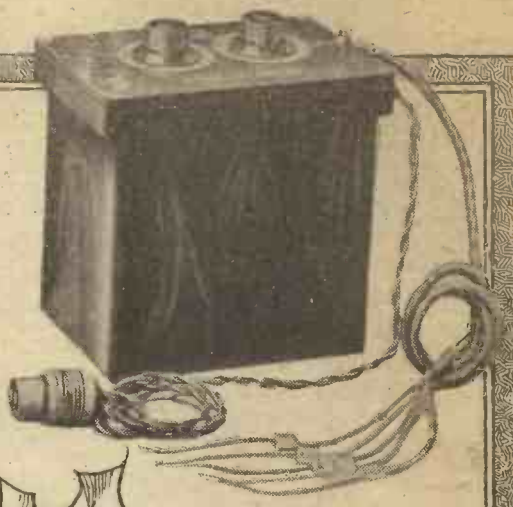
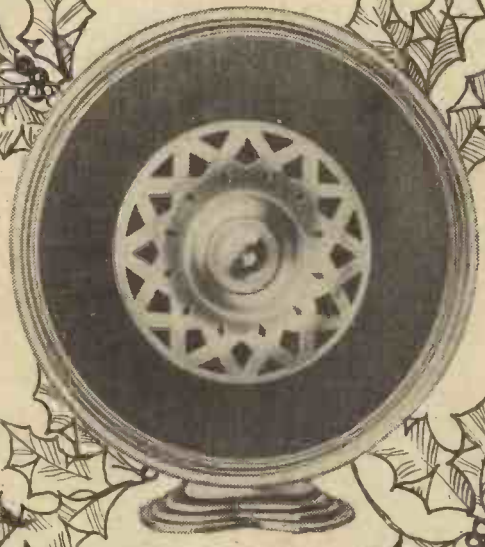
XMAS RADIO PRESENTS

The handsome set shown to the left is the Brandeset IIIA, which will receive English and Continental stations at good loud-speaker strength. The three valves are arranged as detector and 2 low-frequency amplifiers, and the receiver is easily operated by the single control condenser shown. The cabinet is of polished oak, and the price of the receiver is £6 15s. (excluding royalty).



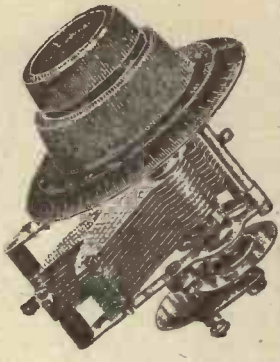
The more general use of multi-valve receivers has resulted in a comparatively heavy drain upon H.T. supply, to meet which many excellent H.T. units have been evolved. By means of a plug-in adaptor, such units can be connected to the electric-light wiring in a moment.
The instrument shown above is the Dubilier H.T. Supply Unit, Model No. 2, and is provided with flexible tappings for four separate high-tension voltages.

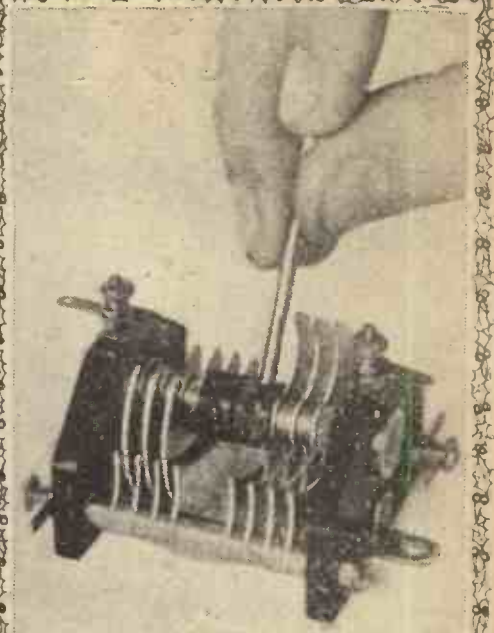
For the modern loud-speaker set, employing power valves, a separate output circuit is almost indispensable. Such an arrangement diverts the steady anode current of the last valve from the loud-speaker windings, thus protecting the loud speaker and preventing demagnetization.
The Igranic C.C. (Choke Capacity) Output Unit, shown below, can easily be built into a set or added externally as a separate output unit.



The loud speaker shown above is the Marconiphone Cone (Model "75"), which is specially designed to give very true reproduction.
To the right is shown the R.I.-Varley Retroactive Tuner, with which a wide choice of aerial coupling and reaction circuits are available. It is specially designed for neutrodyne work, and covers both long and short waves without change of coils.
Below is shown an R.C.C. Unit in which both resistances are of carborundum.

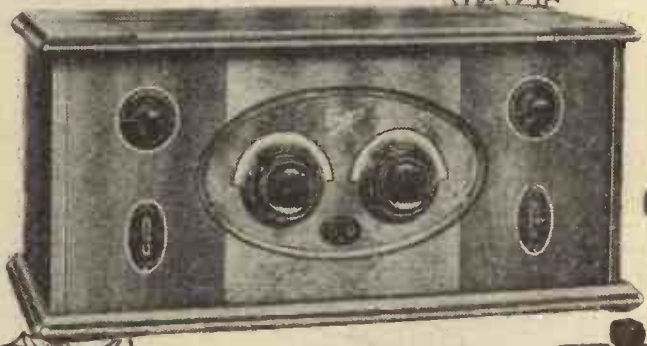
The B.T.H. loud-speaker shown to the left is fitted with a screen which ensures that its working parts are continually protected from damage. The tuning condenser (right) is a "J.B." product.





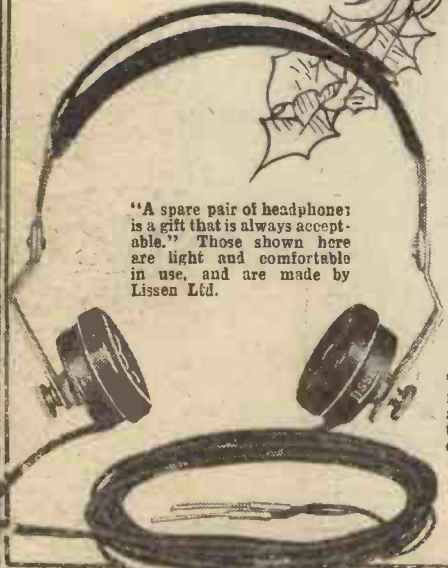
The "Varo-Fix" (Lamplugh) is a filament resistance for baseboard mounting. To the right is a double neutralising condenser (Peto-Scott).

Above is a Remote Control relay (Lotus). The receiver shown to the right is the Standard Burndept Ethodyne, which employs a 7-valve super-heterodyne circuit. The set covers two different wave-length ranges—250 to 550 metres, and 1,000 to 2,000 metres—and the whole of the tuning is done upon the two knobs in the centre of the panel.

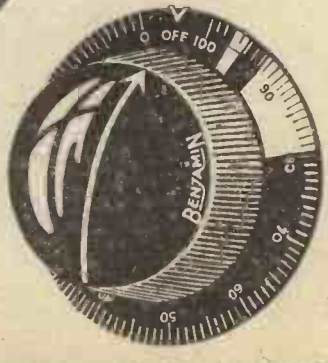


A "Lotus" plug and socket for Remote Control.

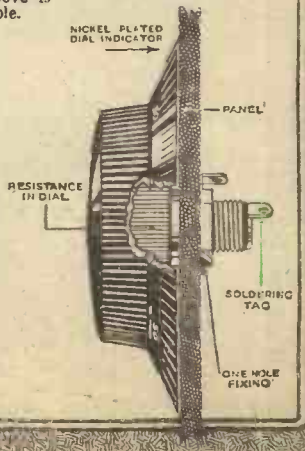
The H.T. Battery Eliminator shown above is made by E. K. Cole.

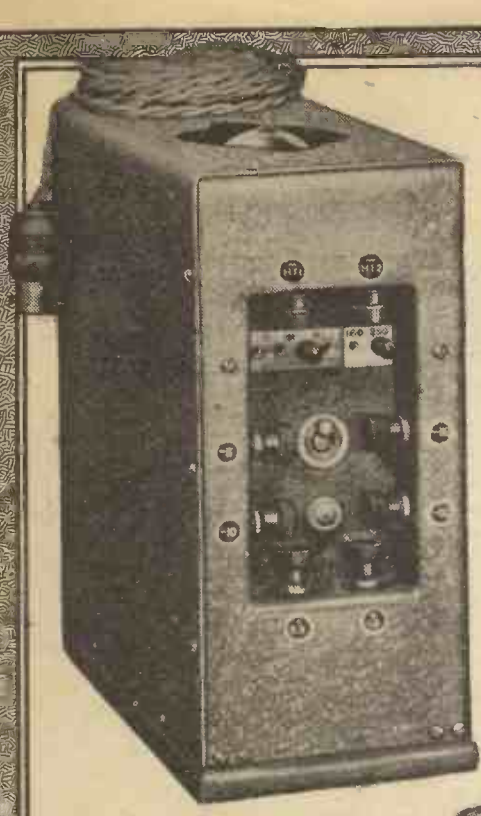


"A spare pair of headphones is a gift that is always acceptable." Those shown here are light and comfortable in use, and are made by Lissen Ltd.



The Unit above (Goodman) is designed to drive a cone loud speaker. To the right is a novel self-contained rheostat.





The 5-valve Portable Receiver to the right is completely self-contained and covers the Daventry (5 X X) tuning range as well as that of local stations. Made by L. McMichael, Ltd., it incorporates a cone-type loud speaker, and utilises 2-volt valves.

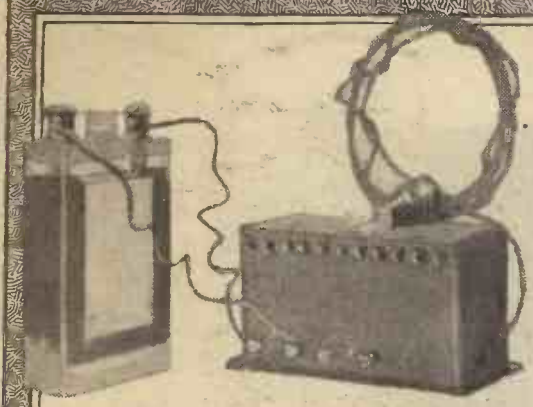
Below is shown one of the popular Lewcos Binocular Coils, inserted in its holder.

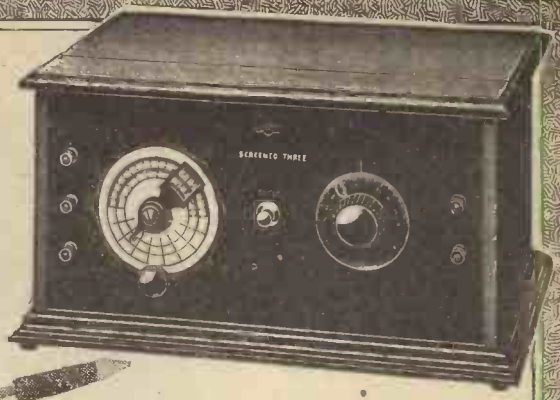
When the house is wired for A.C. mains, the Cosmos Eliminator shown above does away with the need for H.T. and Grid Bias batteries, and provides steady voltages at a low cost.
It incorporates a special smoothing system, and the makers (Metro-Vick Supplies, Ltd.) have found that it can successfully be used for multi-valve sets even in districts where the mains are "noisy."

The S.S.410 H.F. is one of the well-known "Six-Sixty" valves, that show absolutely no sign of glow when operating at the rated voltage. This feature not only ensures long life to the valves, but also means a great reduction in the running costs.

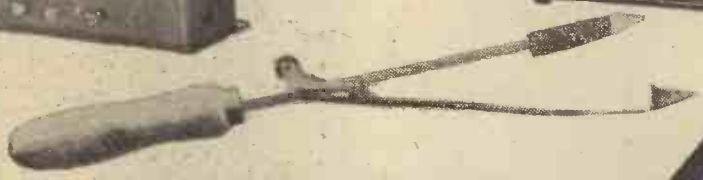
Fixed condensers always make an acceptable present, and the "T.C.C." models (shown below) have the advantage of that firm's great experience in the construction of this class of component. They are arranged for either "screw-down" or soldered connections.

A special feature of the new Amplion Cone Loud Speaker—shown to the left—is the novel easel support. This has curved ends which act as feet when the loud speaker is standing, or as hooks by which it can be hung from the picture rail. A spring catch is provided by which the support is clipped flat against the back of the frame when the instrument is used in the latter position.





The "Screened Three" receiver, shown to the right, is one of the well-known "Magnum" lines, produced by Burne-Jones & Co., Ltd. The circuit employed is H.F., Det. & L.F., the H.F. transformer being of the split-primary type. To the left is the Ferranti Permanent Trickle Charger, for charging accumulators from A.C. mains.

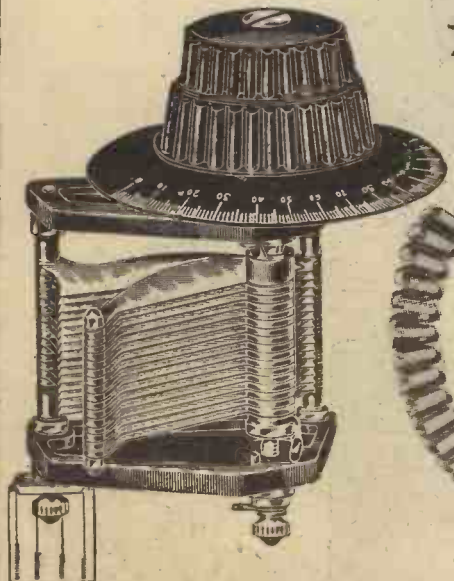


The Peerpoint Soldering Iron (above) has a special cap, as shown, which is detachable and can be removed whilst the bit is being heated.

To the left is an "Efesca" eliminator (Falk, Stadelmann & Co.), of the completely-screened type, whilst to the right is a "Gecophone" Plaque Cone Loud Speaker, which is priced at £4 10s.

The coil in the centre of the page ("Atlas") is useful to increase selectivity. When the ordinary plug-in aerial coil gives a "background" of another station, it can be replaced by one of the type shown, which has additional terminals for the A. & E. leads.

The Low-loss Coil former shown to the right is made of ebonite by Redfern's (of "Ebonart" fame). It is fitted with terminals to which the ends of the windings can be taken.



This semi-circular component is a Benjamin earthing device. To the left is an Ormond variable condenser. The maximum capacity of this is '0005 mfd., and it is suitable for fine tuning, being fitted with a large separate vernier control knob.

The powerful receiver shown below is made by the Bowyer-Lowe Co., Ltd. It employs the famous super-heterodyne circuit, which gives an almost unlimited range of reception.

The "Constant" Two

An H.F. and Det. receiver having only one tuning control and maintaining constant sensitivity over the whole tuning range.

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

LAST week I described my new circuit which gives a very useful constancy of reaction coupling by a method not heretofore utilised, making possible very sensitive single-control receivers utilising but one tuned circuit. This means, of course, the absence of ganged condensers, with their attendant complications, which heretofore have been necessary in sensitive single-controlled sets.

TEST REPORT.

This receiver was tried out on the usual rather inefficient test aerial employed for the customary routine tests of "P.W." sets, the height being 15 ft. at one end, and 12 ft. at the other. It was immediately found that a remarkable degree of uniformity of sensitivity had been achieved, and it was possible to run from top to bottom of the tuning range and bring in stations at intervals all the way without touching the reaction control, and without oscillating at any point.

Apparently, as a result of the increased damping produced by the aerial, at the lower end of the scale the set was a little further from the oscillation point here, but this effect was not noticeable and did not prevent several stations being picked up at this part of the scale.

