6D MONTHLY

The Wireless Constructor

EDITED BY
PERCY W. HARRIS. M.I.R.E.
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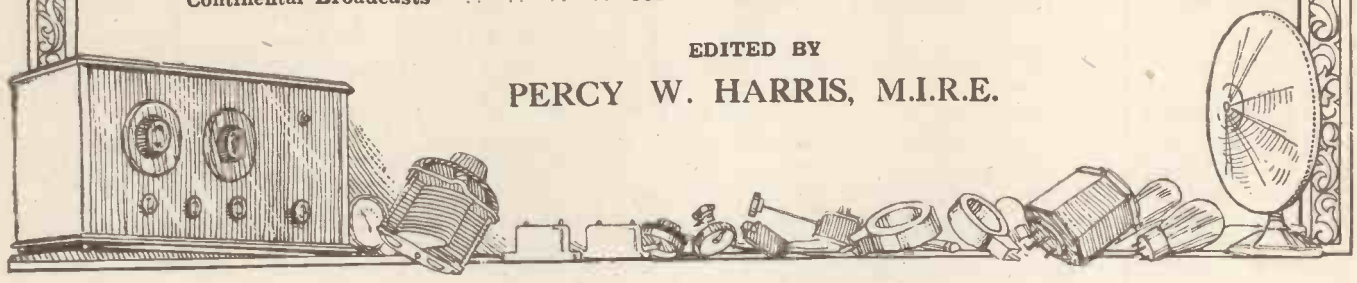
PERCY W. HARRIS, M.I.R.E.



MR. ROWETT SAYS WE'RE TOO MODEST!

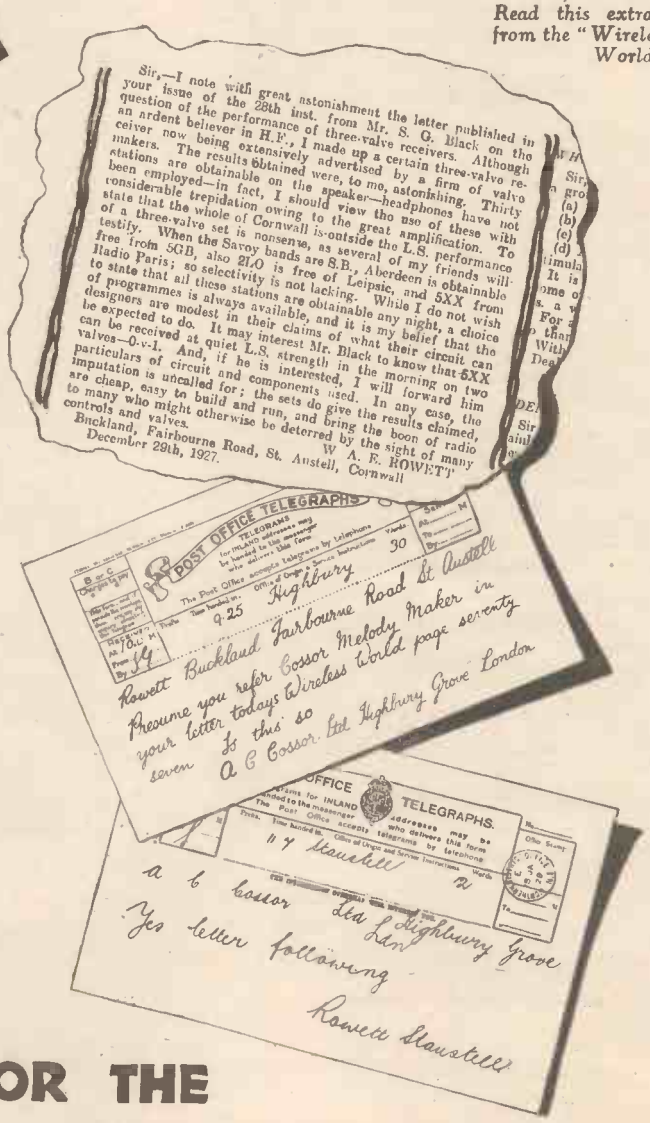
Read this extract from the "Wireless World"

Sir,—I note with great astonishment the letter published in your issue of the 28th inst. from Mr. S. G. Black on the question of the performance of three-valve receivers. Although an ardent believer in H.F., I made up a certain three-valve receiver now being extensively advertised by a firm of valve manufacturers. The results obtained were, to me, astonishing. Thirty stations are obtainable on the speaker—headphones have not been employed—in fact, I should view the use of these with considerable trepidation owing to the great amplification. To state that the whole of Cornwall is outside the L.S. performance of a three-valve set is nonsense, as several of my friends will testify. When the Savoy bands are S.B., Aberdeen is obtainable free from 5GB, also 2LO is free of Leipsic, and 5XX from Radio Paris; so selectivity is not lacking. While I do not wish to state that all these stations are obtainable any night, a choice of programmes is always available, and it is my belief that the designers are modest in their claims of what their circuit can be expected to do. It may interest Mr. Black to know that 5XX can be received at quiet L.S. strength in the morning on two valves—O-v-1. And, if he is interested, I will forward him particulars of circuit and components used. In any case, the imputation is uncalled for; the sets do give the results claimed, are cheap, easy to build and run, and bring the boon of radio to many who might otherwise be deterred by the sight of many controls and valves.

