, it gradually disappears altogether.

On no account should current be drawn from the cell during this time, nor is it wise to stop or interrupt the charging current, unless perhaps it is to empty out the old acid once or twice and fill up again with new of correct specific gravity.

"Being a comedian is a glorious life," says Leonard Henry, and it certainly looks like it from the smiles of this radio revue company.

MY BROADCASTING DIARY



Under this heading month by month our Broadcasting Correspondent will record the news of the progress of the British Broadcasting Corporation, and will comment on the policies in force at B.B.C. headquarters.

European S.B.

It has now been definitely arranged for the broadcasters of Britain, Belgium, and Germany to put out three composite programmes—one in January, one in March, and the third in May. The first programme will be mostly symphonic. The second will be of modern music, and the third of popular orchestra.

I understand that, although the Continent is rather keener to have British programmes, there is still a sufficient desire at Savoy Hill to make exchange a real thing. If the composite programmes of January, March and May are as successful as is anticipated, there will be a revival of discussion of the formation of a Programme Board for Europe.

The "Centralisers" at Savoy Hill, having completed their policy in the provinces, are naturally turning to the possibility of European centralisation. They feel that if it is possible to produce better programmes at a smaller cost by concentrating on London, then it follows that if it is possible to "pool" the programme resources of the whole of Europe, there might be a considerable further demobilisation at the headquarters of the B.B.C. For instance, it might be possible to reduce the staff of the music department.

Kipling to Broadcast

It seems probable that the voice of Mr. Rudyard Kipling will be heard by wireless for the first time on December 12th, the occasion being the broadcast of the speeches at the dinner of the United Association of Great Britain and France.

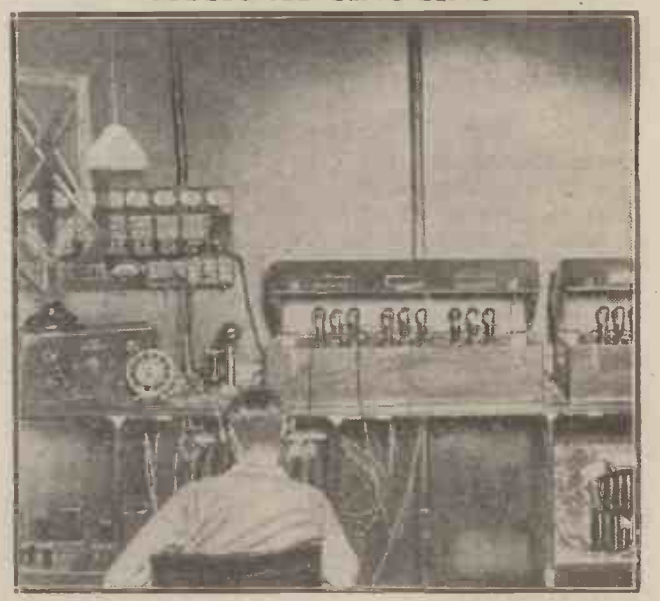
Other speakers will be Monsieur Fleuriau, Mr. Arthur Henderson, and Lord Derby. It will be recalled that hitherto Mr. Kipling has avoided the microphone. Unfortunately his health prevented his participation in the enquiry of the Broadcasting Committee of 1925, of which he was a member.

Civil Service Dinner

The B.B.C. will again broadcast some of the speeches at the Civil Service Dinner, to be given at the Connaught Rooms on February 14th. The Prime Minister will be the chief speaker. Students of broadcasting have marked with interest the difference between the attitude towards the microphone of members of the present Government and of the last. Labour leaders lose no opportunity of getting on the air.

It would be unfair, however, to suggest that any undue advantage is taken of these opportunities. Members of the present Government are as careful as their predecessors to avoid controversial subjects on broadcasting occasions.

MUSIC AT SING-SING



Part of the home-made radio outfit used at Sing-Sing Prison to supply broadcast programmes to the 2,300 'phones and 21 loud speakers installed in the buildings and cells.

Leicester Brass Band Festival

Midland listeners will be particularly pleased to hear that a considerable part of the Leicester Brass Band Festival on March 1st is to be broadcast. This was a feature keenly appreciated last year and the year before.

All the Latest News for Listeners

Birth of the "Midland Regional"

With the introduction of the second wave at Brookman's Park in January, 5GB will begin to assume its normal permanent function of Midland Regional transmitter. This event should have the effect of consoling the Midlands for limitations which will be placed on the broadcasting organisation at Birmingham. As a matter of fact, however, these limitations, particularly in the matter of a smaller orchestra, are being postponed.

It seems, indeed, that even when they take effect the subsidy of the Birmingham City Orchestra which will follow may be on so generous a scale as to nullify the economical argument on which the reduction was based! In view of the terrific outburst of local feeling in the West Midlands, the B.B.C. is likely to move a little more cautiously in further centralisation schemes on the musical side.

National Chorus at the Coliseum

It is understood that the National Chorus will fulfil a week's engagement at the London Coliseum early in the New Year. This Chorus is now regarded as being first-class, and its performances are looked forward to by even the music critics. Much rehearsing has been put in, and Mr. Stanford Robinson, the Chorus master, has received warm praise for his work.

The only snag seems to be that the B.B.C. is expecting rather a lot of the National Chorus. It is, of course, an amateur organisation, and many of its members have to work for a living. It would be a pity if the B.B.C. continues to expect too much of this altogether admirable organisation.

Percy Pitt to Conduct

I am told that it is now definitely arranged that Mr. Percy Pitt will relinquish the post of music director to the B.B.C. on January 4th. Thereafter, Mr. Pitt's services will be available in an advisory capacity on opera, as well as in conducting. Apparently Mr. Pitt will appear before the microphone much more frequently in future than in the past.

There is still some doubt as to who will be the next music director of the B.B.C. It has been announced in Birmingham that Mr. Adrian Boult, on resigning the directorship of the City Orchestra, would go to the B.B.C. All that Savoy Hill would say about this statement was that it was true that a change was contemplated, and that conversations with Dr. Boult were in progress.

I suggest seriously to the B.B.C. that it would be a good thing to clear up this mystery. Here is a case of reticence being rasher than undue candour. It is profoundly to be hoped that Dr. Adrian Boult is secured for the B.B.C. within the next twelvemonth.

The Relay from Canada

It has been definitely arranged to relay a programme from Canada on January 4th, from 11.30 to midnight, Greenwich Mean Time. This programme is being organised and transmitted by the Canadian National Railways, and will cross the Atlantic by Marconi Beam. The B.B.C. will radiate on the national wave, 5 X X, and all the relays. French-Canadian folk-songs and representative Canadian music will be given by the most distinguished Canadian artistes.

If this relay is as successful as it is hoped, then others will follow at regular intervals. Australia, New Zealand and South Africa will be included, and the era of Empire programme exchange will be initiated next year. Meanwhile, arrangements for United States' programmes are proceeding separately.

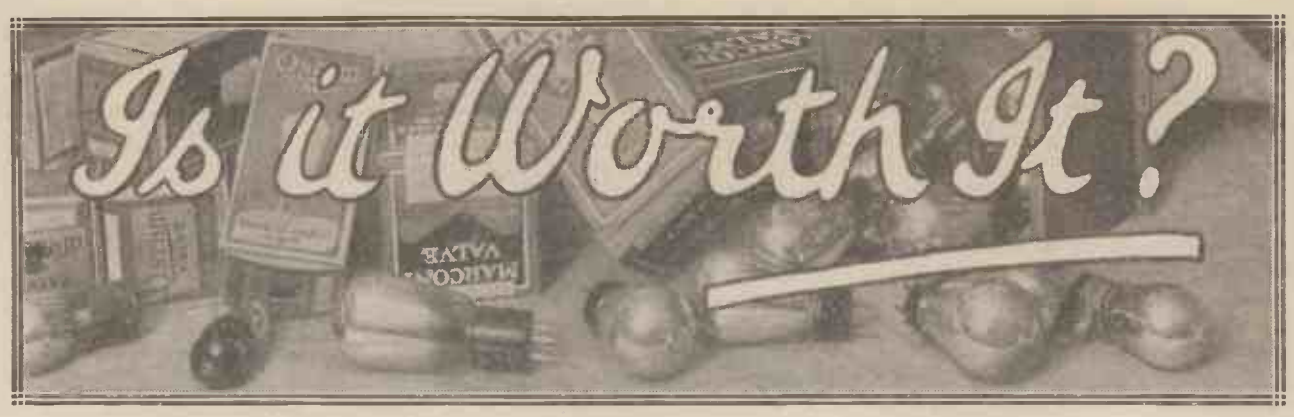
Dundee and Bournemouth

I hear that the premises of the B.B.C. at Dundee and Bournemouth are shortly to be given up; but the transmitters will stay. There is a certain sentimental regret as all the old landmarks of British broadcasting disappear.

Regional transmitters can never be as personal or intimate as the local stations; but the cause of progress must be served, and the B.B.C. has no alternative.

"... THE WIRELESS ORCHESTRA CONDUCTED BY JOHN ANSELL ..."

A tremendous amount of rehearsal is carried out by the Wireless Orchestra, here seen in an interval between numbers.



There are many occasions when a query as to the worth of a particular alteration in set design, or use of a valve or component, is raised, and sometimes the question takes a lot of answering. Readers will find assistance in this plain-spoken article.

By KEITH D. ROGERS.

THIS is a question which is asked by very great numbers of home constructors and listeners concerning various points about their receivers, and especially where the valves are concerned.

This is the time of the year when many alterations are made to receiving sets and when many new sets are constructed, and so if some of the main "is it worth it?" questions are answered here it may prove of assistance to readers who are in doubt about these particular points.

Two typical screened-grid valves—the Marconi and Cossor two-volters.

How many of you have asked yourselves whether it was worth while altering your ordinary receiver to include a screened-grid stage, or building a new set incorporating a screened-grid valve? How many of you have queried whether it was worth while using a super-power in the last stage, whether an ordinary power would be not just as good or even better, or whether a pentode would meet your purpose?

Have you ever queried whether anode-bend or grid-leak rectification is the better? And the old query as to whether transformer or resistance coupling on the L.F. side is preferable is still being asked, while a hundred and one other little points crop up every day in the life of the home constructor.

In the first place let us discuss the screened-grid valve question, to which the answer depends upon two main features which can be expressed as questions themselves. The first is: "Do you want selectivity or sensitivity?" Which of the two is more important? And the second is: "Can you supply the valve with sufficient H.T.?"

Sensitivity or Selectivity?

The answer to the first question depends somewhat on your distance from the local station. There are means of getting both sensitivity and selectivity from a screened-grid-valve circuit, such sets as the "Eckersley" Three being ideal from this point of view, but if you want *ultra selectivity*, and you only want to use one H.F. stage, then the ordinary neutralised valve is more likely to give it to you than the screened grid.

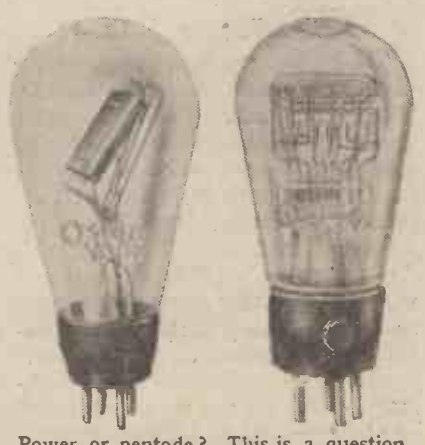
If, on the other hand, you prefer to use a wave-trap, or a rejector, or a special circuit for your screened-grid valve, in order to cut out the local station, which perhaps is rather too near to you, and you want at the same time *sensitivity* to give you distance, then the screened-grid valve will give you what you want.

There is no doubt that the screened-grid valve has much more "punch" than the neutralised valve, but it has the drawback that it consumes far more H.T. current, and, as a rule, unless the circuit is carefully designed the selectivity will not approach that obtained by the neutralised stage.

Bias and H.T.

The screened-grid valve is certainly worth it if you are prepared to use a proper circuit, and not merely to adapt the present set and hope that a screened-grid valve will give better results even though its anode circuit may not be suited to it; and also if you are prepared to supply, say, four milliamps or more of H.T. current instead of the usual one milliamp which is needed for the neutralised valve.

You must also be prepared to bias your H.F. valve. To work properly an S.G. valve nearly always needs biasing, and many valves of the screened-grid type are exceedingly



Power or pentode? This is a question often asked. Above we have the super-power P.625 and the Osram pentode.

Which Type of Output Valve is Best?

uneconomical in their anode current consumption unless they are biased. The bias varies from 1½ volts up to about 4½, which is the maximum I have ever found a screened-grid valve to require. The usual bias required is about 1½ volts.

Suitable Circuit Required

Thus assuming you are prepared to provide a bit more H.T., and some grid bias, and to use a circuit really suited to the valve, go ahead and you will certainly find the screened-grid valve worth while; but if, on the other hand, you are going to make a makeshift circuit of it, not worrying about getting the proper anode circuit impedance, not worrying about the grid bias, and probably attempting to run the screened-grid valve with a number of other valves in your set from only small-size H.T. batteries, then stick to the neutralised stage, for it will give you far better service and greater satisfaction.

The Output Stage

The super-power, power, and pentode problem is rather more difficult to unravel. Perhaps it will help us if we have a look at the valves themselves and see what types of things they are.

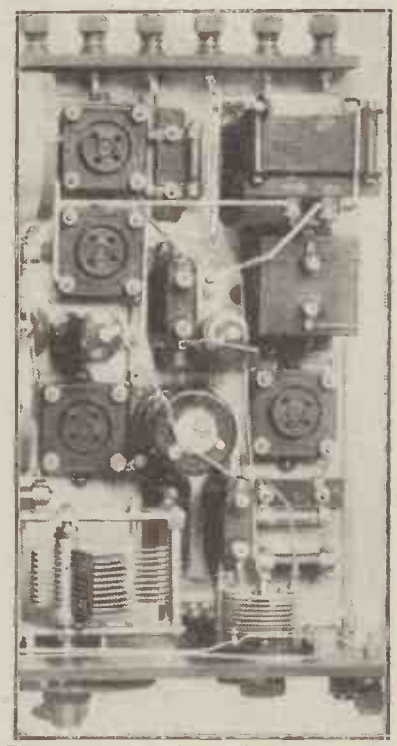
What is usually known as the power valve generally has a magnification factor of anything from 4 to 10 or so, and an impedance of 4,000 ohms upwards. It will not carry any very great grid swing. That is, you cannot put a tremendous signal into it without it causing overloading; but if, on the other hand, you put a moderately strong signal on to the grid, then it will give you good amplification in return.

Super-Power Valves

The super-power valve is not nearly so generous in its amplification. Many people imagine that the super-power valve is a valve which will give more power; in other words, a far greater punch for unit input, i.e. more amplification. But that is quite an erroneous translation of the term "super power." This valve is one which will *handle* more power, not necessarily give you more amplification. As a matter of fact, a super-power valve rarely has an amplification factor greater than 6, unless it be of the special A.C. mains type.

But it has a much lower impedance than the power valve, and will carry a far greater input without overloading. Therefore, if you get a bigger input on the valve you should expect a bigger output, provided the amplification factor is reasonably good. That is exactly what happens with a super-power valve, you have a greater input which can be put into it without overloading and it will give you a bigger power output, operating the loud speaker louder than is the case with the ordinary power valve.

Naturally, in wireless, as in everything else, we do not get something for nothing, so that if you use a valve which will enable you to handle more power you have got to give it more electrical energy, and as a rule the



The output end of a typical multi-valve with parallel output valves. Two super-power valves are best here in the last stage, though one P.M.24A instead of the two super-powers would be very useful for moving-coil work.

super-power valve takes a little more L.T. current and quite a deal more H.T. current, for you must be prepared to give it anything up to 20 milliamps or so of H.T. if you are going to work it at its best.

The pentode valve is rather in a class by itself. It is an output valve which has a very high magnification factor and at the same time a very high impedance. It will not carry a very large grid swing, no larger as a rule than the ordinary power valve, but it will give a tremendous magnification, much greater than the power valve, and input for input the output is several times louder than that obtained with either the power or super-power assuming than none of these valves is being overloaded. But the characteristics of the pentode make it that it is often not worth while using a pentode in place of a power or super-power.

A Question of Quality

With the ordinary loud speaker the pentode valve is hardly suitable unless an output transformer is employed, unless you want the maximum magnification, say, for short-wave working, or on a two-valve set, when you are using a loud speaker which is not very high-pitched.

If your loud speaker is inclined to be very high-pitched or lacking in bass, then the pentode valve, without the special output transformer, is liable to make it very "hard" in quality. For moving-coil work the pentode valve is perhaps more useful, because it imparts a brilliancy to moving-coil reproduction which it is impossible to get with the ordinary super-power or power valve without a specially-designed loud speaker.

Some of the modern pentodes (such as the P.M.24A) will provide quite sufficient power to work a moving coil really well.

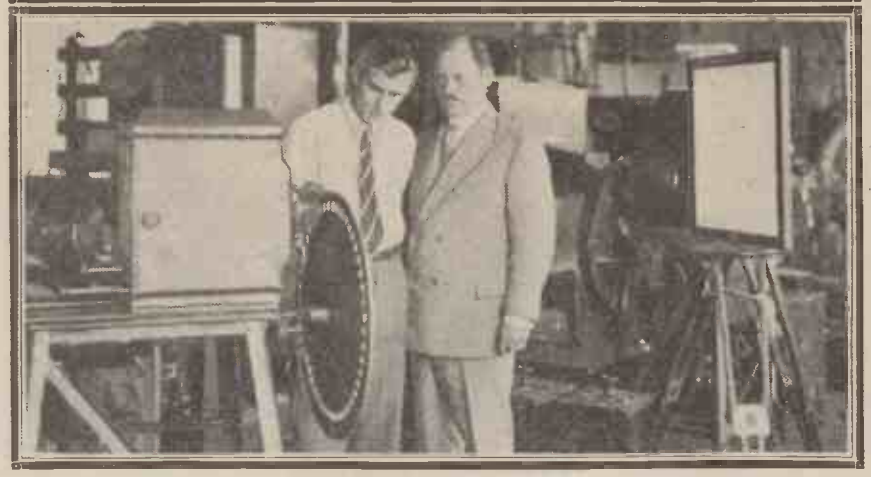
Not Always Worth It

If I were asked "Is it worth it?" when discussing the pentode, I would say "In the average case, no. Use a power or super-power valve." If you are using a moving-coil speaker, however, I should advise you to try the pentode unless *your loud speaker is "peaky" in the high register*. Where you want maximum volume with the minimum number of valves the pentode valve is very useful, but you want to know what you are doing, or to work on advice from the set designer himself, before you rush to place a pentode in the output stage of any ordinary receiver. You always know where you are with a power or super-power valve, but with a pentode, unless you are certain of what you are doing, you may be disappointed.

And that brings us to the case of anode-bend H.F. amplification. Which is the better? Is anode bend worth

(*Continued on page* 696.)

CONSTANT SPEED



One of the biggest problems met in television and its allied sciences is that of synchronisation, and in this article the subject is dealt with from an unusual angle.

By MICHAEL MERLAIN.

IT seems that talking films, the development of which is running parallel with television, may provide a new solution to the problem of synchronising.

Television with any system using rotating discs does not demand a *synchroniser*, but a *speed stabiliser*. It is not essential that the receiver should be exactly in step with the transmitter, provided that both are running at exactly the same speed, and it is not necessary that they should start and stop together.

Actual synchronising is necessary in Fultograph "still" picture transmission, for unless the receiver and transmitter are in step during the whole period of covering the picture drums, not all of the received picture will be obtained. If the receiver starts late, the received picture will not be square on the paper, but, of course, this is not the case in moving picture transmission, for provided the speeds at both ends are identical the image can easily be properly "framed" when the definition is clear.

Accurate Control Required

Therefore, for simple television a speed stabiliser, rather than a synchroniser, is needed; the only difficulty is that it must be extremely accurate and far more sensitive than crude speed governors such as are fitted to gramophones and so on.

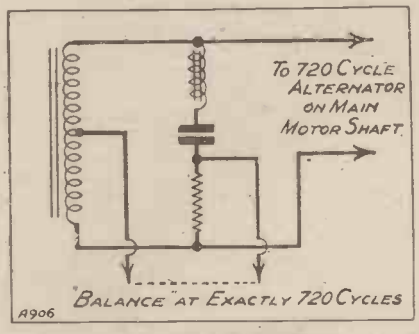
As a matter of fact, it is found that a good musical ear can detect a speed change of less than half per cent, provided this is reasonably sudden. To allow for a reasonable margin when designing the reproducing apparatus for "talkie" systems it was decided to incorporate a governor which would not allow speed variations greater than one-fifth per cent.

This is far too small a margin to be safely covered by any mechanical governor, and so an electrical governor was produced which is now a standard part of the equipment in any cinema showing talking films using Western Electric equipment.

There is one driving motor turning the film projector at one end, and a gramophone turntable at the other. The problem is to maintain the speed of this motor constant to within one-fifth per cent.

The first part of the speed control is a small A.C. generator at one end of the motor shaft, and this supplies a fairly small current at 720 cycles to a bridge circuit of the type shown in an accompanying figure.

This has on one side the two halves of a transformer, and on the other a condenser, resistance and L.F. choke in series. The condenser and choke are tuned to 720 cycles, so that at this frequency the impedance of the choke and condenser is matched to be the same as that of the resistance.



At a frequency of 720, therefore, the voltage across the dotted line shown (that is, between the junction point of the resistance and condenser-choke side, and the centre-point of the transformer) is zero, but *instantly shifts its phase 180 degrees if the 720-cycle frequency changes.*

This abrupt change is very convenient for speed control purposes. It is made use of in the following manner.

The possible voltage changes across the dotted line are applied to a two-valve amplifier, the second stage being a valve of fairly large capacity, so that a large anode current flows when the voltage change in the bridge takes place. The purpose of this is simply to amplify the voltage variations and to change them into D.C. variations.

A Special Transformer

From the plate circuit of the second valve the output is taken to a kind of three-leg transformer. One leg supports a winding in the plate circuit, and the other two carry windings which are connected to a small repulsion motor on the shaft of the main driving motor.

When a speed variation takes place the whole chain of operations is as follows:

The speed of the small 720-cycle alternator is changed, and the frequency drops or rises momentarily in correspondence. This affects the bridge circuit, and the voltage change across the centre of the bridge is applied to the two-stage valve amplifier.

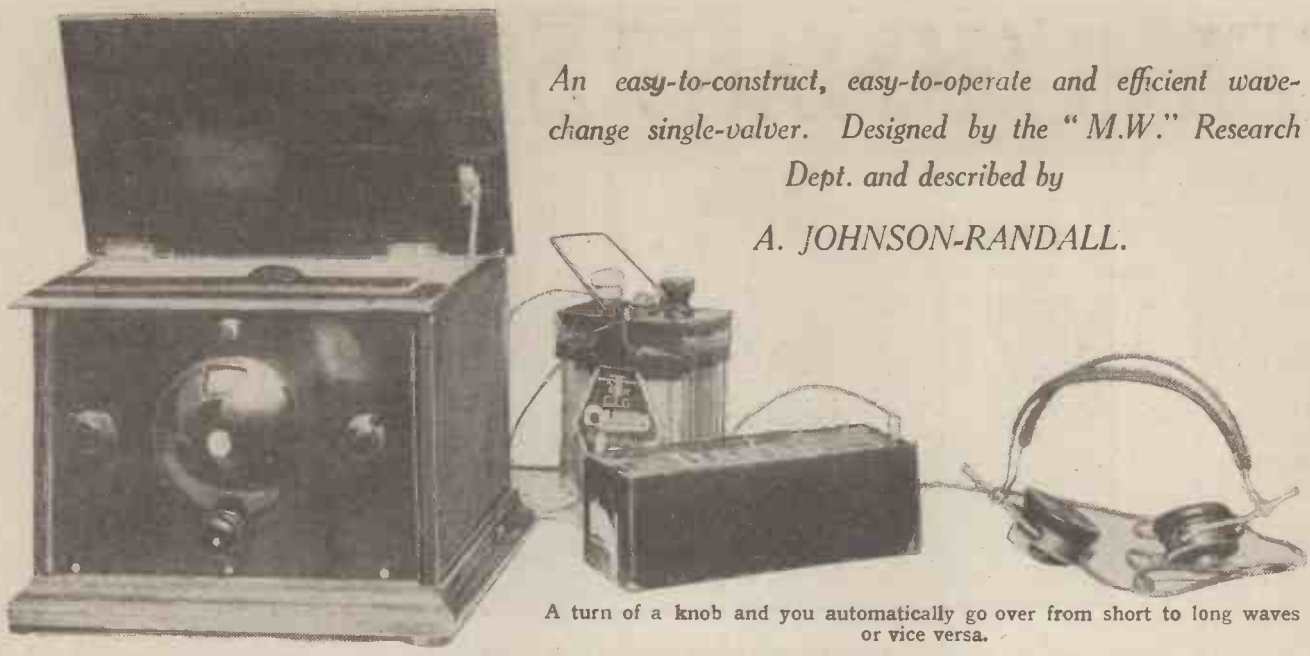
Back to Normal

This, again, causes a change in the steady D.C. flowing in the last plate circuit, and matters are so arranged that this change is sufficient to increase the magnetic flux in the three-legged transformer to saturation.

The result of this is to decrease the impedance of the other two windings on the transformer. These are connected to the repulsion motor, and its torque is correspondingly altered. This is sufficient to bring the main driving motor back into proper speed, and the whole system is again at rest.

An easy-to-construct, easy-to-operate and efficient wave-change single-valver. Designed by the "M.W." Research Dept. and described by

A. JOHNSON-RANDALL.



A turn of a knob and you automatically go over from short to long waves or vice versa.

OF the various wave-change schemes it is doubtful whether there is anything more effective and more satisfactory than a complete change-over from a low-wave to a long-wave circuit. This method is equivalent to a complete change in coil sizes, and is not so likely to produce jamming from low-wave stations when on the long waves.

In certain areas, reports have been received that in some circuits incorporating a loading-coil device interference from 5 G B has been experienced on the long waves. Many attempts to overcome this trouble have been made, and the most puzzling part of the matter is that the effect only occurs in certain districts.

Selectivity Essential

If, however, one makes a complete change-over to another circuit, instead of using part of the existing medium-wave coil, it is difficult to see how a station on the medium wave can cause interference with 5 X X, provided, of course, one is not living within the shadow of the former station.

In designing this single-valve receiver, therefore, the "M.W." Research Department endeavoured to break away from standard practice and to leave out the usual loading coil altogether. In view of the selectivity requirements of the modern receiver, there were certain difficulties to be overcome first of all.

For instance, the circuit had to be sufficiently selective to reduce any possibility of the local station breaking through and interfering with distant reception. Secondly, there was the question of reaction. Obviously, in order to obtain the necessary selectivity it was essential to use tapped coils, but how was one to get reaction on both wave-bands, at the same time retaining simplicity in operation and keeping down expense?

The reaction difficulty was overcome by using a small coil in between the two tapped coils for the medium and long waves, and by arranging the coil socket on the baseboard so that the medium-wave socket could be rotated in order to vary its position in relation to the reaction coil. Thus one coil was made to serve both wave-bands.