It is considered that on this aerial, in the course of an average night, it would be possible to tune in about ten stations at satisfactory 'phone strength, with a constant reaction setting, that is to say, by turning the tuning dial alone, and this indicates a higher degree of constant sensitivity without reaction adjustment than has been exhibited by any set previously tested.

It was interesting to note that the aerial damping was not being used to hold the set down to any noticeable extent, since aerial and earth could be disconnected without causing it to break into oscillation.

Selectivity, as might be expected from any receiver incorporating only a single tuned circuit of normal type, was only moderate, although sufficient for general purposes. In the local area of a main station it would no doubt be advisable to use a good type of wave-trap.

THE "P.W." RESEARCH AND CONSTRUCTION DEPT.

For a long time I have been endeavouring to evolve a receiver which would give the sensitivity of a skilfully handled single-valve reaction receiver with its two controls, with but only one control which can be operated by the most inexperienced reader, without any risk of oscillation and interference. If such a receiver can be evolved it should represent a very big step forward in radio. I have carefully investigated a number of systems put forward with this idea, the most promising so far being the Loftin-White, but this last proved to be exceedingly tricky in actual use if high sensitivity was required. Furthermore, special coils had to be used, while such items as a change of valve, aerial, and so forth, made a great deal of difference to the results obtainable. My new system, developed along lines entirely different from the Loftin-White, possesses the following features:

1. All standard components are used.
2. Suitable valves are obtainable from every maker.
3. Careful tests show that 2-, 4-, and 6-volt valves all work well with it.
4. A preliminary adjustment can be made to the set which enables ten or twelve stations to be received after dark at clear headphone strength on an average aerial—on a good aerial more still.
5. Any form of note magnifier, one or two stages, can be simply added, giving a loud-speaker set with only one control.
6. Once adjusted the set is perfectly "safe," that is to say, searching for stations does not cause any kind of interference with one's neighbours.

Having set out the advantages and claims of the circuit, let us examine any possible drawbacks so that there shall be no misunderstanding.

H.F. and Detector.

In its fundamental form, two valves are used, one a high-frequency valve and the other a detector valve. The sensitivity of the set is not claimed to be as good as is possible with a well-designed neutralised set with one stage of efficient radio frequency, properly neutralised, with a detector. Such a receiver, skilfully handled, will bring in distant stations at greater strength and, if reaction is used, results will be distinctly better in sensitiveness than my arrangement.

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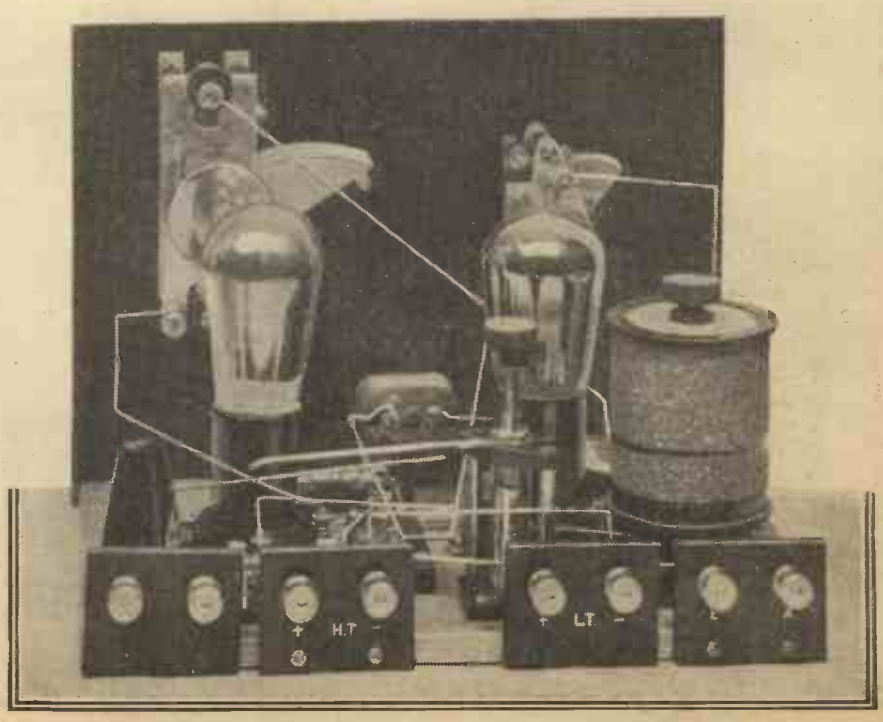


With valves and coils in position—a back view of the "Constant" Two.

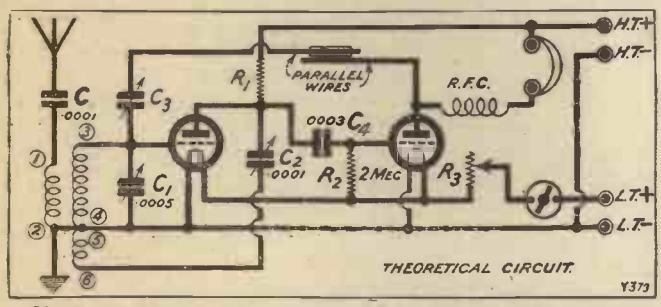
THE "CONSTANT" TWO.

(Continued from previous page.)

At the same time the new circuit is appreciably more sensitive than a detector valve with reaction, unless this latter is pushed to the distortion limit. Thus its sensitivity falls between a single valve with reaction and a properly designed neutralised H.F. and detector set.

The next points relate to the selectivity of the receiver. At a distance of twenty or thirty miles from a broadcasting station the selectivity of this set is all that anyone can require. On the other hand, when used in the immediate vicinity of a station up to six or seven miles, the selectivity is not so good as that of a properly designed and skilfully handled single-valve detector with reaction.

At six or seven miles from London this station can be heard as a background up to about 450 metres, but stations above that, such as Langenberg, 5 G B, Vienna, Munich, Brussels, can all be heard quite free from London.



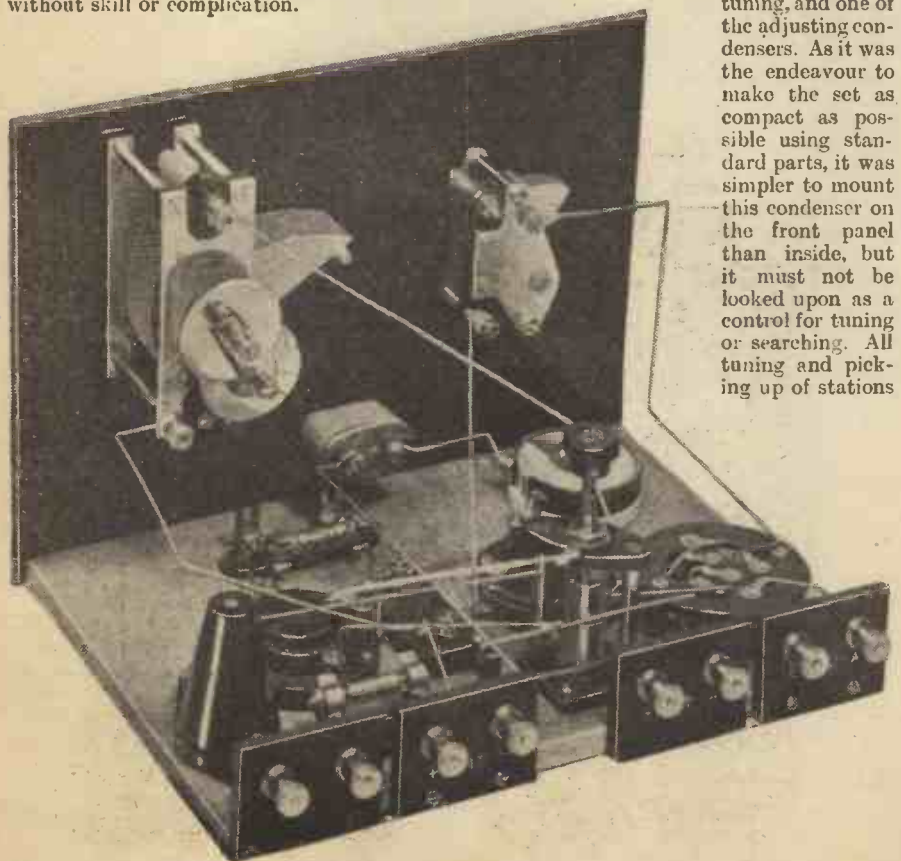
The theoretical circuit of the "Constant" Two. Whereas in the Loftin-White method of obtaining constant reaction the effects of inductance and capacitative coupling were balanced against each other, in Mr. Harris' system use is made of the rising efficiency of resistance-coupled H.F. stages with rise of wave-length; capacity feed-back being utilised to provide reaction.

Users who are working underneath the shadow of a local station would require a wave-trap, of the kind recently described by Mr. G. P. Kendall, to give a high degree of selectivity. This can be set once and for all to the local station, thus retaining the single-control feature and all the virtues mentioned above, plus all the selectivity that can be reasonably required.

Do not forget that this last requires two tuning controls and some little experience to neutralise it properly, while to get the best results rather skilful handling is required. As a contrast, with my circuit the preliminary adjustment is simple, and once made the beginner can obtain remarkable long-distance results not previously possible without skill or complication.

Let us now examine the practical set made up with this circuit and illustrated in the photograph and drawings with this article. It consists, as will be seen, of a small cabinet with a 10 in. by 7 in. panel, carrying on the front a vernier dial for tuning, and one of the adjusting condensers. As it was the endeavour to make the set as compact as possible using standard parts, it was simpler to mount this condenser on the front panel than inside, but it must not be looked upon as a control for tuning or searching. All tuning and picking up of stations is carried out solely on the large vernier dial. Those readers who are prepared to use a larger cabinet can easily find room for this adjusting condenser inside.

The only other piece of apparatus carried by the front panel is the on-and-off switch. Looking now at the apparatus from the back, we see that the baseboard carries a standard six-pin base, two valve holders, a standard neutralising condenser (not used for neutralisation), two grid-leak clips with standard forms of grid leak, a radio-frequency choke and a grid condenser, with baseboard-mounting filament resistor to complete the list.



The terminals are grouped in pairs on separate terminal-strips—a point which greatly simplifies connecting-up and reduces the danger of placing the wrong battery leads on the wrong terminals.

COMPONENTS REQUIRED.

1 Panel, 10 in. by 7 in.
1 Baseboard, 10 in. by 7 in.
Cabinet to take same.
1 Variable Condenser, ·0005 mfd., with vernier dial (J. B.). (Any good make, square law or S.L.F.)
1 ·0001 reaction condenser, variable (Cyldon). (Igranic, Peto-Scott, etc.)
1 On-and-off switch (Igranic). (L. & P., Lissen, Lotus, etc.)
2 Valve sockets (Lotus). (Ashley, Benjamin, Bowyer-Lowe, B.T.H., Burndept, Burne-Jones, Lissen, Lotus, W.B., etc.)
1 Radio-frequency choke (Burne-Jones). (Bowyer-Lowe, Efesca, Lissen, McMichael, Metro-Vick, R. I.-Varley, etc.)
2 Grid-leak holders. (Dubilier, Lissen, etc.)
1 Grid leak, 2 megohms (Lissen). (Dubilier, Igranic, Mullard, etc.)
1 Grid leak, ½ megohm (this is used as the anode resistance) (Dubilier). (Carborundum, Igranic, Lissen, Mullard, etc.)
1 Fixed condenser, ·0003 mfd. (Lissen). (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C., etc.)
1 Fixed condenser, ·0002 mfd. (Lissen). (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C., etc.)
1 Baseboard-mounting filament resistance (Igranic). (Lissen, or other similar type.)
1 Standard neutralising condenser. (NOTE.—This must be of the fine adjustment type. The Jackson shown is particularly suitable for this set.)
1 Standard six-pin base (Colvern). (Bowyer-Lowe, Burne-Jones, Lewcos, Peto-Scott, etc.)
1 Standard Reinartz type of transformer.
Terminals for: Aerial, Earth, L.T.−, L.T.+, H.T.−, H.T.+, and Telephones. (These can be on one long strip or on separate pieces, as desired.)
Wire for wiring up, and a short length of Glazite, if this wire is not used for wiring the whole receiver.

NOTE.—In most cases in the above list the make of the actual component used in the set is indicated, and following this a few suitable alternatives in alphabetical order.

Aerial Series Condenser.

The theoretical diagram and the practical wiring diagram show a ·0001 mfd. condenser in series with the aerial. This was not used in the set when the latter was photographed but has since been added for reasons which will be explained a little later. It is not necessary if the receiver is required merely for the local station and

(Continued on next page.)

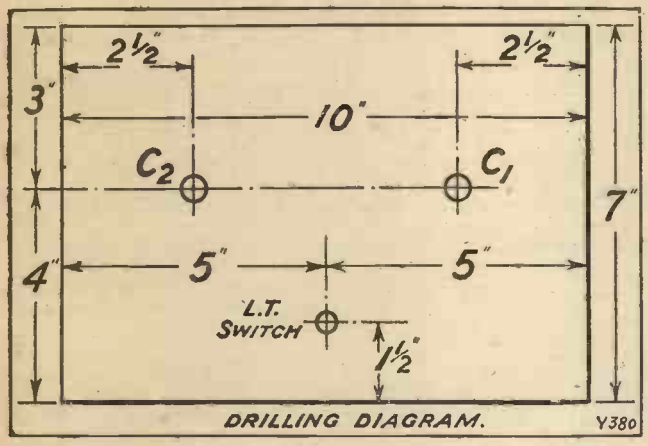
THE "CONSTANT" TWO.

(Continued from previous page.)

5 G B, or when the set is used with an indoor aerial (on which it proves remarkably sensitive).

The first valve is resistance coupled to the detector valve (the anode resistance consisting of a ½-megohm grid leak), thus effecting a very considerable saving in cost. A standard six-pin Reinartz coil is adopted, and what is generally termed "Reinartz" reaction is used in the first circuit, the condenser for obtaining this being mounted on the front panel. In the plate circuit of the detector valve is a radio-frequency choke, while a very small capacity is connected between the plate of the detector valve and the grid of the high-frequency valve. This capacity must be exceedingly small—smaller, in fact, than the standard neutralising condenser, and to get such a low value an adjustable neutralising condenser is placed in series with an extremely small condenser formed of two parallel wires, insulated from one another, but otherwise kept as close as possible. The practical way of making this parallel wire condenser is shown in the illustration.

The lead from the plate of the detector valve and the lead from the neutralising condenser are not joined but overlap for about 2 inches One of these wires is bared and the other consists of a piece of Glazite, the insulation of which is thin but sufficient for the purpose. In the photograph the wires are shown slightly separated for clearness, but once they have been cut and fixed in position they can be gripped together with a piece of sticky tape, such as electricians use. (If you do not do this the capacity will vary with vibration.)



Balancing Results.

As explained in last week's article, the method of obtaining constant reaction is as follows. Reinartz reaction needs more and more reaction condenser in circuit as we pass from the lower to the higher wavelengths, which means in effect that a setting of the Reinartz reaction condenser which will bring the set just to the point of oscillation at, say, ten degrees on the tuning condenser scale, is much too small when the same condenser is set for, say, 100 degrees. On the other hand, the reaction from the plate of the detector valve to the grid of the high-frequency valve, if giving such a state of sensitivity at 100 degrees on the scale, will be too weak at 10 degrees on the scale.

The reason for this is that the resistance capacity is less efficient as we pass from the high to the lower wave-lengths. By making adjustments of the two reaction values (the Reinartz on the high-frequency valve, and the capacity reaction from the plate of the detector valve) we can balance these effects and get a constant reaction adjustment which will "stay put" over the whole scale of the tuning condenser.

Constructional work is very simple, but the actual lay-out of parts shown should be closely followed.

The Valves.