W. A. E. ROWETT

Buckland, Fairbourne Road, St. Austell, Cornwall

December 29th, 1927.



IN OUR CLAIMS FOR THE

COSSOR

"Melody Maker"

HE'S right. We *are* modest in our claims for the Cossor "Melody Maker." We do not believe in over-statement. We know that we can say, *truthfully*, that anyone who builds the Cossor "Melody Maker" according to instructions will, without difficulty, obtain broadcasting concerts from seven countries. That, in itself, is a remarkable statement. Yet Mr. Rowett, in a corner of England which is notoriously bad for Wireless reception, gets results which surpass all our claims. Nor is he alone. From Land's End to John O'Groats comes a daily stream of thanks from satisfied users. Each one tells of new stations heard—stations in all parts of the continent . . . even of American broadcasting. And every letter that comes is another link in the chain of evidence which proves the record-shattering efficiency of the wonderful Cossor "Melody Maker."

"Cheap, easy to build and run," says Mr. Rowett. Ask your Dealer for the free chart, "How to build the Cossor 'Melody Maker'", and see for yourself.

The WIRELESS CONSTRUCTOR

Edited by
PERCY W. HARRIS
M.I.R.E.

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THE EDITOR'S CHAT

Percy W. Harris, M.I.R.E., the Editor of the "Wireless Constructor," has an interesting chat on the question of purity of reproduction in wireless receivers.

A VERY interesting test was recently conducted for the purpose of finding whether the average listener prefers what may be termed a "pleasing" reproduction or genuine fidelity of speech and music. Two loud speakers were used—one a most modern moving coil type capable of reproducing with very great faithfulness all the tones normally broadcast, and the other a good modern cone type which, while considerably better than the average horn speaker, gave a reproduction rather deficient in the low tones.

An Interesting Test

The test was made before a number of people and without exception they exclaimed that the reproduction by the moving-coil instrument was "wonderful"—as, in fact, it was—the effect being almost weirdly natural. But the test did not stop there. After about half an hour's audition a number of listeners began to waver in their allegiance. Without disputing that the moving-coil instrument gave a much more natural reproduction several offered the opinion that for "general listening" the cone type seemed more "pleasing," although if they wanted to sit down and listen to, say, a Queen's Hall concert or one of the excellent classical programmes which the B.B.C. occasionally broadcast they would certainly prefer the moving coil type.

Dangerous to Prophesy!

The result of this test rather confirms the view we have formed that loud-speaker reproduction of broadcast programmes is in most cases used as a kind of "background" in the home, concentrated attention being given to the broadcast only occasionally when some special item makes a particular appeal. Actual fidelity of reproduction in many cases takes second place to a general pleasing effect, and in this, as in so many other affairs, "one man's meat is another man's poison." Considering loud-speaker reproduction in this light we can see why some people prefer the horn type and others the cone, and why there is no one loud speaker which pleases everybody.

Prophecy in wireless matters is more than ordinarily dangerous. With the coming of broadcasting many people confidently predicted the death of the gramophone industry, which, as readers know, is now in a far healthier position than ever before. Two years ago the Editor of this journal was told by a prominent manufacturer that within a couple of years home construction would be dead. This particular prophet has now turned practically all his business over to the manufacture of components for the home constructor. The advent of cone loud speakers

All that remained of the 210-ft. mast and the wireless equipment of the Radio Research Board station at Ditton Park after a devastating fire which broke out in the laboratory. The mast, blazing furiously, crashed down on the main shed, forming a terrible and majestic spectacle.

The Editor's Chat—*continued*

led many people to predict that the horn type would soon "pass out," yet there are a number of signs that certain new horn loud speakers, giving a marvellously improved reproduction, will shortly be available.

The fact is, that progress is rarely made along straight or clearly defined lines. The quality of reproduction given by gramophones when broadcasting started was very low compared with that obtainable now, and much of the improvement owes its origin to broadcasting, for in the recording studios, microphones and amplifiers almost identical with those used in radio are taking the place of the old trumpet, while the technique has developed along lines which have shown themselves to be so successful in broadcast transmission. And now with the use of electrical pick-ups it is possible to play a record through one's own loud speaker so that one can have "fresh" or "preserved" music at will.

Fidelity First

The remarkable fidelity of reproduction obtainable with the moving coil type of loud speaker, such as that described in last month's issue, has led research workers and experimenters to pay much more attention to amplifiers, the defects of which a good moving-coil loud speaker will show up very prominently. An amplifier good enough to do justice to a moving-coil loud speaker will, when turned on to a cone or horn type, give a reproduction far better than one had previously imagined possible with the latter type of instrument, so that progress is being made along several lines simultaneously.

In this issue a design is given for a form of amplifier which has proved to be admirably suited to the most modern type of moving coil loud speaker, and at the same time to be capable of giving a wonderfully good reproduction on any type of speaker.