LIST OF COMPONENTS

1 Panel, size 10 in. × 7 in. × $\frac{3}{16}$ or $\frac{1}{4}$ in. ("Kay Ray," Resiston, Trelleborg, Becol, Paxolin, etc.).
1 Cabinet to suit panel, and baseboard 9 in. deep (Cameo, Lock, Pickett, Bond, Raymond, Caxton, etc.).
1 Terminal strip, 8 in. long by 2 in. wide.
1 ·0005 variable condenser, geared type or with slow-motion dial (Lissen, Igranic, J.B., Dubilier, Utility, Lotus, Pye, Ormond, Burton, Cyldon, Formo, Bowyer-Lowe, Raymond, Colvern, Peto-Scott, etc.).
1 ·0001-mfd. reaction condenser (Bowyer-Lowe, Lissen, Lotus, Utility, J.B., Dubilier, Burton, Formo, Cyldon, Raymond, Peto-Scott, Polar, Magnum, Ormond, etc.).
1 Two-pole change-over switch (Wearite).
1 H.F. choke (Dubilier, Lissen, Varley, Lewcos, R.I., Igranic, Raymond, Climax, Bowyer-Lowe, Ready Radio, Wearite, Precision, Ormond, Cosmos, Bulgin, Colvern, etc.).
1 Formodensor, type F (Formo).
1 Valve holder (Lotus, W.B., Igranic, Benjamin, Bowyer-Lowe, Wearite, Dario, Pye, Marconiphone, Precision, Formo, Junit, Godwinex).
1 ·001-mfd. fixed condenser (T.C.C., Dubilier, Lissen, Clarke, Goltone, Mullard, Igranic, etc.).
1 2-meg. grid leak and holder (Dubilier, Lissen, Ediswan, Igranic, Carborundum, Mullard, Loewe, etc.).
1 ·0003-mfd. fixed condenser (T.C.C., Dubilier, Lissen, etc.).
3 Baseboard-mounting coil holders (Lotus, Igranic, Raymond, Wearite, Ready Radio, Peto Scott, etc.).
1 On-off switch (Benjamin, Lotus, Igranic, Wearite, Lissen, Magnum, Raymond, Ormond, Burton, Bulgin, Junit, Pioneer).
8 Terminals (Eelex, Belling & Lee, Igranic, Clix, Burton, etc.).
Quantity copper wire, wood screws, flex, and Systoflex, etc.

Obtaining Reaction

Do not think that this small coil, however, is the only reaction winding, since obviously it could not be expected by itself to give adequate reaction on the long waves. This coil is only supplementary to the existing windings.

The medium- and long-wave coils are of the standard "X" type and have two tappings. The circuit is so arranged that the tappings are employed not only for aerial coupling purposes, but for reaction also. It will be realised that a tapping which is only sufficiently large for aerial coupling purposes is too small to give adequate reaction over the complete wave-band. Thus the centre coil is used to supplement the tapped winding.

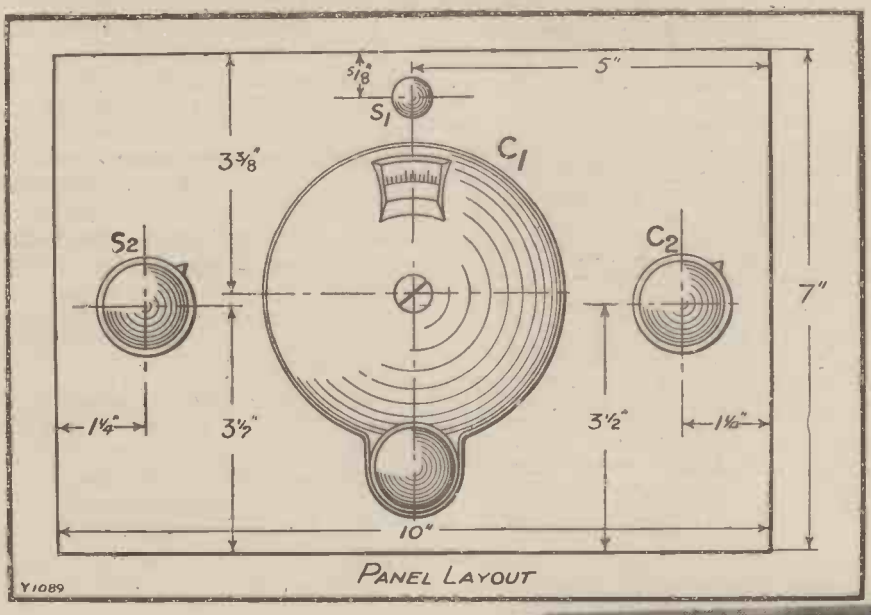
In addition, to ensure a perfectly smooth control a Formodensor has been connected between the plate and filament of the valve as an H.F. bypass, and by suitably adjusting the

The "Duo-Tune" One

small knob on this condenser perfect reaction can be obtained.

The remainder of the circuit follows conventional lines, but as a refinement and safeguard a small fixed condenser has been connected between the anode of the valve and the reaction condenser to prevent the possibility of any damage to the H.T. battery or valve if the moving vanes of the reaction control touch the fixed vanes, in other words, should the reaction condenser short-circuit.

Dealing with the construction of the set, the panel and baseboard layouts are quite straightforward. Drill the panel in accordance with the dimensions given in the diagram, and then place the various components in position on the baseboard. Note very carefully how the three-coil sockets are placed and arrange socket L_1 so that it can be rotated to a certain extent in order to vary the distance between L_1 and L_2. This is important.



PANEL LAYOUT

Wiring-Up

The best plan is to use one holding-down screw only, and then to place the second in position when the final adjustment of the coil holder has been obtained. Of course, once the preliminary adjustments are over the positions of the three coils are fixed.

Now with regard to the wiring, possibly the most difficult part is the connections to the wave-change switch. These are clearly marked on the back-of-panel diagram, which incidentally should be used in conjunction with the photographs. The two sets of inside contacts are joined together, and if you look at your switch you will easily see which are the back contacts and which are the front. You should, therefore, have no difficulty in following the diagram. There are two flexible leads which go from the L.T. terminal on the terminal strip to the tappings on the coils; one lead goes to each coil.

You must take particular care to wire up the coil sockets correctly, noticing particularly where the pins and sockets go. If you get the pin and socket connections reversed you may not get reaction, and, in any case, the "X" coil tappings will be incorrect.

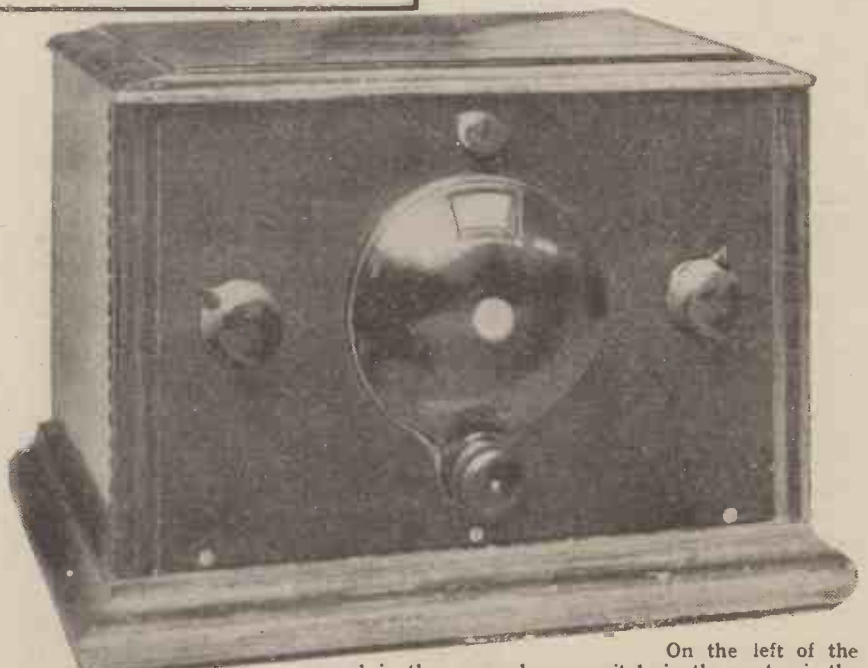
I do not think there are any other points that you should bear in mind concerning the actual construction, but for safety I would advise you to use some form of insulation covering on the wire. Systoflex is probably the easiest to handle.

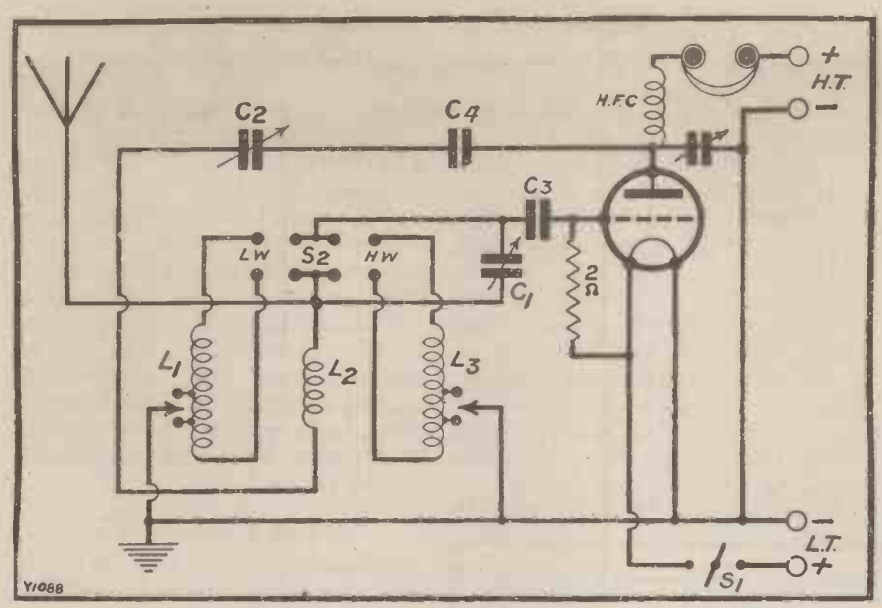
What Coils to Use

When you have completed the wiring-up you will be desirous of testing out the set on actual signals. Before doing so you will want to know what coils to use and what type of valve to insert in the detector valve holder. Well, in the low-wave socket L_1 you will require a No. 60 "X" coil, and in L_3 a No. 250 "X" coil.

The size of L_2 will have to be decided by experiment, but you will probably find that a 35 or 50 is about right. When you have placed the "X" coils in their sockets, connect up the flex leads, using the higher tappings for the preliminary tests. This, however, is not very important, for you will obviously try both tappings on each coil directly you receive signals.

In the valve holder insert a valve of the "H.F." type, or alternatively


On the left of the panel is the wave-change switch, in the centre is the tuning control, and on the right the reaction condenser. The remaining knob is that of the on-off switch.



one of the general-purpose type. Connect up a pair of 'phones and your H.T. and L.T. batteries to the terminals marked. You will need about a 60- or 72-volt H.T. battery, and it is best to buy a tapped battery so that you can vary the H.T. until you get maximum results.

With the coils in position and the valve switched on, rotate the variable condenser until you hear your nearest station. In some cases this station may be 5 X X, in which case you will place the wave-change switch in the position for the high waves.

Alternatively, if your local is a regional transmitter, such as the new Brookman's Park or 5 G B, place the wave-change switch in the medium-wave position. For these preliminary tests it is advisable to keep the reaction condenser at zero, that is, with the moving vanes right out.

Testing Out

When you hear signals rotate the reaction condenser a little, and note whether there is any increase in strength. Then experiment with the Formodensor, obtaining an adjustment that will give you the smoothest reaction control. In addition, try moving the coil holder L_1 away from L_2 by rotating it on the one holding-down screw.

Then when you get the position which gives best reaction control on the medium waves, switch over to the long waves and note carefully whether the reaction is adequate for this wave-band also. Do not forget to try both tappings on the "X" coil. The smaller tapping will give you greater selectivity.

Perhaps it will be helpful if I give my own experiences with the set on actual test. In the first place, I had only a poor aerial for my test work, because one end had broken away from the mast and had to be lashed temporarily to a convenient tree trunk.

Not Ideal!

The average height was about 15 ft., and the length 90 ft. This you will see was by no means an ideal aerial for testing a single-valve receiver, but I knew that if I could get good results on such a poor pick-up system I would have no fears of the set giving bad results in the hands of the average listener.

I connected up the aerial and earth leads and also the H.T. and L.T. batteries. In the valve holder I inserted a valve of the D.E.H. type, applying about 70 volts H.T.

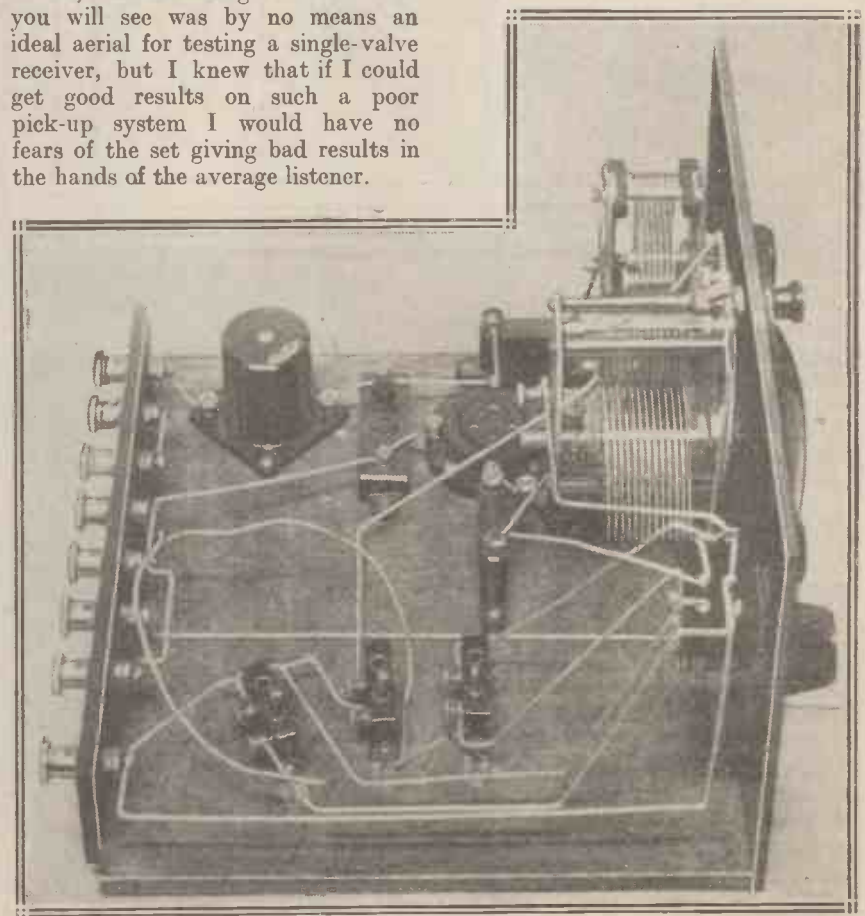
The two "X" coils were Lissen 60X and 250X respectively, and I joined the flex leads to the higher tappings.

In the centre socket I used a No. 50 coil. On switching on the valve I found that while the set would oscillate with the wave-change switch in the long-wave position there was no sign of reaction on the medium waves.

A Curious Trouble

This seemed rather curious and puzzled me somewhat at first. I then tried rotating the coil holder L_1, and noticed that this quickly remedied the trouble. In fact, L_1 had to be well clear of L_2 before the set oscillated freely.

It was now possible to obtain reaction on both wave-bands, and 2LO, 5 G B, and 5 X X came in at good strength. I then reduced the size of the reaction coil, and with a No. 35 adequate control was obtained, even with the Formodensor screwed in a little.



The two flexible leads in the foreground of this photograph are for the tappings on the two "X" coils. The centre coil holder is the supplementary reaction coil.

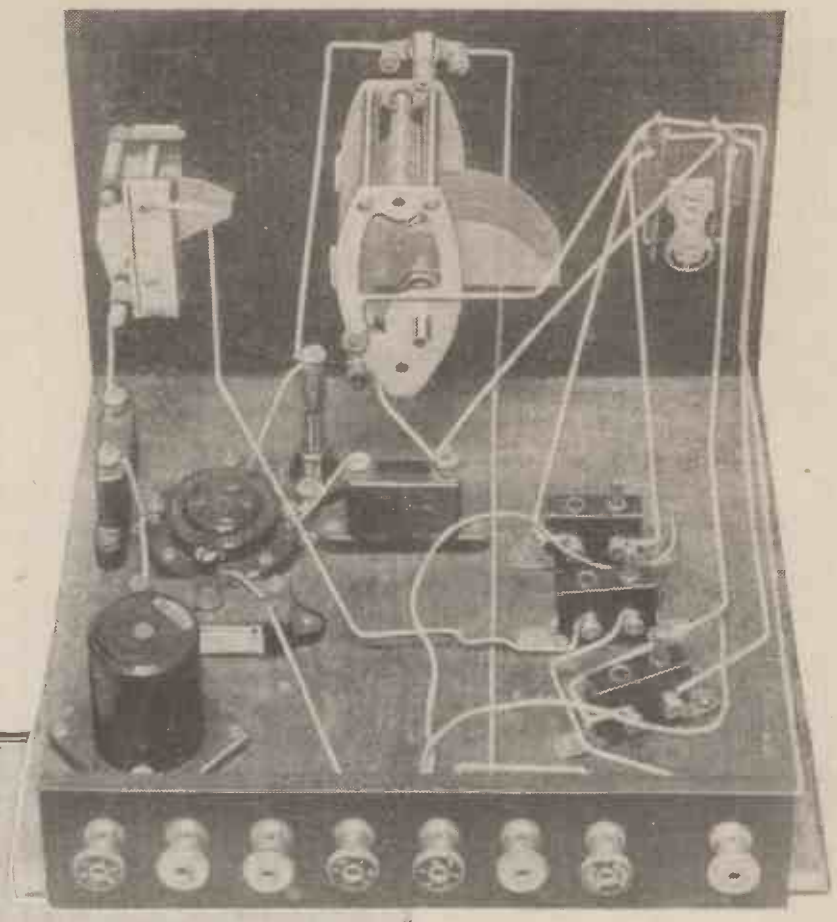
I am inclined to think, however, that a No. 50 is probably better, since with a No. 35 the adjustment of the Formodensor and H.T. are somewhat critical. Again, the reaction control varies with the type of valve used. Remember that if you use the lower tappings on the "X" coils you will need a size larger coil for L^2.

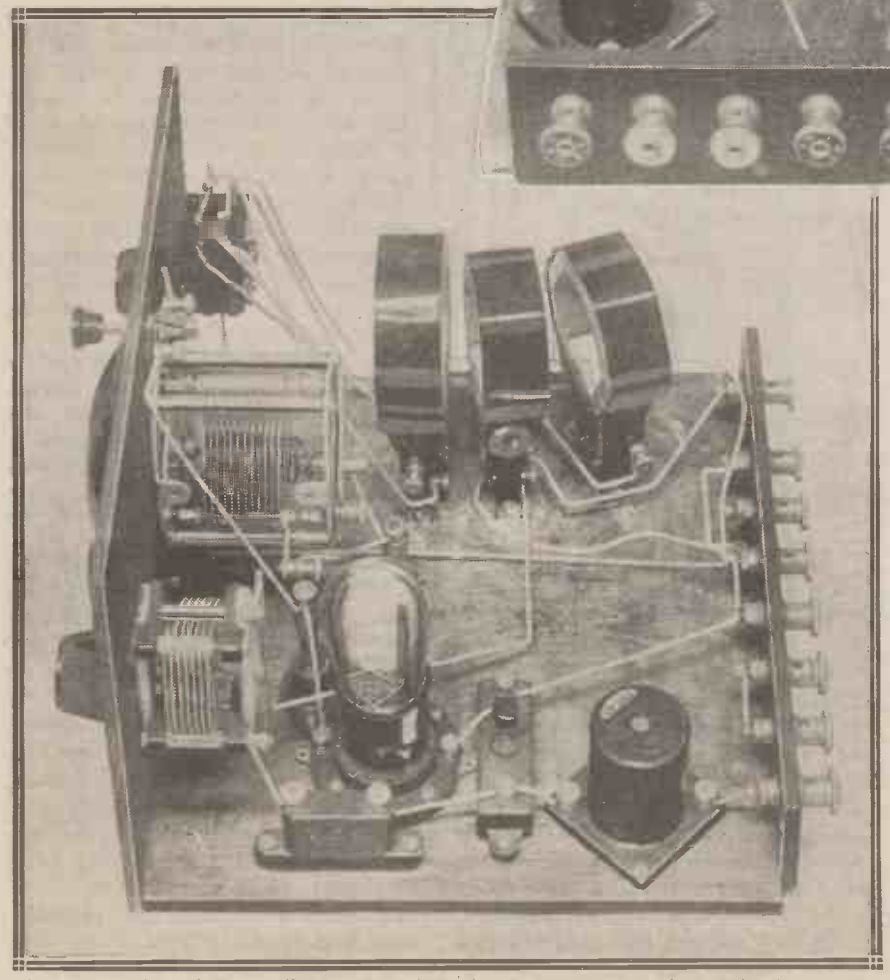
Incidentally, in the case of the wave-change switch used in the set, the adjustment for the medium waves is with the knob turned clockwise.

'Phone Reception Only

Now I should like to say a few words about the results which one may expect from a set of this description. In the first place, the receiver will not work a loud speaker, since there are no L.F. stages. If loud-speaker reception is desired, then it will be necessary to add a separate amplifying unit. The set as it stands is intended for telephone reception only.

Assuming that you have a moderately good aerial, of the outdoor variety, there is no reason why really good 'phone reception from two British tations on the medium wave-band, and 5 X X on the long waves, should not be obtained at all times.





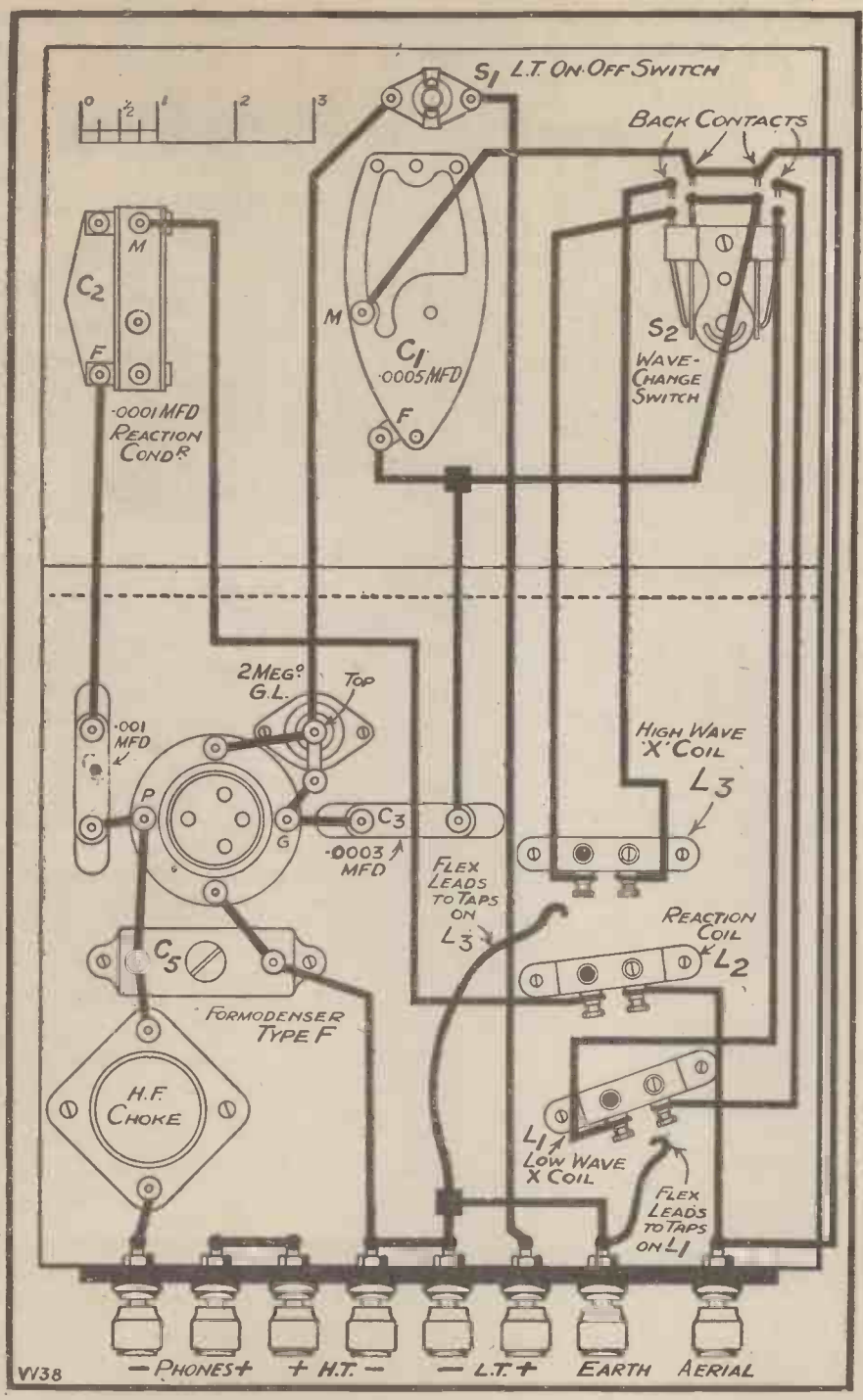
The orientation of the medium-wave coil holder (nearest the terminal strip) is very important, since it has a great bearing on the smoothness and efficiency of the reaction control.

I mention this because there is a big difference between daylight and night-time reception. Some listeners are not quite clear on this point. At night the conditions for reception are entirely different, and are much more favourable. Those of you who have handled sets before will know that directly darkness falls Continental transmissions begin to come in and a whole host of stations can be heard which were not previously audible in daylight.

Night Conditions

Therefore, in considering the range of any set it is necessary to take into consideration the daylight as well as night-time conditions. On the long waves in daylight you should be able to hear Radio Paris and probably Hilversum. On the medium wavelengths, with the exception of the British Regional transmissions, you will not hear very much.

At night, however, the various German stations, together with other Continentals, should be received at good strength with the judicious use of reaction.



If you are unfortunate in being limited to a very poor aerial or one of the indoor type your range will be cut down very considerably. In such a case you cannot expect to obtain anything phenomenal in the way of results from a single-valver. For long-distance reception with an indoor aerial an H.F. stage is very desirable.

Then, again, we come to the question of selectivity. The two tappings on the "X" coils will give you adequate selectivity for all normal conditions, but many of you may be residing within, say, ten miles of a powerful station, such as Brookman's Park. Here you may strike a patch of trouble owing to the spreading effect of this powerful transmission.

Perhaps you will find that it covers a very considerable portion of your tuning dial, and, in consequence, you will not be able to tune-in other stations. Now, the first thing to do is to cut out this local transmission.

To do this you will need a device of the Brookman's Rejector type. This rejector will probably be described in the next issue. You must adjust the rejector until your local station no longer troubles you, and then you can proceed to tune-in any other transmission you may desire.

Do not blame the set for this lack of selectivity, because it is impossible to obtain greater sharpness without adding to the complication of the design. For instance, another tuned circuit would be necessary, and this would involve a second tuning condenser.

Some Final Hints

Next, we have the adjustment of the Formodensor. This is a refinement which in practice has been found to increase signal strength. It does more than this, however, it makes the reaction control smoother. This is a very important factor in tuning-in distant stations.

If the set goes into oscillation with a plop it is obvious that this effect is preventing the listener from obtaining the most sensitive adjustment.

Correctly adjusted reaction glides smoothly into oscillation with a hiss, but with no signs of a plop. The set is in its most sensitive condition when the reaction control is adjusted just below the point where this hiss commences.

Now the Formodensor is a great help in obtaining this desirable state of affairs. You will find that as you screw down the adjusting knob, thereby by-passing more of the H.F., you will be able to rotate the moving vanes further in mesh before oscillation commences. You will also notice that at the same time the reaction control gets smoother.