The first valve *must* be a resistance-capacity valve, and the second a valve of a magnification factor of about 15 to 25 and an impedance round about 15,000 to 25,000 ohms. You have a wide choice of makes, but it is essential that the types should be as indicated, the detector valve being what is generally termed a "high-frequency" valve. Most makers plainly label their valves "R.C." or "H.F.", but, unfortunately, the Marconi and Osram firms have labelled some of their new valves in rather a misleading fashion For example, the D.E.H. is really an "R.C." valve, although the H would rather suggest it is an ordinary high-frequency valve of medium impedance, while the D.E.L. is much nearer the high-frequency type of valve than the low-frequency, the impedance being 13,000 ohms and the amplification factor 15 (in the 6-volt series). Incidentally, a D.E.H. and a D.E.L. make a very good combination for this set, as do a P.M.5B, and a P.M.5X, Cossor R.C.610 and H.F.610, and Six-Sixty types 610R.C. and 610H.F. The same makes of 4- and 2-volt valves also work very well.

Setting the Reaction.

Preliminary adjustments are very simple to make, and far easier than the usual process of neutralising a high-frequency circuit. The first step is to connect up the batteries and telephones, but to leave the aerial and earth terminals free. Set the neutralising condenser on the baseboard at its minimum position and the Reinartz condenser on the front panel, also at its minimum. Choose an H.T. voltage of 90 to 120 (it is not very critical). Now swing the tuning condenser backwards and forwards, listening carefully in the telephones for signs of oscillation.

This set goes into oscillation so smoothly and quietly, that unless you are careful you may not notice whether it is oscillating or not. The simplest way to find out is to wet the finger and touch the fixed plates terminal of the tuning condenser. When the set is oscillating you will hear a "plop" when you touch the terminal, as well as when you withdraw your finger. When it is not oscillating you will hear very little sound, if any.

If the set is not oscillating (it should not be at this stage) screw the neutralising condenser down a few turns and swing the condenser backwards and forwards again. You will soon find a position by adjusting this where the set will oscillate freely at the

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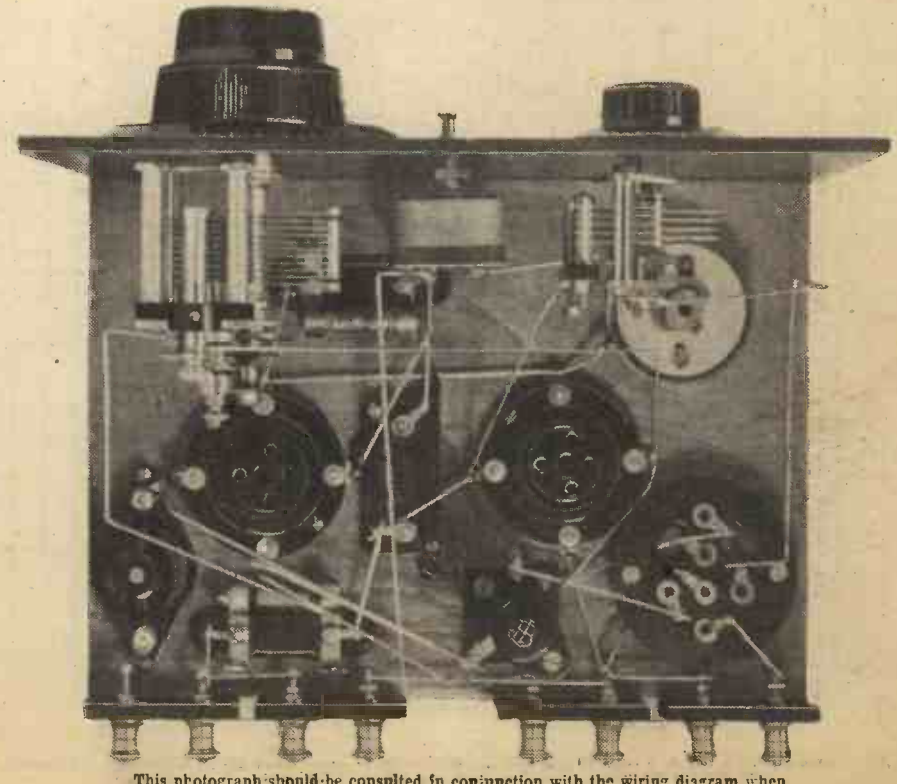


This photograph should be consulted in conjunction with the wiring diagram when building the receiver

THE "CONSTANT" TWO.

(Continued from previous page.)

top of the scale but not at all at the bottom. When this state is reached, turn your attention to the Reinartz condenser.

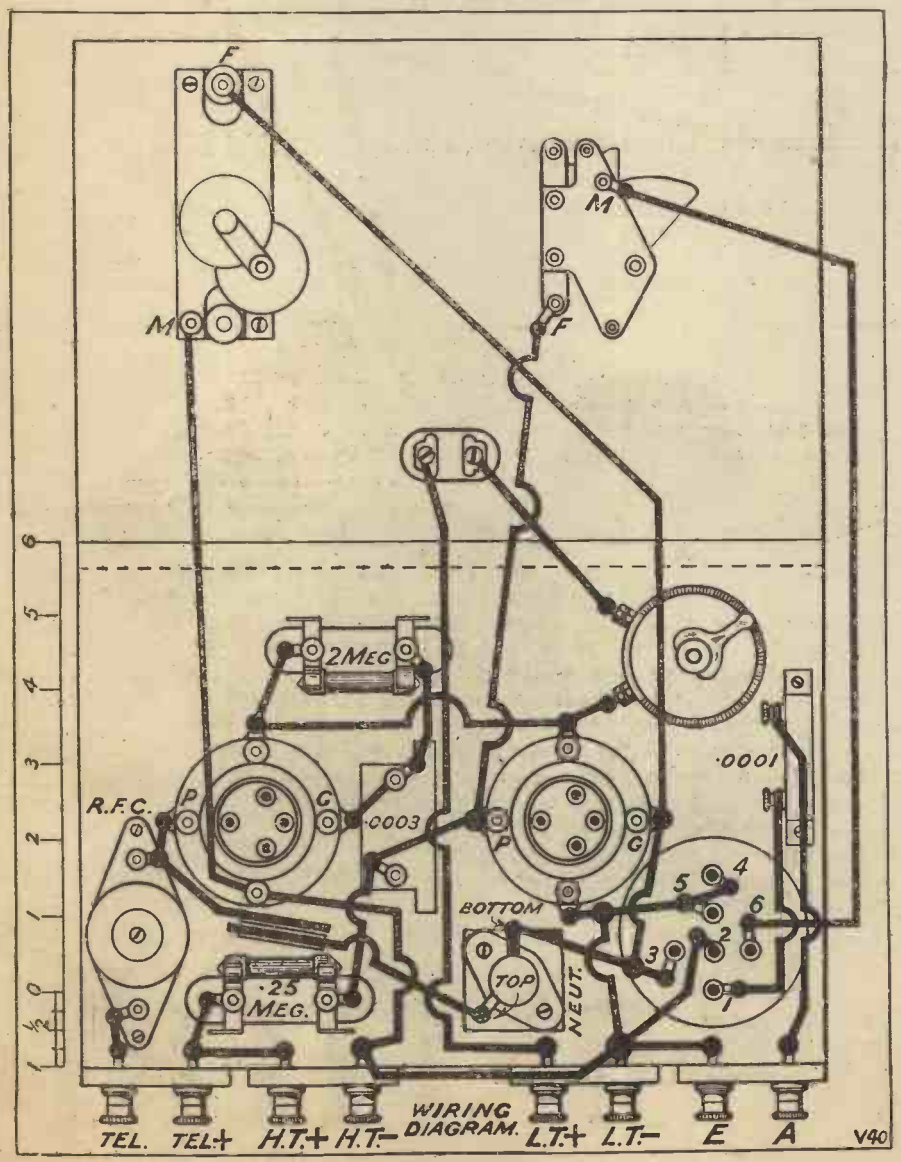
Now if you turn the Reinartz condenser you will find that this will make the set oscillate still more freely, but here the tendency will be to oscillate more freely at the bottom of the scale than at the top. Aim for a combination of the two condensers where the set is oscillating freely over the whole range, and then reduce one or the other, or both, until the set is just below oscillation point the whole scale. If all is well, the set will oscillate practically uniformly over the whole scale from top to bottom, and by decreasing the reaction control you will come to a condition where the set is just below oscillation point over the whole scale. Actually, there will be a slightly reduced tendency to oscillate in the middle of the scale, but this is scarcely noticeable.

Making sure that the set is not oscillating at any point, connect aerial and earth. You will now find the set is surprisingly sensitive, and you can turn the dial backwards and forwards and pick up a number of stations. There is no need to make further adjustments of the reaction condensers for general work.

An Interesting Feature.

Now we come to a very interesting point in regard to this, and, in fact, all "constant-reaction" receivers.

Any aerial which will receive will also radiate, and for a given aerial the efficiency of radiation will increase as we decrease the wave-length. This means that an aerial connected to a set such as this will absorb more energy from the set at the bottom of the condenser than it will at the top, and this means that when the aerial is connected and the adjustments left as they are, the set will be in a slightly less sensitive condition towards the bottom end of the condenser than at the top. In many cases, however, the sensitivity of the set will be quite sufficient without the insertion of a series condenser, but a more uniform sensitivity is obtainable by inserting a ·0001 or ·0002 mfd. condenser in series.



Aerials differ so considerably that a set itself cannot be made automatically to adjust itself without trial to every aerial, and so, having designed a set which in itself gives constant reaction over the tuning scale, I must leave it to the reader to fit it to his own aerial conditions. In some cases no series condenser will be needed, but in others it will be. If the set is found to be sufficiently sensitive over the whole scale with your aerial, join the wire going from the aerial terminal of the set to terminal one on the six-pin base. If your aerial is such that the set is less sensitive at the bottom of the scale than at the top, then wire the set as shown in the practical wiring diagram.

If you are very close to a station then a simple wave-trap will give you all the selectivity you need.

This set is particularly suitable for giving good strong telephone signals (on several pairs of 'phones) from the local station and 5 G B, using a very poor indoor aerial, such as a wire round the picture-rail. A change to the alternative programme, that is from the local to 5 G B or vice versa, is made in a second by turning the tuning dial from one point to another. Once you have found the tuning positions for these two stations they will always remain the same, providing you do not change your aerial, or the make of valves.

On the Long Waves.

It is rather interesting that the method of reaction on this set remains just as good on the Daventry range, while the efficiency of the high-frequency side is, of course, higher, owing to the greater efficiency of resistance coupling on the longer waves. However, the set is very unselective on this range, and it is not possible to separate Radio-Paris from Daventry on an average aerial. Nevertheless, for Daventry alone it is exceedingly sensitive.

Of course, a readjustment must be made of the two reaction condensers, less of the neutralising condenser being required on the Daventry range than on the ordinary broadcast band. If at the minimum position on the neutralising condenser the set is still found to oscillate a reduction of the high-tension voltage will overcome the difficulty.

In general the set works very well indeed on a 100-volt H.T. battery, which need not be of large size, as the consumption of the set is quite low For example, with an old H.T. battery of 100 volts, giving actually 93 volts, the H.T. consumption was only 2 milliamperes, at which figure no one can grumble.

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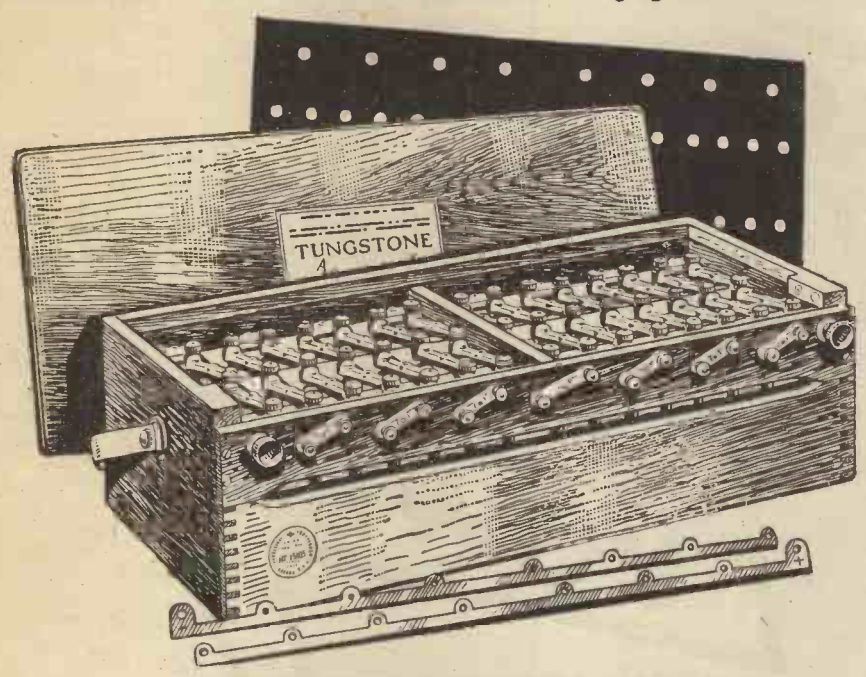

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WIRELESS AND HUMANITY

A CHRISTMAS ARTICLE

by SIR OLIVER LODGE

A Christmas "P.W." number without an article by its Scientific Adviser would not be a real Christmas number. But Sir Oliver is always obliging—and when we invited him to contribute to this special issue, he wrote the following article specially for "P.W." readers. He has chosen a theme which is very suitable for a Christmas number, and readers will, we know, read his article with considerable interest.

THE EDITOR.

THE new powers available for easy communication between scattered people has developed a great feeling of co-operation and friendliness throughout the country. Broadcasting is a privilege which everyone can enjoy, both the transmitters and the receivers. Never before has anyone been able to address personally so large an audience, and never before has it been possible to receive instruction and entertainment with so little effort.

Importance of the Mind.

People sometimes say that the brain of man has achieved wonderful things; but to my mind, in saying that, they are crediting the brain with more than its due. The brain is only the instrument or organ of mind; it is very like a transmitting and receiving instrument; but it originates nothing of the messages sent, nor does it understand the messages received. We do not really see with the brain, or with the eye, but with the mind. Similarly, the ear "hears" no more than does the telephone; it is a receiving instrument which stimulates cells of the brain, so that in some mysterious way the mind is able to interpret the message. All that we emit when we speak are vibrations of the air, which are then by skilful operators transmuted into etheric vibrations. How is it that those vibrations, whether etheric or aerial, are able to convey ideas and transmit thoughts from one person to another is still a mystery, and it is well for us to remember that the mind is dominant over all, and that without it the whole operations would be meaningless.

Much to be Done.

At this Christmas season, moreover, our attention is directed to things of still higher importance than even the intelligence. The needs of humanity are brought to our notice, and there is a spirit of willingness to help, so that family affection overflows into a love for mankind in general, pity for the distressed, and relief of suffering so far as comes within our power. Humanity is becoming welded more and more into one family.

Calamities have always occurred, but not till now has knowledge of them been so universal, and gradually the idea of purposely inflicting pain and suffering and bereavement, which appears to be the only object really achieved by war, will become unthinkable.

The results of scientific research have made travelling all over the world easy, and increased the facility for intercommunion. Civilisation is far from complete at present. There is still much to be done.