The Quest for Quality

While to give its full output a large demand is made upon one's high-tension supply, it can be used in a variety of ways—all giving excellent reproduction—according to the high-tension current available. A particular feature which will make a wide appeal is that the amplifier as a whole can be joined up to any existing set, home-constructed or factory-built, without altering a single wire in the receiver, it only being necessary to withdraw the detector valve from the receiver and to substitute for it a plug connected by a flexible lead to the amplifier. The detector valve is then placed in the amplifier, where provision is made for it, and the whole amplifier unit is thereupon automatically substituted for any existing note-magnifiers in the set. Many receivers are giving excellent service in every respect other than quality, and this amplifier will now enable any user to get the high quality which he has so long desired.

"The Cottager"

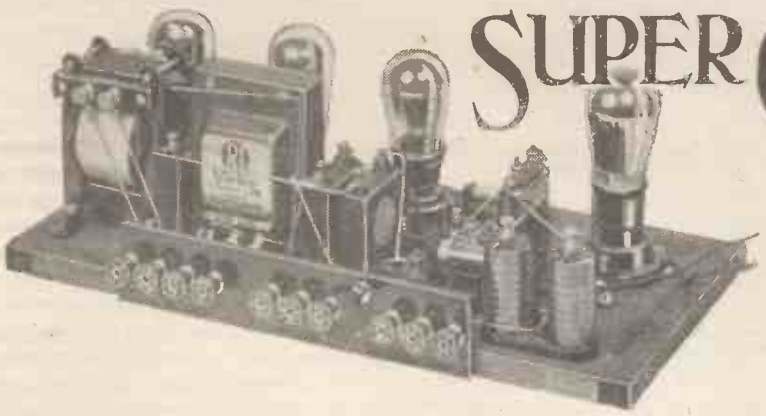
So much for loud-speaker reproduction. At the other end of the scale, for those who desire only telephone reception, I can particularly commend "The Cottager" set, which will come as a boon to many thousands of listeners who want a very simple set for 'phone reproduction on the local station only. I must leave it to Mr. Wootton to tell you how the set has been designed.

Many queries reach this journal relating to what are called "mains units," and it is evident that a great deal of misconception exists regarding these useful accessories. A special article this month, to be followed by a further article in the next issue, deals with the whole subject of mains units, the way they work, how they should be chosen, and the results of a number of laboratory tests and experiments. The subject is one of very great interest, and the home constructing aspect is being carefully considered in both articles. Every reader will be interested in the article, whether or not he has in mind the home construction of a mains unit, for it will help him to understand why some of the shoddy "eliminators" of foreign manufacture give thoroughly bad results when tried at home, although at a demonstration they appear quite good. Fortunately, the British manufacturer is more conscientious than some of his foreign rivals, and a number of excellent mains units are now available at reasonable prices.

High Tension

The word "reasonable" is used deliberately, for a well-built and thoroughly reliable high-tension unit cannot possibly be produced for the price of an ordinary high-tension battery. In the case of two different makes of high-tension unit, one priced at, say, four pounds and the other at ten pounds, both may be excellent value, or neither cheap.

The high-tension supply being such a vital point in all wireless experiments, readers will be glad to find a further article on high-tension batteries and their performance. Both this and the article which appeared in last month's issue have necessitated hundreds of tests on practically all the high-tension batteries on the market, and are thus unique.



SUPER QUALITY WITH ANY SET

A REMARKABLE NEW AMPLIFIER DESIGN

BY PERCY W. HARRIS
M.I.R.E.

A really modern L.F. amplifier, which can be plugged into any set—without disturbing the present L.F. side—to ensure good quality reproduction, and plenty of volume, when really first-class results on the "local" are required.

THERE are three factors which go to make up first-class quality reproduction—the actual transmission itself, the receiver used to pick up the transmitted programme, and the loud speaker which converts the electrical energy into sound waves. Two of these may be perfect, but if the third is faulty we cannot possibly get that high-grade reproduction which is the aim of every serious experimenter.