Of course, the H.T. adjustment is also important, and you should try the various tappings on the battery until you get the best results. You will observe that one of the 'phone terminals is marked with a plus. Now there is a reason for this.

The Red Tag

With a great many makes of telephone receivers there is one particular way of connecting up the two tags. Perhaps you will find that one of your telephone tags is marked with a cotton stripe, probably red in colour. This is the positive tag and should be connected to the terminal marked with a plus.

If there is no marking on the tag, then it is quite possible that your particular pair of receivers have magnets of chromium steel, in which case it does not matter which way they are connected. If you join up a pair of ordinary headphones wrongly they will become less sensitive.

TALKING VALVES

Some very interesting details of a radio device in which the sound comes not from the loud speaker, but from the valve itself.

By J. C. JEVONS.

THE three-electrode valve is the focus of so much ingenuity that it is difficult to say where its possibilities will end. As oscillator, amplifier, and rectifier it has for many years been the mainspring of wireless progress in general. Similarly most of the recent advances in picture transmission and in television are due directly or indirectly to its aid.

As applied to electrical recording and reproduction it has revolutionised the gramophone industry, whilst in another direction the "talkie" side

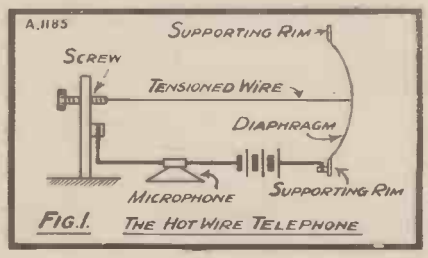


FIG. 1. THE HOT WIRE TELEPHONE

of the kinema may fairly be said to owe as much to the thermionic valve as it does to the light-sensitive cell. The valve is to be found in almost every field of modern engineering.

Speaks for Itself

So that on the score of general utility and outstanding merit the valve may fairly be left to speak for itself. Curiously enough, in one of its latest variations this statement becomes literally true.

An English inventor, Mr. B. S. Cohen, has just protected a thermionic amplifier which is capable of reproducing a broadcast programme or a gramophone record without the interposition of any loud speaker. The electron stream flowing from the filament impacts on the plate in such a way as to send out sound waves which reach the ear directly.

In order to explain how this result is achieved it will be useful to consider some of the effects of a pulsating electric current on the conductor through which it flows.

The Thermophone

One well-known illustration is the action of the so-called hot-wire ammeter as used to measure the value of the current flowing in a transmitting aerial. Here the effect of the high-frequency current is to heat up a thin wire so that it expands in length. In expanding, it moves the indicator needle and the extent of movement is a direct measure of the average current flow.

Another example is the hot-wire telephone receiver or thermophone. There are two known types of this instrument, one working on a slightly different principle from the other. In the thermo-telephone as invented by Sir W. Preece, and shown diagrammatically in Fig. 1, a fine platinum wire is attached at one end to the centre of a metal diaphragm and at the other end to a tensioning screw.

Once the wire has been suitably tensioned the passage through it of a voice-frequency current from a microphone causes it to expand and contract alternately. In this way it pulls on and vibrates the metal diaphragm, causing the latter to emit corresponding sound waves.

Another Method

In the other type of instrument called the thermophone by its inventor, Dr. Eccles, the voice currents are passed through one or more very thin filaments of Wollaston wire mounted in a small casing, which is usually designed to fit inside the ear cavity.

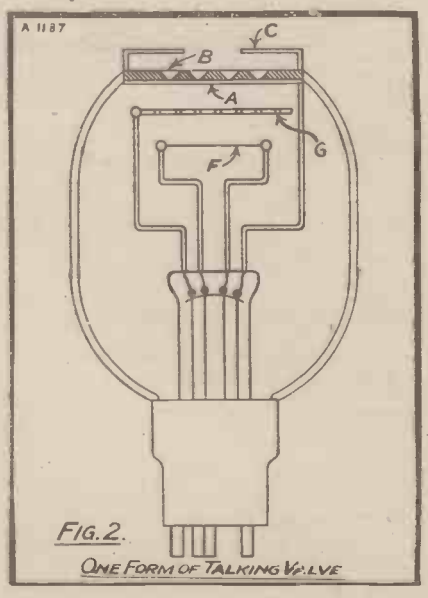


FIG. 2. ONE FORM OF TALKING VALVE

Here the actual sound reproduction is not due to the contraction and expansion of the wires, so much as to the effect of the heated wires upon the adjacent layers of air.

Ingenious Device

The wires are so fine that the passage of speech currents creates corresponding fluctuations in temperature. These rapid molecular changes in turn "impulse" the nearest layer of air molecules and sets it into vibration. The net effect is to create a succession of air-waves which reproduce the original speech currents.

Much the same principle is employed in Mr. Cohen's new speaking valve. As shown in Fig. 2, the glass bulb is made with a flattened top, and a thin metal anode or plate A is sealed into the glass.

A perforated disc of non-conducting material B is secured to the plate A,

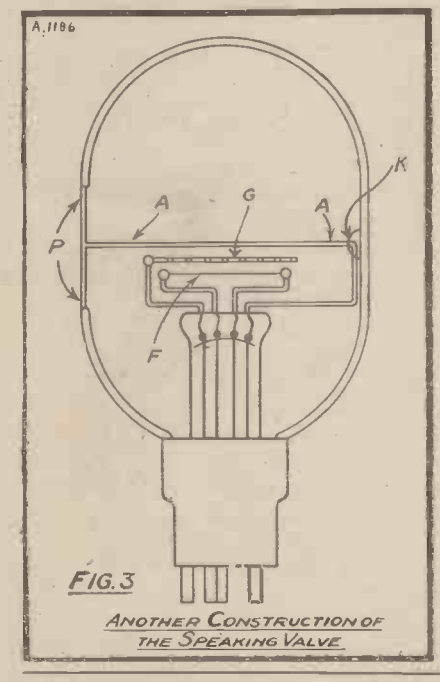


FIG. 3

ANOTHER CONSTRUCTION OF THE SPEAKING VALVE

and flanges C are attached to the latter so as to form a partially enclosed air-space, which acts as a resonator to strengthen the sound. The grid G and filament F are arranged as shown.

In operation the valve functions as a power amplifier in the ordinary way, except that the electron stream is used to impact upon the thin metal plate or anode A and thereby set up corresponding changes in its temperature, which in turn react directly upon the adjacent layers of air outside the glass bulb. The action is similar to that of the thermophone already described.

Wire Anodes

All changes in temperature are accompanied by corresponding variations in the molecular activity of the heated body. Accordingly, in the case of the plate A, the layer of air lying next to it will be influenced by the increasing or decreasing activity of the metallic molecules. In other words, it is subjected to a series of varying impulses.

The resultant effect is that a train of air-waves is created on the outside surface of the anode A, and pass outwards through the resonating chamber B, C. From here the waves reach the ear directly without the aid of any other device such as a telephone or loud speaker.

If necessary, in order to increase the effect, the metal plate A may be kept at an operating temperature somewhat higher than the normal by means of a local heating battery.

In a slightly different arrangement, shown in Fig. 3, a similar result is obtained by making use of the alternate expansion and contraction of a fine wire anode under the influence of the fluctuating electron stream.

In this case a thin metal diaphragm P is fused into one side of the glass bulb as shown. To the centre of this diaphragm is attached one end of a wire A forming the anode of the valve. A bundle of wires or a thin

Will the talking valve replace the loud speaker?

strip of foil may be used instead of a single wire, so as to increase the pull.

At the other end, the assembly of wires is firmly anchored to a lug K formed in the thickened side of the glass bulb. As will be seen, the wires are arranged in close grouping with the grid G and filament F.

Miniature Loud Speaker

When the valve is working, the varying electron stream flowing from filament to anode will heat the latter and cause it to expand and contract alternately. As one end of the anode is firmly anchored at K to the glass bulb and cannot move, the changes in length must necessarily be taken up by the flexible diaphragm P.

As in the Preece thermo-telephone previously referred to, the resulting vibrations of the diaphragm P are communicated to the air and set up a train of waves which impact directly on the ear of the listener.

USEFUL RADIO HINTS AND TIPS

To prevent interaction between your set and that of your neighbour your aerial should be placed as far from his as possible.

* * *

When using R.C. coupling in a short-wave set be certain to employ wire-wound resistances of reliable make, or you may experience a constant "mush."

* * *

The most desirable factor in a short-wave set is perfectly smooth reaction.

Higher Leak Value

If you would like to try and increase the value of your highest grid leak for short-wave work, and do not wish to buy an extra leak, remember that two leaks may be connected in series with one another for this purpose.

* * *

When atmospherics are spoiling short-wave reception they can often be reduced enormously by slackening off the aerial coupling.

It often pays to lift a short-wave set off the table on which it is standing by means of valve boxes or similar non-metal supports in order to keep coils, etc., well above grounded objects.

* * *

An output choke system or an output transformer is almost essential for high-quality loud-speaker reproduction where good volume is required.

* * *

Owing to its excellent insulation properties, glass can be used for the panel of a radio set, but it is comparatively difficult to drill.

* * *

One of the most curious points about short-wave reception is that an excellent outdoor aerial is not necessary, good results frequently being obtained on short and apparently inefficient indoor aerials.

* * *

In R.C. coupling the value of the anode resistance is not the only important one, for the size of the coupling condenser and the resistance of the grid leak both have an important bearing upon the quality.

Better Stability

One reason for the popularity of a stage of resistance coupling followed by a transformer is that one can obtain high quality and volume with very little risk of L.F howling due to interaction.

* * *

With push-pull amplification very large volume is possible, even although the H.T. maximum is not particularly high.

* * *

One disadvantage of a large coupling condenser is that it is rather liable to cause grid choking.

THOSE SUNDAY PROGRAMMES

Why Are They Dull?

A trenchant article on a very vexed topic in which the Editor suggests that the austerity of the Sunday broadcast programmes is deliberate; and that they are "meant to be dull."

WHENEVER a burst of criticism of the B.B.C.'s programmes appears in the newspapers—in the form of letters from readers or caustic editorials by leader writers who have had to find an oulet for "that Mondayish feeling"—inevitably the invective of the writers reaches boiling-point when the Sunday programmes are referred to.

Just "Dull"

Some people must spend an awful lot of time searching dictionaries for new words of contempt, dislike, disgust and dissatisfaction, to express their feelings about Sunday programmes, but in the end the consensus of opinion apparently results in a

R. H. Eckersley, the head of the programme department, is notable for his imperturbability and dogged resolution. He it is who largely decides upon the programmes from each station.

judgment being passed which can be briefly but devastatingly summed up in the single word "dull."

Now, like everything else in life, dullness is a matter of degree. Some people find chamber music "dull"; others find talks "dull"; while others think a long religious service "dull." Sometimes the critics say that such and such an item was "very dull"; others again that so and so was as dull—as dull as ditchwater.

The adjectival qualification supplies the indication of degree; and although there is divergence of opinion among listeners as to the degree of dullness of an average Sunday programme, there does not seem to be any serious disagreement on the chief point—that dullness is the keynote of the B.B.C.'s Sunday programmes.

Becoming Worse

Many reasons have been given as to why the Sunday programmes should be dull—why a cloak of sombreness should, apparently, descend upon Savoy Hill and remain there, in gloomy obstinacy, so long as the Sabbath lasts.

Frantic efforts have been made to brighten this gloom; criticism, reasonable and unreasonable, has been poured forth with amazing prodigality—but with singularly little effect. The Sunday programmes remain dull—are becoming (if that were possible) even duller.

Why is this? Why is something not done to brighten up Sunday programmes? After all, the great majority of people do not believe that Sunday should be a gloomy day because it *is* Sunday, nor do the great majority of people consider that it is irreligious to be reasonably cheerful on a Sunday.

Majority Ignored

Sunday is a day of rest and worship—rest, mark you, *and* worship. And by "rest" all reasonable people mean relaxation—not a complete cessation of activity, nor a complete abandonment to that form of relaxation which results in rowdyism, but rest of a kind and of a quality which gives peace and happiness to members of the community who have had, perhaps, a pretty hard week's work.

There are, of course, people who won't agree with the foregoing—but the majority will. And, as the B.B.C. maintains that the *majority* of listeners must be considered before the cranks and the faddists, it is hard to see (at first) why this theory is so ignored on Sundays.

No Sunday Gaiety

The fact is that the Sunday programmes are not meant to be anything else but dull, because if they were they would be incompatible with the ideas about Sunday held by the Director-General of the B.B.C.

Sir John Reith, Director-General of the B.B.C.

"The majority of listeners undoubtedly would greatly like somewhat lighter and more cheerful fare on Sundays—but Sir John Reith doesn't agree."

Sir John Reith does not believe in any form of gaiety on a Sunday. In his view, Sunday is an austere day—a day for Calvinistic sermons and perhaps (as a concession) a Bach cantata or an oratorio by Handel.

No one objects—or has any right to object—to such views, providing they are not imposed on other people against their wishes. The majority of listeners undoubtedly would greatly like somewhat lighter and more cheerful fare on Sundays, but Sir John Reith doesn't agree, and that's that.

The other day, Jack Payne, the popular B.B.C. dance band leader, was invited to give a series of Sunday

Jack Payne and his Dance Band

concerts. Now Jack Payne's dance band is not, of course, allowed to figure in the B.B.C.'s Sunday programmes, and so he and his merry men are "off duty" on Sundays, and free to accept outside engagements.

So one would think. But Jack Payne had forgotten Sir John Reith's views about Sunday entertainment, especially dance band entertainment. When he asked the Director-General's permission to use his free day by accepting a concert engagement, the request was definitely refused.

As a result the engagement was taken over by Jack Hylton, and Payne and his men lost a very good chance.

Only Two Remedies

Theatrical and concert managers were not at all pleased at this example of Sir John's Sunday attitude.

"Why," asked one of them, "should he dictate the nature of a Sunday entertainment? Let him keep to his own job."

What Jack Payne thought—or said—is not on record.

But the serious fact remains that this refusal to allow Jack Payne and his bandsmen to accept a Sunday engagement to play dance music is indicative of the rigid views held by Sir John, and it explains a good deal of the "dullness" of the average B.B.C. Sunday programme.

The inevitable result is that Sunday programmes are designed to suit Sir John's views. The majority of listeners who want lighter and brighter Sunday broadcasts can, apparently, go on wanting.

So long as Sir John Reith is Director-General listeners will have to put up with what Sir John considers good for them on Sundays.

How long listeners will put up with this Sunday dictatorship depends on how long they refrain from forcing parliamentary attention to the unsatisfactory Sunday regime, or how long the present Director-General remains in office.

One thing is certain—dull Sunday programmes will continue until one or the other of the above alterations transpires.

THE "A.C." THREE

A Reader's Views.

SIR,—I feel I must let you know what a fine set you have designed in the "A.C." Three, in July's "M.W." The results from a purity point of view, I find, are all that can be your readers. I think a four- or five-valver using an AC/S screen-grid would be a fine set to use with a frame aerial, and so does Mr. J. English, according to his very interesting article in this month's (November) issue. Being so near (18 miles) from Daventry, we are troubled with the problem of cutting them out.

Advantages of a Frame

The frame aerial appeals to me as perhaps one way out of the difficulty. In fact, I intend to make up the "Universal" frame aerial described in March "M.W.," by G. V. Colle, to experiment with the "A.C." Three.

I believe you like to hear the opinions and suggestions of your readers, so am sending these for what they are worth. This is the first time I have written, though I am an old reader and admirer (from No. 1, in fact).

Wishing you and "M.W." all success.

Yours truly,
W. F. SEAGER.

Radford, Coventry.

PREPARING A RADIO DRAMA

Good, well-chosen radio plays would not be out of place during Sunday broadcasts, and we could well take an example from other countries in this respect.

USEFUL HINTS

For short-wave working where threshold howl is experienced a different L.F. transformer should be tried if this is on hand.

* * *

If two stages of L.F. transformer coupling are employed it is necessary to use special care in spacing and wiring the components.

* * *

When L.F. transformers are placed adjacent to one another, they should always be aligned so that their coils are at right angles.

Microphonic Noises

Ringing or microphonic noises are caused by very small vibrations of the filament, which give rise to corresponding variations in the flow of plate current.

* * *

If you have old bright-emitter valves on hand you will find they can be used quite well as rectifiers in an A.C. mains H.T. unit.

From Ferranti, Ltd.—Ultra Air-Chrome Speaker—Oldham Activities—Some Eelex Lines—A Useful Instrument—The Varley Nicore II, etc., etc.

From Ferranti, Ltd.

THE latest radio publications of Ferranti, Ltd., include brochures dealing with Ferranti radio meters, the Ferranti dynamic speaker and the various fine L.F. transformers and output transformers due to the Ferranti people.

Ultra Air-Chrome Speaker

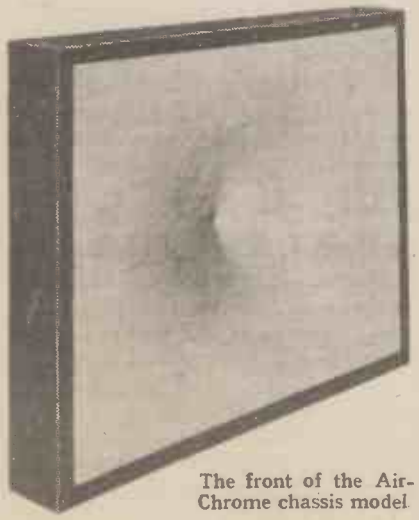
The Ultra Air-Chrome loud speaker is an instrument of an exceptionally interesting character. At the recent Radio Exhibition we heard one in operation that had a diaphragm measuring some 6 ft. by 9 ft. Shortly after we had on test the 2-guinea type L Air-Chrome whose largest diaphragm is less than a foot square.

The amazing thing is that the results given by those two Air-Chromes were very similar, except, of course, that the bigger one was handling greater volume. There was no boominess about the big one, while the small one had ample bass. The Air-Chrome embodies a balanced-armature unit and there are two diaphragms.

These diaphragms are of specially treated fabric, the one being much larger than the other and responding more readily to the lower frequencies. The Air-Chromes have very uniform sensitivity, and their responses are the same to small inputs as to large inputs. This is, of course, a very considerable advantage and one possessed by but few types.

The performance curve of the Air-Chrome is remarkably even between 5,000 and 70 cycles, but even at this low point there is no direct cut-off, and the falling is not appreciable until 40 cycles have been reached. The curve continues with remarkable evenness above 5,000 cycles right through the harmonic range. Altogether it is a loud speaker of undoubted merit.

Manufacturers and traders are invited to submit for test purposes radio sets, components and accessories to the "Modern Wireless" Test Room at Tallis House, Tallis Street, London, E.C.4. Under the personal supervision of the Technical Editor, all tests and examinations are carried out with the strictest impartiality.
Readers can accept the Test Room reports published monthly under the above heading as reliable guides as to the merits and demerits of the various modern productions of the radio industry.



The front of the Air-Chrome chassis model.

Oldham Activities

Messrs. Oldham & Sons, Ltd., are one of the most enterprising of all our accumulator manufacturers. This is proved by the fact that they have this season produced three decidedly new lines: the H.T. Auto-power unit, the L.T. Auto-power unit, and a new H.T. charger. Each one of these is a definite contribution to trouble-free radio, and readers having mains should hasten to acquire details of these useful devices.

Some Eelex Lines

Messrs. J. J. Eastick & Sons, Ltd., have adopted a new system of construction in their latest terminals and plugs and sockets. The pin, spade, and hook terminals have grub screws in their sides for the purpose of enabling secure connections to be obtained. The plug portion of the "All-Shrouded" type of plug and socket, which is particularly suitable for mains units and sets, has an internally threaded insulated sleeve, a grub screw being accommodated in the interior structure.

Here the unit of the Air-Chrome can be seen.

The special construction also enables efficient connections to be taken to the socket portion on the panel without the necessity of soldering. The insulating material used in all these Eelex devices, besides being of high electrical character, is of very attractive appearance. It is smooth and glossy, and the red particularly is decidedly striking. The plugs and sockets are excellent alternatives to terminals, and the insurance they provide against short-circuits and shocks alone should make them appeal to discriminating constructors.

A Useful Instrument

The Wates' panel-mounting test meter enables you to measure L.T. and H.T. voltages and H.T. current, so that you can carry out all the measurements your radio set needs; additionally you can, of course, on the milliamp range, test for distortion in the usual way.

The instrument consists of three portions, although it is quite a simple matter to mount it on a panel. There is, first of all, the meter itself, and immediately below this an ivorine tablet of instructions. At the bottom comes a bakelite case, in which there are eight sockets, surrounded by distinctively coloured discs. Three plugs are provided, and you vary the positions of these in accordance with the measurements you wish to make. It is all very simple, and the plugs are quite as easy to operate as switches.

The Wates' panel-mounting test meter.

The three ranges covered are 0 to 150 volts, 0 to 6 volts, and 0 to 30 milliamps. The readings given are quite accurate. It is indeed a most useful article and one that could be fitted to most sets with advantage. The price of the complete device is 13s. 9d., and we can recommend it to any set builder.

A Reaction Condenser

The Voltron baby condenser is a reaction variable having a maximum capacity of ·0001 mfd. It is sold complete with bakelite knob, in brown or black, at 3s. 9d. An interesting point is that it is provided with an insulated pigtail. It has two moulded bakelite end-plates, and there are bearings at both ends of the structure. It is a one-hole-mounting component and seems to be very reasonably priced. The design is good and its finish is of a high standard.

The Brown Budget

The latest "Brown Budget" from Messrs. S. G. Brown, Ltd., publishes the first photograph of the new works' extension made necessary owing to the great demand for Brown products.

Worth Consideration

The hire-purchase scheme of acquiring goods has much to commend it. Properly entered into, it makes for thrift, and for this alone can be commended. Supposing, for instance you want a really first-class set, or a kit of parts for the assembly of such. Well, you can get something which is pretty good through Peto Scott, Ltd., and their "Easy Way to Perfect Radio," for round about a £1 a month. Really magnificent sets are obtainable for about £2 a month. It would take a year to pay off for a receiver in this way, and the point is: would you have saved the money spent on those instalments had you not entered into such a contract? At the end of the year your bank balance is untouched, and you have a decided asset in the way of first-class radio apparatus.

The Varley Nicore II

In any set where it is used the L.F. transformer is a critically "key" component. At one time the advanced constructor would not think of using such an item, and would sacrifice amplification for "the sake of purity," by using R.C.C. throughout. But now one can get the straight line of R.C.C. with the advantages of greater amplification by using an L.F. transformer such as the Varley Nicore.

There are two Nicores and the Nicore II retails at 15s. It is surprisingly light in weight, being only 9 oz. It is ideal for portable sets, for it is also of small size, although its lightness and compactness are advantages in any construction. Its ratio is 4 to 1. Its core is built up of nickel-iron stampings, and these are magnetically superior to stalloy. By no means all nickel-iron core transformers have proved successful, and it is greatly to the credit of the Varley people—although in view of their reputation it is only what we suppose would be expected from them—that they have been able to produce such a component. The Nicore II is best used with a shunt H.T. feed, and in these circumstances very even amplification is possible.

The Varley Nicore II L.F. transformer.

Ediswan Catalogues

The mighty new Ediswan amalgamation of interests is now well under way with the result that a series of catalogues have been published incorporating all that is best in the resources of the Ediswan Electric Co., Ltd., the British Thomson-Houston Co., Ltd., and Metro-Vick Supplies, Ltd. "Mazda Radio Valves," "Radio Receivers," "Battery Eliminators, etc.," "Accessories and Constructors' Components" are some of the most interesting of the publications.

Bulgin Radio Products

Messrs. A. F. Bulgin, Ltd., tell us that over 7,000 written applications were received at the recent London Radio Exhibition for their new catalogues. It is a very interesting catalogue, for of its 55 or so pages a goodly proportion is devoted to short, well-written articles of an informative character.

THE PROGRAMMES OF EUROPE

This is the time of the year when foreign stations are most easily received in this country. Below the principal European broadcasting stations are listed, the wave-length range covered being from about 200 to 550 metres. Under good conditions many of these stations provide alternative programmes for British listeners.

STATIONS WORKING ON WAVE-LENGTHS BETWEEN 190 AND 250 METRES.

Wave-length in Metres.	Name of Station.	Remarks.
196	Karlskrona, Sweden	Relays Stockholm. Power ·25 kw.
200	**LEEDS (2 L S)**	Relay station. Power ·13 kw.
202	Jonkoping, Sweden	Relays Stockholm. ·25 kw.
203	Kristinehamn, Sweden	Power ·25 kw.
218	Bjorneborg, Finland	·8 kw. Relays Helsingfors
218	Ornskoldsvik, Sweden	Relays Sundsvall. Power ·2 kw.
218	Flensburg, Germany	Relays Hamburg. Power ·5 kw.
218	Karlstadt, Sweden	Relays Stockholm. Power ·25 kw.
221	Helsingfors, Finland	Power ·9 kw.
224	**CORK, IRISH FREE STATE**	Call-sign 6 C K. Power 1 kw. (Weekday evening programmes usually from Dublin.)
227	**COLOGNE, GERMANY**	Power of 2 kw. Langenberg programmes.
228	Biarritz, France	Power of 1·5 kw.
231	Boras, Sweden	Relays Goteborg. Power ·15 kw.
231	Umea, Sweden	Power ·2 kw.
231	Malmo, Sweden	Power ·6 kw.
231	Helsingborg, Sweden	Power ·2 kw.
234	**MUNSTER, GERMANY**	Relays Langenberg. Power ·5 kw.
237	Orebro, Sweden	Relays Stockholm. Power ·2 kw.
237	Juan-les-Pins, France	Irregular
238	Bordeaux-Sud-Ouest, France	Irregular.
239	**NURNBERG, GERMANY**	Relays Munich. Power 2 kw.
239	Nimes, France	Power 1 kw.
242	**BELFAST, IRELAND**	Call-sign, 2 B E. Power 1 kw.
246	Cassel, Germany	Relays Frankfurt. Power ·25 kw.
246	Kiel, Germany	Relays Hamburg. Power ·35 kw.
246	Linz, Austria	Power ·5 kw.
246	Jakobstad, Finland	Power ·25 kw.
	NOTE.—This wave-length is shared also by Kalmar, Saffle, Eskilstuna, and Kiruna (Swedish relay stations), and by Cartagena (Spain), and Abo (Finland).	

NOTES.—The more important stations are shown in heavier type, for easy reference. The British stations are included, as their transmissions will act as "finger-posts" and assist the listener in identifying foreign stations by comparison with adjacent dial-readings.

Certain comparatively unimportant stations are omitted altogether owing to lack of space. The **Schaerbeck** (Brussels) station was recently heard on 247 metres, but the exact wave-length allotted to it by the Hague Conference was 250·9 metres, so that it should not appear in the above section, but in that below. The **Juan-les-Pins** station (237 metres) is shortly to have increased power.

STATIONS WORKING ON WAVE-LENGTHS BETWEEN 250 AND 310 METRES.