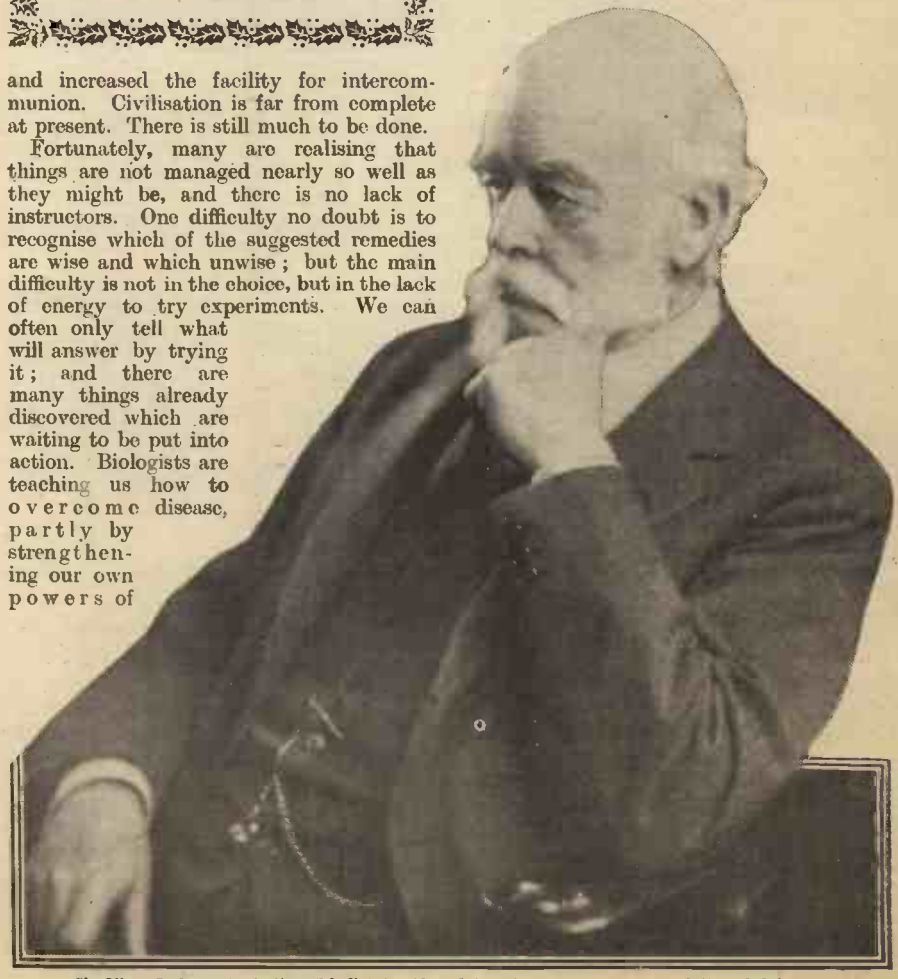
Fortunately, many are realising that things are not managed nearly so well as they might be, and there is no lack of instructors. One difficulty no doubt is to recognise which of the suggested remedies are wise and which unwise; but the main difficulty is not in the choice, but in the lack of energy to try experiments. We can often only tell what will answer by trying it; and there are many things already discovered which are waiting to be put into action. Biologists are teaching us how to overcome disease, partly by strengthening our own powers of resistance, and partly by competing against the pests and parasites by introducing and utilising their natural foes.

Mutual Co-operation.

In new countries this process has already been begun on a large scale; but the same principle can be applied in less obvious ways.

Agriculturists are studying how to increase the fertility of soils, and how to breed more favourable and more disease-resisting varieties. Biologists are teaching us how man can control the influx of life in its association with matter, so as to regulate it for the benefit of the higher organisms.

(Continued on next page.)



Sir Oliver Lodge, who is "P.W.'s" Scientific Adviser, in a characteristic and thoughtful pose.

WIRELESS AND HUMANITY.

(Continued from previous page.)

They have also taught us many instructive things about symbiosis, or the art of living together—the mutual co-operation which is so prominent between animal and vegetable, and between the members of a family; flourishing life is dependent on the help and assistance which one organism can, often quite unconsciously, give another. This principle of symbiosis can be applied to humanity, for the prosperity of any one nation is closely connected with the prosperity of the whole: we do not really prosper at the expense of our fellows. Poverty and disease in any one part of the world is a danger to all the rest. We are beginning to learn that we are members one of another, that we have a corporate existence, that damage to any one part is felt by the whole, and that hostile attack by one part on another is suicidal.

"The More We Are Together. . . ."

The progress of physics has made us realise how small a unit the world is, and is beginning to make social intercourse possible all over its surface. There is a song which says, "The more we are together the happier we shall be," and whether we call it symbiosis or something else, that is a pregnant truth for the different units of humanity.

The extension of the means of communication, so familiar and conspicuous at the present time, has been due to the utilisation of something else than matter. We do not live by matter alone. Children kept in merely material surroundings develop rickets and many other diseases. We are associated not with matter only, but with ether also; and it is through the ether that radio-telegraphy occurs. The ether is a comparatively recent discovery, and we little know what its powers are.

All our energy reaches us from the sun in the form of ether vibrations, and we have begun to find out that these ether vibrations are essential to health. The applications of ultra-violet light are but beginning. We have indeed only recently begun to use electricity; we use it now for lighting and locomotion and the transmission of power. But who would have thought, thirty years ago, that we should be enabled by its aid to see inside opaque bodies, and to speak, and perhaps soon to see, round the world? We are not working with matter alone, but with ether also, though only recently have we begun to do so consciously, and there is much more to be done.

Great Possibilities.

Humanity as a whole is still very ignorant and does not realise the possibilities ahead. No one can predict them with any certainty. We can only see what has been done in the past, and try to apply our knowledge with more wisdom and less mistakes in the future. Our association with matter has produced a whole crop of problems which we have not known how to tackle. Not by attending to matter alone shall we be able to deal with them wisely. The universe contains so vastly much more than matter. Most of our mistakes are due to a too exclusive attention to it. We have been told this, time and again, by seers and poets and prophets.

We are beginning to realise, even in science, the importance of our etheric environment, and how much can be done by harnessing the dominating forces of electricity and magnetism and light; which, though physical, are not material. And so we shall go on to realise that above and beyond these are mental and spiritual realities, to most of which our temporary absorption in matter has made us blind.

The destiny of humanity, whether as an individual or as a race, is something far higher than at present we can apprehend. The universe is a far bigger thing than we as yet realise. Its material aspect is only one of many. Our present embodiment has been reached through æons of gradual evolution and development, and we can only dimly speculate on what we shall become in the long future ahead.

This "bird's-eye" view of Paris was taken from the top of the Eiffel Tower. The strings of insulators which can be seen are only a few of the total used for the great radio aerial.

TECHNICAL NOTES. By Dr. J. H. T. ROBERTS, F.Inst.P.

A RADIO DETECTOR.

An Underground Aerial—Vertical Container Type, etc., etc.

IF you were given the following list of components, how many different circuits could you make? A contest on these lines formed part of the proceedings at a recent gathering of the American Radio Relay League, and was the source of a great deal of entertainment. Each competitor was given a sheet of paper with the following instructions:

Draw as many circuit diagrams as possible from the apparatus listed below. No single piece of apparatus may be used more than once in any one circuit, but any one piece of apparatus may be used in any number of different circuits. Each diagram must be in working condition and must be labelled:

One earth, one aerial, three receiving valves, three filament rheostats, one 6-volt battery, one pair of headphones, one H.T. battery tapped to 90 volts, two variable condensers (·0005), four air-core receiving coils, two low-frequency transformers, two valve holders, two high-frequency chokes, one grid leak and condenser.

An Underground Aerial.

Underground aerials have not as yet achieved very much popularity in this country, although in the States a considerable percentage of sets employ aerials of this kind. One of the best-known commercial underground aerials is that which goes by the trade name of "Sub-Antenna." This consists of a length of lead-sheathed cable, loaded at intervals, and completely sealed up at the end remote from the wireless set. This type of antenna is laid in a trench, about 4 ft. square and about 3 ft. deep, in a series of three or four flat layers, rising successively by intervals of about 12 in., the whole of the trench being then filled in with earth.

Vertical Container Type.

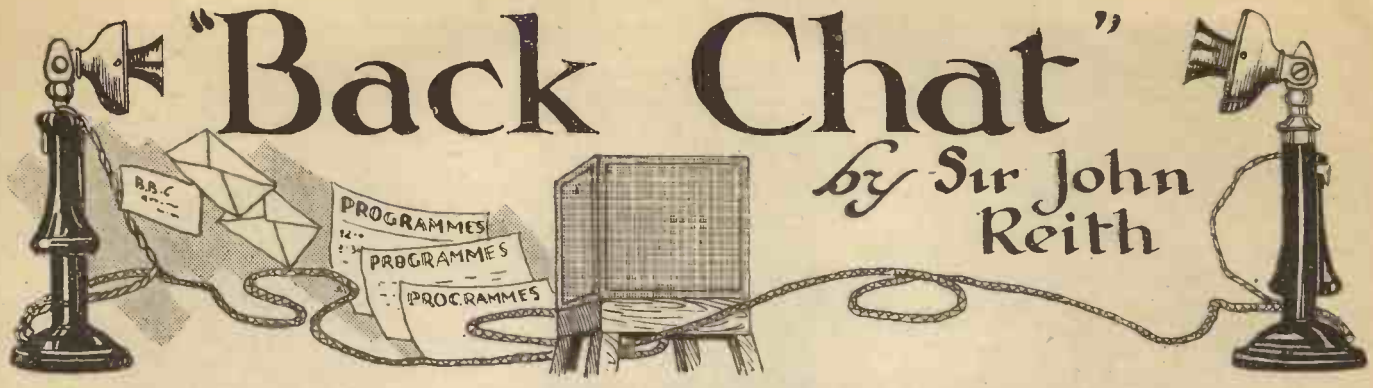
A new type of underground aerial has now made its appearance, in which a vertical metal container is used, within which is a vertical coil of wire. A hole is sunk in the ground, about 2 ft. deep and about 12 in. in diameter, and the container is simply dropped into the hole and the latter filled up with loose earth to which plenty of water is added. The container is similar, both in size and shape, to the conical type of fire extinguisher with which you are probably familiar. A rubber-covered wire leads from the antenna to the earth-terminal of the set in the usual way.

It is claimed for this aerial—which goes by the name of "Aer-O-Liminator"—that

(Continued on page 820.)

"Back Chat"

by Sir John Reith



When we received the following article from the Director-General of the B.B.C. it had no title; but we think that our readers will agree that this is one of the most entertaining articles Sir John Reith has ever written. The title we have chosen for it is, perhaps, rather colloquial—but we take full responsibility!—THE EDITOR.

AT an hour when most decent self-respecting offices are well and thoroughly closed up for the night, the cat put out, and the watchman fast asleep, my telephone rang.

Now there are telephone rings and telephone rings. In my office I can fairly accurately judge the importance of the call by the nature, volume, and persistence of the ring. Our telephone exchange is intelligent, very intelligent, but even their judgment in this matter is sometimes at fault; they invariably, for instance, give what might be termed a Class A ring for my wife on the rare occasions when she calls me up at the office, but, of course, they cannot be expected to "jalouse," to use a good Scotch word, that it is nothing more urgent than an enquiry as to just *how* late one is going to be for dinner.

By differentiation between telephone calls I do not mean to suggest that the summons of anyone "below the salt"—say, Class C or D—is ignored or even postponed without due or adequate cause. I am only suggesting that when one is already talking on another line or engaged in some really momentous conversation, or signing cheques which are urgently required (as most cheques seem to be), an unassuming, tentative ring can probably be left to itself without inviting catastrophe of one kind or another.

The Telephone Call.

To revert back to this particular call last Friday, if it was not a Class A ring it was very near it. It might, in fact, be described as Class 2A plus. At any rate, I answered it pretty quickly. None the less one was a little annoyed. It was, so to speak, past office bedtime.

"Yes," I said—just like that—irritable like, you know.

And the voice replied:

"This is the Talks Director of the British Broadcasting Corporation."

This was rather astonishing. Unusual carelessness on the part of the telephone exchange. A call for some unfortunate celebrity being inveigled into giving a talk for us. Telephone connections gone adrift.

"The Talks Director of the B.B.C. speaking," repeated the voice.

"Oh, is it," I said. "Well, this is the *Director-General* of the B.B.C." (And I nearly added "Huff you.")

"Wait, wait," said the voice hurriedly, with some agitation, the owner of the voice being apparently apprehensive of a cut-off.

Naturally, when one member of the staff addresses another by means of his official title, in an agitated tone of voice, one, so to speak, fears the worst (or sometimes the best—a resignation, for example, or at any rate, a crisis). And we *enjoy* crises here.

"Well," I said.

"I am speaking to you on the instructions of the Programme Board. They have decided that you shall give a talk at 9.10 next Monday night."

"Oh, they have, have they?" I said. "They had better think again. It is not the first time they have done a stupid thing, anyhow."

"But they have really, and they insist on your doing it. You really *ought* to do it."

"Very well, for purposes of argument even at this late hour of the day (although any further dallying with affairs of state will inevitably cause complete ruin to our respective dinners and, incidentally, still further imperil domestic harmony) let us investigate the subject. What *ought* I to talk about?"

Sir John Reith.

"Some sort of official message from the B.B.C., or a pronouncement of policy, or something of that sort."

"And who do they think would be interested in that? Do you mean the kind of thing that begins very solemnly and portentously and ends up with 'The Radio Times' on sale on every bookstall, or the libretto of 'Rigoletto'?"

The reply was inconclusive.

"What do the Programme Board in their omniscience and omnipotence propose I should speak about, anyway?"

Embarrassment at the other end of the telephone line was marked. The Programme Board had apparently made their sapient decision and left it at that. No effort, you will observe, to sketch out main points for me. Nothing at all. Just "9.10: Director-General. Put it down. Let him know about it," and left at that.

"What *do* they suggest?"

Obviously they had suggested nothing.

But the Talks Director was gradually recovering equilibrium and balance.

"Tell them the number of programme hours we have to fill per annum."

"I think they know that already" I replied. "How many are there, anyhow?"

"66,000 per year; 5,500 per month; 1,270 per week; 181 per day, approximately."

"Really!" I said. "Thank you. And then I suppose you were going to suggest my giving the breakdowns worked out to the third place of decimals. I know that one, ·07 per cent."

"Quite," replied the Talks Director. "Then about having to plan programmes so long ahead."

Some Suggestions.

"Yes, months and months; and every detail fixed *at least* six weeks ahead. 9.36 p.m.: Songs of Araby from the Studio. 10.4 p.m.: Songs of Araby from Eastbourne. Very clever work that; takes a lot of doing to avoid having two people singing the same song at the same moment in the same studio, or even *more* to avoid having two people singing a different song at the same moment in the same studio. Then, perhaps, I might tell them about the number of alterations, cancellations, and expurgations in the programmes at the last moment."

But that idea was apparently not acceptable to the Talks Director.

"We have to do clear thinking," the Talks Director went on, "often dealing with very delicate matters in an atmosphere of incessant telephone calls, red lights, and other signals of alarm."

"Alarms? Who from?" I interposed.

"They have to perform complicated jig-saw puzzles, wonderful feats of dovetailing one station with another, reconciling the various claimants to programme time——"

"Well, anyhow," I interjected. "*I* am not a claimant on programme time. May I go now?"

". . . provide alternative programmes on various wave-lengths, cover fields as various as religious services and dance music, education and variety, chamber music and children's fairy talks, church organs and mouth organs . . ."

"The mouth organ got past me," I said. "When was that on?"

". . . and satisfy differing tastes of

(*Continued on next page.*)

"BACK CHAT"

(Continued from previous page.)

twelve million listeners, scattered over an area from Land's End to John O' Groats, and from Cromer to Londonderry . . ."

"I know, California to Maine, from the Gulf to the Great Lakes. Greenlands icy mountains . . ."

". . . On this task are employed hundreds of engineers, programme staff, editors, and publishers, accountants, Station Directors, announcers, writers, conductors of music, musicians, administrators . . ."

"Yes, yes, 'the rich man in his castle, the poor man at his gate.' Further, why not a Director-General here and there?"

". . . the artistic temperament has to work side by side with the business man, the idealist has to learn to be practical, and the technician not to despise the dreamer of dreams . . ."

Properly "Het Up"!

"Half a minute," I said, "half a minute. Repeat that last bit. I broke my pencil. You should give warning of a shock like that."