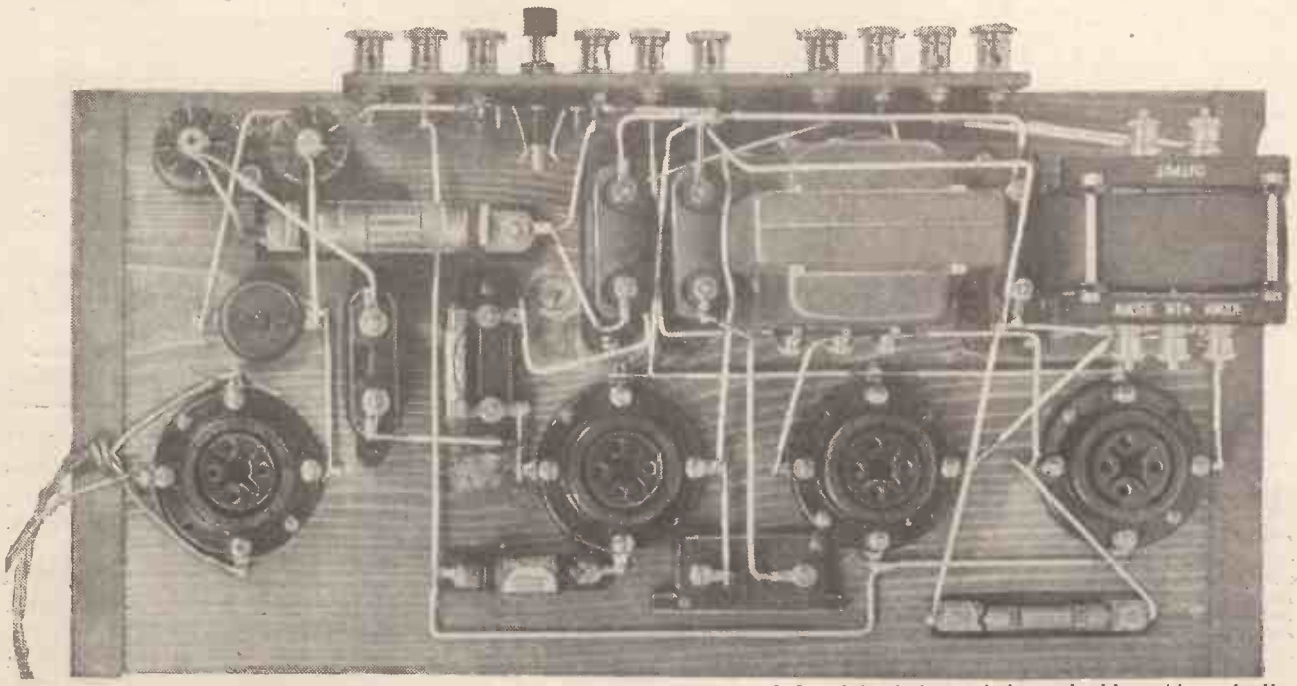
Let us consider these three factors separately. First of all, the broadcast transmission must be of the highest quality. Here the British listener is indeed fortunate, for the fidelity of transmission from our stations is unrivalled in any other part of the world. For the purpose of this article the transmission will be considered as perfect, although, of course, it is not actually so. It is, nevertheless, so nearly perfect that if the other two factors are properly looked after the reproduction possible can be far better than ninety-nine out of a hundred people would credit.

Loud-Speaker Variations

Receivers, as a whole, are unfortunately quite mediocre in their performance. There are thousands, or even hundreds of thousands, of sets now in use which, in sensitivity, selectivity, and tuning are up to all normal requirements, but in *quality* of reproduction are far below what they might be.

So far as the loud speakers are concerned, there is only one type which at present can do full justice to the broadcast transmission even when a first-grade receiver is used to "feed" it. This type, of course, is the "moving coil," a description of which has already appeared in these pages. Such speakers, when properly made, reproduce with remarkable fidelity, giving a uniformity of reproduction which, while it is still some way below the ideal, is considerably better than that given by any other type. The moving coil types, however, are by no means so convenient or so sensitive as other kinds, and thus in their present form remain the less popular, while their first cost is rather prohibitive unless home-made.

In the next class come the many cone speakers, deservedly popular, as they reproduce many of the low tones which are quite absent from the reproductions given by the average horn type of loud speaker. A careful survey of the field has shown that the

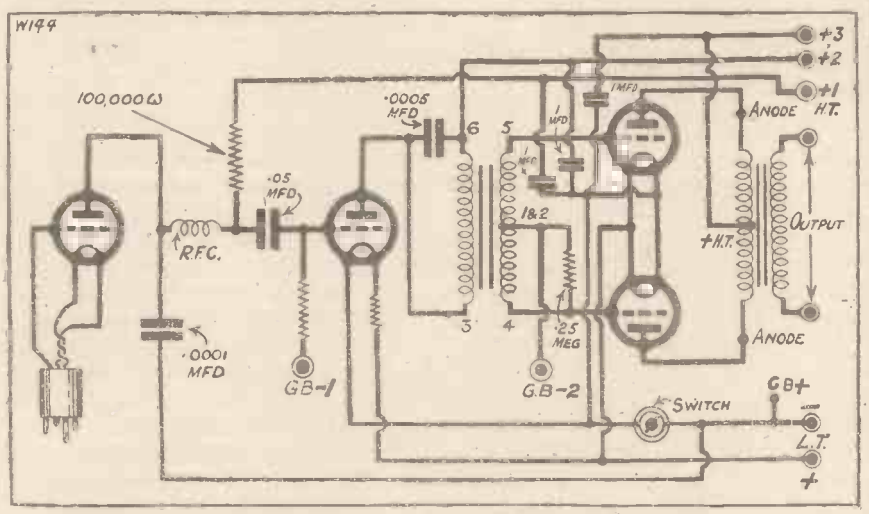


No panel is required for this amplifier, as no controls of any sort are needed. This photograph is a valuable guide as to the layout and wiring of the components, and should be used in conjunction with the wiring diagram given on another page.

Super Quality with any Set—*continued*

average modern cone type is capable of reproduction with remarkable faithfulness, and that very few sets are capable of doing justice to even this type.

operation, and if required it will provide sufficient modulated energy to actuate a first-class moving-coil speaker similar to that described in our last issue.



The purpose of this article is to tell readers of the WIRELESS CONSTRUCTOR how they can build for themselves a supplementary amplifier which can be plugged into any set (home or factory built) without altering any wires in the existing receiver, in such a way that the present audio-frequency side (everything after the detector) is cut out and the new modern amplifier, to be described, substituted. This means that first-class quality and volume are obtainable from even the cheapest valve set, no matter how badly its audio-frequency side may be behaving at the moment. Furthermore, the amplifier is extremely flexible in its

Before proceeding with constructional details it is necessary to present a number of facts, many of which will be new to most readers, in order that we can see why the apparatus is developed along the lines mentioned, and how it is that the average set and amplifier falls down so badly when low notes have to be reproduced.