Wave-length in Metres.	Name of Station.	Remarks.
251	Schaerbeek, Brussels (Belgium).	"Radio Schaerbeek."
251	Almeria, Spain	Call-sign E A J 18. Power 1 kw.
253	**GLEIWITZ, GERMANY**	Power 5 kw. Relays Breslau. Usually commences about 8 a.m., and transmits all day at intervals.
255	**TOULOUSE, FRANCE**	(P T T) Power 1·5 kw.
257	**HORBY, SWEDEN**	Relays Stockholm. Power 10 kw.
259	**LEIPZIG, GERMANY**	Power 1·5 kw.
263	**MORAVSKA-OSTRAVA (CZECHO-SLOVAKIA).**	Power 10 kw.
265	**LILLE, FRANCE**	Power ·7 kw.
268	**BARCELONA, SPAIN**	"Radio Catalana." Call E A J 13. Power 10 kw.
268	**STRASBOURG, FRANCE**	Power 1· kw.
270	Trollhatten, Sweden	Wave-length shared by four relay stations.
270	Hudiksvall, Sweden	
270	Norrkoping, Sweden	
270	Kaiserslautern, Germany	
274	**TURIN, ITALY**	"Radio Torino." Power 7 kw.
276	**KONIGSBERG, GERMANY**	Power of 2·5 kw. Transmits all day, at intervals.
279	**BRATISLAVA, CZECHO-SLOVAKIA.**	Power of 12·5 kw.
281	Copenhagen, Denmark	Power of ·75 kw.
283	Magdeburg, Germany	Power of ·5 kw.
283	Setttin, Germany	Relays Berlin. Power of ·5 kw.
283	Berlin (Relay), Germany	Power of ·5 kw.
	NOTE.—This wave-length is shared also by Notodden (Norway), Innsbruck (Austria), and two Swedish relay stations.	

(*Continued on next page.*)

STATIONS WORKING ON WAVE-LENGTHS BETWEEN 250 AND 310 METRES—*continued.*

Wave-length in Metres.	Name of Station.	Remarks.
288·5	**BOURNEMOUTH (6 B M)** ..	1 kw.
288·5	**BRADFORD (2 L S)**	·13 kw.
288·5	**DUNDEE (2 D E)**	·13 kw.
288·5	**EDINBURGH (2 E H)**	·35 kw.
288·5	**HULL (6 K H)**	·13 kw.
288·5	**LIVERPOOL (6 L V)**	·13 kw.
288·5	**NEWCASTLE (5 N O)**	1 kw.
288·4	**PLYMOUTH (5 P Y)**	·13 kw.
288·4	**SHEFFIELD (6 F L)**	·13 kw.
288·4	**STOKE-ON-TRENT (6 S T)** ..	·13 kw.
288·4	**SWANSEA (5 S X)**	·13 kw.

Exclusive wave-lengths for British stations.

Wave-length in Metres.	Name of Station.	Remarks.
293	Kosice, Czecho-Slovakia ..	Power of 2 kw.
299	Hilversum, Holland	Changes wave-length 5.40 p.m. Power 6·5 kw.
301	**ABERDEEN (2 B D)**	Power of 1 kw.
304	Bordeaux, France	"Bordeaux Lafayette" (P T T). Power of 1 kw.
308	Radio Vitus, France	Power of 1 kw.
310	**CARDIFF (5 W A)**	Power of 1 kw.

NOTES.—An interesting feature of this part of the wave-band is **Hilversum**, the famous Dutch long-wave station, which has recently been working on 299 metres until 5.40 p.m. and then changing to the long waves. **Gleiwitz** (253 metres) and **Breslau** (325 metres) have recently exchanged wave-lengths, and as they generally radiate the same programme, confusion between the two transmissions may easily arise.

Moraska-Ostrava, on 263 metres, is a comparative newcomer, and very powerful. **Turin** and **Bratislava**, on rather longer wave-lengths, have been exceptionally strong of late. A pleasing peculiarity of the Turin transmission is the interval signal, which takes the form of the song of the nightingale. (Played on a gramophone.) The **British stations** (except Daventry and 2 L O) are not usually received well in this country, except in or near their own service areas.

STATIONS WORKING ON WAVE-LENGTHS BETWEEN 312 AND 550 METRES.

Wave-length in Metres.	Name of Station.	Remarks.
313	Cracow, Poland	Power ·5 kw.
319	Dresden, Germany	Relays Leipzig. Power ·25 kw.
319	Bremen, Germany	Relays Hamburg. Power ·35 kw.
322	**GOTEBORG, SWEDEN** ..	Power 10 kw.
325	**BRESLAU, GERMANY** ..	Power 2 kw. (Recently exchanged wave-lengths with Gleiwitz.)
329	**PARIS, FRANCE**	"Petit Parisien." Power 5 kw.
332	Naples, Italy	Call-sign 1 N A. Power 1·5 kw.
335	Posen, Poland	Power 1·2 kw
335	Cadiz, Spain	Power ·5 kw.
342	Brno, Czecho-Slovakia ..	Power 2·4 kw.
349	**BARCELONA, SPAIN**	Call-sign E A J 1. "Radio Barcelona." Power 8 kw.
352	Graz, Austria	Power of 7 kw. Relays Vienna's programme.
356	**LONDON (2 L O)**	Power 30 kw.
360	**STUTTGART, GERMANY** ..	Power 1·5 kw. On all day at intervals from 10.30 a.m.
364	Algiers, N. Africa	Announces in French
364	Bergen, Norway	Power of 1 kw.
368	Seville, Spain	Power of 1·5 kw Call-sign E A J 5.
368	Paris, France	"Radio L L"
372	**HAMBURG, GERMANY** ..	Power 1·5 kw. Usually commences about 6 a.m. and on at intervals all day.
377	**MANCHESTER (2 Z Y)** ..	Power 1 kw.
381	**TOULOUSE, FRANCE**	Power 8 kw. "Radio du Midi"
385	Wilno, Poland	Power ·5 kw.
385	Genoa, Italy (1 G E)	Power 1 kw.
390	**FRANKFURT, GERMANY** ..	Power 1·5 kw. Uusally commences 6.30 a.m.; on all day at intervals.

Wave-length in Metres.	Name of Station.	Remarks.
394	**BUCAREST, ROUMANIA** ..	New station with power of 12 kw.
399	**GLASGOW (5 S C)**	Power 1 kw.
403	San Sebastian, Spain	Power of ·3 kw. Call-sign E A J 8.
408	**KATOWICE, POLAND** ..	Power of 10 kw.
412	**RABAT, MOROCCO**	Power of 10 kw. (Announces in French.)
413	**DUBLIN, IRISH FREE STATE.**	Call-sign 2 R N. Power 1 kw
418	**BERLIN, GERMANY**	"Witzleben." Power 1·5 kw. On at intervals all day from about 6 a.m.
424	**MADRID, SPAIN**	(Union Radio). Power 2 kw. Call-sign E A J 7.
436	Stockholm, Sweden	Power 1·5 kw. Programmes relayed by Motala (on 1,348-metre wave-length) and many other stations.
441	**ROME, ITALY (I R O)** ..	New high-power station just completed.
447	**PARIS, FRANCE**	Ecole Superieure (P T T). Power ·8 kw.
459	**ZURICH, SWITZERLAND** ..	·63 kw.
466	**LYONS, FRANCE**	"La Doua," 5 kw. Relays Ecole Superieure.
473	**LANGENBERG, GERMANY**	13 kw.
479	**DAVENTRY EXPERIMENTAL, 5 G B.**	25 kw.
487	**PRAGUE, CZECHO-SLOVAKIA.**	5 kw.
493	**OSLO, NORWAY**	1·2 kw.
501	**MILAN, ITALY**	7 kw.
509	**BRUSSELS, BELGIUM** ..	(No. 1 Station). 1 kw.
517	**VIENNA, AUSTRIA**	"Rosenhugel," 15 kw.
533	**MUNICH, GERMANY**	1·5 kw.
550	**BUDAPEST, HUNGARY** ..	20 kw.

The most interesting newcomer to this part of the medium wave-band is **Bucarest (Roumania)** (394 metres). Until lately this station was testing on low power, but now it is receivable at great strength. (The announcements are made in German, French, Italian and Hungarian, as well as in Roumanian.)

The greatly increased power of London 2 L O (upon the opening of the new transmitter at **Brookman's Park**) has caused some difficulty in the Home Counties, but except at very short distances the "wipe-out" can usually be overcome quite easily by means of an efficient wave-trap.

Many of the German stations recently reduced the power employed, but the transmissions are still heard at great strength. It is reported that the new Rome station is now complete, and this may be transmitting regularly during December. It is to be the super station of Europe, employing more power than Motala, Zoesen or Brookman's Park, which until now have been the best stations.

NEVER BREAKS DOWN

SILENT BACKGROUND NOT A WHISPER

AMPLIFIES LOWEST BASS TO HIGHEST TREBLE

THAT'S THE eight-and-sixpenny LISSEN TRANSFORMER

Over half a million Lissen 8/6 Transformers have been sold—and still Lissen have never heard of one breaking down in normal use. These huge sales have been built up on performance; they are undeniable proof that for every ordinary purpose of L.F. amplification the Lissen 8/6 Transformer gives perfect satisfaction.

There is no sound in the background of reception when you use the Lissen Transformer; not a trace of extraneous noise. Amplification is remarkably pure over the whole band of audible frequencies—you hear the bass distinctly, and the highest notes are clear and true—people call it a wonderful transformer and it IS.

8/6 **8/6**

You can pay more but never get a transformer that will give you more in return for the money you pay.

TURNS RATIO 3 to 1
RESISTANCE RATIO 4 to 1

LISSEN TRANSFORMER

TURNS RATIO 3 to 1
RESISTANCE RATIO 4 to 1

LISSEN LIMITED, Worple Road, Isleworth, Middlesex. Factories also at Richmond (Surrey) and Edmonton (Managing Director:—T. N. Cole.)

RADIO ABROAD

Notes and News of Wireless in Other Lands. By Our Special Correspondents.

Edison Celebrations

THERE have been great celebrations recently in the United States on the occasion of the fiftieth anniversary of the discovery of the electric light. The United States Government had a special medallion struck and also a special postage stamp issued in order to do honour to the greatest of all inventors —probably the greatest inventor the world has ever known—Thomas Alva Edison.

I suppose everyone knows the story of how Edison had tried out the usual metal filaments, such as platinum and so on (which in those days could not be drawn into sufficiently fine filaments and which, in any case, have not a sufficiently high melting point), and how he was searching about for something which would have a much higher melting point, and which yet could be made into a fine filament.

Cotton Thread Filament

He is said to have thought of making a carbon filament by carbonising a piece of cotton thread, and although this first experiment was far from being successful, it was sufficiently so to point the way to the commercial carbon filament. After that it was purely a matter of experimenting so as to produce a strong resilient carbon thread—and this, as everyone knows, Edison and Swan succeeded in doing.

Since those days the very refractory metals such as tantalum and tungsten have become much better understood, and methods have been found for drawing these metals, especially tungsten, into an extremely fine filament, so that a filament of convenient size can be used with house voltages up to as much as 250 volts.

A Television Sidelight

An interesting sidelight on the practical applications of television comes from Chicago. I learn that Mr. Austin Rahe, a television expert of New York, who was present in connection with some television demonstrations at the Annual Chicago Wireless Exhibition, said: "If actresses do not put on make-up and plenty, of the blackest kind, they are going to look like *animated pumpkins* on the television screen, and if they *do* put on plenty of make-up they will look like *aged walruses* in the studio! It is just about the most disconcerting problem which television has ever met."

From this it would seem that the actress may pay her penny and take her choice as to whether she will look her best or her worst in the studio or on the screen; she cannot have it both ways.

A Chicago Station

A wave-band of 100 kilocycles has been allotted to station W E N R (Chicago) by the Federal Radio Commission for the purpose of television broadcasting on a power of 5 kw. The actual wave-length band is from 2,850 to 2,950 kilocycles.

The Premier's Speech

The speech made to the Council of Foreign Relations in the United States on October 12th last by the British Prime Minister, Mr. Ramsay Macdonald, was relayed not only to a large number of short-wave transmitters, but also to about 50 regular broadcasting stations.

A Big Industry

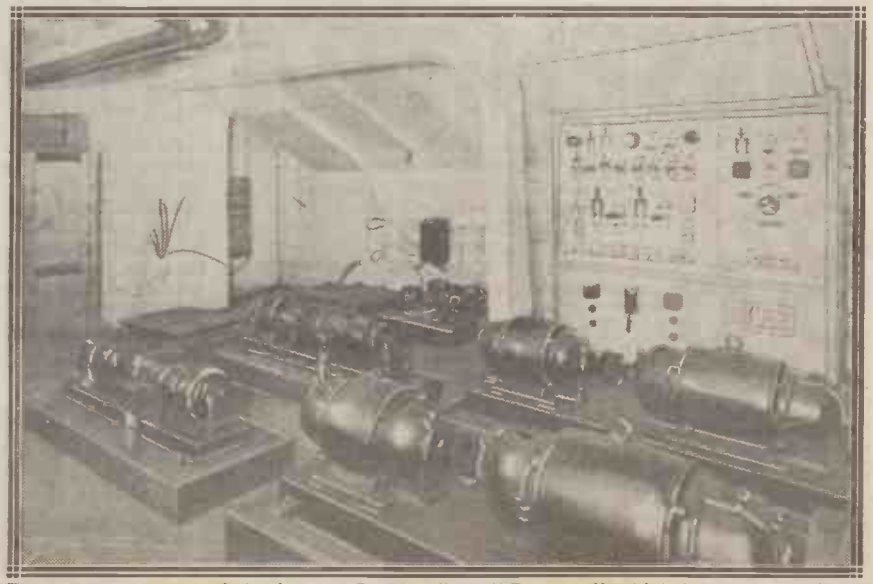
The radio industry in the United States has now reached such colossal dimensions that it is computed to involve capital investment close upon four hundred million dollars, or not far short of £100,000,000. The industry employs directly and indirectly about half a million people.

A Powerful Czech

Amongst foreign stations which are being completely overhauled and having an increase of power is Brunn, the Czecho-Slovak station, at present

(*Continued on page* 698.)

A MINIATURE POWER STATION



The generator room of the famous German liner "Bremen," which has an exceedingly up-to-date radio installation.

REALISM IN RADIO

An account of a series of scientific experiments with loud speakers in which various important measurements were taken.

By L. G. BOSTWICK.

WHAT constitutes a good loud speaker? To answer this question there is needed a more precise method of ascertaining the capabilities of a loud speaker than is provided through a mere listening test. While the ear is, of course, the final judge of the merits of a loud speaker, it is quite unsatisfactory as a means of analysis. One loud speaker

The horn type of loud speaker which is now largely displaced by cone types. The horn shown is not of logarithmic design.

may sound better or worse than another with which it is directly compared, but to describe or specify in a definite manner the peculiar characteristics which distinguish one from the other is usually extremely difficult unless the two are widely different.

Furthermore, a direct comparison between two devices is necessary, and the magnitude of the difference is always a matter of opinion and therefore of controversy.

Wide Variety of Factors

On the other hand, physical measurements on loud speakers are complicated by a wide variety of factors arising in the acoustic part of the measuring system. Such factors as peculiarities in the distribution of sound energy by the speaker, and sound reflection, absorption and interference effects due to enclosure in a room, may greatly affect the results of tests.

When these factors are not taken into account, performance tests may be made to give entirely misleading information as to the relative merits of loud speakers. But by comparing measurements at different positions in the sound field of the speaker, outdoors and indoors, the causes for variation in results can to a considerable extent be segregated and analysed. The measurements and their interpretations which follow illustrate how this can be done.

The system used in making these measurements is shown diagrammatically in Fig. 1. The available power-output of the oscillator is kept constant at all frequencies by means of a valve voltmeter. With the oscillator connected to a loud speaker, through the transformer, the gain of the amplifier associated with the thermo-couple is adjusted at different frequencies until a mid-scale deflection of the meter is obtained as a result of the voltage generated by the condenser transmitter.

After each adjustment the oscillator is switched from the loud speaker to the input terminals of the attenuator, and the attenuator is adjusted to give the same meter deflection. Variations in the attenuator settings with frequency show the variations in the performance of the loud speaker in decibels (the official name of the transmission unit).

Curves Differ Widely

Performance curves obtained for the same loud speaker by such a procedure may differ widely, due primarily to three causes. These are: Variations with frequency in the energy distribution of the sound field of the loud speaker; wave interference at the condenser-transmitter position, due to sound reflections from

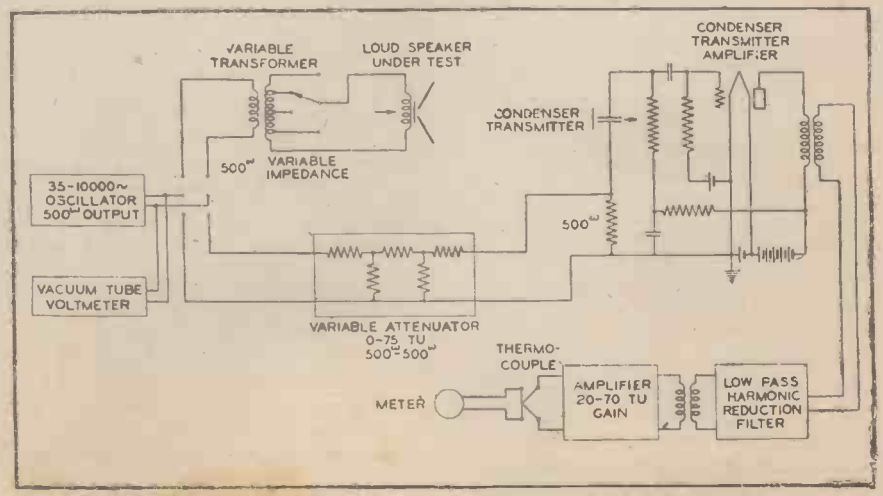


Fig. 1. The circuit of the loud-speaker response-measuring system.

the walls of the measuring room; or to a difference in distance from the transmitter to different points on the radiating surface; and variations with frequency in the energy-absorbing power of the measuring room.

The magnitude of variations in the sound-field distribution can be shown from measurements obtained outdoors in an open field, where the effects of any room enclosures are absent. Such measurements appear in Figs. 2, 3, and 4 for a 115-cycle cut-off exponential horn with a loud-speaker unit of the moving-coil type.

Fig. 3 shows response curves obtained when the condenser transmitter is placed 12 ft. from the centre of the horn mouth and at different angles from the axis. As the transmitter is moved away from the horn axis, the response at the higher frequencies becomes lower, while at low frequencies the change is slight.

Peculiar Interference Effects

This is because the angle-subtended by the sound field becomes smaller the higher the frequency, and the sound energy is increasingly concentrated along the horn axis. Thus a response frequency characteristic of almost any desired trend may be obtained by suitably locating the condenser transmitter. Fig. 3 is a polar co-ordinate curve plotted from the data of Fig. 2, showing the sound-field angles for four frequencies.

Fig. 4 shows a curve obtained for the same loud speaker, but with the condenser transmitter on the axis only 2 in. from the mouth. This curve is considerably more irregular than the axis curve of Fig. 2. These irregularities can be attributed to interference between sounds reaching the condenser transmitter from different points of the horn mouth.

After a distance of about 12 ft. has been reached, the sound paths from these points to the condenser transmitter become substantially

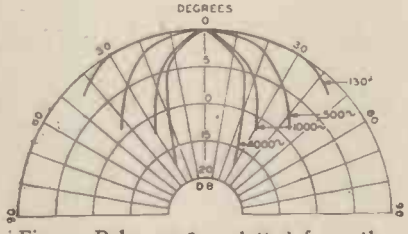


Fig. 3. Polar curves plotted from the Fig. 2 data.

equal, and therefore the interference disappears. Thus the two apical curves in Figs. 2 and 4 are quite different.

The effect on the indoor response measurements of interference or standing waves due to reflections from the walls of the measuring room is illustrated in Fig. 5. These measurements are of a loud speaker with a 3½-in. diaphragm of the piston type, with the condenser transmitter located about 12 ft. away on a line perpendicular to the centre of the diaphragm.

The loud speaker and transmitter were located equally distant from and on opposite sides of the centre of the room, and mid-way between the ceiling and floor. The bounding surfaces of the room were covered with hair felt ½ in. thick. Although an attempt was thus made to reduce the magnitude of the reflections, the curve obtained is very irregular.

Special Machine Employed

One method of compensating for the effect of standing waves, and of thereby obtaining indoors a curve that is representative of the performance of the loud speaker, is to average the measurements at several positions, or within a region, rather than at one position. This is accomplished in the Bell Telephone Laboratories in America by a machine pictured in Fig. 6.

This machine rotates the condenser transmitter in a circle which is nearly 6 ft. in diameter and whose plane is inclined at an angle with the horizontal. Fig. 7 shows a curve for the piston-diaphragm loud speaker measured under the same conditions as the curve in Fig. 5, but with the rotating condenser transmitter.

The centre of the circle was located at the same point as the condenser transmitter for Fig. 5. A comparison of the solid curve in Fig. 7, with the dotted curve, obtained outdoors for the same loud speaker, shows the extent to which rotating the

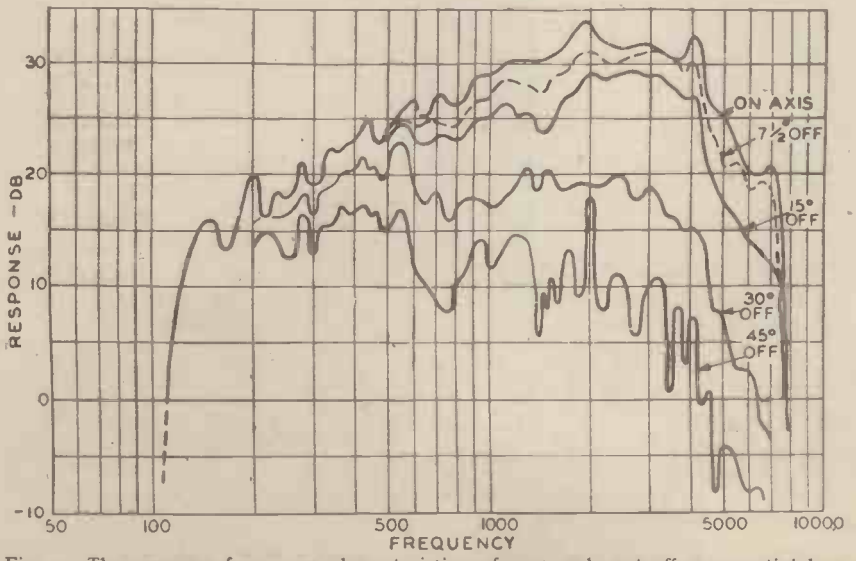


Fig. 2 The response-frequency characteristics of 115-cycle cut-off exponential horn with a moving-coil unit. Measured outdoors 12 ft. from mouth of horn at specified angles to horn axis.

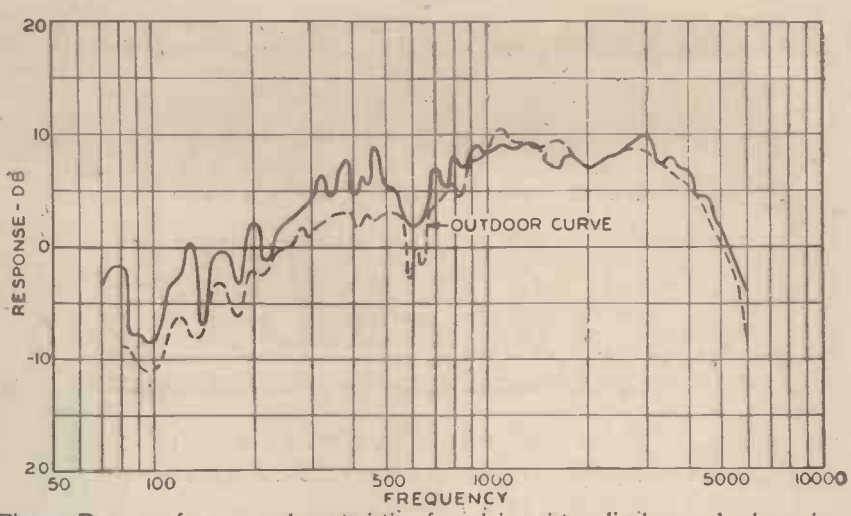


Fig. 7. Response-frequency characteristic of a 3½-in. piston-diaphragm loud speaker. Measured in a highly absorbing room and averaged in small region 12 ft. from diaphragm.

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1 Wearite combined series aerial condenser and switch unit	2 3
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A Machine that Compensates for Standing Waves

transmitter in this manner obviates the effect of wall reflections.

The uniformly greater response at low frequencies of the indoor curve in Fig. 7. can be attributed to the fact that the sound-absorbing ability of the measuring room varies with frequency. Indoors the energy reaching the condenser-transmitter position directly from the loud speaker is supplemented by energy reflected to the same position from the walls of the measuring room.

Variations with frequency in the reflecting or absorbing ability of the walls of the room will, therefore,

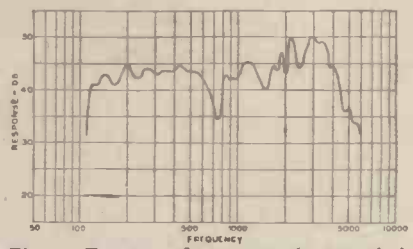


Fig. 4. Response-frequency characteristic of 115-cycle cut-off exponential horn. Measured outdoors on horn axis 2 in. from mouth.

probably undergoes several reflections before returning to this position again.

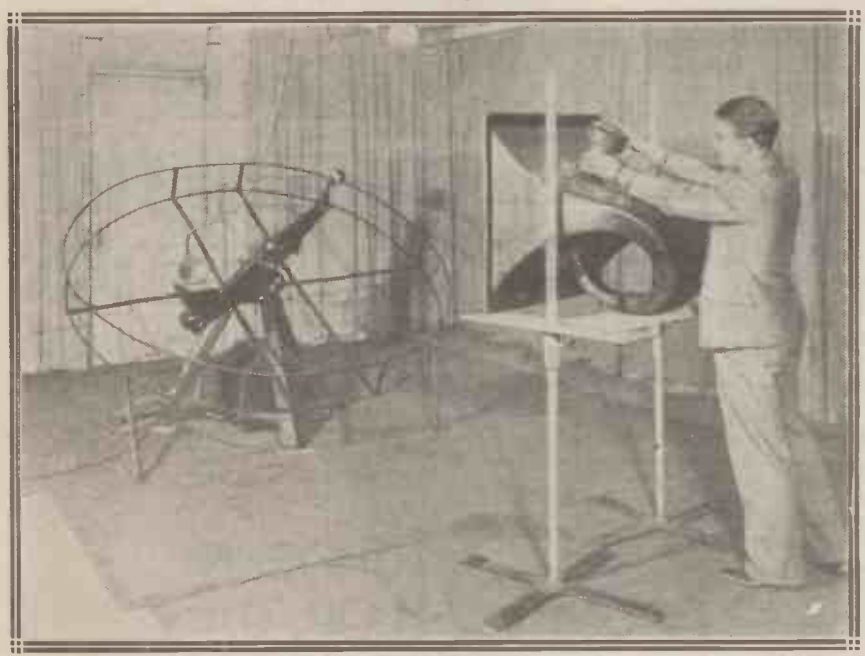


Fig. 6. The machine for rotating the condenser-transmitter to make indoor loud-speaker measurements.

cause variations in the magnitude of the response measurements. From the difference between the two curves in Fig. 7 it is possible to calculate the ratio of the outdoor to indoor energy densities at different frequencies at the transmitter position, and to obtain the solid curve shown in Fig. 8. The dotted curve is an average curve showing the trend.

Several Sound Reflections

A comparison of this dotted curve, with the dot-dash curve of the absorbing ability of ½ in. of hair felt, shows an interesting correlation in the trends of the two curves.

The difference in magnitude of the two curves can be accounted for by the fact that the sound passing through the transmitter position

From the foregoing illustrations it is obviously quite impossible to determine from acoustic measurements whether or not a loud speaker is "good," unless the curves expressing the measurements are qualified by statements regarding the measuring conditions.

Important Considerations

Especially must information be given as to the position of the condenser transmitter relative to the loud speaker, the method of measurement (whether pressures are measured at one position or averaged within a region), and the size and nature of the medium.