"The artistic temperament has to work side by side with the business man, the idealist has to learn to be practical, and the technician not to despise the dreamer of dreams."

"Sorry to interrupt you so often, but who is the dreamer of dreams, and what time of day is he dreaming? Office hours 9.30 to 6, and then some."

The Talks Director was, as one might say, properly "het up," and a halt had to be called sometime. The labourer is worthy of his hire—and his dinner.

"What about adjourning this till tomorrow? Growing indignation in the kitchen, and so on . . ." "Well," I said, "there is nothing new in all this, and it does not sound particularly interesting. Have you any *more* ideas? How about, for instance, giving the public what they want?"

"No," said the Talks Director, "I do not think I would refer to that. But what about telling them why we do a certain amount of modern music?"

"Yes," I agreed, "that might be a good point. Why do we? I have often wondered."

Very Interesting!

But the Talks Director felt that that question should be addressed to another colleague.

"Of course one of the most interesting events that has happened in the last twelve months has been the change in constitution of the B.B.C."

"Oh yes? What about that?"

"Some listeners have professed to detect in the programmes a change of spirit which they attribute to what they call 'Government control.' Tell them they are quite wrong, of course. Not only has there been no increase of Government control, perceptible or imperceptible, but there has been no change in the spirit or personnel. There may be some signs of our growing up, or settling down."

"Yes. About time, too, wasn't it?"

"And a great point," the Talks Director went on, "is the exercise of imagination, always searching for new ideas, carrying out experiments, investigating new lines of programme development . . ."

"Yes," I said hastily.

". . . but even if there is a vast administrative machine, the B.B.C. will never settle down into anything like the humdrum operations of a machine, working by a routine . . ."

"Festooned with red tape," I suggested.

My interruption was ignored.

"The strange instrument, the microphone, into which you will speak contains in itself an element of wonder and mystery. In all our work there is that sense of voices and harmonies cast into the void, echoing back in high welcome from all over the earth."

("Boomerang," I thought.)

"What was that bit about 'high welcome'?" I asked. "I suppose you are thinking of the Programme Correspondence Section—ten thousand letters per week—especially after some particularly bright effort of the Programme Board's has fallen flat."

Then came a *real* Class A ring on the other telephone.

"I must go now," I said to the Talks Director. "I have so much enjoyed our little chat. Good-night to you, good-night."

A dangerous task; a workman painting the aerial mast at Langenberg, the great German broadcasting station.

BROADCAST NOTES

FROM OUR BROADCASTING CORRESPONDENTS

Christmas Programmes—A Nativity Play Again—"Rigoletto"—"Hansel and Gretel"—The Radio Christmas Party—Bach's Oratorio—Bank Holiday Features—Sir Harry Lauder—Charlot and the B.B.C.

Christmas Programmes.

CHRISTMAS DAY, falling this year on Sunday, necessitates careful treatment of the Yuletide broadcasts. The programme builders at Savoy Hill have overcome their difficulties by arranging a whole fortnight of special transmissions, and these will cover both Christmas and the New Year. The most ardent Sabbatarian will have no cause to complain that Christmas Day itself will see any departure from the rigid observance of B.B.C. convention. At the same time those who like laughter and frivolity will find it in plenty both before and after Christmas Day.

Let us take a peep behind the scenes at what is being done by those who are preparing the wireless fare we are to have between December 18th and the last day of 1927.

First we see a symphony concert on Sunday afternoon, December 18th, conducted by John Barbirolli and a recital by Pouishnoff. Mr. Victor Hely Hutchinson, a member of the B.B.C. staff, who won the Carnegie Award this year for his orchestral suite of variations, has written a special work which will be given its first performance during this concert. It is a Christmas Symphony based on some well-known seasonal tunes. The evening concert will be relayed from the Grand Hotel, Eastbourne, where Sandler can be relied upon to put on a programme up to his usual high standard.

Monday, December 19th, will remind some of us of the passing of time when we hear the end-of-term concert by the boys of Shrewsbury School. Later we shall hear some variety turns and a play entitled "The Ship," the latter being performed in the Manchester Studio.

A Nativity Play Again.

Do you remember that beautiful Nativity play performed just before last Christmas by village children at Marazion in Cornwall. It was written by the Vicar, the Rev. Bernard Walke, and was performed as an act of devotion, and not in any way adapted for broadcasting. Arrangements have been made to repeat it again this year and listeners will hear it on Tuesday, December 20th. Mr. Filson Young will probably make some explanatory remarks so that we can better appreciate the efforts of the performers.

"Rigoletto."

Verdi's opera, "Rigoletto," occupies most of the programme on Wednesday, December 21st, and many listeners will sit up on this night to hear A. J. Alan tell a new story. It is called "The Visitors' Book." On the following evening we are to hear a Carillon of Carols, relayed from "somewhere in London," to perform which, I understand, a well-known carilloner is coming over specially from the Continent.

"Hansel and Gretel."

Friday brings us to a performance of Humperdinck's fairy opera, "Hansel and Gretel," without which the Christmas

(Continued on page 816.)

FIVE WIRELESS CHRISTMASES

by The Duke of Sutherland

The following article has been written specially for our Christmas Number. The Duke of Sutherland is President of the Radio Association, and has always evinced a keen interest in the development of broadcasting in this country.

I AM often astonished at the large number of references to wireless among writers of older days who can have known nothing personally of the greatest innovation of the twentieth century.

For example, I can picture Robert Burns switching on his set at an evening hour when he is already a little uncertain of the exact time, and musing:

"Perhaps it may turn out a sang,
Perhaps turn out a sermon."

Sir Walter Scott, too, wrote the perfect final message for our evening announcer when he penned the words:

"To all, to each, a fair good-night,
And pleasing dreams, and slumbers light!"

And it has long been clear to the wireless enthusiast that Ariel in Shakespeare's *Tempest* was (as his name implies) the personification of future radio discovery. We all know how Prospero spoke to the other characters in the play through this invisible messenger. "This is the tune of our catch, played by the picture of Nobody," says the awestruck Trinculo after one of these broadcasts.

HIS GRACE THE DUKE OF SUTHERLAND.

Shades of Christmas.

Dickens, however, is the writer who is most apt to my present subject. It would be easy to adapt his *Christmas Carol* to describe the progress of popular wireless during the last five years. Just as there rose up before Scrooge the ghosts of Christmas Past, Christmas Present, and Christmas Future, so we may raise up the spectres of Christmas Wireless Past, Christmas Wireless Present and, with more difficulty, Christmas Wireless Future.

First, then, the Shade of Christmas, 1922.

It was in this year that popular broadcasting became an accomplished fact. Tens of thousands of people listened-in that Christmas who had never done so before and who, a Christmas earlier, had never dreamed of the possibility. It was in 1922 that the London, Daventry, Birmingham, Manchester and Newcastle stations were opened and seventeen millions of people brought into potential contact with broadcasting.

The Shade of Christmas, 1923, reveals three more stations—Aberdeen, Sheffield and Bournemouth—and five million more prospective listeners. Dickens would show us the father of the family switching on his receiving set and the delight of all members of the Christmas Party, especially Tiny Tim.

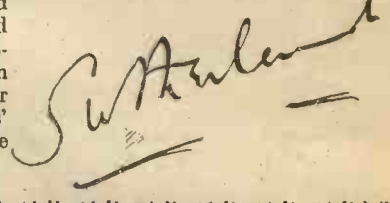
Work of Amateurs.

Not to raise too many of these Christmas ghosts, let us, however, summon the Shade of Christmas Present. It shows us more than twenty broadcasting stations in the British Isles, more than twelve million listeners. Dickens would be astonished at these figures, for in his day, a hundred years ago, the whole population of Great Britain was only sixteen millions.

I should like to summon the Shade of Christmas Future—say, 1930—but I do not think there is anyone, however enthusiastic, who feels competent to foresee the pitch of development at which wireless may arrive in the next few years. Christmas Wireless Future undoubtedly holds the promise of television, but no one knows which year will add this marvel to the household.

It is true of all great lines of scientific development that the greatest discoveries have been made almost by accident, although in the course of careful and instructed research. The wireless of to-day owes very much to the work of amateurs, and it is possible that in their ranks may be the men who will make the most remarkable discoveries of the future.

As President of the Radio Association, I sincerely hope that all researches in this country will go forward with the aim of it enlarging and quickening the vision (and the television) of Christmas Future, so that, in this as in so many other directions, we, Dickens' countrymen, may lead the world.



An Empir Xmas Part

The idea of an Empire Radio Christmas Party has been much below we publish some of the views of some eminent people on this i development of short-wave wireless.—THE EDIT

MR. RAMSAY MACDONALD

From the Rt. Hon. J. Ramsay Macdonald, P.C., M.P.

I watch with keen interest the development of opportunities for Empire Broadcasting. What a fine thing it would be this Christmas if the firesides of the Empire were united in one family community by wireless . . . if we could hear each other's songs and stories and mirth. What a joy it would be to those of us in the old country who have friends and relatives in the Dominions if we could know that they were dancing on those far remote floors to the same band that stirs even the most unskilled of us Londoners to tread a measure!

Five years ago the bare possibility of holding such a radio party would have seemed ridiculous; to-day it is all but an accomplished fact. Perhaps by this time next year such a party will have been arranged. Closer relationships between us and our far-flung Dominions are coming sure as the Springtime, and the bonds of human sympathy and friendship that bind this wayward earth together will then be enormously strengthened.

* * *

From Lord Danesfort, President of the British Empire Union.

As President of the British Empire Union, I rejoice to hear of the extension of broadcasting to and from Britain and her Dominions. It is at Christmas-time that we most desire of the presence of those who have gone out to Canada, Australia, New Zealand and other parts of the Empire, and I know of no better means than broadcasting by which we can bridge the gulf that lies between us. What London lad on those shores would not welcome the sound of St. Paul's bells ringing out glad tidings of Christmas Day and the voices of carol singers here chanting those old, familiar songs?

LORD DANESFORT

What boundless possibilities Empire broadcasting open up for us hardly anyone can adequately realise as yet, but of its power as one of the most mighty links in the chain that binds we British men and women together there can be no doubt. Already we owe a vast debt to science; we shall be infinitely greater creditors in the near future and, I trust, grateful ones.

SIR GODFREY LAGDEN

From Sir Godfrey Lagden, K.C.M.G., K.B.E., Vice-President of the Royal Colonial Institute, and of the African Society.

In the past the various peoples of the British Empire have been more or less in the dark as to each other's thoughts and doings. Possibly there is no more striking way in which we reveal our true characters than by our celebration of Christmas. This is one of those occasions when the world may see Britons as they really are. At this season a mutual exchange of courtesies and information by radio between members of the Great British family will turn darkness into light and result in better feeling and better business.

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From H.H. The Maharajah of Rajpipla.

MAHARAJAH OF RAJPIPLA

I have not spent a Christmas in England for many years, and it would be an immense pleasure to me to take part in a radio Christmas party, even though I should be divorced from the scene of it by thousands of miles. But distance does not mean anything nowadays.

I hope that the plan put forward by the Editor of POPULAR WIRELESS *will be taken up by the B.B.C., so that the whole British Empire may gather, in imagination, round the same Yule-log in the Mother Country. By making use of what is undoubtedly the strongest sentimental note in the world, I see broadcasting assuming a new and very definite importance.*

After my visit to London this year I took back to Rajpipla with me three additional powerful sets, and I shall look forward with a great deal of pleasure—and I might say excitement—to such a Christmas party. I shall also make arrangements for as many people as possible to listen-in as well. I hope that all over the Empire similar arrangements will be made, for Christmas Day in this respect affords an opportunity that no other day provides.

* * *

m Miss Pauline Frederick, the World's most famous screen actress.

u are going to have a Christmas party by wireless next year, and that party is going to be st from London to all parts of the world, then I am really sorry that I am going back home. If I could, believe me, I would have waited a whole twelve months for it!

What a wonderful idea! After all, most parties—even Christmas parties—are very selfish. Just you and your invited friends. But how different to provide a real Empire-wide Yuletide gathering. That seems to me to be the nearest that we have ever been to the real Christmas idea of things.

And London, after all, is the only place in the world from which such a party could be broadcast. In America, London always seems to us the spiritual home of everything belonging to Christmas; we imagine the Strand on Christmas morning under the snow, and we still think of Mr. Pickwick enjoying himself at Dingley Dell.

MISS PAULINE FREDERICK

It is the Christmas party which everyone will want to hear. Where I shall be on December 25th, 1928, I don't know, but I shall do my best to be near a radio set so that I can drop in as a guest at the biggest party that has ever been held. That is, if you will allow an American who loves the British Empire very much to do so!

* * *

From The Rt. Hon. J. H. Thomas, M.P.

An Excellent Idea!

* * *

From Colonel Harry Day, M.P.

An Empire Radio Party should be one of the finest treats ever organised, and I see no reason why it should not be a rollicking success.

Broken Notes

By G. V. DOWDING, Grad.I.E.E.
(*Technical Editor.*)

ARE your loud-speaker results illusions or are they delusions? There is a difference—or, at least, there is in the way I intend these words to be read upon this particular occasion. This is what I mean. The loud speakers of some enthusiasts, but only a few, eject such perfect sound waves that if one were to close one's eyes or switch out the light one would be compelled continually to say such things as "Hear, hear!" "Nastly outlook, that, old man," "Thanks very much!" "Good-evening, sir!" and so on. That is what I would call complete illusion, the more or less perfect reproduction which should be every true radio enthusiast's one ideal.

"So Mellow."

On the other hand, you have those outfits which emit what I style "sugaration." The proud owner of such a set will draw your attention to the "mellowness" of the music. All the strings sound as though they are playing in treacle, the brass takes on the subdued cadence of wood-wind, the drums resemble the soft sploshing of streams of very thick oil falling on more oil, there is such damping, such sogginess, that the piano might well be operating in a bath of mercury. Yet the happy exhibitor will beam with joy as he says "So *mellow*; you might be in the studio." That is a complete delusion.

Now it is extremely difficult to achieve the first very desirable state of affairs and rather easy to attain "mellowness." Providing you tack plenty of capacity across your transformers, loud speaker, and other such points, and use a cone type of speaker having a large diaphragm, or a horn speaker having a nice thick wooden flare, or a well-boxed-in type of reproducer, "mellowness" is yours. But while you will no doubt obtain sounds which will soothe in their sugariness, you will never experience the thrill of the silvery brass (or should I say the silvery silver and the brassy brass ?), the soul-stirring scritch of the strings, and so forth.

Permissible "Coloration."

And the pity of it is that thousands are daily drugging their aural senses with morphined music; a multitude of "mellowness" manufacturers are even now indulging their vice. Not that just a trifle of "coloration" isn't permissible, more particularly on the part of the speaker. This will smooth over little resonances in the average set which otherwise would not be tolerable. But wholesale "mellowing" is for the wine trade only and not for the true radio enthusiast.

Musical sounds are remarkably complex structures. There is not just one smooth "swish, swish" up and down for, say, middle "C" on the piano. There are all sorts of secondary ripples, which, known as "overtones," lend the note the timbre which distinguishes the instrument from which it is projected. Take an orchestra of forty different instruments (you could form one quite easily). Every one of these instruments could emit a note of exactly the same fundamental frequency, but you would be able to pick out the violin from the piano or the flute by its distinctive "timbre." Your radio set should be able to pass out clean notes, each of which retains a very full measure of its original timbre.

I say *should*, you will notice, because it is going to mean a moving-coil loud speaker, super-power valves, and so on, if you would attain perfect "naturalness." But if you cannot run to these you can at least endeavour to preserve instead of "conserve" your chorus of frequencies as they proceed on their journeys from your aerial to your speaker.

Octave Shifts.