Those Low Notes

The stations of the British Broadcasting Corporation reproduce all frequencies above about thirty cycles per second up to some 6,000 or 8,000, or even more. The proportionate amount of energy transmitted on thirty to fifty cycles is not large, but at least some is there. A good moving-coil loud speaker probably starts its reproduction somewhere about sixty or eighty cycles, and specially constructed ones can be made to go much lower. I recently had the opportunity of hearing one of these which is capable of going down to thirty cycles, but very special care has had to be taken in the design to enable this to be done.

COMPONENTS REQUIRED.

- 4 Anti-phonic valve sockets (Ashley, Benjamin, Bowyer-Lowe, B.T.H., Burndept, Burne-Jones, G.E.C., Igranic, Lotus, W.B., C.E. Precision, etc.).
- 1 Fixed resistor (Any good make, to suit valves).
- 1 Terminal strip with ten terminals as shown (Eelex terminals have been used and suit this amplifier very well).
- 1 Fixed condenser, ·0001 mfd. (Lissen, Dubilier, Atlas, Mullard, Igranic, T.C.C., etc., etc.).
- 1 Fixed condenser, ·0005 mfd. (Lissen, Dubilier, Atlas, Mullard, Igranic, T.C.C., etc., etc.).
- 1 Mica fixed condenser, ·05 mfd. (Dubilier, Mullard, T.C.C., etc.).
- 2 Grid-leak holders (Dubilier Dumetohm holder). (Mullard, Lissen Combinator, etc.)
- 1 Grid leak, ½ megohm (Mullard, Dubilier, Lissen, Igranic, etc.).
- 1 Grid leak, ¼ megohm (Mullard, Dubilier, Lissen, Igranic, etc.).
- 1 Anode-resistance in holder (Dubilier, Mullard, R.I.-Varley, C.E. Precision, etc.).
- 1 On-and-off switch (Igranic, L. & P., Benjamin, Lotus, etc.).
- 1 Radio-frequency choke (That shown is a Climax. R.I.-Varley, Magnum, Bowyer-Lowe, Cosmos, Lissen, Marconiphone, Ormond, etc., can be used).
- 3 Mansbridge-type condensers, 1 mfd. (Lissen, Dubilier, T.C.C., Mullard, etc.).
- 1 Push-pull input transformer (R.I.-Varley).
- 1 Push-pull output transformer (R.I.-Varley).

NOTE.—The R.I.-Varley straight-line transformer is so arranged that it can be used either as the ordinary type of transformer or as the push-pull.

The amplifier with valves in position. The first is of the R.C. type, for this has to act as detector if the amplifier is to be used on an ordinary set, the plug being inserted in the detector valve socket of the receiver. The next valve is of the power type, while if super-power valves are used for the last stage the 25-megohm leak shown in the foreground has to be removed.

A very large number of horn loud speakers reproduce nothing whatever below about 150 cycles; and the best type of cone speaker, while reproducing tones lower than this, does not reproduce them very efficiently. The average cone, however, reproduces the low tones to a far greater extent than the ordinary horn type, although it is possible by building a very large horn of special shape to come down

Super Quality with any Set—*continued*

possibly as low as any speaker that can be made. Such instruments, nevertheless, are totally unsuited for use in the ordinary living-room.

More Power Required

The next point, and one which is both enormously important and barely realised by the average listener, is that if one listens to two notes, one a high and the other a very low note, so that both seem to the ear to be of equal intensity but different in pitch, the amount of energy required to give the low note is greatly in excess of that needed to give the high note. This, indeed, is one of our biggest problems in radio reproduction, as the generation of the deep tones requires a very great expenditure of energy. Some realisation of this may have come to the reader who has had the opportunity of listening to a deep organ note quite close to the organ. Although the sound does not seem particularly intense, the movement of air required is so great that one can positively feel the air pressure on the skin.

The variations of current required in our loud-speaker winding to produce the sounds we hear, come, of course, from variations in the plate current of the output valve. These variations are caused by changes of grid voltage, and the greater the plate current change the greater the grid voltage change or "grid swing" necessary to produce it.