In general, response measurements, to be most indicative of the capabilities of a loud speaker, should be made with the condenser transmitter at a distance from the loud

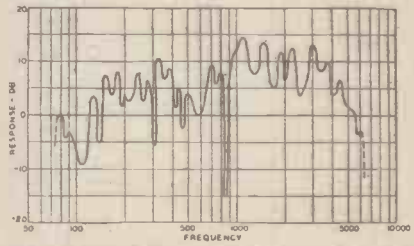


Fig. 5. Response-frequency characteristic of 3½-in. piston-diaphragm loud speaker. Measured 12 ft. from diaphragm in highly absorbing room.

speaker commensurate with or equivalent to the most likely listening distance of an observer.

Although complicated by such a wide variety of factors, the response frequency characteristic has been found the most significant single criterion upon which to base a judgment of the merits of a loud speaker.

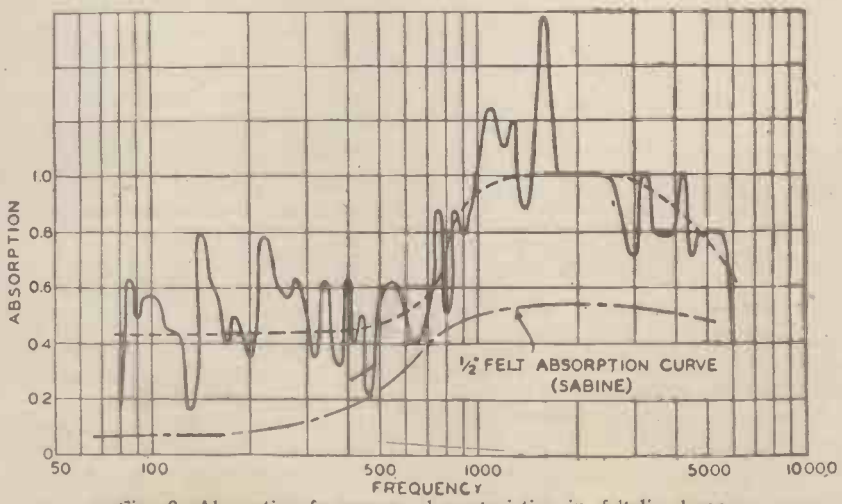


Fig. 8. Absorption-frequency characteristics in felt-lined room.

THIS being the month of Christmas, I suppose that I shall be expected to impart a festive twang to my ramblings, though my perverse mood would prefer something about the rigours of spring. Unhappily for the world it is no longer fashionable to write about

"To make too much conversation impossible."

plum-pudding, turkey, holly, and mistletoe; we are grown so sophisticated that these erstwhile joys are now classed as Diet and Superstition. Dickens *is* dead, and no mistake!

Nevertheless, the spirit of the Fat Boy lives for ever. That adipose lout who could only eat and make people's flesh creep did but preserve the continuity of a long line of lugubrious souls who, coming in on the high note of joy, would emit a base and terrifying blast with such devilish skill that the lute strings snapped and everybody said how chilly it was.

A True Experience

The skeleton at the feast; the skull which was passed round to cheer folk up at ancient Egyptian banquets—like the speeches nowadays; "In the midst of life we are in death"; these are a few examples of the doctrine which led to the telling of ghost stories at Christmas parties and their intrusion into magazines.

I have never seen a ghost. I keep away from the Moated Granges and Haunted Rooms of life, preferring the Savoy Grill and a bit of a band—enough to make too much conversation impossible. I remember that once a band broke down, and in the interval my lady friend completely spoiled for me the loveliest bit of lamb I ever gnashed, by explaining why she had been named Hilda. Gosh! It needs explaining.

But, as I said, I have never seen a spectre, unless you count my Aunt Harriet in her bathing rig. I have, however, had one terrific experience on a Christmas Eve, and as it was all mixed up with a loud speaker I think you might as well have it. It's true, of course!

How it Happened

It was the Christmas Eve of 1924. You remember that year, because green was all the rage, especially in winter tailor-mades, and the fullness was run up to the left shoulder, with a tuck in the 'thwartship's gusset. Right! Archie Curtis, who lived in a quaint old reconditioned sort of farmhouse three miles off the high road to the east of Potts Parva, Berks, had asked Yillop, Mackay, and myself to spend a few days with him to tide him over Christmas.

He was not then married, and he could not very well ask his housekeeper, old Mrs. Grant, to take wine with him, nor did he relish the notion of making merry amongst the cowherds at the "Slate and Dibble." We three were at that time equally unmarried. So we accepted and prepared for a dampish time. Curtis is a dull old dog, but he always gives one a run, with trimmings.

At six-thirty on that dark, cold, blowy Christmas Eve we crawled from our cosy "smoker," wherein Yillop had been entertaining us, and a brace of sporty wenches who tumbled aboard at Reading, with impressions of George Robey reciting "Casabianca." We had before us two miles of straight going as far as Potts Parva; then a plunge into unknown wilds, probably frequented by cattle.

"I think old Curtis might have sent a bus, or at least a guide," grumbled Mackay. "Serve him right if we get lost like those blithering babes in the wood."

"Give us an appetite, anyhow," said Yillop, who was not nicknamed "Piggy" for nothing.

"What about that hike we had from D—— to Le—— in 1916," I put in. "Fifteen miles in a foot of mud, full equipment, a month's front-line behind us, and the battle of O—— before us. This is cushy! Hep, hep!"

Still Plodding On

We did the two miles in an hour and a half. The tremendous velocity was due to the weight of our suitcases and the (a) "Owl and Cot," (b) "Swinging Lanthorn," and (c) going back to the "Swinging Lanthorn" in case we had left our matches behind. At Potts Parva we drew up before the "Old Leather Tun" and debated whether we should have rest and refreshment or make ahead for Curtis's place.

"The blighter isn't even *here* to meet us," growled Yillop, and walked in behind Mackay, who started giving an order before he had his foot on the rail. Something seemed to be biting Mac.

Back to the "Swinging Lanthorn."

"I don't like the feel of things, he said. "I've Highland blood in me, and it's talking to-night. A bad night! Though that brown ale at the last but one place wasn't too poisonous. I've my great-great-grandmother's gift of seeing things——"

"Yes! And your Uncle Dan's, too." chimed in Yillop.

We Hear Voices from a Spectral Speaker

Uncle Dan was Mackay's skeleton in the cupboard. He specialised in seeing red-hot chameleons.

"All right, Yilly! Mark my words—it's going to be a *dommed* hectic nicht—I mean *night*," replied Mackay.

At this juncture there was a commotion in the bar, and we heard a woman's voice. The owner of the voice was referring to me and to Mackay.

"Ha!" said Yillop. "First traces of the recluse named Curtis. If that isn't Mrs. Grant I'm vastly mistook."

"Me great-great-grandmother was a Grant," said Mackay, like a fool.

I walked into the public bar and greeted Mrs. Grant.

"Ef yer please, sir, Mester Curtis says he been detained, and will yer come up to house and make yerselves comfortable. I've left door on latch, but ye'll find none at home, since I'm for the village."

"Very well, Mrs. Grant," I said, "we will go along presently and wait." The lady, however, seemed fain to linger, yet anxious to go. "Was there anything else, Mrs. Grant?" I asked.

The Forbidden Door

She looked a bit scared and then said: "Well, sir, p'r'aps I didn't ought to mention it, but if I was you, sir, *I wouldn't go in the back sitting-room.*" Then she turned tail and scuttled out, leaving me with a Bluebeardy kind of feeling. Sounds of mirth from the snuggery told me that the playful Yillop was up to something.

How Henry proposed to his fifth wife.

I found that Yillop had wreathed old Henery, the octagenarian sexton, with paper-chains, given him a cheroot strong enough to blow his head off, and was making him tell the great story of how he proposed to his fifth wife.

Thanks to our having parked our suit-cases at the village, we were able to reach Haylofts—Curtis's house—by quarter to ten. Cautiously making a big loop round a chained dog as big as a pony we walked up to the front door. All was as dark as pitch. Mackay gave the door a gentle push and it swung creakily back, leaving us staring into a warm and odorous darkness.

We Creep Upstairs

"Strike a match, Jones," said Yillop, "and let's get in."

Mackay was mumbling about hospitality. I made a light and took the lead.

"Beware the back sitting-room," croaked Yillop, as we passed its door on our way upstairs, where, as I knew, was Curtis's den.

We lit a lamp in our host's workroom, and also our pipes, disposing ourselves on a fine large settee. The lamp was very flickery and made the stuffed bear in the corner appear as though blinking its eyes. With ill-concealed glee Yillop called Mackay's attention to this phenomenon.

"Let's try the radio," I said, and switched it on. Nothing resulted, and we began to investigate.

"All right, boys," cried Mackay, "the battery has gone to be charged. Here are the leads hanging down."

"*That's* where Curtis is, maybe," I said. "Anyhow, that's that. We'll have to sit and yarn."

We were quietly talking some ten minutes later when the lamp-flame turned blue, gave a sort of moan, followed by three *pops*—and expired.

"Heck!" observed Mackay. "Think of that damn bear!"

"Or the back sitting-room," said Yillop.

And there we sat. Dead silence and Cimmerian gloom!

Sepulchral Voices

Then a booming voice from the loud speaker said:

"*Is he come yet?*"

My blood prickled, I confess; and I heard Mackay draw in his breath sharply. Yillop whispered:

"What in blazes *have* we struck?"

A voice replied: "*He's coming across the field. See and be ready.*"

"*Have ye the thing ready, Dave?*"

"*Ay! He'll not feel nothing.*"

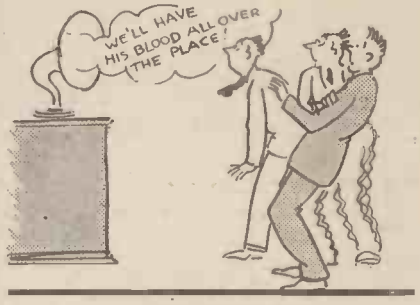
"*Hist!*"

Mackay grabbed me by the arm.

"Man," he hissed, "the battery was gone. The set *cannae* work! It's plain witchcraft. Me great-great-gran—— Aw! hearken to you!"

There was a sudden scuffle, a muffled shout, and then a piercing scream.

"*No, no! Let me go! Let me go!*"



"It's plain witchcraft!"

"*Dang it! He'll rouse the village. Clap your hand on his mouth. Get him to the sink or we'll have his blood all over the place.*"

Another scuffle and a sound of dragging feet. Muffled cries.

Yillop and I jumped to our feet and went over to the loud speaker, when the cries broke out again and then abruptly ceased.

Mackay started up. "Where's the door?" he shouted. "I cannot stand this. Open air! We're bewitched!" He stumbled against us, and we all three fled downstairs. A light was now burning in the back of the house, and towards it we went, flinging ourselves into the scullery.

Two sheepish-looking men and a scared boy were there.

"What the deuce are you doing?" said Yillop, grabbing one of the men, while I overhauled the boy, who spat blood.

"Ef ye please, zur, takin' a tooth out of young Steve Bond yonder. He be no end scart o' dentist, so we done it for him."

The Mystery Solved

"Yes," said Curtis, as we filled up our glasses for the last time that night. "There's a ventilator just over the loud speaker, and I've noticed myself that voices in the scullery come up between those two walls and buzz through it. Very annoying! Have a double peg, Mac!"

"But what about the back sitting-room?" asked Yillop.

"*Wet paint!*" said Curtis.

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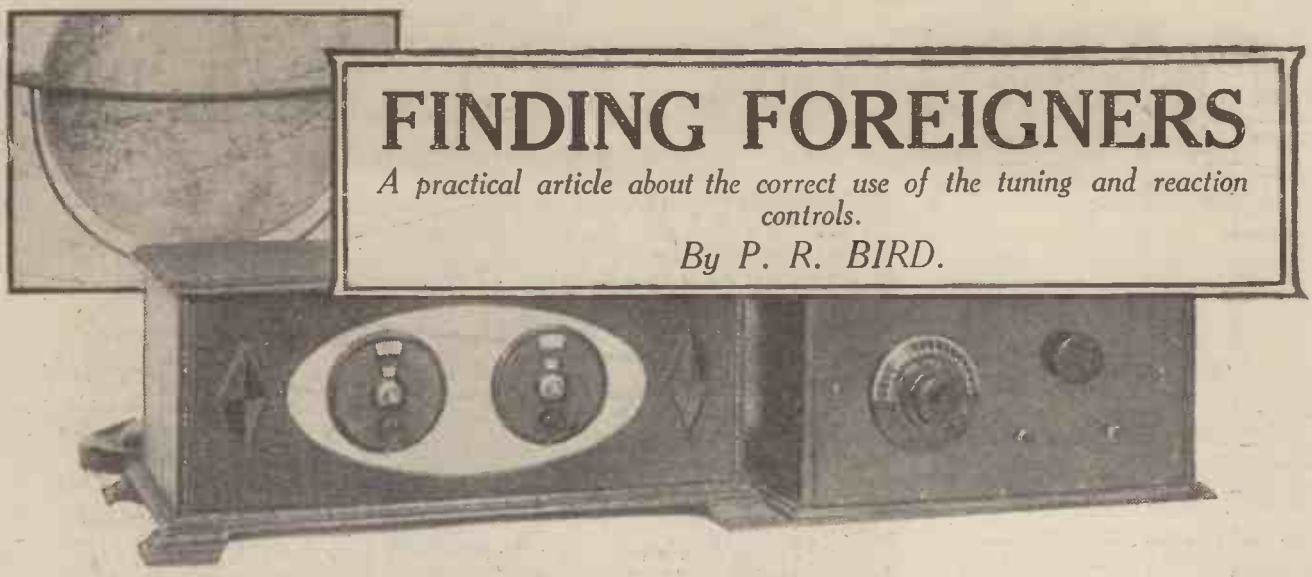


FINDING FOREIGNERS

A practical article about the correct use of the tuning and reaction controls.

By P. R. BIRD.

WITH an ordinary simple one- or two-valve set there is only one way to pick up foreign stations with any degree of regularity, and that is by taking the trouble to learn how to handle the receiver. Twisting the dials haphazard here and there *may* result in accidentally bringing in a foreign station—but it is certain to interfere with your neighbour's programme; it is selfish and unnecessary, for by taking a little trouble the knack may be learned, and foreign stations brought in with certainty.

How to Begin

You can learn how to handle a receiver properly in about half an hour or so, if you will take the trouble to set about it properly as outlined below. The first thing to do—and this is important—is to choose a time when no broadcasting is on, say either late at night or before the afternoon programme commences. Wear 'phones if you have them, but if not, prop up the loud speaker at an angle where you can get your ear close to it, so that you can study every sound coming from the set.

When everything is switched on, turn the reaction dial to its minimum, set the tuning dial (left hand) halfway round, and *listen*. If you have chosen a quiet time of the day all you will hear is a very faint suggestion of sound, a kind of ghostly background that tells you the set is "alive."

Is it Oscillating?

Now put your right hand on the reaction control and slowly "increase" it, listening carefully all the while. Perhaps for the first five or ten degrees you will notice no difference, but if you are listening closely you will observe that although no stations are coming in the tiny sounds referred to are getting louder. The set is becoming more sensitive.

Continue *slowly* to revolve the reaction control until these sounds, getting louder and louder, suddenly terminate in a kind of "plop," followed by a soft rushing sound. This indicates that the set is oscillating.

Just to make sure of it, wet your forefinger and touch the grid terminal of the detector valve holder. This will give rise to loud double clicks as your finger connects and disconnects with the metal. Turn back the reaction knob again and these signs of oscillation stop.

Practise bringing the set up to oscillation in this way several times,

Do you know how to "balance" the dials so as to get those elusive foreigners?

until you can be sure you know just when the set is oscillating and when not. The point is that when you have passed the oscillation point the set will cause interference with your neighbours, and you are getting too much reaction for good results. If, on the other hand, you slack off the reaction too far the set will become insensitive, so the object is to get as near the oscillation point as possible *without actually oscillating*.

You have now mastered the main principles, but the next thing to do is to apply this in practice—i.e. to turn the reaction properly in conjunction with tuning. To do this, set your tuning control about half-way, bring the reaction right up near the oscillation point, until the set is in its most sensitive condition, and then leave the reaction dial alone and turn your attention to the tuning dial.

Interlinked Dials

First of all, tune it *upwards*, that is, increase the wave-length, noticing at the same time exactly how this affects the reaction symptoms to which you have been listening. You will find that as the wave-length is increased reaction seems to fall off.

Next, turn the tuning dial slowly downwards to decrease wave-length, and you will find that even when the reaction dial is left alone the set goes into oscillation! Reaction is to some extent interlinked with tuning!

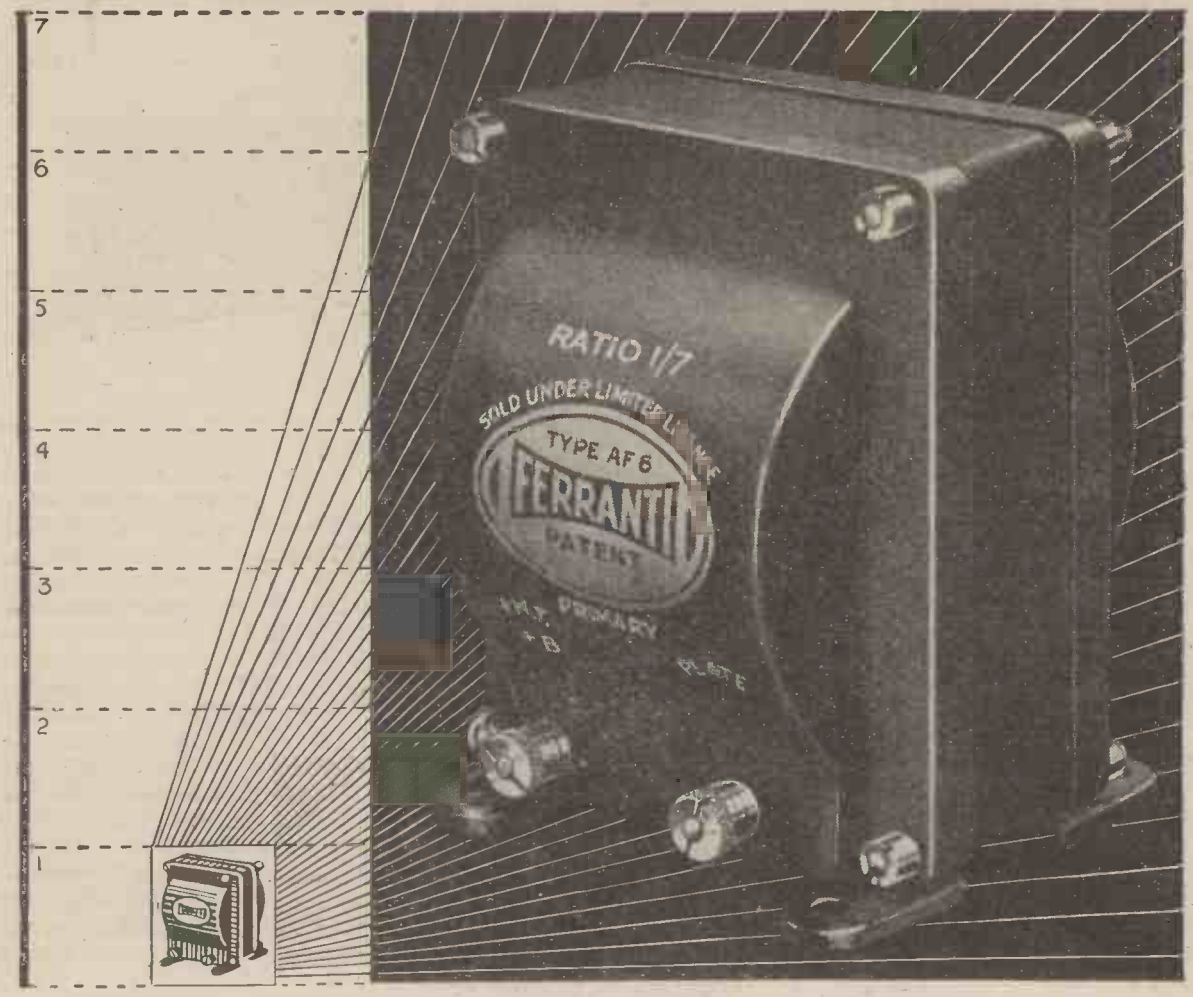
So in order to bring the set close to the oscillation point you must always tune-in with one hand on the reaction dial and one on the tuning dial.

The Ups and Downs

If you are slowly moving the tuning dial "up," in order to keep the set sensitive you must slowly increase the reaction at the same time. If you are slowly turning the tuning dial *down* towards the lower wave-lengths, you must at the same time slowly *slacken off* the reaction, or the set will go into oscillation.

It is quite a simple matter with the left hand to turn the tuning dial from the lowest to the longest wave-length, and simultaneously with the right hand to keep the set really sensitive. And when you do that the stations simply roll in.

ONE TO SEVEN



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THE OTHER SIDE

Here is an exceptionally interesting letter from a Californian reader who has something to say about radio in general and one of Mr. Corbett-Smith's articles in particular.

The Editor, MODERN WIRELESS.

SIR,—Through the kindness of a friend recently in London I have just obtained a copy of "Popular Wireless" for July 20th, 1929, and a copy of MODERN WIRELESS for July, 1929.

I desire to correspond with radio fans who reside in foreign countries, and who construct their own sets. On page 592 of "Popular Wireless" I see you have published the request of another American who has the same desire. I would greatly appreciate it if you would publish a similar request for me if you can see your way clear to do so.

I was very much interested in Mr. A. Corbett-Smith's article in MODERN WIRELESS, entitled "Shall We Copy Uncle Sam?"

While hardly very flattering to us, it is nevertheless entirely true, and I wish that it could be published in the principal magazines of this country. We need something like that article, as we never hear the "other side."

What America Thinks

I am very much interested in radio in all countries, yet the best information I was able to obtain concerning English radio gave me this idea of the situation there:

Listeners were burdened with prohibitive taxes on their receivers, retarding interest in radio, while the programmes, such as they were, were limited, and in the hands of persons incapable of presenting them or without interest in the listeners' welfare; the government controlled broadcasting to keep everybody else out—in general, the average fan didn't have a chance. And that, I believe, is the average idea held in this country about English radio.

Mr. Corbett-Smith's article throws a different light on the subject, and indicates that British radio is a great deal more advanced than we are led to believe. Probably the Radio Corporation of America has something to do with this—but I am getting on to dangerous ground, so I will leave that and turn to something of which I know more.

Perhaps some of your readers would be interested in reading about some of the daily conditions met with here by American fans—or at least this one.

I have built my own receiver, which is a five-tuber, operating on the 110-volt A.C. lines (I believe you would call it a "mains set") through an A-B-C battery eliminator.

The hook-up is an old stand-by here—one stage of radio-frequency, regenerative detector, and three stages of audio-frequency—which I believe would be called a stage of H.F., reaction det., and three stages of L.F. in your country. I use a moving coil to control regeneration—a variable condenser is sometimes used instead.

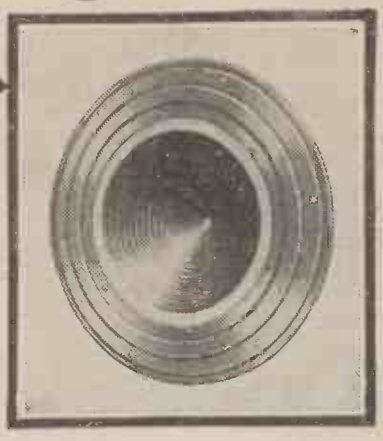
The first four tubes are what we call the "99" type. They draw 60 milliamperes of filament current at 4½ volts. The last audio tube is a "71" type power tube, with 180 volts on the plate and 5 to 7 volts raw A.C. on the filament.

Single Dial Tuning

The set itself is mounted on a standard 7-in. by 16-in. hard-rubber panel, and the sub-base (or baseboard) is about 6½ in. by 15 in. A two-gang variable condenser is used for tuning, making the receiver a single-dial control. There are two other controls—one for regeneration and one for current. Due to the type of eliminator used to supply current, a high-

The concert studio of KGO, in Oakland, California, one of the broadcasters that our correspondent can hear.

easy...



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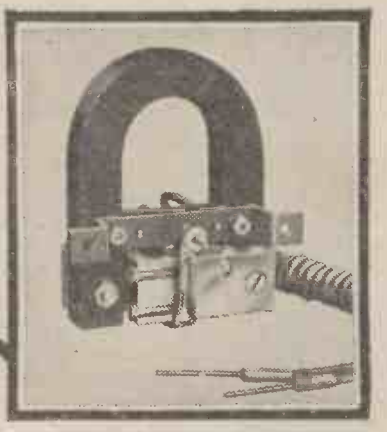

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"The Average Set Here is of Seven to Nine Tubes"

resistance of the graphite type and a milliammeter are used.

The eliminator which supplies the entire current for the receiver is a local make, using a gas-filled (filamentless) rectifier tube, and is only about 4 inches high, 6 inches wide, and 10 inches long—smaller than the usual storage battery alone. However, this eliminator will operate only the "99" type of tubes, and they must be wired in series instead of in parallel as in a battery set.

Two "Locals"

We have two local stations, one 1,000 watts (K F S D), and one 250 watts (K G B), but we get most of our programmes from Los Angeles, about 100 miles up the coast, where are located a dozen or so stations, ranging from 100 to 5,000 watts power. Through K F I, Los Angeles, we get the National Broadcasting Company (N B C) network programmes, most of which originate in New York (about 3,000 miles distant) or San Francisco, about 600 miles up the coast, or at any point throughout the U.S.A. where a special event may be taking place. We here on the coast arose at 2.00 a.m. one morning for a special broadcast which originated in London. Thanksgiving Services in Westminster Abbey for King George, broadcast by 5 S W, were picked up on the east coast on a short-wave set, sent by wire to New York, where they were relayed over the coast-to-coast network, arriving here at 2 o'clock in the morning.

Through K M T R (Hollywood) (a part of Los Angeles) we receive the programmes of two other networks—the Columbia Broadcasting System (C B S) and the American Broadcasting Company (A B C). The A B C network covers the Pacific coast and is now extending eastward across the country and will eventually extend from coast-to-coast. Their Southern California outlet is K M T R. The C B S is an eastern network, whose programmes for the most part originate in New York, which is now also becoming a coast-to-coast hook-up, and pending the completion of their system the C B S programmes are released locally on the A B C chain.

This is the control panel in the transmitting room of K F I, the Los Angeles station of the Packard Motor Co. This is the broadcaster mentioned several times by Mr. Werner in his interesting letter. You can see the main panel in the large reflecting mirror.

Then there are many minor hook-ups, such as the Don Lee Chain (to be absorbed by the C B S, January 1st), comprising K H J (Los Angeles), K F R C (San Francisco) (about 500 miles north of Los Angeles), and K M J (Fresno), midway between the two.

Distant Reception

Sometimes a programme will originate in a Los Angeles station and be rebroadcast throughout Southern California by stations up to 100 miles distant. Static is not bothersome in this part of the U.S.A., so this method is quite satisfactory.

Distant stations are well received here during the winter, and on my set it is not unusual to have good loud-speaker reception from Chicago, or even Pittsburgh, nearly 3,000 miles away. At times other distant stations are received throughout the country, and I have also heard Japan, Canada, and Cuba, proving that DX is possible even with electric sets.

During summer the limit of enjoyable reception is cut to under 1,000 miles, although in a summer D X contest conducted by a local magazine, in which I participated, about 2,000 miles seemed to be the limit of possible speaker reception.