And bear in mind that there are ways of shifting notes up and down as much as an octave. Some loud speakers do this, specially with the lower tones, with the greatest of facility and so cunningly that you are deluded into believing you have a full bass if you are not "au fait" with the bottom of the scale. It has truly been said that one doesn't miss the lower notes if one has never had them. But as truthfully it can be said that one never misses anything of which one has no knowledge. But listen to the big drum, the pedal notes of the organ, the double basses of a large orchestra, the sixty cycles of syncopation on a set and speaker that does such things real justice, and another page of radio interest opens for you.

Let me tell you how you can do this without running to fifty-guinea outfits. First of all give up that idea of developing Town Hall volume with a two-valve set. Generally speaking, the first requirement is plenty of "low mag." stages. Instead of trying to work up "full loud-speaker" strength by using one or two high amplification amplifiers, have two or three lower amplification stages. Valves are much cheaper these days, and resistance-capacity couplers are not expensive items. Endeavour to operate your set with no reaction at all—at least, when you are prospecting for low notes from your local station. Be as generous as you can in respect of H.T. and of the use of power or super-power valves.

Not Guess Work.

Avoid cheap foreign low-frequency transformers and chokes, and pay as much for such items as you can. There is nothing like a bad low-frequency transformer for snipping off the low notes. Buy a cone speaker of good make, such as the Amplion, Marconiphone, Brown, and so on. There are plenty of them at really reasonable prices.

There are all sorts of other rules and regulations for which I have no space to discuss here, but you will find them fully dealt with in other "P.W." articles that are published from time to time. And in this connection I would like to point out that we are now able to work out set designs to conform with definite quality standards. Don't believe that pessimistic fellow who says it's all guess work and nobody really knows how a receiver works. We don't know everything about wireless yet any more than anyone knows everything about anything, but we do know how to make a fiddle sound like a fiddle after its sounds have been wheedled from a loud speaker.

The B.B.C is putting over some excellent stuff these days, from a technical point of view, but I can conceive of no tragedy to equal in poignancy Mr. Percy Pitt or Capt. P. P. Eckersley being forced to listen for one whole evening to one of those so-called "mellow" sets!

A member of the "Popular Wireless" Technical Staff testing components. Every part of a radio outfit must be of a high standard of efficiency if first-class results are to be obtained. Always buy British radio gear of well-known branded makes.

The MELODY MAKER

CAN BE BUILT WITH LISSEN PARTS

Congratulations to Messrs. Cossor on an excellent set.

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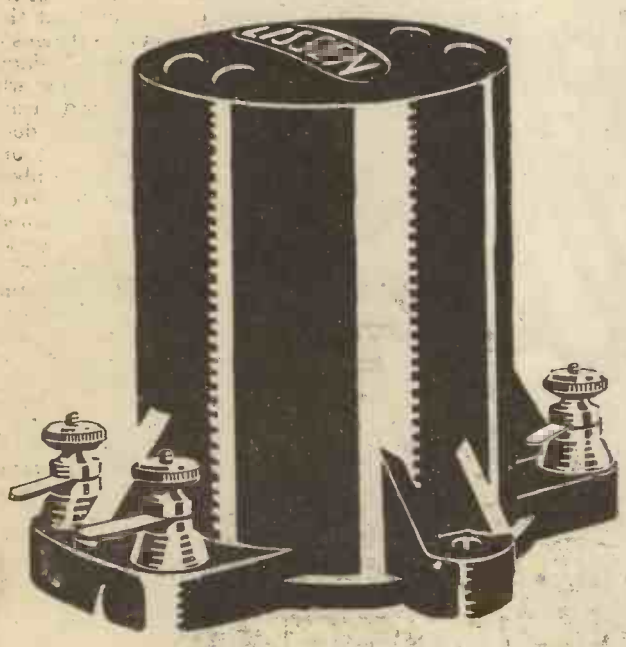
Use the other LISSEN parts as well, resistances, condensers, rheostats, valveholders, batteries, etc.



Lissen Parts for the Cossor Melody Maker

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Also use the Lissen H.T. Battery

All these Lissen parts for the Cossor Melody Maker are obtainable from 10,000 radio dealers throughout the country. Ask for Lissen parts in a way that shows you will take no other, and be sure of perfect results.

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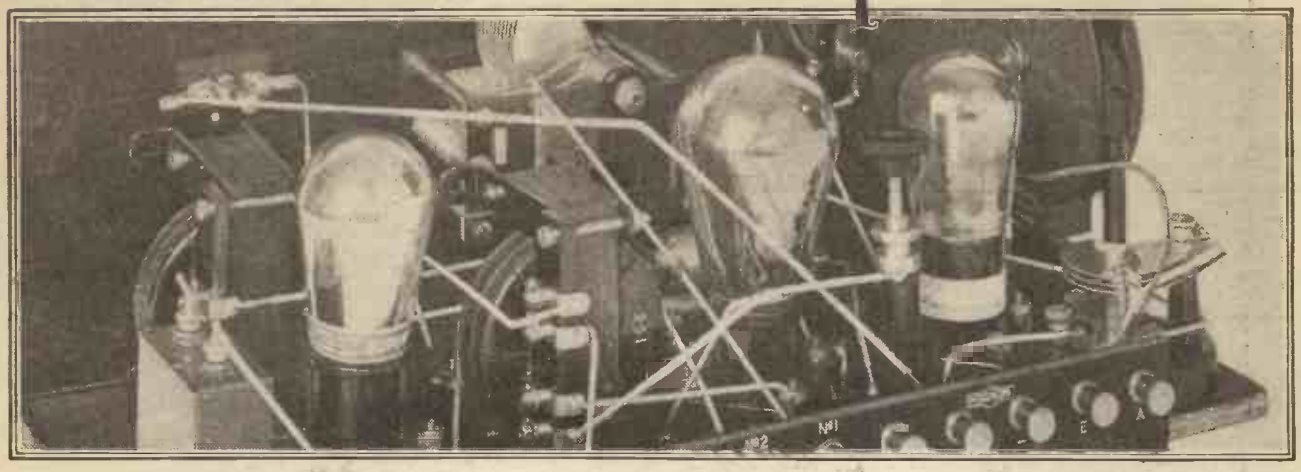
The A B C of H.F. Amplification

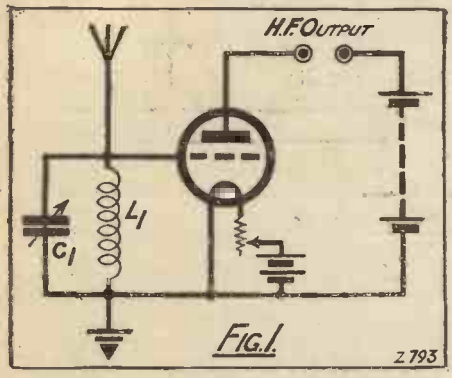


This is the first of a series of three articles which form a continuation to the recently published popular series for the new amateur.

(1) First Considerations.

By G. P. KENDALL, B.Sc.

HUMAN nature being what it is, once perfection is reached in any direction one is rather apt to lose interest, simply because there is no more to be done and further progress is impossible. That is probably one of the many reasons why wireless is so fascinating a hobby, for perfection is never quite achieved. One can go on improving and improving, yet one never arrives at a state of affairs when one can truthfully say, "My results are perfect in every way, and no further improvement is possible." Always there is the possibility



of, perhaps, just a little more volume to fill the room properly, a little more selectivity to cut out the local more easily, a little more faithful reproduction from the loud speaker, and so many of these matters can be attended to with just a little more work and experimenting, that it seems that one can go on indefinitely and never lose interest.

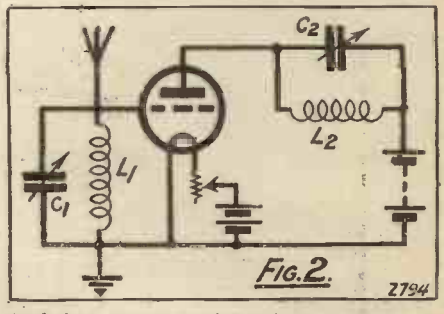
Louder Signals,

Those who have been following the special series of articles for the new reader in recent issues of "P.W." will by now have acquired a fair idea of what can be done with a single valve in the more straightforward types of circuit, using the valve as a rectifier with or without reaction, and very likely by this time have begun to feel that they would like to investigate some circuits of greater possibilities. The range and sensitivity of a single-valve receiver can be enormously increased by the judicious use of reaction, but a time is bound to come when the user wants to amplify his signals still further, and begins to think of the addition of another valve so that he may get louder signals and still more distant stations.

Two Methods,

Now, when one decides to try and amplify the signals obtainable from a simple detector valve, there is a choice of two methods. First, we can amplify the low-frequency rectified current which would otherwise be used to work the telephone, and then put our amplified currents through the 'phones or even a loud speaker. This is called low-frequency amplification, and is a process which goes on immediately following upon the detector valve. It will be dealt with, of course, at a later point in this series. Secondly, we can take the high-frequency currents just as they are received from the aerial circuit and amplify these by means of a valve working in a suitable way, and then pass the output from this high-frequency valve, as it is called, on to the detector valve for rectification as usual. In more elaborate sets, of course, both methods will be used.

Now, there is nothing very special which need be done to make a valve act as a high-frequency amplifier, since the valve is a particularly accommodating piece of apparatus, and it will amplify any currents of an oscillating or fluctuating nature which are applied to it, so that it is merely a matter of feeding the currents into it and providing some means of passing them on from the output side of the valve to the next stage of the set. Evidently all that we need do to make the valve act as a



high-frequency amplifier is to connect it across some part of the circuit when the high-frequency incoming signals are flowing, and this, in the case we are considering, is the aerial and earth circuit.

Turning to Fig. 1, it will be seen that we simply connect our H.F. valve grid and filament across the tuned-aerial circuit in exactly the same way as we should connect a detector valve, but, of course, we do not provide any grid condenser or leak or other means of making the valve rectify. It will, therefore, act as a pure amplifier, and the signals flowing in the tuned circuit L_1–C_1 will be reproduced in a magnified form in the anode circuit of the valve. In this same diagram, it will be observed that two

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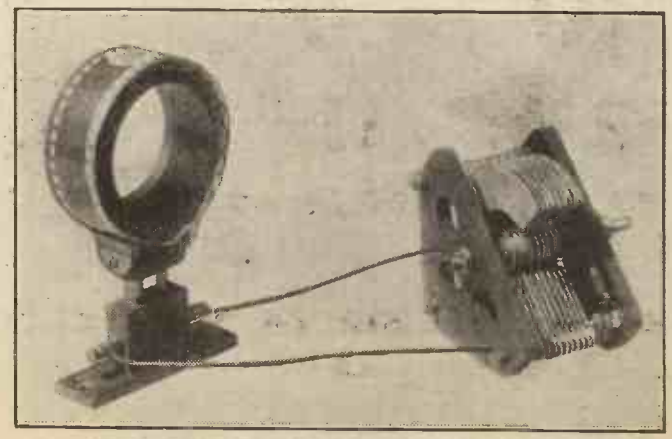


Just a coil and condenser forms the simplest kind of H.F. intervalve coupling circuit.

THE A B C OF H.F. AMPLIFICATION.

(Continued from previous page.)

terminals are provided marked "H.F. Output," from which it is understood that we shall take our magnified signals and apply them to the detector valve. So far so good, but to obtain the desired effect, we must provide some sort of output circuit in the anode circuit of our H.F. valve, in order that it may amplify properly and also give us our amplified signals in a form which will be most effective for applying to the detector which follows.

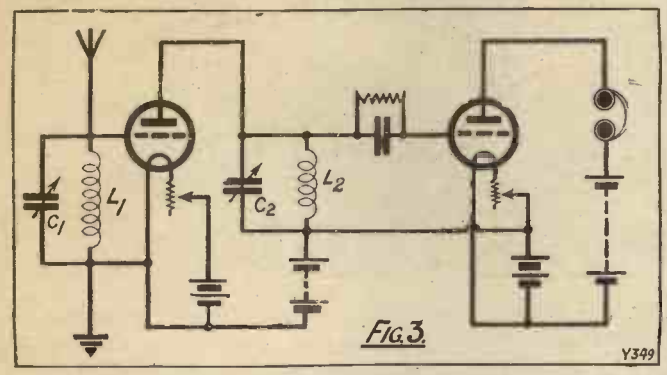


FIG. 3.

The Tuned Anode.

Perhaps the simplest and most easily understood form of output circuit which we can use is the familiar tuned anode, which is illustrated in Fig. 2. Here we have another coil (L_2) which is tuned by the condenser C_2, and when this is brought into step with the other tuned circuit, C_1–L_1, we shall get amplified signals built up in it, and, consequently, we can connect our detector valve grid and filament across it just as though this were the aerial circuit.

Fig. 3 shows how a detector valve can be connected across the tuned-anode circuit of the H.F. amplifying valve, and the reader should examine this diagram carefully to see just how the various connections are made in the simple theoretical form. The usual grid leak and condenser is provided to make the second valve rectify, and the lead from this goes to the anode end of the tuned-anode circuit. This corresponds to the high potential or aerial end of a simple detector valve receiving circuit, the filament lead from the detector valve going to the lower end of the tuned-anode circuit, and in this case the H.T. plus end, which, of course, corresponds to the earth.

Fig. 3 was drawn specially to make the principles of working of the circuit as clearly as possible, but the reader must realise that this is not exactly a practical method of arranging the circuit, because he will observe that two separate sets of batteries are needed, one for the H.F. valve and one for the detector. This, of course, is wasteful, since by making certain little changes the circuit can quite easily be arranged to use one accumulator and only one H.T. battery to serve both valves. Actually all that we need to do is to modify the connections of just one little component, and that is the grid leak of the detector valve. In Fig. 3, you will observe that the grid leak is connected in what is called the parallel position—that is to say, straight across the grid condenser. Turning now to Fig. 4, you will see what must be done in order that common batteries may be used for the two valves. The grid leak is now connected directly between the grid of the valve and the positive end of the filament, the same H.T battery feeds the anode circuit of both the valves, and their filaments are both lit from the same accumulator.

Obviously, we cannot leave the grid leak in the previous position, that is to say, across the grid condenser, because if we did so the positive potential of the high-tension battery would be communicated to the grid of the second valve and would make it positive in regard to its filament and upset its action. With the grid leak connected in what is called the series position, however, as shown in Fig. 4, the positive potential of the H.T. battery cannot get to the grid of the second valve, because the grid condenser keeps it off, and so the detector can work in the normal way. With separate batteries of course, as in Fig. 3, this question did not arise, because although the positive potential from the first H.T. battery was applied to the grid of the second valve through the grid leak, it was also applied to the filament circuit of that valve so that it did not produce any difference of potential between grid and filament.