Question of Grid Swing

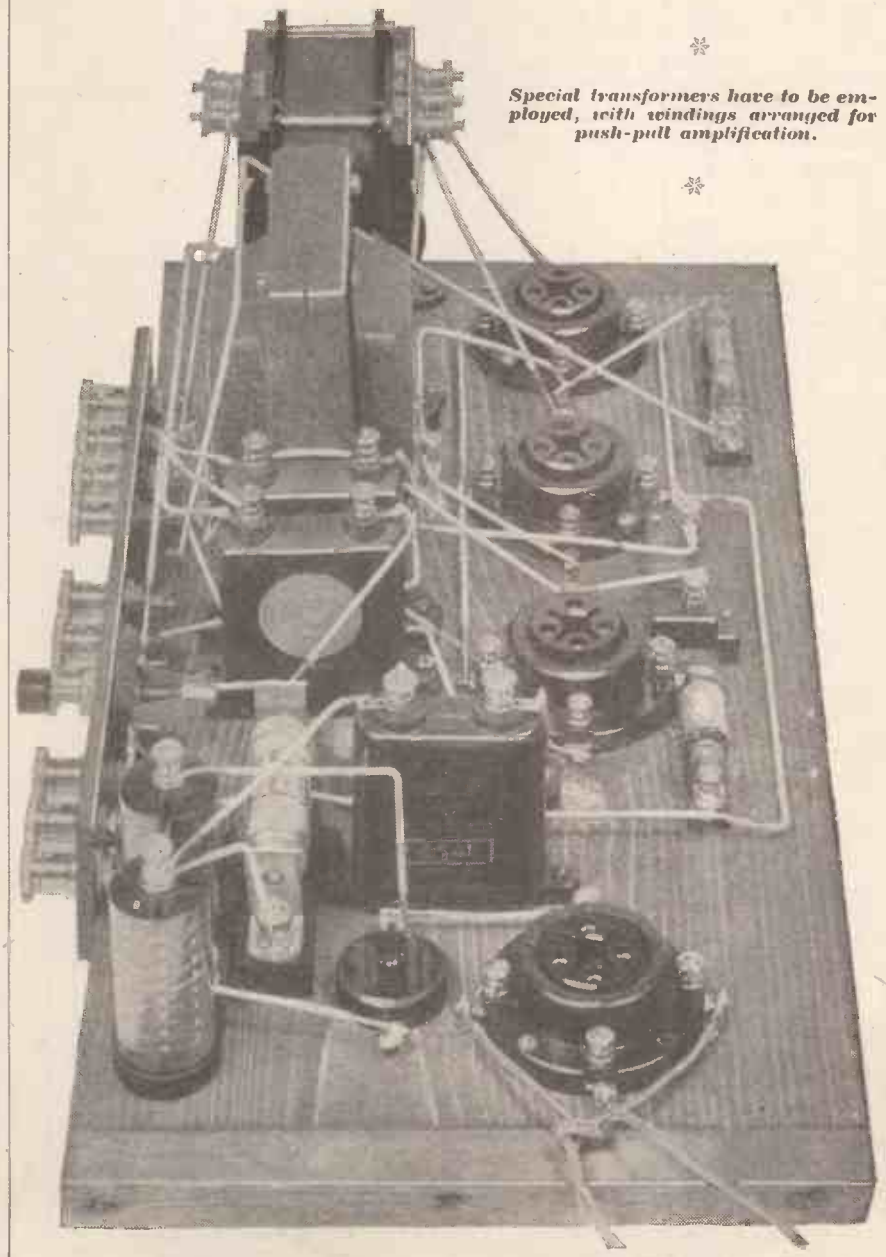
As variations of current in the plate circuit mean a variation of voltage in the grid circuit, we can soon arrive at a point where the question can be asked, what is the minimum variation of grid voltage required to give us satisfactory reproduction of the low notes (down to about eighty cycles) in an ordinary living-room? The answer is rather disconcerting for it can easily be shown if one has the apparatus (as in the case in my laboratory) that with a really efficient type of moving-coil speaker a grid swing of 25 volts either side of the working point is required! This is when using the push-pull type of amplifier to be described, and suitable output valves.

"But," exclaims the reader, "this is nonsense! I am only using nine volts on a power valve and 120 volts on the plate, and I get far greater volume than we can possibly stand in our room! What is more, everyone says the reproduction of my loud speaker is practically perfect! If I run the set at all loudly it rattles the loud speaker."

"Rattling the loud speaker" is quite a good description of the sound that is heard, but in nine cases out of ten—I might even say in ninety-nine cases out of a hundred—this rattle has nothing whatever to do with the loud speaker, but it is simply an indication that the last valve is being overloaded. It may come as a surprise to readers to learn that a hundred times as much energy may be required to give the same intensity of sound on a low note as on a high, and while quite a small grid swing may be sufficient to reproduce all sounds without distortion above, say, 200 cycles, and with a volume quite enough for any room, as we go down the scale so the grid swing necessary becomes greater and greater.

For low note reproduction we must have a valve which will stand a grid

Special transformers have to be employed, with windings arranged for push-pull amplification.