As I write these lines I am listening to the Saturday night broadcast of the Symphonies Under The Stars, from the open-air Hollywood Bowl, located in the foothills of Hollywood, through K F I (Los Angeles) and the Pacific coast network of the N B C, "sponsored by the Union Oil Company of California——"

Multi-Valvers Everywhere

The average set on the market here at present is of about seven to nine tubes, with three and four stages of radio-frequency amplification, though many use but one stage of audio; push-pull being the most favoured. Dynamic speakers are used almost exclusively in the new sets, and new models come out every few months and great advertising campaigns announcing the "world's greatest set" are of almost weekly occurrence. Everything is single-dial control, there being but two other controls—a volume

(*Continued on page* 693.)

MUNICH'S BROADCASTER

Munchen, or Munich, has recently greatly improved the quality and programme matter of its broadcasts. This is largely due to the better studios and control rooms which have been built in a new "broadcasting house" which is described in this special article.

From Our Own Correspondent.

THE new broadcasting house in Munich has been completed, and listeners receiving Munich or one of its relays already know that the acoustic properties of the new studios are quite excellent. The general aspect of the house and studios have been described elsewhere, and I would like to stress the technical equipment in this article.

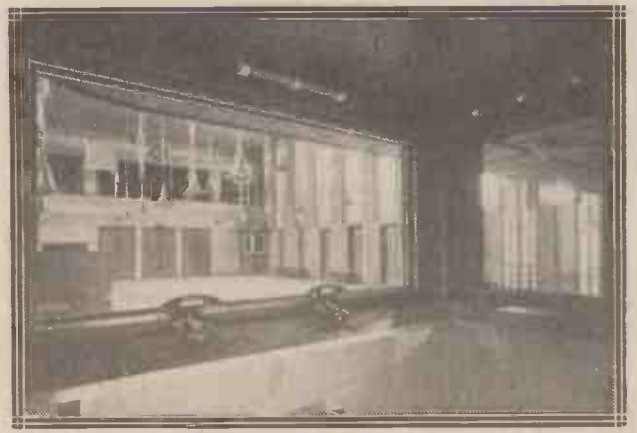
Talking to Professor G. Baumgartner the other day—Professor Baumgartner is responsible for the complete design and construction of the technical equipment in the new house—he quite plainly said that the Munich installation was almost unique; only in London, at Savoy Hill, was there a similar technical installation. It is perhaps interesting to note that Professor Baumgartner was over in London some time ago to study B.B.C. methods, and that it is largely due to this visit that the Munich house embodies many technical ideas hitherto unique to Savoy Hill.

One instance is the echo-room, first to be found in London and now in Munich.

Two Distinct Parts

The central control-room in Munich is situated in the basement, below the medium-sized studio, and is connected to the central microphone control board, situated between the main and the medium studios by a small staircase. The whole amplification system has been divided into two distinct parts: First stage of amplification and microphone switching arrangements, together with the switching for the interval and opening signals, and the light signalling for the studios' mixing switches, etc., on one central control board between the two main studios; then down one stair below the

TO BE HEARD EVERY EVENING ON 533 METRES



On the left we have a view of the large studio from the producer's cabin, while on the right is the control panel, situated behind the little cabin seen in the right background of the left-hand photograph.

Based Very Largely on Savoy Hill

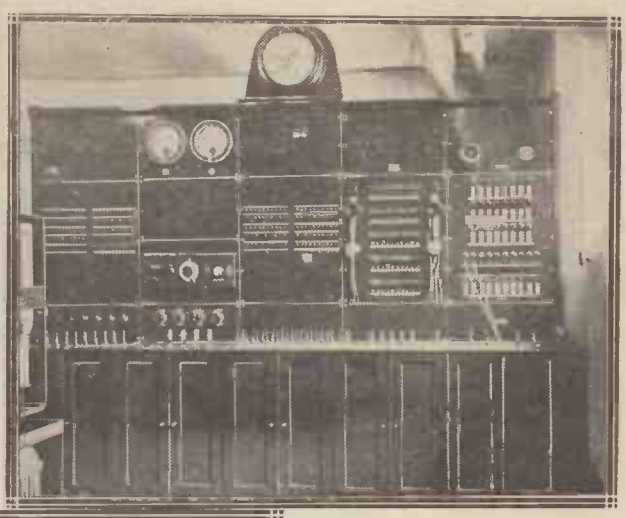
smaller studio the last stage of amplification, the complete switchboard for the batteries and high-tension supplies, and the central control board for outside broadcasts and for the outgoing currents to the four transmitters.

Control board 1 contains no less than fifteen microphone amplifiers and the necessary fifteen first-stage amplifiers. The main studio can contain three microphones, all working at the same time, also the smaller studio. The other studios can only carry one microphone at a time.

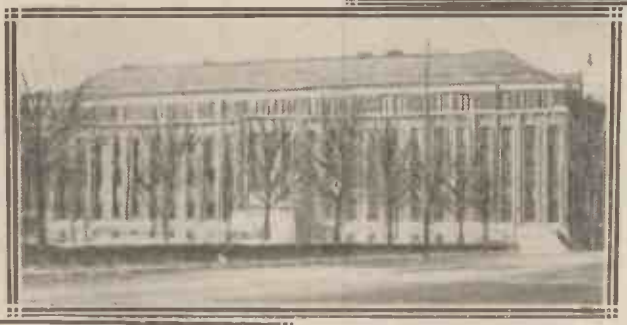
The Control Rooms

The house has twenty-five different contact points for microphones and additional three positions for gramophones. The control board 1 carries the mixing switches and controls and a small microphone for the announcer, together with the signalling switches. A large electro-dynamic loud speaker is fitted as a control loud speaker, but is automatically cut out when the announcer puts his microphone into circuit.

From twenty to thirty loud speakers are constantly working in the different rooms and offices in the broadcasting house. The necessary amplifiers for these are in the basement control room.



Above we have control board No. 2, which contains measuring and control apparatus for the amplifiers, the switching for outside broadcasts and lines to the relay stations. (Left) a general view of the huge new Broadcasting House.



Below is a photograph of Prof. G. Baumgartner, the technical chief of Bavarian broadcasting, who was responsible for the design of the technical equipment of the new station. He is seen here at his short-wave receiver by means of which he frequently relays American and Australian stations via the Munich transmitter. A recent relay of Bangkok was also successfully carried out.

* * *

Control room 2 contains the amplifiers proper; that is, the last-stage output amplifiers. These amplifiers can be bodily replaced within a few seconds in case of breakdowns. There is a special amplifier for the loud speaker in the echo room, and one for the two loud speakers in the main studio, called the order loud speakers, as it is by means of these and a mike that the producer conveys his orders to the performers in the main studio from his special glass box in the same room.

Control room 2 further contains a special receiver for the control of the programme via ether. Either this programme or the programme straight off the amplifiers can be fed to the loud speakers in the house. Then there is the electrically-controlled clock for the time signals. It is interesting that Munich and relays do not give the Nauen time signal, but gives its time signal which is electrically controlled by the State Observatory in Munich.

The "Broadcast Casino"

The apparatus for the daily weather chart, after Professor Dieckmann's system (Munich was the first broadcasting station to start broadcasting a daily weather chart), and the opening signal apparatus is still in control room 2. The interval signal is placed in a small separate room more like a very small prison cell, where it tinkles out its tune, and a special microphone conveys it to the transmitters.

All the current for the amplifiers is taken from batteries; tensions of 6, 20, 300, and 600 volts being required. The accumulators, together with the charging machines, are situated in separate rooms, also in the basement.

The house itself contains four indoor studios and one courtyard, which is regarded as Studio No. 5. Apart from studios and offices and rehearsal rooms, do not let us forget a jolly little "broadcast casino" down in the basement, where you can even get cocktails—if you know the bar-tender—a very strange delicacy in the way of drinks in beer-sodden Munich.

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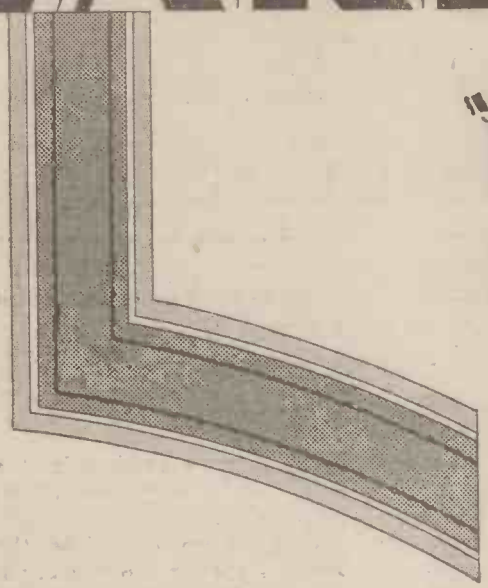

Once again VARLEY has satisfied the experts. Selected as one of the best on the market—the VARLEY L.F. Choke is specified in the "ECKERSLEY" THREE. That's proof enough of VARLEY quality. Designed for use as a smoothing choke in H.T. Eliminator Circuits and mains-operated sets, or as an output filter choke after power valves, this L.F. Choke has marked advantages where the voltage drop across the smoothing circuit must be as low as possible. Increase in current means only a small drop in inductance.

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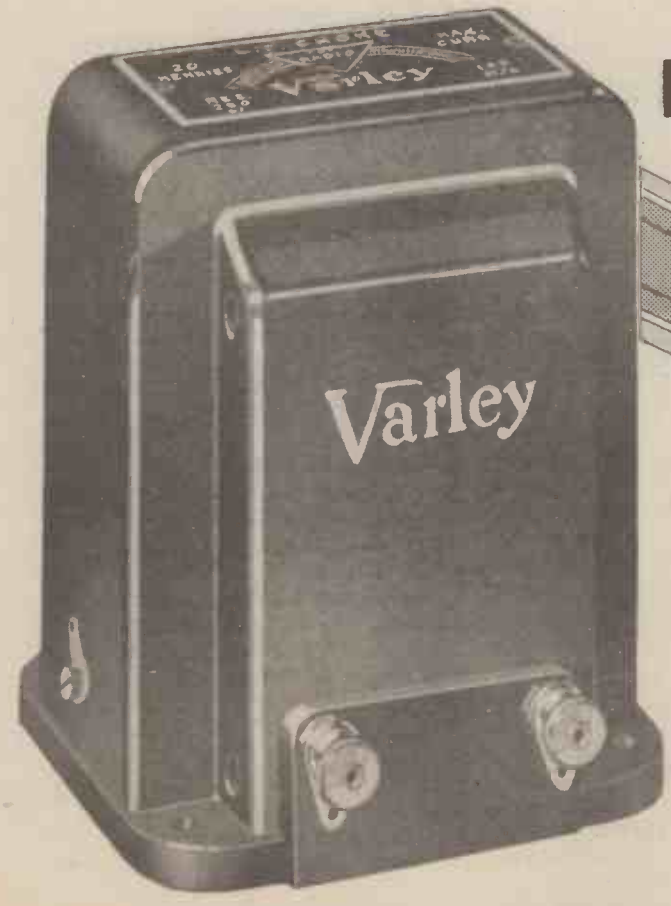

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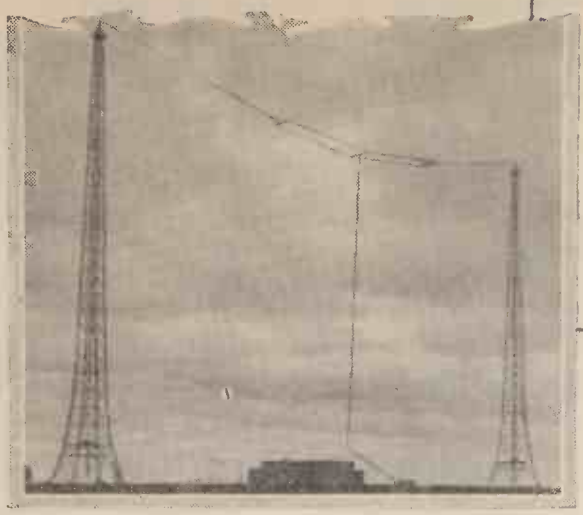


THE BEST WAVES FOR BROADCASTING

Short, medium, and long waves each have particular uses for radio communication, though these uses may be widely different, as shown below.

By F. GILLETTE.

THERE are so many factors which go to account for the difference between good and bad broadcast reception that it is difficult to say how much importance, if any, is to be attached to the particular wave-length used for transmitting the programme through the ether.

At the same time, many listeners are of opinion that, other things being equal, programmes transmitted between 300 and 400 metres come in better than those transmitted on wave-lengths higher up or lower down the scale. Taking this belief for what it is worth, there are certain points which can be made in its favour.

In the first place it is significant that the bulk of the world's broadcasting takes place between the wave-length limits of 200 and 600 metres. This particular range of wave-lengths was selected by competent technical experts in consultation with the administrative authorities of the various countries concerned.

Special Precautions

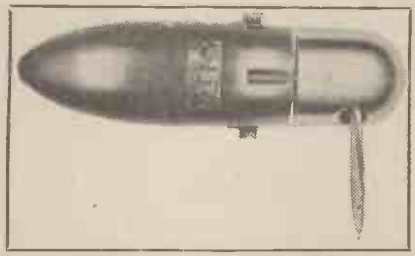
The 200-metre limit is also imposed by the very practical consideration that the ordinary type of receiving circuit is not adapted to handle wave-lengths much below this figure. As the wave-length is shortened the frequency increases, and at or above the neighbourhood of two million cycles per second special precautions have to be taken to ensure efficient reception.

It does not necessarily follow that the broadcast service is definitely barred for all time from the region below 200 metres. On the contrary, it is more than likely that before long there will be a general move in this direction, owing to the growing congestion in the relatively narrow ether band now available.

The technique of short-wave reception is, however, developing so rapidly that when the move does come, both the radio manufacturer and the amateur constructor can be depended upon to meet the new conditions and to produce short-wave sets that will be fully up to the required standard.

The "Fading" Trouble

In considering the possibility of short-wave broadcasting, one must not overlook the fact that "fading" is far more troublesome on the short waves than on the long. Also it is difficult to cover short distances when



The small one-bladed propeller-driven generator used in aircraft for supplying power to the radio installation.

transmitting on very short waves. The latter are excellent for long ranges, but since they travel mainly at an elevation, and not along the ground, they are inclined to "skip" over the intermediate areas.

So much for waves below 200 metres. When it comes to wave-lengths above the 600-metre mark, other objections arise which have, however, very little to do with efficiency in reception.

The most convincing argument against the general use of long waves for broadcasting is lack of accommodation.

In practice, the minimum separation laid down by the International Committee in Geneva is 10 kilocycles between one broadcast station and its nearest neighbour on the wave-length scale.

Under these conditions there is barely room for 100 primary broadcast stations in the whole gamut of wave-lengths between 200 and 600 metres. Actually, of course, there are many relay stations in operation working on a common wave-length, so that this figure is exceeded in practice.

On the other hand, only 35 long-wave stations could be accommodated without overcrowding inside the limits of 600 and 2,000 metres. Even if the limit were to be extended to cover all the wave-lengths between 600 and 20,000 metres, there would only be room for 48 separate programmes in all, or less than half those now operating inside the 200-600-metre band.

Long Waves Easier

So far as reception is concerned there is much to be said in favour of using a long-wave carrier. The programmes are less subject to fading, particularly during the summer-time and in daylight generally, whilst the simplest type of resistance-coupled circuit can be used with advantage on this type of transmission. Finally, on the transmission side it is a simpler matter to radiate high power on long waves than on short.

At the same time, the increasing demand from the various European countries for more ether space for their new stations makes it impossible to hope that the bulk of the broadcast service can ever be carried on above 600 metres. The 200-600-metre band is already crowded out, and although there may be room for a few more long-wave stations, the only hope for permanent relief lies in the direction of the shorter waves.

Radio and the Gramophone

In this section of MODERN WIRELESS each month will be discussed both technical and other data of interest to the set owner who is also interested in gramophones.

Conducted by KEITH D. ROGERS.

CONTENTS

Exposing a Fallacy

THIS Christmas a number of you will probably be debating whether or not you will change over from your ordinary gramophone to a pick-up and reproduce your records electrically, or whether you will buy a cheap gramophone turntable and motor, and use a pick-up with your wireless set in order to provide yourself with a gramophone. And a number of you will be faced with a fallacy which, although it originated some years ago still exists, about the question of record wear.

A great many people imagine that a pick-up spells ruin to a record, and that if they want to use electrical reproduction they must necessarily put up with excessive record wear.

What Experiments Proved

Such a reputation may have been deserved at the commencement of electrical reproduction, but it is not true to-day, for the modern pick-up is exceedingly light on the record, and it is possible to play a record at least eighty or a hundred times without any signs of " audible wear," if we may call it such, being present.

If you cannot hear the effects of the wear in a record, then for all intents and purposes that wear can be considered to be absent. That is obvious, but for the more scientifically-minded further investigation than the mere listening to the record is required, so in order to dispel from the minds of readers the idea that the pick-up is hard on records we have carried out a series of tests with various sound-boxes and pick-ups with a view to finding whether there are any grounds for the stigma which has been placed upon the pick-up.

The results of these tests are discussed in an article in this issue entitled " Do Pick-ups Ruin Records ? " and show very definitely that they do not. In fact, it has been found that the average sound-box wears the record more than the average pick-up.

Really Long Record Life

So if you feel inclined to use a pick-up instead of your gramophone sound-box this Christmas, do not hesitate because of record wear, but choose a good pick-up, being careful to track it properly, following the maker's instructions, change the needle after every side, and you will be sure of getting really long life from your records.

In fact, so long a life will be available that you will probably be heartily sick of any particular record long before it shows signs of wearing out.

In conclusion, we should like to take this opportunity of wishing all our readers a really Happy Christmas and every success in the New Year, while assuring them that if they are ever in difficulties with their receivers or gramophones a letter to the Query department of this journal will soon put matters right.

ROUND THE TURNTABLE

Interesting Odds and Ends—by "Tone-Arm."

HERE are a few useful hints regarding the running of your clockwork gramophone motor. Always wind the motor when running, being careful not to overwind when the motor is nearly fully wound up.

* * *

When you have finished playing let the motor run down almost to the end, and do not keep it overnight or from day to day fully wound up. Regular oiling of the necessary moving parts has a great effect upon the life of the motor.

Oil Regularly

Carefully clean the various moving parts and oil them with fine machine oil. If the motor is of the electric type, clean the commutator carefully and see that the brushes are bearing properly on it.

* * *

Careful oiling and cleanliness will do much to make for reliability of the motor, while it must not be forgotten that even and silent running are essential to really good radio-gram reproduction.

* * *

Many cases of poor results which have been brought to my notice have been due to the fact that the grid-bias battery has been left for well over a year, or probably two years, and is covered in dust, while the voltage has dropped to zero.

* * *

The result is that the grids of the valves have no bias at all, the filament emission is being spoiled, and the H.T. battery is having a very bad time of it. So just have a look at your grid-bias battery, and make sure that it is up to the mark.

The Scratch Business

For the best reproduction a certain amount of scratch must be tolerated, as to cut down any of the frequencies below about 4,500 is seriously to affect the quality of reproduction, many of the harmonics being so reduced that the whole quality of particular notes is affected. Scratch filters therefore are to be avoided if they affect the reproduction below 4,500 cycles.

Angle of the Needle

A number of people recommend that the needle should be set at an angle of nearly 90 degrees to the record, instead of the more popular 60. They argue that this is nearer the recording conditions and that it enables the needle point to reach the bottom of the groove, thus preventing the needle from rising up on the walls of the groove and causing unnecessary wear or breaking down of the walls.

* * *

The new needle-armature pick-ups require a practically vertical needle, and, contrary to the opinions of many, the effect of this on the wear of the record seems to be quite negligible.

Minimising Wear

The best way of averting wear on the walls of the grooves of the record —assuming tracking is quite O.K.—is to use a needle which has a very fine point, or a fibre needle, although, personally, I think fibre needles affect the quality of reproduction in an adverse way.

* * *

The needle, however, should not be inclined to whip, otherwise excessive wear and inferior reproduction will result. The Sympathetic Chromic needle, with its special grip, which prevents the needle from whipping badly, seems to give very fine results both from the point of view of quality and the lessening of record wear.

The Gramophone Company

In the Hall of Music at the Housing and Health Exhibition, at Glasgow, the various tableaux representing operas recorded by "His Master's Voice" had, amid the scenery, people attired as are the principals on the stage. In addition, live stock were installed.

* * *

Messrs. H.M.V. have commenced a series of lectures at the London Polytechnic upon the theory of the radio gramophone, for the benefit of dealers who are not conversant with the science of radio.

The course is being very thoroughly carried out and illustrated by practical demonstrations with the new H.M.V. radio-gramophone.

When the baize of a turntable ruckles up it should be stuck down immediately, for such bad condition will cause uneven playing of records and unnecessary wear.

DO PICK-UPS RUIN RECORDS

This is a short account of one of the most interesting of several tests made with a view to disproving once and for all the fallacy that a gramophone pick-up is necessarily "bad for records." It proves that such a stigma is by no means just, and that, as a matter of fact, the pick-up is remarkably light on the record.

By KEITH D. ROGERS.

IT has often been stated that the gramophone pick-up is much harder on the record than the ordinary sound-box, and a great many people have decided not to use electrical reproduction simply because they have the idea that the pick-up will ruin their records.

The very early pick-ups possibly did wear the records rather badly, but the modern design is far more scientific than its early brother, and as such it is interesting to look into the question of record wear and to compare the behaviour of the pick-up with that of the sound-box.

Now there are two forms of wear which take place on a gramophone record. One is due to the direct friction of the needle on the walls and base of the groove, and the degree of wear is dependent upon the tracking of the pick-up or sound-box and the pressure between the needle and the record.

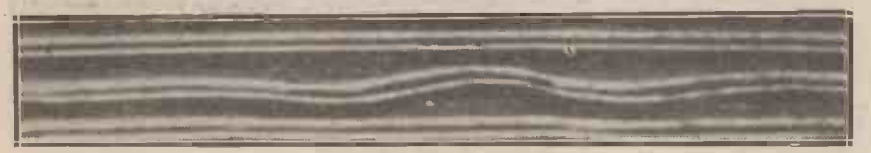


Fig. 1. A section of a "band" record before the sound-box was employed.

Wear Due to Inertia

This latter can be reduced by using a counter-balanced sound-box or pick-up. Unfortunately, however, it is best not to reduce the effective weight below about four ounces; though it should never be greater than six and a half, otherwise excessive wear due to friction will take place. The other form of wear is due to friction due to the inertia of the needle system.

We will not take into consideration the needle itself in this article, though undoubtedly the type of needle has something to do with the amount of wear caused by friction. Fibre needles assist very greatly in reducing this wear, and so do steel needles which have very fine points, but the type of wear due mainly to the inertia of the whole needle and sound-box is that which causes most damage in modern reproduction.

It is not difficult to see that this particular type of wear is due to the pressure of the needle against the sides of the grooves, and that it will take place more forcibly where heavy modulation of the record occurs. Obviously, if the needle could follow the path of the record perfectly and had no inertia, no wear due to the difficulty of the needle in following the grooves would take place.

Fig. 2. An untouched photograph of a similar section of the same record after the sound-box has played it 50 times. Note how the groove has been deformed.

Readers will understand that although we talk about the needle following the path of the groove, actually the needle is stationary except for its lateral movements due to the various ins and outs of the grooves which cause the needle to wobble from side to side.

Now this forcing of the needle from side to side has to be done not only against the whole inertia of the weight of the needle and the rest of the armature, but also against the damping of the needle system. Consequently the record has to expend quite an amount of energy in forcing the needle from side to side, and the greater the amount of energy that the record has to expend the greater will be the wear. Also, the more sudden the change in the groove, the greater will be the wear, owing to the fact that far greater energy has to be exerted in order to make the needle change position quickly.

Where Damage is Greatest

This will be fairly obvious and consequently it will be easy to see that wear is going to take place most at heavy passages, especially when they are passages containing both notes of high and low frequencies together. In such cases the modulation will be deep and complicated and the movement of the needle has to be very rapid, with the result that the grooves wear very considerably.

Of course, the whole weight on the record of the sound-box or pick-up system has an effect upon this type of wear, as it does upon the other. If

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Needle Angle and Damping are Very Important Factors

the weight on the record is too small the pick-up will chatter, jumping about in the groove and possibly jumping right out into the next groove.

The same trouble may occur if a very fat needle is used which has no point to speak of, or if the needle is placed at a very small angle with the record. Then it will ride up on the grooves and tend to break them off at the top and ride into the next groove.

An Interesting Experiment

Obviously, then, the damping of the pick-up, besides the alignment and weight, has a tremendous effect upon the wear of the record, and it is interesting to note, when mentioning the question of alignment, that quite a number of the well-known gramophones have their sound-boxes very badly aligned indeed.

I have been carrying out experiments with various sound-boxes and pick-ups with a view to determining how much record wear is caused, and whether the stigma that has been placed upon the electrical pick-up by a large number of people is deserved. The results prove conclusively that it is *not* deserved.

Apart from the fact that with the average sound-box record wear does not seem to be audible so early as with the pick-up, or, in other words, the sound-box has to wear the record far more than a good pick-up does before the results of wear are noticeable aurally, the tests prove that on equal runs on the same passages, or very similar passages, of a record, the sound-box causes visible wear much sooner than most pick-ups.

I do not say that all pick-ups are equal or anywhere near equal in the wear which they cause on a record. Obviously the various designs and various weights make that impossible, but in the photographs shown here we have the results of two well-known pick-ups, "A" and "B," and the Columbia standard Viva-tonal gramophone sound-box.

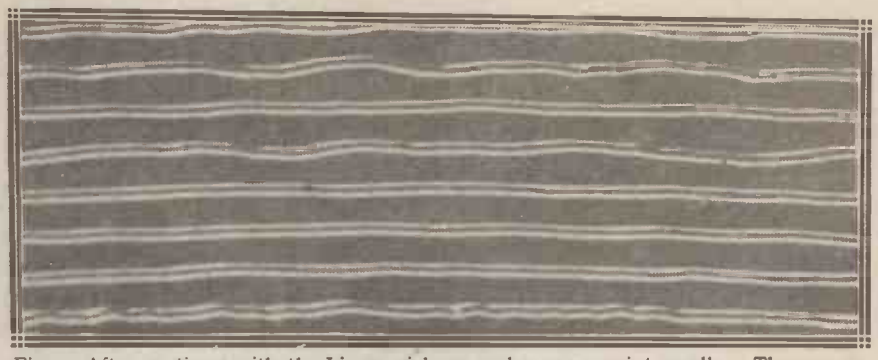

Fig. 4. After 50 times with the Lissen pick-up and a spear-point needle. The grooves show no trace of wear.

Each has run over a passage of record fifty times, the needle being changed five times, and the running of the record was so arranged that the needle had ample time to grind itself in before it reached the passage over which the effects of wear were being observed.

Sound-Box v. Pick-Up

At a casual glance, watching the record while it was being played, it appeared that from the point of view of the dust collected on the needle the Columbia and pick-up A were about equal, while pick-up B was very little behind with the amount of dust collected.

This experiment was made doubly interesting by the fact that the pick-up B used was one of the Lissen new needle-armature types, while pick-up A was the latest B.T.-H. of more orthodox design and greater needle-suspension inertia.

The grey appearance on the record (denoting wear) appeared after about twenty-five runs with A, and a little under with the sound-box, but it is worth nothing that the record did not really go grey at all over the whole of the fifty runs with pick-up B. This is rather remarkable and was quite unexpected, although it was known that the inertia of the needle system in pick-up B was far less than that in the case of either pick-up A or the sound-box.