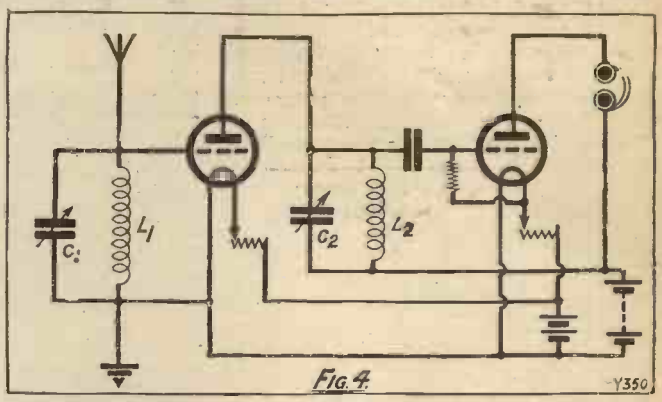
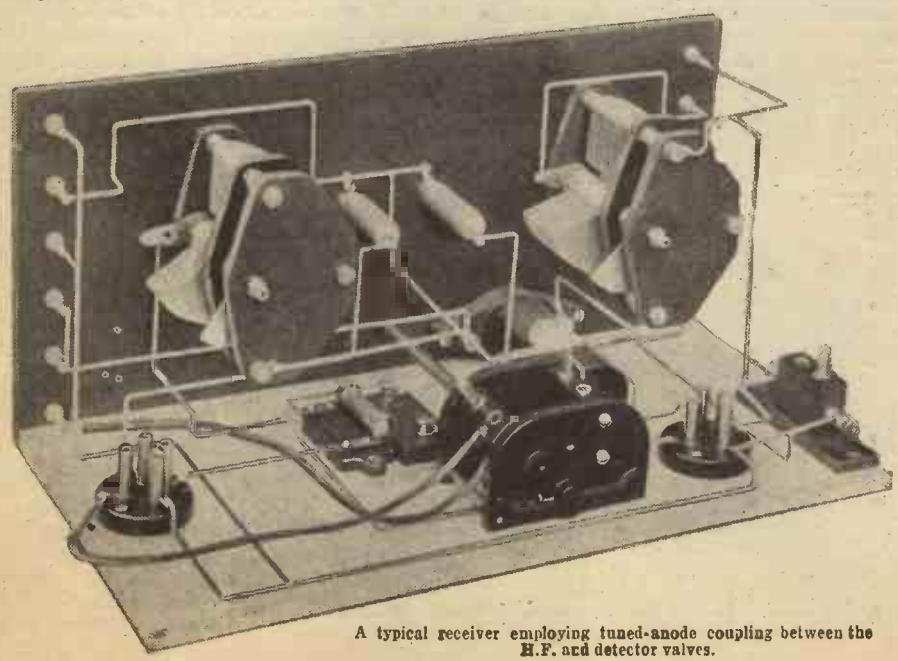


FIG. 4.

Transformer Coupling.

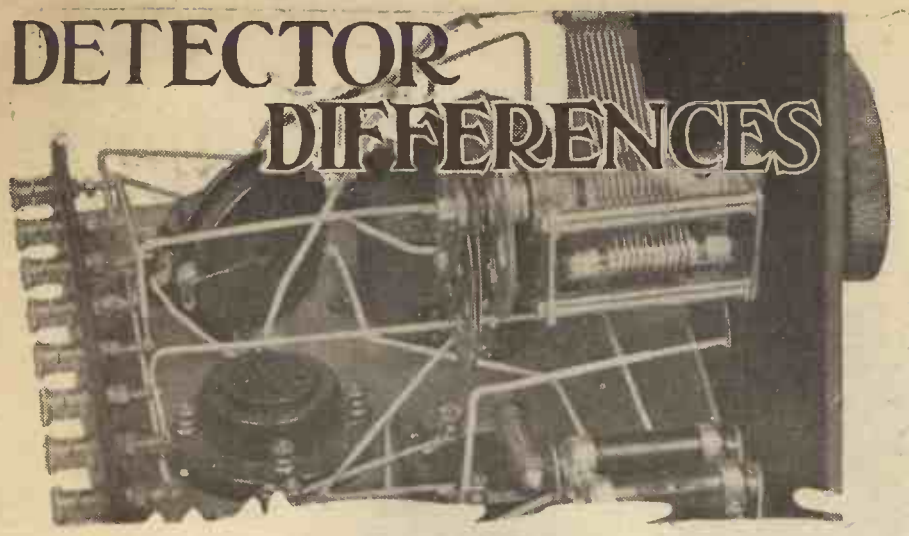
Fig. 4 shows a practical type of circuit, with which very fair result scan be obtained if certain little precautions are taken.

Before we leave this branch of our study of simple H.F. circuits, just a few words about another form of what is practically the same thing as the tuned anode, namely, the old type of tuned-transformer coupling. Here we have the same tuned-anode circuit, but instead of connecting the detector valve across this, we connect it across a secondary winding, which is closely coupled to the tuned anode. These two windings together form what is called a high-frequency transformer, and in the days when this circuit was popular, it was usual to employ one of the barrel or mushroom type of four-pin transformers. The functioning of this circuit is practically the same as the tuned anode, except that the signals are not transferred straight to the grid of the detector valve, but are transferred from the primary to the secondary winding by electro-magnetic induction, or transformer action. In theory, there may be only slight difference between the two circuits, but in practice there is perhaps some slight advantage to be obtained from the use of the transformer, chiefly in matters of stability and to some extent in selectivity. As regards stability, this is probably largely a matter of a false impression in the case of the transformer-coupled circuit, because the old barrel-type transformers were usually less efficient as coils than the type of inductances used in tuned-anode circuits, and consequently there was less trouble from instability.



A typical receiver employing tuned-anode coupling between the H.F. and detector valves.

DETECTOR DIFFERENCES



By W. JAMES.

EVERY wireless receiver has to have a detector, and when this is a valve, only too often it is found that the valve is put in the receiver and used without any great attention being given to see whether it will work efficiently.

One form of valve detector uses a small condenser and high resistance, popularly known as a grid condenser and leak. Grid current is encouraged to flow in a detector of this type, and for a given valve it is found that the amount of grid current which flows under normal conditions—that is, when

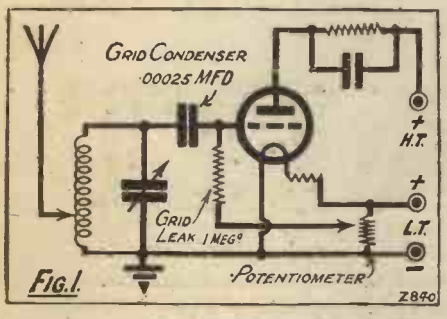


FIG. 1.

there is no signal—determines, to a large extent, the effectiveness of the valve as a detector. The grid current which flows is controlled by the voltage of the grid with respect to the filament, and the majority of valves require that the return end of the grid leak be slightly positive, with respect to the negative side of the filament.

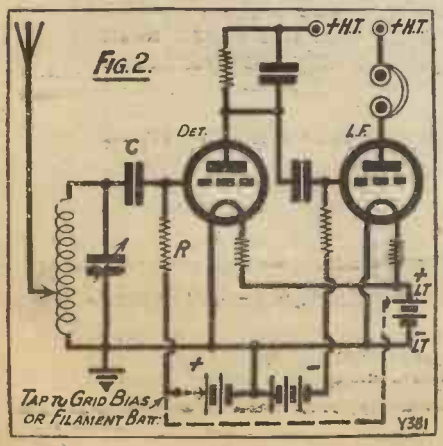


FIG. 2.

It has to be remembered that the grid is not connected directly to the filament battery, however, but is connected through a high resistance of 1 to 5 megohms, with the result that the voltage of the grid is not the same as that applied to the grid leak by the battery. Thus, if we try different grid leaks, the voltage of the grid will alter and so will the grid current. Here, then, is one method by which the grid potential can be varied for the best results. We can try different values of grid leak and in this connection readers will remember that a year or two ago adjustable grid leaks were very popular. But many of those available were apt to vary with use and after a time seemed to become noisy.

The Best Adjustment.

A fine adjustment of the normal grid voltage and hence of the efficiency of the detector can, however, be obtained by another method. We can use a grid leak of known value such as 2 megohms and connect its return end to a potentiometer which has its ends connected across a filament battery (Fig. 1). When a weak signal is being received it is very easily proved that the setting of the potentiometer plays an important part in the operation of the detector, for signals will almost invariably be increased in strength by setting the potentiometer in one particular position. This position will, of course, depend on the valve used and the value of the grid leak, and in those instances where it is necessary to make sure of obtaining the very utmost from a receiver, a potentiometer for setting the detector is a very useful component.

When the extra expense of a potentiometer is objected to, or when this additional control is considered not advisable, the grid circuit can be connected to one of the cells of the filament battery, or to the grid-bias battery as shown in Fig. 2. Quite a material improvement in signal strength can often be obtained by this simple means. All that is required is an extra wire which is connected as shown in the figure.

Double Duty Detectors.

In many receivers the detector valve has to do two things—first, to rectify the signals and, secondly, to enable a smooth control of reaction to be obtained. We, therefore, usually find, as might be expected, that the adjustment of a detector which is best from the point of view of obtaining a smooth control of reaction, is frequently not the best for maximum rectification efficiency. Here again the potentiometer control, or the tapped battery method, will enable the best results to be obtained.

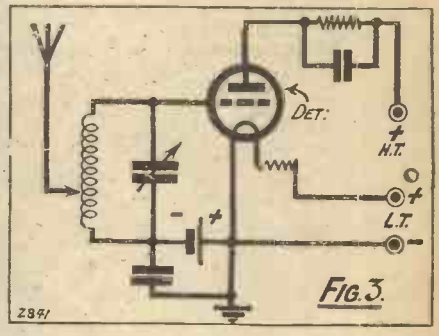


FIG. 3.

When we come to the anode rectifier, you will find it of the greatest importance to provide a more or less exact adjustment of either the grid bias or the anode voltage. In this method of rectification, a sufficient negative grid bias is given to the detector to prevent grid current, and one part of the incoming signal alters the anode current while the other does not.

The sensitivity of this type of detector depends enormously on the voltages used, and the best value of grid bias will have to be chosen to suit the type of valve used for rectifying. When a valve of the R.C. type is used as a detector, a grid bias of negative 1·5 is usually suitable. Such a valve should have R.C. coupling, and the H.T. voltage will have to be of the order of 90 volts.

Professor Popoff's detector, evolved in the year 1901.

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EMPIRE BROADCASTING

With the growing interest in the development of short-wave wireless this article by the High Commissioner for Australia is both topical and valuable.

By Major-General the Hon. Sir GRANVILLE RYRIE, K.C.M.G., C.B.

EMPIRE broadcasting has now been brought within the range of practical achievement. This much has been proved by the success which has attended the experiments of Mr. Gerald Marcuse in the transmission of wireless concerts to Australia via his private wireless installation at Caterham, and also by the reception in this country of the concert transmitted from 2 F C, Sydney, in September. This transmission, it will be remembered, was picked up by the B.B.C. "Listening Post" at Keston, relayed to 2 L O, and broadcast throughout Great Britain. I am quite aware that many technical difficulties have yet to be overcome before perfect reception, either in Great Britain or in the Dominions, can be assured, but I am confident that before very long these difficulties will be solved and Empire Broadcasting become the order of the day.

Cheering News.

In its official report on the Sydney broadcast the B.B.C. stated that this relay from Australia was, if anything, slightly better than the first relay from America which was attempted by the B.B.C. two years ago, and, considering the advance which has been made in reception from America, "it is reasonable to hope, in view of the experience of trans-oceanic broadcasting which has been gained in the past two years, that reception from Australia will improve even more rapidly than reception from America." That is cheering news, at any rate, from the point of view of reception of Australian transmissions in this country.

Australia is Alive.

In regard to Empire broadcasts generally we have the assurance of the B.B.C. engineers that their experiments will have advanced so far as to enable them to open an experimental short-wave transmission station for Empire transmission and reception before the end of the year.

Empire Broadcasting, of course, is dependent not only on the B.B.C. It calls for co-ordinate action on the part of the broadcasting authorities in all the Dominions.

As far as Australia is concerned, the experimental broadcast from Sydney, to which I have referred, was the first official Empire transmission to be attempted, and indicates that Australia at least is alive to her responsibilities in this matter. The other Dominions, I am sure, are ready and willing to co-operate; but much will depend on the B.B.C., to whom we all look for guidance and help.

As a medium of fostering the goodwill and assisting the interchange of cultural ideas between the Mother Country and the Dominions, Empire broadcasting has unlimited possibilities. It could be used to broadcast information on subjects affecting the well-being of the Empire, and to encourage trade and development by disseminating knowledge of the resources and products of the Empire. I may be looking far ahead, but is it not possible to anticipate the day when special lectures on Australia will be broadcast from Australia to the schools in Great Britain? Then, from the entertainment point of view, I can well imagine the delight of the people in New South Wales listening-in to a running commentary of the Test Match between England and the "Waratahs."

Major-General The Hon. Sir Granville Ryrie.

In the Bush.

I appreciate that these suggestions, which are made at random, could scarcely be fitted into an ordinary broadcasting programme, but I have set them down to indicate the possibilities of a broadcasting service between Great Britain and Australia. There would be no difficulty in arranging suitable programmes, educational as well as entertaining; for Australia is thoroughly British in population, in ideals, in its customs, its culture and its sport.

There is another phase of Empire broadcasting which I should like to emphasise. The development of wireless has been a great boon to settlers in the remote parts of our Dominions and Colonies. From personal knowledge I can say that the broadcast programmes from Sydney, Melbourne, and other capital cities in the Commonwealth, have done much to interest and amuse settlers in the bush.

That Personal Touch.

These pioneers of the Empire are the people who would appreciate most of all an Empire broadcast from 2 L O. It would help them to forget their loneliness in the thought that they were linked up with the heart of the Empire. Therefore it seems to me that Empire broadcasting, properly developed and maintained, might well become a factor in the settlement of the more or less empty parts of the Empire. A regular series of broadcasts from London would keep the Dominions in touch with affairs at home, and the fact that the news is transmitted, so to speak, "by word of mouth," gives that personal touch which makes all the difference.

B.B.C. AND THE RADIO TRADE.

Some Criticisms and Some Suggestions.

By THE EDITOR.

WHEN the B.B.C. was made up of manufacturers of wireless apparatus, it was the fashion for ill-disposed critics to suggest that the broadcasting service was wrongly exploited in the interests of the radio trade. Far from this being the case, it is doubtful if the old board of manufacturing directors availed themselves of any of the numerous opportunities of turning their position to account in a selfish way. Sir John Reith has declared repeatedly that he received his public service mandate right at the beginning of the Company.

Admitting that there was no wrongful exploitation of the medium by the old B.B.C. Board, was there any conscious progressive policy in support of British radio enterprise? Careful examination of the history of the Company reveals no sign of such a policy. This would appear to be a surprising omission, but probably it was due to the chronic difficulties experienced in securing anything resembling a coherent unified policy for the radio industry.

In Better Position.

At the time of the change over from the Company to the Corporation, there was at first no little anxiety on the part of the trade as to the possible withdrawal of B.B.C. support. It was not generally realised that the only support which the B.B.C. had given was in the provision of programmes requiring wireless apparatus for their reception! Beyond this, there was literally nothing to withdraw. There were some, however, intelligent enough to perceive that the B.B.C. as a State Corporation would be in a position to do very much more for the radio trade than the B.B.C. controlled by the manufacturing element.

It was apparent to these observers that the Corporation could do many things, and be commended for them, which if done by the Company would involve public scandal. At the beginning of this year, therefore, it was hoped in many quarters that the Corporation would lose no time in initiating a wisely conceived policy to support the British radio industry.

Not Enough Activity.

There have been the customary asseverations of friendship, and two or three detached gestures; but beyond this, nothing. The blame does not fall entirely on the B.B.C. There is in existence a strong committee of the trade, charged specifically with the responsibility of safeguarding trade interests in broadcasting. The sum total of the results of the activity of this committee during nine months is a slight revision of the morning concert times of 2 L O and 5 X X. It may be that the committee has met serious obstruction, or unexpected difficulties. If so, these should be given full publicity.

The trade as a whole is entitled to a much more complete account of the activities of this organisation than has been offered so far. Let the committee take a leaf out of the book of the "Wireless Organisations Advisory Committee," and release for publication a detailed account of its work for the past nine months. It may be that all is well, but the absence of information, accompanied by the absence of action, is disconcerting to general confidence.

No Initiative.

And what of the future? Is a constructive policy feasible? And if so, what should it be? My view is that these questions, like most others, are answered best by reference to the arbitrament of common sense. This year the B.B.C., although deplorably late, *did* take the initiative in connection with National Wireless Week. But efforts of this kind, fruitful as they are at the moment, should be linked and integrated. They do these things much better in Germany and the United States. There is ample room for a small paid staff to do nothing else but develop and co-ordinate liaison between the B.B.C. and the trade. This should have eventuated from the ill-fated British Radio Development Association.

Technical Talks.