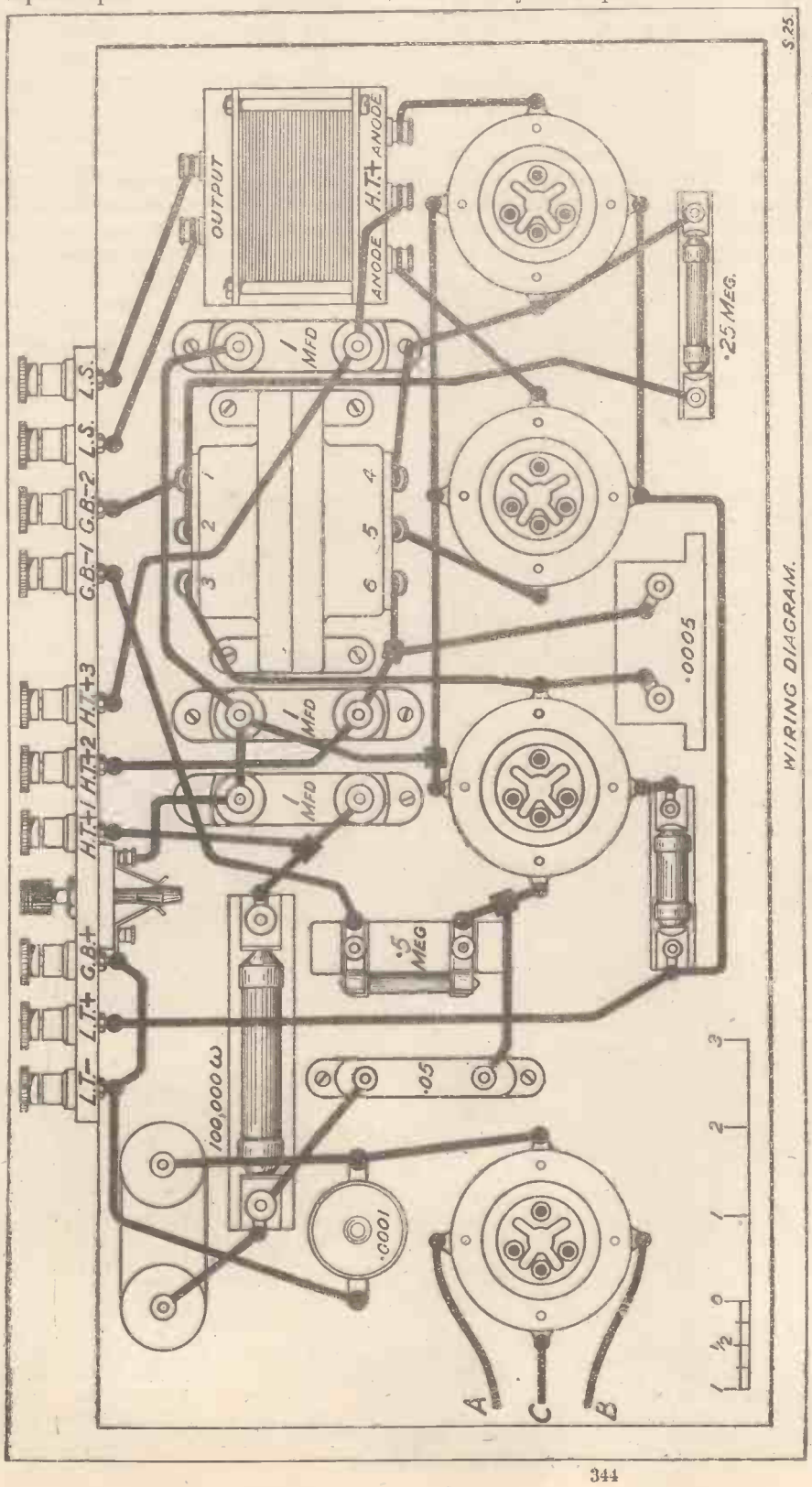


A general view taken from the detector socket end. Note the simple layout and easy wiring employed in the design of this amplifier.

Super Quality with any Set—*continued*

bias at least somewhere near the figure mentioned above. How far down you need to go in your biassing will depend upon:

1. How low are the tones which your loud speaker can reproduce.
2. What degree of perfection you aim at in your amplifier.
3. The volume of sound you want to produce.



False Reproduction

Many loud speakers seem to reproduce low tones, whereas actually they are only reproducing harmonics of the low tones. This is rather a complex matter requiring a much longer article than the present and much greater skill than I possess to make it clear, but briefly it may be stated that none of the sounds we hear is really pure in the sense that it contains only one frequency. The violin and the saxophone can play the same note, but they sound entirely different from one another, owing to the fact that there exists in practically all sounds various overtones, all of which must be reproduced if we are to get faithful rendering.

The violin, for instance, produces a very complex note in which the third harmonic is very prominent. If this third harmonic is reproduced by the loud speaker, and the fundamental note is missing, we may still get a fairly good resemblance to the violin tone, but if you were to hear the fundamental and all harmonics faithfully rendered, you soon notice the difference. In most cases what appears to be the low tones in a loud speaker are only some of the harmonics of the low tones, the fundamentals often being entirely missing. The box, too, often "booms" on low frequencies, giving a kind of imitation low note reproduction.

Easily Employed

While on the subject, it is worth mentioning a few facts regarding the speech frequencies. Good speech articulation can be obtained within a frequency range of 250 and 2,500 cycles, and if we do not reproduce any notes below 500 cycles it is still possible to understand what is being said. Readers who have compared loud speakers have often found that an announcer's voice on one loud speaker sounds entirely different from that on another speaker, although both seem perfectly natural if one has not heard the particular speaker "in the flesh."

So much, then, for theoretical consideration, which I hope has not bored the reader, but it is essential that these points should be fairly grasped if we

Super Quality with any Set—*continued*

are to obtain the high quality now possible with modern apparatus. Knowing how poorly many sets reproduce the low tones, and how unfaithful they are to the broadcast transmission, it occurred to me some time ago that it would be very useful to design an amplifier which could be quickly attached to any set, so as to provide a complete new audio-frequency unit which would take the place of the existing audio-frequency stages, for in ninety-nine cases out of a hundred (excluding reaction distortion) the distortion which annoys us so much starts after the detector, and is nearly always more pronounced in the set itself than in the loud speaker.