It is interesting to examine the micro-photographs of the portions of the record over which each pick-up and sound-box went. Three portions of a record having very definite musical phrases were chosen, and micro-photographs were taken before and after fifty runs in each of the three cases. "Medium" needles were employed for the sound-box and "A."

Taking the sound-box section of record first, although no audible effects of wear were noticed, and the wear is certainly not at all excessive, being far less than that caused by many other makes, or by earlier models of the same make, yet definite record wear did take place.

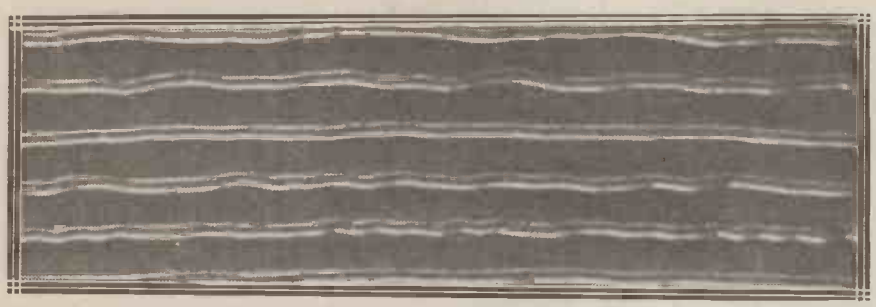

Fig. 3. A section of the same "band" record after the B.T.-H. pick-up has played it 50 times. Little trace of deformation of the grooves is visible. The polish of the record face is worn off, hence the dullness of some of the "crests."

Deviation from the Path

If you examine the centre line in the reproduced photographs you will see that it is a portion of a fairly heavy passage, the nature of the grooves being clearly shown in Fig. 1. On turning to Fig. 2, however, which is a photo taken after the record has been run fifty times, you will notice that the needle in its path from right to left of the photograph has done everything possible to avoid going round the corners.

It has ridden up the sides of the grooves, and in some cases right over on the top before slipping back to its somewhat erratic path. The corners have been deformed, in one case a

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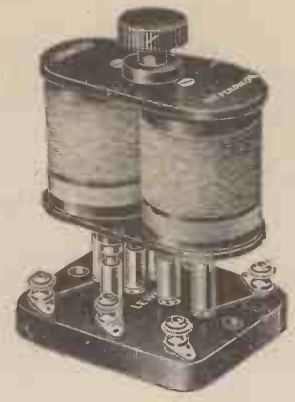

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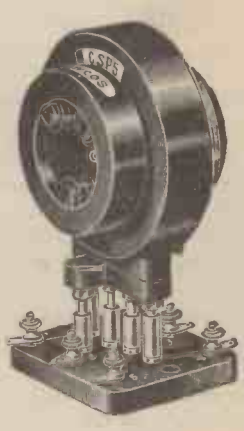

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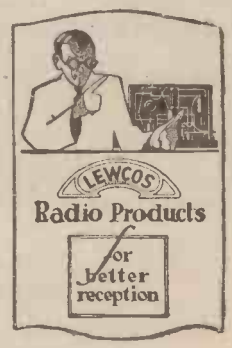

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The Pick-Up is Remarkably "Light" on Records

corner has been made sharper, while in another, right on the left of the photograph, the needle has attempted to go dead straight, instead of round a bend.

It can be seen that in one instance the needle has evidently taken a rather sharp corner very badly, and has skidded up either on the one side or the other (at different times) of the walls of the grooves, coming down again to make a very erratic pathway round the big bend before taking a fairly straight path along the straight portion of the groove.

It is interesting to compare this with the photo of a section of the

Fig. 5. This photo shows how badly a "loud" needle may fit into the groove; the point is much too blunt, and the needle is riding on the walls of the grooves.

B.T.-H. pick-up track (Fig. 3), where little wear can be detected. The B.T.-H. outfit is quite as heavy as, if not slightly heavier than, the sound-box in question, and was fitted according to the maker's instructions as to special aligning, tests being made before the run, and it proves conclusively that if a good pick-up be used properly there need be very little wear.

Extremely Little Wear

Some wear is present, as is apparent from the removal of the polish of that portion of the record over which the pick-up has passed, but there is no sign of the wear which causes corners to be knocked off, and the photo shows no sign of the needle rising up on the sides of the grooves as in the case of Fig. 2.

Finally we come to the section of the record over which the Lissen pick-up passed, this pick-up being of the new needle-armature type. This is shown in the "after" photograph (Fig. 4). Here it is impossible to detect any wear, and comparatively little of the polish appears to have been removed from the record surface.

This is undoubtedly due to the fact that the pick-up has the needle placed in a vertical position, so that it goes well down in the grooves, wearing the groove at the bottom rather than on the walls.

The average method of holding the needle does not allow it to move properly in the groove, and instead of reaching the bottom it often wears itself along the walls' channels. A very fine needle certainly gives results with decreased wear, providing that the nature of the needle is not such that it will not "whip" badly and cause erratic movements in the grooves. The tungstyle type of needle runs pretty well down in the groove, owing to its peculiar point, and its very sturdiness makes it immune from excessive "whip."

Vertical Needle Best?

The comparative fineness of needle points and the size of the grooves can well be imagined from the photographs (Figs. 5 and 6), while the amount of record dust collected can be seen in another photograph. In this case (Fig. 7) we have the new needle on the left, followed by the same needle which has been run once over a new twelve-inch record, which has been very carefully cleaned with a cleaning pad to eliminate any trace of grit or dust on the record surface.

The third example shows a similar needle which has been run once over another record, which is much more worn than the first one, and which has not been carefully dusted. You will note the amount of dust and portions of record surface which are clinging to the point of the needle.

These pieces of record have been collected mainly from the sides of the grooves and not from the bottom. It is only when we come to the vertical type of needle, or very fine needles,

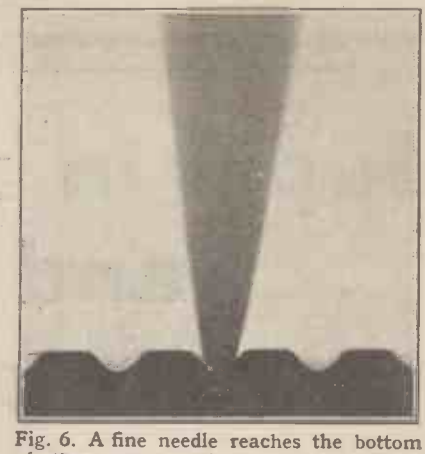


Fig. 6. A fine needle reaches the bottom of the groove and causes less wear, provided it does not "whip" badly.

that we really do wear the record in the way they should be worn, that is, at the bottom of the groove and not mainly on the walls.

The average gramophone always wears more on the walls, but the electrical pick-up is now being designed so that the wear is being taken more from the base of the groove, therefore greatly *increasing* record life, and improving the purity of tone.

These experiments and photographs prove without doubt that there is nothing in the idea that the pick-up "ruins" records. On the contrary, as also shown by many other tests which are not illustrated here, the fact is that the average pick-up is far "lighter" on records than the average sound-box.

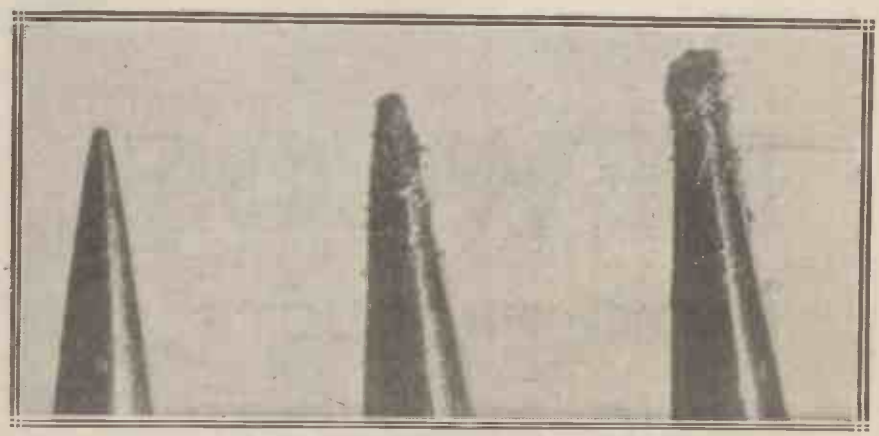


Fig. 7. Showing (left) a new needle; (centre) after one run on a new record; (right) a new needle after one run on an old record.

CONTROLLING TONE

One of the most difficult things to arrange with simple circuits is a true "raising and lowering" control of tone. A thoroughly practical and simple solution is provided by this interesting article.

By G. P. KENDALL, B.Sc.

VARIOUS half-hearted attempts have been made in the past to provide a tone control for radio-gramophone work, but as a rule they fell a long way short of fulfilling the requirements of the case. The majority of these devices were simply schemes for *reducing* to a greater or lesser extent a certain range of frequencies, usually the upper ones.

That could scarcely satisfy any reasonably exact definition of a tone control, useful as it might be on occasion. It seems to me that a tone control, to be any real use at all, should give us the power not merely to weaken the frequencies in which we are interested, but also to strengthen them above normal if desired. That, of course, is not a very easy matter with simple circuits, or it would by now be quite a common practice.

What Sort of Control?

I have recently devised a scheme for my own use which achieves the desired end in a rather indirect but nevertheless quite practical fashion, and I think the more enthusiastic radio-gramophone users may be interested to have some details thereof.

First of all we should make up our minds what we want to do with our tone control. Well, in my experience we want chiefly to control the upper register. The question of the lower end of the scale is usually a simple matter; we want all the bass we can get! We rarely get nearly enough, partly because there is a considerable falling off of the strength of the bass in actual recording, due to the limitation on amplitude imposed by the necessity of keeping within the standard width of groove, and also because very many pick-ups fall off here considerably. All we really want here, therefore, is a means of raising the level of the bass, but this seems impracticable without the use of a special type of filter circuit of a nature difficult for the amateur to handle.

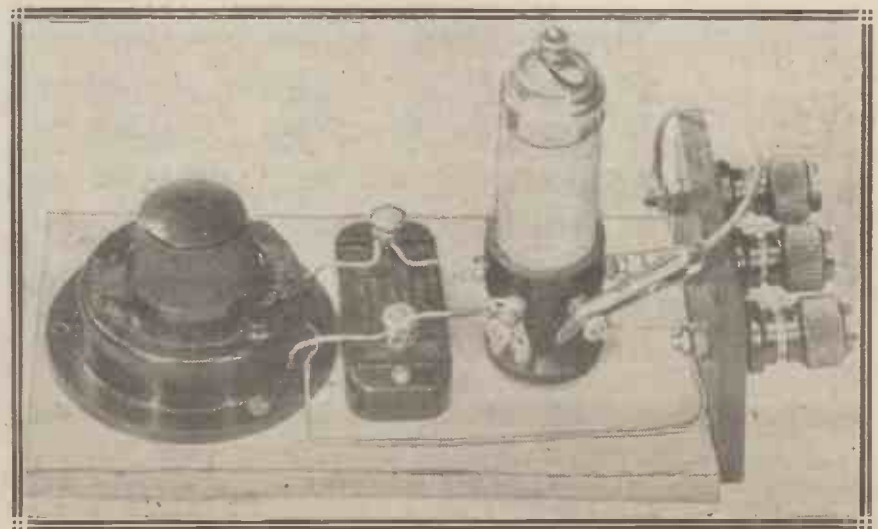
Our main concern, then, is with the upper part of the frequency range, and we want a means of raising or lowering the level of our pick-up's response curve in this region. The effect here, by the way, is far more marked than anything which can be done at the bass end, for it produces a very audible change in the whole character of the reproduction.

Value of High Note Control

When we raise the high note level, a sparkle and brilliance is added which is often very welcome, especially if it happens to compensate for the fact that the pick-up or the loud speaker possesses a falling characteristic in the upper region. In such a case the result to a critical ear will be a decided improvement in naturalness of reproduction.

Discretion Required

Again, if we are already obtaining a fair high note response from pick-up and speaker and we control in the other direction—i.e. downwards, we shall make everything sound more rounded and what some people call "mellow" (a quality I distrust profoundly!) Now, in general, I do not like the idea of taking liberties of this sort unless one has considerable musical knowledge and training, but there are cases when it is desirable. For example, it cannot be assumed that the balance of high and low is always correct in the recording, and it may sometimes be permissible to alter it at the receiving end, so to speak, if it be done with due discretion.



An example of a tone-control which only controls "downwards" on the higher notes

This is perhaps an arguable point, but a case where such a reduction in the higher frequencies is desirable does certainly arise where we have the combination of a pick-up with a good upper range and speaker with one or more really pronounced "peaks" in the upper register. Such a combination is apt to sound distinctly "screechy" and unpleasant at times, and it is no uncommon thing to find the owner of a speaker like this preferring what is really an inferior pick-up simply because it is weak in high-note response, and so does not aggravate the speaker into misbehaviour.

A Complicated Question

It would seem then that the lesser evil is to use a good pick-up with an adequate high-frequency response and tone-control it down until the loud-speaker peaks just cease to be really obvious. So much for what we can do with a high-note tone control. Now for a few suggestions as to when it is likely to be worth trying. Unfortunately, the question is complicated by the fact that both pick-up and speaker must be taken into consideration.

A Case for Trial

Take, first of all, the loud speaker. Now, quite a large number of the moving-coil types would be improved by an increase in the higher notes, and this we can take as a very general rule; if you have a moving coil try giving it more pronounced higher notes and see if the reproduction is not improved. On the other hand, a certain number of "moving iron" types, including some of the balanced-armature variety, possess some pretty marked peaks up here, and if your pick-up is a good one and gives adequate high-note response they may tend to be a little unpleasant on some records. Here is a case where a little high-note reduction may make things better.

When it Doesn't Work

Now about pick-ups. It is my experience that a really adequate high-note response is decidedly unusual. True, there are a few (notably the new B.T.-H.) that really do go up, but many cut off even as low as 3,000 cycles. I have even come across one which is by no means unpopular, which begins to drop at 2,000, has gone down heavily at 2,500, and gives practically no response from 3,000 upwards! In all such cases a raising of the high-note response is obviously worth trying, although in very bad cases there may be so little energy given out by the pick-up on the high frequencies that the tone control may be unable to raise it up to any noticeable extent.

Altogether you will see it is decidedly difficult to know what will happen in a given case unless you know the curve of the pick-up, and have some idea what the loud speaker does. It is really one of those cases in which one can only say that if the means of actual measurement are lacking (as they usually are) the best course is just to try the effect of a tone control capable of working either way, and see whether a more pleasing result is obtained.

Fortunately it is not a very expensive or difficult matter to try it, and I will explain next month how I arrange matters myself for this purpose.

The Gam-brell "Novotone" in operation with an ordinary set. Note the 30-ohm variable resistance for reducing scratch.

THE NOVOTONE

We recently received for test one or two samples of the new Gam-brell Novotone (price £5) for use with electric gramophones. The overall dimensions are, roughly, 9 in. by 5 in. by 4½ in., and you will be able to see from the photograph the general appearance.

It is constructed of plywood, artistically finished with a crystalline surface, and there are three terminals at one end and two at the other. The three terminals are: two for the pick-up input and the centre one for a special scratch filter resistance, while the two at the other end are for the output to the set.

The whole idea of the instrument is to increase the brilliance of the higher register and to increase the amount of bass in the pick-up reproduction. This is effected by a special circuit which has the effect of lifting up the bass and the high notes until they are on the same level as the middle register.

The overall response given by the Novotone with an average pick-up is exceedingly good, and the voltage step-up is such that the average three-valve amplifier used with an average pick-up is hopelessly overloaded.

Reducing Scratch

Scratch reduction is obtained by placing a 30-ohm rheostat across two of the three terminals and adjusting this according to the requirements of the record.

Unfortunately, the Novotone cannot be used with every pick-up, and those who contemplate purchasing one should enquire from the makers as to whether the particular type of pick-up with which they intend using it is suitable for use with the Novotone.

The B.T.-H. pick-up works exceedingly well, and so does the Woodroffe, but there are others, notably the Lissen, which have characteristics which make the Novotone quite unsuitable for use with them.

It is obviously impossible to design one instrument which will in all cases have the effect for which the Novotone is designed, and the makers are to be congratulated that with a large number of pick-ups, including the majority of the popular types, a great improvement in overall reproduction is obtained by using their instrument.

RECORD REALISM

By HALSEY A. FREDERICK.

A short article in which the difficulties that beset the recording engineer, and the designer of pick-ups, are discussed by a well-known authority on the subject.

SUCCESS of recording and reproduction of sound by the so-called "electric" method with a disc record may be considered as depending on several factors.

The chief problem is that of making the speech or music reproduced in the auditorium a faithful duplicate of the original sounds, using this chain of apparatus. Cost, reliability, and the time required for the process of recording are among a number of other considerations, but these are all subordinate to the problem of fidelity.

Analysing Results

While it may be convenient or even necessary to introduce distortion into certain of the steps to compensate for such distortion as may be unavoidable in others, experience shows that it is desirable for the sake of simplicity, reliability and flexibility to reduce such corrective warping to a minimum and to make each step in the process as nearly perfect as possible.

Perfection of a complete recording and reproducing system may be judged by the practical method of listening to the overall result. Each element of the system must be analysed thoroughly, however, if outstanding excellence is to be attained.

One of the most useful of the means of analysis is study of the response-frequency curve. In order that all frequencies be reproduced equally and that the ordinary faults of resonance be avoided, this curve must be flat and, particularly, free from sharp peaks. Good reproduction requires that frequencies from 50 to 5,000 cycles be included without discrimination.

If, however, frequencies down to 25 or 30 cycles be included, a noticeable improvement will be obtained with some classes of music, while if the upper limit be increased to 8,000 or even 10,000 cycles, the naturalness and smoothness of practically all classes of reproduction will be noticeably improved.

Since our standards of perfection in sound-reproducing systems are growing constantly more exacting, overall results that seemed excellent a short time ago are only fair to-day, and before long may seem intolerable. It has, therefore, been necessary for the analysis of each step of the system to be constantly more searching and more fundamental.

In recording, the usual procedure is to use a disc from 1 inch to 2 inches thick and from 13 to 17 inches in diameter, composed of a metallic soap to which small amounts of various substances have been added to improve the texture.

Shape of the Groove

The shape of the groove varies somewhat in commercial practice. That used in records for Western Electric apparatus is approximately 0·006 inch wide and 0·0025 inch deep, and the pitch of the spiral is between 0·010 and 0·11 inch, so that the space between the edges of the grooves is about 0·004 inch.

Thus the maximum safe amplitude is about 0·002 inch. If this is reached at 250 cycles the corresponding amplitude at 5,000 cycles, assuming that the sound is constant in absolute intensity over the intervening range, will be 0·0001 inch.

Grinding the Needle

In the records used with Western Electric apparatus the linear speed of the groove past the reproducer point ranges from 140 ft. per minute at the outside of the spiral to 70 ft. per minute at the inside. The rate of rotation is dependent upon the outer diameter of the grooves, which is determined primarily by the length of time to be covered by a single disc. Some records have been of laminated structure. There has not, however, been much latitude allowed the experimenter in his selection of materials. The records must be quite hard and, to have a reasonable life, must contain enough abrasive to grind the needle quickly to a good fit. At the beginning of the run of a new needle the pressures are very high, on

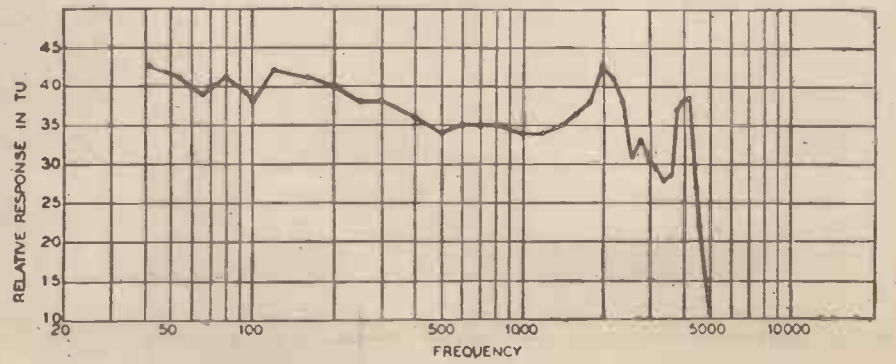


Fig. 1. The response curve of a pick-up, showing several resonance peaks.

Increasingly Wide Response Curve Required

account of the small bearing surface. They decrease rapidly, however, so that with an ordinary loud steel needle in a phonograph of the usual type the bearing surface is increased to such an extent after one minute's wear that the pressure is only about 50,000 pounds per square inch.

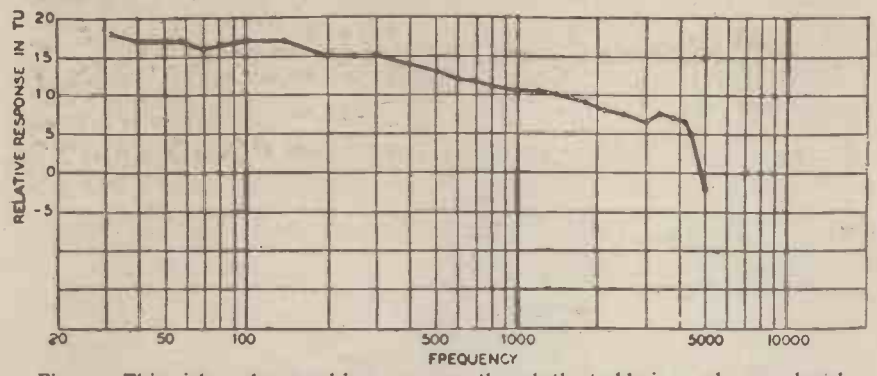


Fig. 2. This pick-up has good bass response though the treble is poorly reproduced.

The high pressures and the necessary abrasive characteristics have introduced irregularities which are responsible for most of the extraneous noise commonly known as "surface" or "needle scratch."

Recent development in the material of the finished records, together with refinement in the plating processes, has reduced the surface noise of records used in Western Electric Company theatre equipment by fifty to seventy-five per cent within the last two years.

An Important Point

It is not necessary to reduce the level of surface noise to the zero-point, but merely to the threshold of audibility under the minimum auditorium noise.

Moreover, the important point is not the absolute amplitude of the imperfections giving rise to surface noise, but their relative magnitude with respect to that of the useful sound amplitudes.

Thus an effective reduction in "surface" could be made by using larger records or reducing the playing time of the present records, in either case increasing the spacing of the grooves and the amplitude with which they are cut. Conversely, any large reduction in surface noise made by an improvement in the record material would make it possible to increase the playing time for records of a given size.

There is no known absolute or fundamental reason why further improvements in record materials may not be expected, with corresponding reduction in surface noise.

Large advances have been made within the last two or three years in designing electric reproducing structures. The mechanical impedance at the needle point has been reduced so that the point follows the undulations of the groove truthfully without the necessity of somewhat destructive bearing pressures.

Wear Reduced

At the same time, the mechanical transmitting structure has been so designed that a very broad range of frequencies is conveyed properly from the needle point to the armature.

The curves shown in Figs. 1 to 3 show the improvement which has been made. The pick-up shown in Fig. 2 is free from the resonances shown in Fig. 1. In the earlier pick-up there were high needle-point impedances in the region of these resonances, involving large driving forces destructive to both needle and record. Certain records were injured by only a few playings with this reproducer.

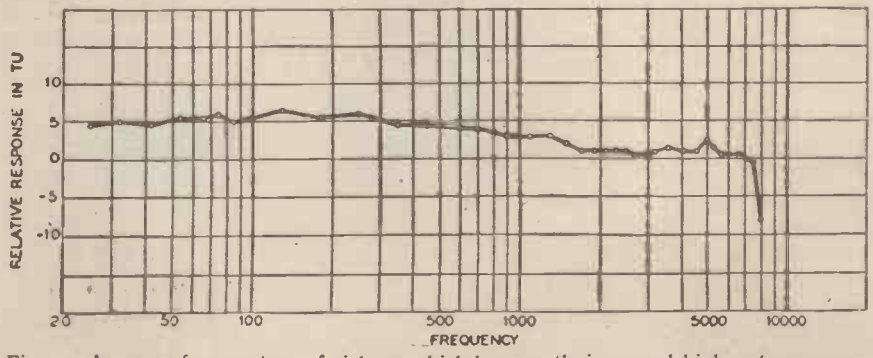


Fig. 3. A curve of a new type of pick-up which has greatly improved high note response.

The reproducer of Figure 2 is characterised not only by considerably reduced average needle-point impedance but, as shown on the curve, by a practical elimination of resonance. Hence there is an even greater reduction from the maximum impedances which occurred at resonance in reproducers of the earlier type.

A third curve, Fig. 3 was obtained with a more recent experimental model in which a lighter, though very much more rigid, structure is used to connect the needle point with the armature.

In this model a further large reduction in needle-point impedance has been effected, with corresponding reduction in wear on the records; in addition, greatly improved reproduction has been secured at the high-frequency end of the scale.

A VALUABLE BOOK

We have received from Messrs. Cassell what is probably the first text-book on the subject of gramophone electrical reproduction entitled "Modern Gramophones and Electrical Reproducers," and written by Messrs. E. Wilson and G. W. Webb, both intimately connected with the well-known journal, "The Gramophone."

This excellent book contains over 250 pages of the most interesting and valuable information concerning gramophone record reproduction. Chapters are devoted to sounds and sound waves, records and recording systems, reproducing systems, sound-boxes, horns, tone-arms, the subject of record wear, pick-ups, loud speaker, and amplifiers, and finally a chapter of interesting miscellaneous tips concerning the practical care of the gramophone, or electrical reproducer.

Published at half a guinea we feel that it is really good value for money, and strongly recommend it to the attention of those of our readers who want to go deeper into the subject of the radio gram receiver, and to learn more about the science of both the making and the reproduction of gramophone records.

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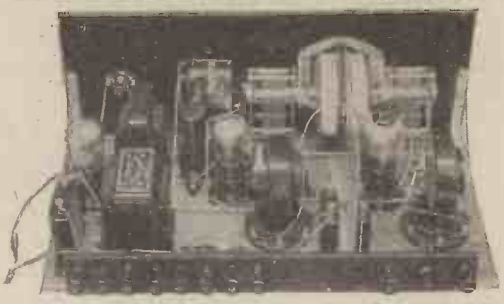

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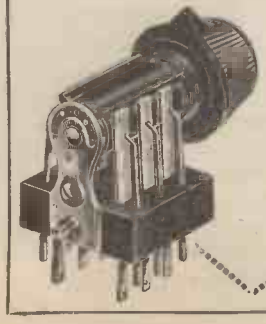

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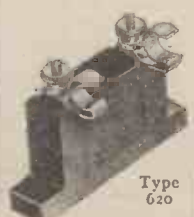

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RECENT RECORD RELEASES

Our monthly review of Gramophone Records.

Broadcast Records

THE Broadcast "Twelve" Dance Records have some very outstanding numbers this month and some very fine recordings. Perhaps the best recording of all is on 2520, ***I'll Always be in Love With You,*** played by the Manhattan Melody Makers. This is from the film, "Syncopation," and has an organ accompaniment running through the number. On the reverse side is ***Excuse Me Baby,*** a delightful little foxtrot. Other well-known numbers include: ***Sing a Little Love Song,*** introducing Teddy Brown and his Xylophone, and ***My Song of the Nile,*** with the organ of the Stoll Picture Theatre, on 2522; ***Yours Sincerely,*** and ***Too Wonderful for Words,*** on 2515, both by the Manhattan Melody Makers; while we have Al Benny's Broadway Boys playing ***Singing in the Rain*** and ***Nobody But You,*** from "Hollywood Revue of 1929," on 2523; and ***Making Whoopee,*** from the film of that name, with ***From Sunrise to Sunset,*** on 2524. All these records have vocal refrains.