As for a continuous constructive policy, let it be laid down as fundamental that the B.B.C. quite definitely and firmly sides with British radio apparatus as against foreign radio apparatus. There should be some qualification with regard to radio apparatus made in the Dominions, but otherwise the B.B.C. should be pronouncedly and avowedly protectionist with regard to all wireless apparatus.

Having established this fundamental policy, with the full cognizance of the Board of Trade, the B.B.C. should then develop an educational campaign with a view, not only to advertising British radio apparatus, but also to assisting in the technical education of listeners generally.

"Get on with the Job!"

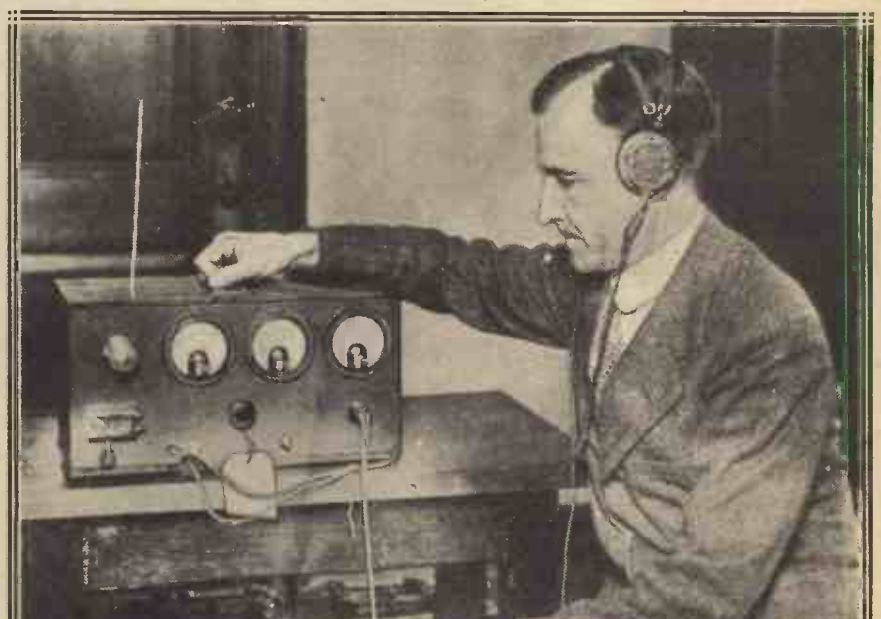
Of course, the Wireless Technical Press should be invited to collaborate, both in the preparation of the syllabuses for the series, and in their execution.

The B.B.C. is fond of calling attention to the widening scope of its educational work. This is entirely commendable as far as it goes. But it is curious that an organisation so alert and enterprising in most other directions should have failed to realise the programme value of sound technical talks rightly placed and skilfully given.

Their first purpose should be to correct notorious elementary popular misconceptions. Their second purpose should be to set listeners thinking along the right lines technically; their third purpose should be to spread intelligent interest in the technical side of wireless reception. As each or all of these purposes may be served, so, inevitably and progressively, will the demand for receiving apparatus and accessories develop and expand.

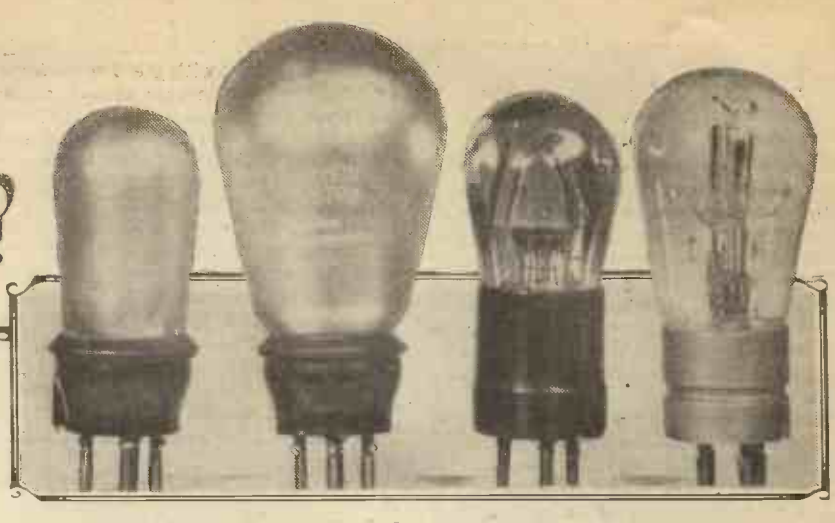
The B.B.C. should then take steps to insure that every new technical invention and development is appropriately recorded either in the News Bulletin or in special announcements.

The omission of this in the past has been serious. It is in the power of the B.B.C. to regain for radio some considerable measure of the romantic glamour which enveloped its infancy. Incidentally, but quite legitimately, this glamour is first-class business. Get on with the job!



Dr. J. H. Dellinger, Chief of the Radio Laboratory of the American Bureau of Standards, who spent three months in Europe studying radio conditions. He is shown with the special wave-meter he used for checking the frequencies of the various broadcasting and commercial stations. Dr. Dellinger also attended the recent International Radio Conference in Washington.

Which is the BEST VALVE?



If you have bought, or built, a new set, and are doubtful as to what valves you require this article will help you in your choice.

By KEITH D. ROGERS.

I AM very often asked by people who have either just bought new sets or had them made for them, the question "What valve shall I get?" This is always a very difficult question to answer if one has no knowledge of the set concerned, because it is difficult to explain to the non-technical man that he cannot just buy three or four valves and place them in any position in his set and expect them to work satisfactorily.

An early model of the Interdyne self-balancing H.F. valve.

Unfortunately, the choice of valves for a radio receiver is not quite such a simple business as it might appear, for there are one or two points that one has to consider, which, unless they are attended to, will prevent the maximum results from his receiver.

The main thing governing the choice of a valve in any set, is the low-tension supply. As a rule this should be decided before the valve is chosen, and the majority of people find that they have to make a choice of valve from the 2-, 4- or 6-volt class to suit the accumulators they buy. Too much has already been said about the various merits of the 2-, 4- or 6-volt classes of valves, so that there is no need for discussion on that point here.

Two, Four or Six Volts?

They are all very good, although perhaps a little more "punch" can be obtained from a 6-volt valve, especially if a large volume is required. But for the average man who will use a two, three, or four-valve set just for comfortable loud-speaker reception on his local station, with perhaps one or two others thrown in if he can get them, a choice among the 2-, 4- or 6-volt classes will give almost equally good results, though the two-volters may not neutralise so well as their 6-volt brothers.

The first thought in the actual choice of valve for any set concerns the particular circuit employed in that receiver. For instance, if a man has a four-valve set employing one H.F. stage, a detector and two note-magnifying stages, he will have to choose valves so that they can operate the set successfully in those four stages. It would be no good his putting a low-frequency valve in the high-frequency stage and expecting to get really good results, while it would be even more absurd to put a high-frequency valve in the last stage and expect it to carry the volume required to operate his loud speaker.

What he does, then, is to look through his circuit, or if he does not understand the technicalities of wireless to ask a friend to give him some assistance, and he finds that he has, say, one neutralised high-frequency stage, an ordinary detector working on either grid leak or the anode bend principle, followed by a resistance-capacity-coupled low-frequency stage. This latter is, we will say for the sake of argument, transformer coupled to the last stage. Now, this is a perfectly typical receiver, and we will see what valves are likely to give the best results.

Four Valve Types.

Roughly speaking, valves can be classified into about four types, and these are generally known as R.C. valves, H.F. valves, L.F., and power or super-power valves. Thus the mere classification gives one an idea as to where the valves are likely to work best, and it only remains for the average man to choose his particular valves and to place them in their correct sockets.

If he does do this he will not go very far wrong, for if he places an H.F. valve in an H.F. stage, a resistance-coupled valve in a stage followed by resistance coupling, an L.F. valve in an L.F. stage, and then a power or super-power valve in the last stage, he is sure to get moderately good results, though he may not get the absolute best from his set. In order to obtain this, a little care must be taken in the choice of the valves, and it is with a view to helping the man who wants to get the utmost out of his receiver that this article is written.

It is hopeless in such a short space to go fully into this matter, but I hope that by the time the reader has reached the end of this chat he will have learned something of the principles on which valves are chosen, and will to some extent benefit from what I have said.

Let us return to the four-valve set we took as an example. The H.F. stage we have found is neutralised, and we have to find a valve suitable for it. In all examples we will consider the 6-volt type of valve, though it must be understood that 4- or 2-volt counterparts can be substituted where 2- or 4-volt accumulators are being used.

The H.F. Stage.

Now, valves really vary a very great deal, though there is no absolute lines of demarkation between any two types of valves. They all overlap a little. So, by looking at the figures on the boxes in the various H.F. valves, or upon the characteristic curves if you are able to understand them, you will see that what is called the impedance or A.C. resistance of the valve may vary between anything from 15,000 ohms to 40,000 ohms. On the list of characteristics these figures will be accompanied by others among which will be the magnification or amplification factor, say, ranging from 13 to 30. These are the two factors

This popular last-stage valve—the D.E. 5A—takes ·25 amp. at 6 volts.

which we have to consider, and we find we have a wide range of valves from which we can choose, though they are not all equally suitable for the circuit which we are discussing.

Those with the high-impedance figures and high-magnification factors would do

(*Continued on next page.*)

WHICH IS THE BEST VALVE?

(Continued from previous page.)

better with tuned-anode coupling than with a transformer. Those with the lower figures would do probably better as detectors than H.F. amplifiers, and indeed it will be found in most makers' catalogues that the H.F. valves and the detector valves are grouped together. In other words, you can usually employ an H.F. valve as detector, or vice versa.

Roughly speaking, we find that for average good results, we must take a valve with average figures and, indeed, in practice H.F. valves of 20,000 ohms, or thereabouts, with a magnification of 17 to 20 prove the best in most circuits, and if with the four-valve circuit we want a really reliable H.F. valve, we shall hardly do better than to choose one with about 20,000 ohms impedance and a magnification factor of 17 to 20. Such valves are the P.M.5X., S.S.610 H.F., Cossor 610 H.F., E.S.5 H.F. and D.E.5 B, though these latter have a slightly higher impedance. With such valves in the H.F. position, you will be quite sure of good results.

The Detector Stage.

With regard to the detector stage, there is a little difference of opinion as to whether a high-magnification valve or one with a medium magnification should be used when it is followed by resistance-capacity coupling. Personally, I do not like resistance-capacity coupling circuits to have anode resistance values of more than 500,000 ohms and so, for reasons which need not be stated here, the detector need not be of the very high magnification type, and can quite easily be one of the H.F. valves similar to those chosen for the H.F. stage. Indeed, where strong signals are likely to be received the use of a valve with a very high magnification factor will probably only lead to trouble in that, even if it is not itself overloaded it will overload the first L.F. valve, for, of course, if the detector valve has a fairly low magnification figure (say about 13 to 20) no such danger will arise, and much clearer results will be obtained.

One of the new screened-grid H.F. valves which are capable of providing a very high degree of amplification with stability in operation.

The next valve (the first L.F.) is followed by transformer coupling and we must not have too high an impedance. We also have to remember that, on local stations especially, this valve is likely to have to carry quite a large grid swing, or in other words is likely to have to deal with a fair volume, so that it must be capable of handling this input without distortion.

Now high-impedance valves are not able to carry much input without overloading so that here we have to use a valve with moderate magnification, but yet not likely to cause saturation of the transformer primary by taking a large plate current.

In this case, we find that an ordinary L.F. valve with an impedance of about 13,000 ohms is one to be used, and is one which will give satisfaction as a rule. Such a valve is D.E.L.610. The Cossor 610 L.F., which I have used with great success, would be useful in such a case as this, although its impedance is 10,000 ohms. But in this latter case one has to know what one is doing, and I would not like to guarantee that this valve would work perfectly in every set using a circuit similar to that mentioned. To be on the safe side, I would advise any man with a large set to use a valve having an impedance of about 10,000 ohms for his first L.F. stage, using, of course, suitable grid bias in order that the valve will be working under its proper conditions, and a good make of transformer. There is, of course, quite a lot of technicality behind all this, but it is, unfortunately, impossible to go any further into it in this article.

The Last Valve.

When it comes to the last valve the matter of choice is slightly more difficult, because it is here that the volume is really reaching large proportions. Furthermore, it is essential that a valve be used which will adequately deal with the input of the grid circuit without being overloaded. If overloading occurs the distortion caused will ruin the whole reception, and no matter how good the loud speaker may be, pure results will be impossible.

Therefore in this stage you should choose a valve which will not be overloaded by any amount of signal strength that you are likely to require. In other words, when you are listening to the local station, you must make sure that the valve you have chosen is capable of carrying the strong signals that you will receive from that station. If the valve will not carry this, and if you have no volume control, the only remedy you can employ is to detune the set so that the input from the aerial is not as strong as it would be if the set were perfectly in tune.

Super-Power Valves.

There are two types of valves which can be chosen for the last stage, those known as power valves and those designated as super-power valves. The former are very good, and will carry a certain amount of input, but if really strong signals are required, then you must use the latter. The super-power does not mean that the valve will give out extra magnification, but that it will handle an extra amount of input power without overloading. There are super-power valves available in each class, that is in the 2-, 4-, and 6-volt classes, and the only trouble about running such valves is that they consume rather a large amount of H.T. current. If you use a super-power in your set, and with strong signals it is advisable to do so, you must, therefore, use an H.T. battery of quite large proportions.

Such large-capacity dry batteries are available, and though they cost a little more than the ordinary type, they are well worth it, or if you are out for the absolute maximum of purity and signal strength, wet H.T. batteries will probably be best.

H.T. Voltages.

A third choice remains in high tension from the electric-light mains, and as will have been seen by many of my readers, in previous articles in this journal, the construction of an electric-light mains H.T. eliminator is by no means a difficult task, and it fully repays the time and trouble spent. H.T. derived from this source can be free from hum and the running costs are negligible

But I am diverting from my subject. You will see from the foregoing that the only way to get the absolute best out of your receiver is to choose a valve with an idea of the task which it has to perform. Wrong valves in the wrong sockets will only cause distortion or, at the best, poor results, while if each valve is chosen properly, you may be sure you are getting the maximum out of your receiver.

Another point which I might mention here concerns the H.T. voltages which you may give to your valves While they should not have a voltage very greatly in excess of the maximum rating by the manufacturers they should not be starved. A good all-round voltage for an H.F. valve is 100 to 120 volts, especially if the set is neutralised, while the detector can usually do with 80 to 100 volts, possibly more if anode-bend rectification is being employed. The first L.F. valve should not have less than 100 volts, if it has a large input, while the last valve, if it is of the super-power type, should have 120 as a minimum, the voltage being increased with advantage to 150 or so.

Correct Bias Essential.

It should be remembered that the more the H.T. voltage, the more the H.T. current consumed, but at the same time greater purity is likely to be obtained, provided grid bias is suitably adjusted. Within limits an increase of H.T voltage enables a valve to deal with a greater input than would otherwise be the case, and a great many sets have their results spoiled by the fact that the last valve has insufficient H.T.

Grid bias should also be carefully chosen according to the makers' instructions, and then while signals are being received, it is best to vary the grid bias to obtain the most pleasing results from the loud speaker.

Don't go absolutely blindly by the manufacturers' figures, because they are only given for the *average* valve of any particular type and do not represent *working* conditions, and they may vary somewhat for the particular specimen you are using. Thus, if the H.T. voltage is rated at 120 and for this the grid bias is given as 9, set the voltage to that figure at first, then try varying the grid bias up and down until the best results are obtained, using fairly strong signals for the purpose. If you use weak signals and adjust the grid bias, you will find that adjusting to 3 or 4 volts on either side of the stated voltage will make no difference to the reception, and it is only when strong signals are being obtained that the real advantages of correct grid bias can be noted.