On the ordinary Broadcast Records some interesting Christmas items are provided by the Military Band of H.M. Welsh Guards, with male chorus and effects. We have ***Christmas With Jack*** and ***Christmas With Tommy,*** on 470; and ***Christmas-time in Merrie England,*** arranged by Theodore Bennett, on X5. These are two exceedingly interesting discs and are, of course, specially suitable for release this month.

On the humorous side, Mabel Constanduros, assisted by Michael Hogan, provides us with ***Christmas Day at the Bugginses,*** on 461, and ***Mrs. Buggins Makes a Christmas Pudding,*** on 486.

Among the Broadcast "Twelves" we have the Choir of The City Temple, London, singing ***Once in Royal David's City*** and ***It Came Upon the Midnight Clear,*** as special Christmas items, on 5112, and the Stoll Picture Theatre organ, played by Herbert Griffiths, F.R.C.O., A.R.C.M., playing Christmas medleys on 5113.

Other outstanding items are ***Softly Awakes my Heart,*** from Samson and Delilah, on 5114, sung by Constance Willis; and ***Love's Old Sweet Song*** and ***The Second Minuet,*** a couple of duets, on 5115.

There is no doubt that the Broadcast Records are good value. Played with a pick-up, really first-class quality can be obtained with them, while the long-playing qualities of the Broadcast Super Dance Records make them extremely useful.

H.M.V.

Among the colossal list released by The Gramophone Company it is difficult to pick out any striking records, but we should like to discuss here two or three outstanding numbers of widely different interest. The first is a twelve-inch recording by the band of H.M. Coldstream Guards of ***Swan Lake,*** a Ballet by Tchaikowsky (C1745). With pick-up reproduction this is almost perfect. The cymbals come out with remarkable clarity and the whole effect of the record is extremely realistic.

Of a different type, though equally interesting from a recording and reproduction point of view, is ***Pastorale,*** with Arthur Meale on the organ, and pianoforte played by A. Neville Taylor, and the reverse ***Glockenspeilen,*** also by the same two artistes, on B3097. The reproduction of the piano with the organ in the background is extremely good, and this record forms a very interesting test record for pick-up reproduction, in that one is faced with the problem of getting the deep organ notes properly reproduced and at the same time keeping the piano completely "clean."

Ploddin' Along and ***Wake Up Chillun, Wake Up,*** by the Revellers, on B3156, is a record which no lover of light music of the dance variety should miss. The diction all the way through on both these recordings is perfect, and even allowing that this combination, which is said to be the best male quartette in America, can always be relied upon to give us good stuff, this record is indeed remarkable, both for purity of recording and the remarkably fine reproduction which can be obtained from it.

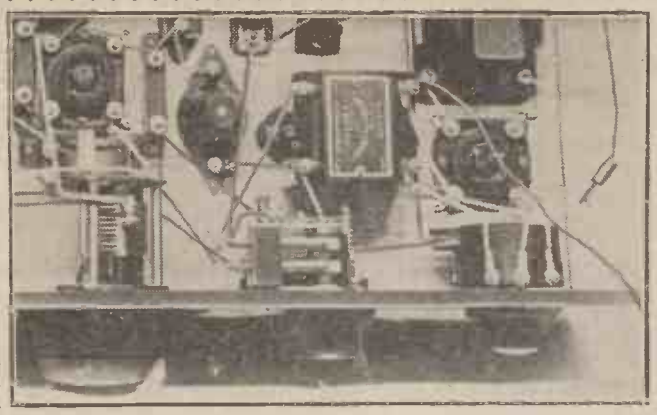
Zonophone

One of the choicest of the Zonophone records this month is ***Vocal Gems from the Merry Widow,*** on A367, by the Zonophone Light Opera Company. It is beautifully recorded and will give immense pleasure to all lovers of light opera.

Two other old favourites, ***The Moon Has Raised Her Lamp,*** and ***Excelsior,*** on A368, are provided by Browning Mummery and Foster Richardson, with orchestral accompaniment. These singers are almost as world-famous as the songs, and the two in combination form an exceedingly good recording. The Zonophone Salon Orchestra is still well to the fore, and this month gives us ***The Call of the Angelus*** and ***Fairy Tiptoe,*** on 5421.

Among the dance numbers we have Franklyn Baur, tenor, singing ***My Heart is Bluer Than Your Eyes, Cherie,*** and ***When My Dreams Come True,*** two talkie-film songs, while the ever-welcome Rhythmic Eight give us a really good list. We are exceedingly glad to see the Rhythmic Eight back again in such quantity, as we are of the opinion that this is undoubtedly one of the finest recording dance combinations in London.

They give us ***He's a Good Man to Have Around*** (5434), ***Come On Baby*** and ***I'm Just In the Mood To-night,*** on 5436, ***Louise*** and ***Kansas City,*** on 5437, four remarkably successful discs. By the way, Jimmy Rodgers is still being listed in the monthly Zonophone catalogue.



PRACTICAL HINTS FOR THE SET-BUILDER

A page of helpful advice about the making and operating of broadcast receivers.

WHEN drilling lead remember that the hole is liable to get out of centre unless a little lubricant is used with the drill.

* * * *

A good paste for lubricating a drill which is used to drill an accumulator lug can be made from a little lard worked up into a paste with linseed oil or turpentine.

* * * *

Do not try a low-resistance potentiometer for "controlling the volume," as this cannot be done unless the resistance of the potentiometer is in the neighbourhood of that of a grid-leak, i.e. 250,000 ohms or so.

* * * *

A white "coating" forming upon the plates of your accumulator is one of the indications of sulphation.

* * * *

The little vent plugs in an accumulator not only prevent the loss of electrolyte from spraying, and allow the gases formed in the cell to find a way out, but also keep dirt out of the cells. So on no account fail to replace a lost plug.

* * * *

The main factor in bringing up short-wave signals of the long-distance stations to audibility is the correct use of reaction.

* * * *

Ordinary bench clamps which can be secured from ironmongers for a few pence afford a very convenient and cheap means of clamping a drill to the bench, so that it can be used like a small lathe for winding coils or similar work.

* * * *

If a small quantity of common soda is powdered and mixed with an equal quantity of finely crushed coal ash, and the mixture formed into a thick paste with a little water, it will be found that enamel insulation on wire can be removed by rubbing between the fingers, or by applying with a rag.

* * * *

Where a pentode is to be used in conjunction with a mains unit for H.T. it is usually necessary for each valve in the circuit to have its own H.T. tapping plug if motor-boating is to be avoided.

* * * *

Failing separate tappings for all the valves in a powerful set employing a pentode, the tendency to motor-boating may be overcome by the use of an "anti-mobo" device in the circuit of one of the valves run from the common tap.

* * * *

Unsatisfactory service from an accumulator service station is often due to the return of accumulators with dirty terminals, and although it should not be necessary, the listener can, with a penknife, scrape the contacts and eradicate this trouble himself.

A fruitful and often unsuspected source of distortion is the allowing of grid-bias flexible leads to run close to other leads in the set.

* * * *

Do not have your battery placed a long way from the set unless this is unavoidable, for not only are long leads unnecessarily dangerous and unsightly, but there is a drop in efficiency in such cases.

* * * *

Although slow-motion condensers for reaction control are used, and are preferable to the older types, there is generally no reason why an old-fashioned condenser should not be used for reaction if on hand.

* * * *

When using a screened-grid valve for the first time remember that the plate pin (i.e. the one opposite the grid) does not really carry the output from the valve. The "P" or "A" socket on the valve holder will be connected to the screening electrode.

This set, designed only 18 months or so ago, already looks old-fashioned because of the terminals on the panel. The modern tendency is all towards simplicity.

RADIO NOTES AND NEWS OF THE MONTH

A feature in which our Contributor brings to your notice some of the more interesting and important Radio news items.

Conducted by "G.B."

Political Broadcasting

ONE of the things to be discussed during the present session of the House of Commons is the future of political broadcasting, for there is a widespread feeling that since the General Election the habit of broadcasting political views has been growing steadily, and some sort of a list of regulations ought to be prepared.

Clearly Defined Occasions

Some critics say that the facilities for political broadcasts have been abused, but the B.B.C. recently sent out a statement saying that controversy, political and economic, will be admitted on clearly defined occasions with adequate safeguards for impartiality and equality of treatment, the subject being dealt with in such a way that the main opposing views can be presented, clearly contrasted and linked as closely as possible.

Impartiality Maintained

Certain Conservative supporters don't think this has been carried out, and an enquiry is likely to be made as to the possibility of an arrangement being made by the B.B.C. to go through the MSS. of talks before they are delivered.

As a matter of fact, most reasonable critics are of the opinion that the B.B.C. has been extraordinarily successful in maintaining a balance of impartiality and fairness in connection with all forms of controversial talks, although it is admitted that some definite rules for the guidance of the B.B.C. should be formed as a matter of course.

Too Much Talk

The "Evening News" gave a representative selection from a 2 L O programme the other day, which ran as follows :

6.30.—Talk.
6.45.—The Foundations of Music.
7.—Talk.
7.15.—Musical Interlude.
7.25–7.45.—Talk.

When you get it down in black and white like that it does seem rather a lot, doesn't it ?

Empire Broadcasting

Controversy about Empire broadcasting still continues and certain sections of the Press maintain that the B.B.C. should do something about building a new short-wave station and improving the Empire service for short-wave broadcasting. But another section of the Press, and a very large section of the public, maintain that the listeners' money should not be spent on building a new short-wave broadcasting station when there is so much to be done about the Regional Scheme improvements and programmes, and other means of spending listeners' money for the benefit of listeners in this country.

(*Continued on page* 682.)

RADIO NOTES AND NEWS OF THE MONTH

—*continued from page* 680

Does Wireless Ruin Artistes?

Sir Landon Ronald is of the opinion that the lamentations about wireless ruining artistes are unfounded. It is good to hear a man of Sir Landon Ronald's experience putting his foot down with such a loud bang on stupid and indeed fallacious remarks about broadcasting.

Sir Landon Ronald says his experience is that the opportunity of broadcasting has been very useful to young people of talent. There has been a lot of talk lately about the pernicious influence of canned music, but then some people always try to interfere with progress.

A Scheme for Scotland

The B.B.C. scheme for Centralisation for Scotland has now come into force, and in future listeners may expect that any item that can be better done in the London studio will originate from there, while all programmes and items of a Scottish nature will be transmitted from the station best suited to supply them.

A Photographic Mix-up

On page 506 of our November issue the Celestion loud speaker, type C14, is said to be illustrated, whereas the actual picture is the Z20 model.

There is a considerable difference in both appearance and in price between these two models.

Did You Hear It?

It is reported in the "Daily Telegraph" that, using a special short wave, the wireless station 6 W F (Perth, Australia) and 7 Z L (Hobart, Tasmania) broadcast the description of the Melbourne Cup on November 5th.

It will be interesting to know from readers of MODERN WIRELESS whether they were successful in picking up these transmissions, and description of the sets used would be welcomed by the Editor.

Cables for the B.B.C.

Very soon the B.B.C. hopes to have its own particular landlines for S.B. work. At present all stations broadcasting on S.B. use wires which are loaned to them by the General Post Office. Some of these cables are overhead and some are underground, and there is a good deal of general variation which, from a technical point of view, does not make them exactly for S.B. work.

It is understood that negotiations between the B.B.C. and the G.P.O. are now very nearly completed, and that very soon the B.B.C. will have better cables of its own and so be able to give a better service.

New National Orchestra

What is happening about the new National Orchestra we have heard so much about, and which was, in

(*Continued on page* 684.)

RADIO NOTES AND NEWS OF THE MONTH

—continued from page 682

conjunction with Sir Thomas Beecham, to have been one of the B.B.C.'s really big efforts? It is over a year now since the question of a National Orchestra was first mentioned, but nothing much seems to have come about in a practical way.

It has been suggested that the B.B.C. Centralisation Scheme will have to be modified, and consequently provincial orchestras will be retained on a bigger scale than was hitherto anticipated. In such an event, the National Orchestra Scheme may probably peter out. The public are very interested, and we suggest the B.B.C. should issue a clear statement as soon as possible.

The Centralisation Scheme

Listeners in the Midlands, by the way, are getting very restive about this Centralisation Scheme. There has been a gigantic protest, signed by over a hundred thousand people in Birmingham and the Midlands. Lord Clarendon and Mrs. Philip Snowden recently paid a visit to Birmingham in order to get in touch with local feeling, and they admitted that Sir John Reith had warned them that there would be strong opposition to the Centralisation Scheme if the Board decided to go ahead with it.

Midlands Won't Stand It

Critics in Birmingham are now asking in no uncertain voices whether Sir John and other directors of the B.B.C. have really committed themselves to the policy of Centralisation. Whether they have or not, there is no doubt that the Midlands are not going to put up with it in the form originally suggested by the B.B.C.

"Anglicising" Aberdeen!

"Scotland is not being robbed of her birthright in regard to broadcasting," said Mr. David Cleghorn Thomson, the Scottish Regional Director of the B.B.C., at an address to members of the Aberdeen Rotary Club. Mr. Cleghorn Thomson was speaking on broadcasting as a national force, and he assured his listeners that the B.B.C. was not trying to anglicise Aberdeen.

Scottish listeners will be glad to hear these reassuring words, and the fact that young Scottish music composers and dramatists are to be given every encouragement.

Radio in Court

At the Willesden Police-Court the other day an applicant said:

"I have come to complain of oscillation. The people in the downstairs flat have a more powerful wireless set than I have, and they make funny noises come on my set by oscillation. Can I have their licence cancelled?"

This was a bit of a poser for the magistrate, and he decided that it must be left to the Postmaster-General to settle the dispute.

The Last Word

Another applicant, a woman, stated that a neighbour complained of her aerial.

(Continued on page 686.)

RADIO NOTES AND NEWS OF THE MONTH

—continued from page 684

"She says it is the wrong wave-length, and upsets her washing, making it as black as soot!"

The magistrate asked whether the neighbour hung her washing on the aerial.

"No, sir," said the applicant; "above it."

"Well," said the magistrate, "I can do nothing. You must come to terms with her."

But the applicant got the last word in.

"The wave-length seems all right for her bad language, anyway!"

Yes, there's a lot of humour in the courts.

The B.B.C. Critic

The B.B.C. critic is now to be invited as such by theatre managers to go to first-nights—but on conditions! It is one of the six points agreed upon between the B.B.C and the theatre managers that the B.B.C.'s criticisms must be reasoned. The critic must also be "temperate in vocal tone," and he is to be discouraged from giving expression to personal idiosyncrasies.

The B.B.C., on second thought, seems to have capitulated rather completely as regards this dispute between the B.B.C.'s critic and theatre managers.

The Pitfall

As Mr. James Agate explained the other night: "Plays which are morally bad and cheap, and generally representative of the commercial prostitution of the stage, will not be referred to at all. Musical comedies also will not be dealt with."

There is a pitfall here, for if Mr. Agate forgets to mention one very good play which may be running, listeners may assume that because the play has not been mentioned it must come under the above description.

Scotland's Regional

It was stated in the Press the other day that a new Scottish Regional station is to be erected near Larbert. In making this announcement the B.B.C. stated that the new station would be able to bring into service practically 80 per cent of the population of Scotland. Somewhere about the spring of next year there should be a start made with the building.

ITEMS FOR CONSTRUCTORS

Holes which have been made in an ebonite panel and are now unwanted can be filled with "Play-wax," Glitterwax, or black sealing-wax, and thus made inconspicuous.

* * *

The best way of all to fill ebonite holes is that adopted by the experienced constructor who obtains a piece of ebonite rod of suitable diameter, forces it through from the back of the panel, and polishes the end until it is exactly flush with the external surface.

* * *

If in a receiver of published design you wish to make an alteration, such as changing over from grid-leak to anode-bend rectification, or using transformer instead of R.C.C. couping, remember that there may be some easily-overlooked snag in this.

It would be cheaper to inquire of the Query Department whether such alteration is practicable than to buy components which would afterwards be "white elephants."

THE A.C. "BROOKMAN'S"

—*continued from page 588*

Connected across the filament terminals of the valve is a 400-ohm potentiometer (200 ohms will also serve), with its slider terminal wired to a convenient point on the earth circuit. (Actually the screen.) An adjustment of the slider somewhere near the middle of its travel should remove any hum.

Indirectly-Heated Valves

The detector and L.F. stage are treated separately. Here we have provided for the use of indirectly-heated A.C. valves, which usually have decidedly better characteristics than battery types. Valves of the five-pin type are required here, and five-pin valve sockets should be fitted.

The valves required are one H.F. type ("Green Spot" in the Marconi, Osram and Cosmos ranges), and one power for the L.F. stage ("Red Spot"). By the way, in the Marconi and Osram ranges these valves are sometimes supplied with a four-pin base and an extra terminal on the side. These are also suitable without any alteration of wiring. Simply connect the extra terminal on the side of the valve to the "K" terminal on the five-pin socket.

Another potentiometer is provided for the earthing of the heater circuits of these valves, and the slider should be adjusted as before for the elimination of hum. The heaters, by the way, are wired with twisted flex to the old L.T. terminals on the back strip, to which the "3·5-volt" terminals of the power unit should be connected.

The old L.T. switch on the panel, by the way, is no longer required, and should not be included if you are building the set for the first time in its all-mains form. If you are converting an existing set, just leave the switch without connections. All turning on and off is now done at the mains point controlling the power unit.

Grid bias alone is derived from batteries, since only small ones of very long life are required, and to provide G.B. from the power unit increases its cost and complexity considerably. In addition to the one for the L.F. stage (a 9-volt unit) you will also require another small one for the detector valve, which needs a little positive bias.

There, that really completes our survey of the general modification called for by the use of A.C. valves. We give a list of components, and also a complete wiring diagram on these pages, but for a detailed account of the set we must refer you to the September issue, in which the original description of the set appeared.

The question of H.T. voltages we think will be quite clear to you after reading the description of the power unit appearing elsewhere in this issue. The maximum voltage available should be applied to H.T. + 3, 120 volts or thereabouts to H.T. + 1, and a suitable voltage for reaction control to H.T. + 2.

Screening Electrode Bias

By the way, with a mains unit it is just as well to apply a separate voltage to the screening electrode of the S.G. valve, and see whether you get a better adjustment in this way. In the original set the correct voltage is obtained through a dropping resistance, but since a separate terminal is provided on the power unit for the purpose it is as well to make use of it.

Just remove the 100,000-ohm resistance from its holder and take a flex lead to the appropriate terminal on the power unit from the terminal of C_5, which is wired to "S.G." on the valve socket.

RESONANCE IN CIRCUITS

—continued from page 581

the other, and so on *ad infinitum*. Now we know that this is not the case, for if we cease tapping the weight the amplitude of its swing will gradually decrease until it finally comes to rest. In other words, to keep the pendulum in motion to its full extent a small amount of energy must be applied to it. Any clockmaker will tell us at once that this energy is necessary to overcome the air resistance and the friction at the pivots, and that it is obtained in our modern watches and clocks from the mainspring, or from the weights in the case of the old-fashioned "grandfather's clock."

A Close Analogy

This forms a very close analogy to the electrical case. As has been pointed out, a certain amount of resistance is bound to be included in the closed circuit under consideration, and whenever a current flows through a resistance there is a direct loss of energy, since heat is produced. Consequently, if a circulating current were set up in the closed circuit by the application of the alternating potential, when the latter was removed the current would decrease and, finally, cease, since during each swing of the energy a little would be wasted in the resistance of the circuit.

What actually happens in the case of our wireless tuning is that the potential is applied continuously and a small current is supplied to the closed circuit—in much the same manner as the taps to the pendulum—to compensate for this loss of energy in the resistance. The impedance of the circuit as a whole is a maximum at this particular frequency, which is known as the "resonant" frequency.

The object of using so-called "low-loss" coils in a receiver will now be apparent; it is to reduce the resistance of the coils to alternating currents of high frequency to a minimum. Such a coil, when used in a tuned circuit in parallel with a condenser, will waste very little of the useful applied energy.

Practical Considerations

In experimental work, the necessity often arises for predetermining the values of capacity and inductance which will "tune" or be resonant at a certain frequency. Here a brief excursion into applied mathematics is necessary and the values are calculated as follows:

The current applied to an inductance of L henries when a voltage E of frequency f cycles per second is applied to it is

$$\frac{E}{2\pi fL} \text{ amps.}$$

(The factor π, of course, is our old friend which occurs so much in the mensuration of the circle and equals

(*Continued on page* 692.)

WORK-BENCH WISDOM

WHEN using "Play wax," heel-ball, or similar material for filling holes in a panel, remember that a slightly warmed, flexible knife blade will enable a smooth finish to be obtained.

* * *

If you are experimenting with a new lay-out on the baseboard, remember that there are many advantages in making a cardboard duplicate of the baseboard and placing the components on this, marking in positions for wires, etc., in order that the best positions for the various parts may be ascertained.

Cone Camouflage

A good stunt for rendering a cone loud speaker inconspicuous is to cover it with a piece of the room's wall-paper, providing, of course, that this can be done without impairing its efficiency. This is often the case if the area of the cone is not very large and the volume handled is not small.

* * *

When a potentiometer is included in a high-frequency circuit the resistance in use should be shunted by means of a fixed condenser connected to the slider.

* * *

Many a set is blamed as being non-selective when its "fault" really lies in the omission of the owner to use a wave-trap, necessary owing to his proximity to the transmitting station.

* * *

If you are not getting satisfactory wave-trapping results from your instrument, remember that when a wave-trap is first installed it must be set properly, and that yours may be failing in this respect.

On Short Waves

A variable condenser for short-wave tuning should be of the square-law or S.L.F. type if possible, and must be fitted with a slow-motion drive of some kind owing to the sharp tuning effects on short waves.

* * *

At a pinch the constructor can make a thoroughly sound job of supporting a panel by using a small wooden block or two instead of panel brackets.

* * *

About 75 turns of No. 34 S.S.C. wire wound on a 3-in. diameter former will make a satisfactory H.F. choke for short-wave work.

Pages 693-700 are missing.

RESONANCE IN CIRCUITS

—continued from page 690

3·142 approx.) The current supplied to a condenser of C farads, with the same applied voltage, is $2\pi fCE$ amps.

Now these currents are in opposite phase, so that the total current flowing, if the condenser and the inductance are connected in parallel, is

$$\frac{E}{2\pi fL} - 2\pi fCE \text{ amps.}$$

Neglecting the resistance of the circuit, this current is zero at resonance. Hence the con ition for resonance is expressed :

$$\frac{E}{2\pi fL} - 2\pi fCE = 0,$$

or

$$\frac{1}{2\pi fL} = 2\pi fC, \text{ i.e. } f = \frac{1}{2\pi\sqrt{LC}}.$$

A more useful form of this formula may be developed for tuned wireless circuits :

$$f = \frac{3 \times 10^8}{\lambda}$$

where λ is the wave-length of the incoming signal in metres. Therefore, $\lambda = 3 \times 10^8 \times 2 \times \pi \times \sqrt{LC}$, or, alternatively, $\lambda = 1{,}885 \times \sqrt{LC}$, where L and C are now expressed in microhenries and microfarads respectively.

TELEVISION IN GERMANY

—continued from page 584

Nobody was quite sure as to the actual cost of these receivers. Mihaly's will cost the same as a good loud speaker. Baird's, on the other hand, are supposed to cost the same as a good broadcast receiver. The German post office exhibited transmitting apparatus for films. Banneitz's daylight television apparatus is also on show.

The Transmission "Spread"

Then Karolus-Telefunken showed their television receiver and transmitter with simultaneous sound transmission. This, however, is only laboratory apparatus, and again one must remember that the Karolus system works with over 9,000 hertz, all the other systems, as far as the German Wireless Exhibition was concerned, work with something like a band of 7 000 hertz, or a very little more.

Denes von Mihaly was kind enough to introduce me to all the Post Office experimenters, and it was from one of these that I heard for the first time particulars as to Baird's system of synchronisation.

Synchronisation Troubles

It will be remembered that during the Baird demonstrations the picture sways up and down, whereas Mihaly's picture is absolutely steady. The gentleman from the German P.O. gave me a lot of highly technical reasons and finished up by mentioning that the sychronisation system employed by Baird had just that one drawback that it was very unstable and difficult to keep absolutely steady.

At the opening of the German Exhibition in Berlin it was interesting to note that the Baird people were not demonstrating, whereas the other systems gathered numbers of people to witness demonstrations. I am sorry I could not stay until the Baird Co. got going. Possibly there was some difficulty in adapting the system to the standard transmission sent out by the German P.O.

I heard confidentially that the Mihaly people were on the point of fixing up an English company working with that system, and possibly by the time this appears in print this will have become a fact. Dr. Alexanderson had also come over from Schenectady to see the television demonstrations in Berlin. It is the first time that all the television companies have been able to show what they could do by receiving what was sent out by one standard transmitter.

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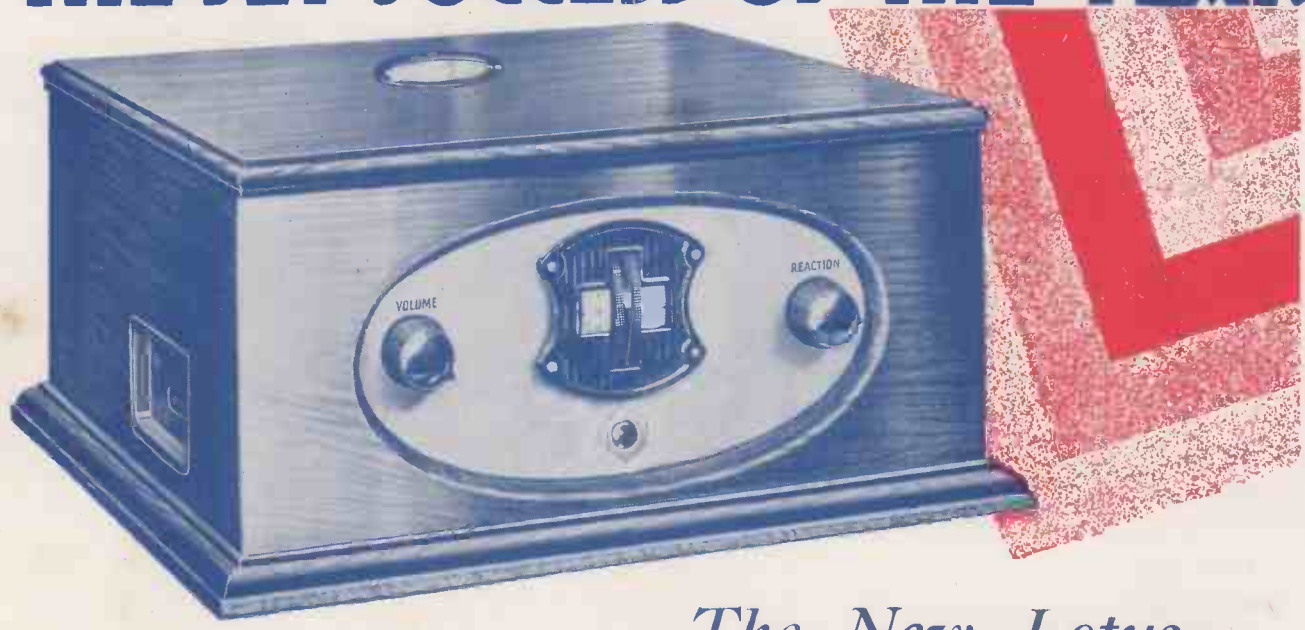

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