Used with Existing Set

Few readers will wish to build an amplifier for one purpose alone, so pains have been taken to make the instrument as adaptable as possible for a wide range of uses. Furthermore, its use is not confined to radio purposes, for it can be used as an amplifier with gramophone pick-ups for the electrical reproduction of gramophone records. A wide variety of valves can also be made use of, from ordinary general-purpose valves up to super-power valves of the latest types.

The circuit is given in Fig. 1. Here will be seen a detector valve (without any detecting arrangement) resistance-coupled to the first note-magnifying valve, which is in turn coupled by a push-pull transformer to two output valves. The output of these two valves is re-combined in an output transformer which can be either of a 1-1 ratio for ordinary loud speakers, or a 25-1 ratio for the moving coil type, if this is of the low-resistance variety.

No Alterations

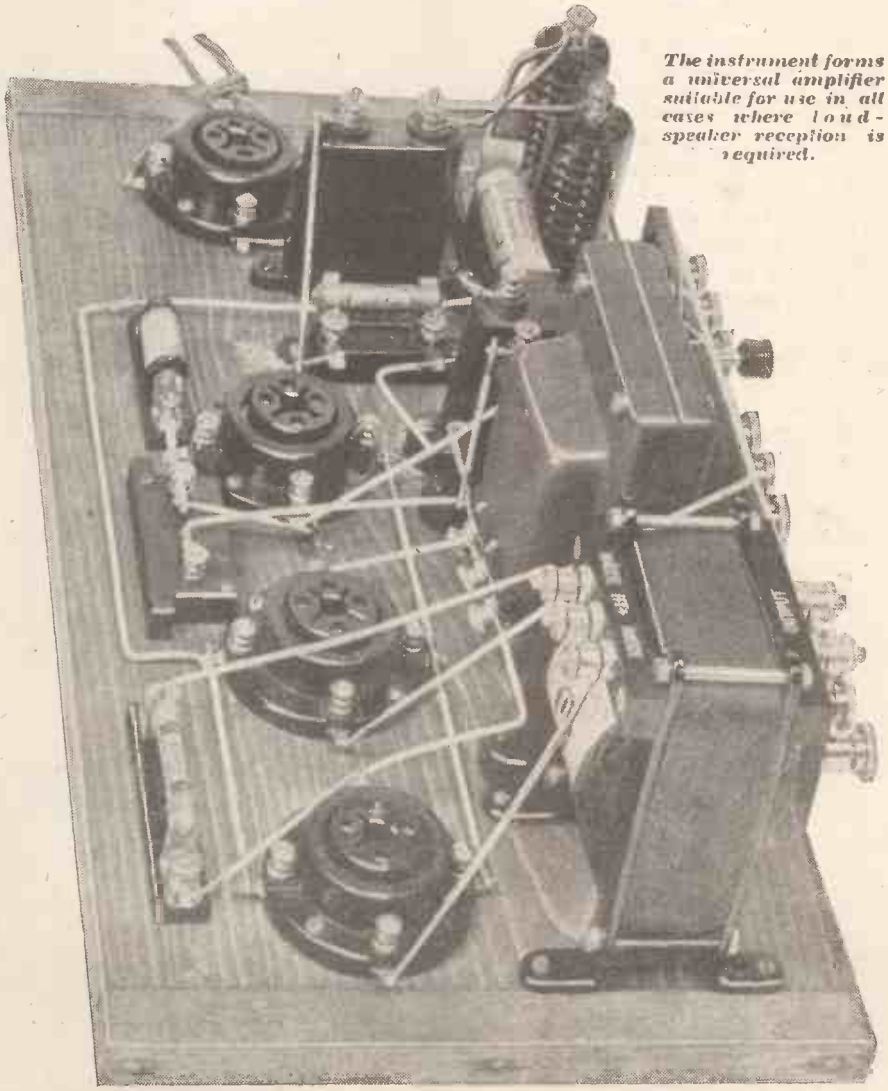
On the left of the circuit will be seen an extension terminating in a plug resembling an ordinary valve base with four pins. This plug is used as follows: The existing detector valve is withdrawn from its socket and placed in the first socket of the amplifier, the plug just referred to being pushed into the detector-valve socket in the set.

The effect of this change is to transfer the detector valve to the new unit, and simultaneously to cut out the plate connections of the detector valve and substitute others for them. The existing grid leak and condenser or anode-bend rectification is utilised, as are all the tuning arrangement, high-frequency valves, etc., in the receiver to which the amplifier is attached.

One point should be mentioned at once, before proceeding farther. If you are at present using reaction in your set, this amplifier cuts it out, on the principle that first-class reproduction can be only obtained from the nearest station, and in such circumstances it is advisable to cut out reaction. If, however, it is still desired to use it, a slight alteration in the wiring can be made in an existing set using Reinartz reaction, so that this form can be used as before. The alteration is simply to disconnect the lead which comes from the reaction condenser and coil, and normally goes to the plate of the detector valve, and to connect this wire to the plate terminal of the detector valve in the amplifier.

Push-Pull Amplification

Space does not permit a full description of push-pull amplification in theory, but it may be briefly explained as follows: The primary of the input transformer is used in the normal fashion, while the secondary is split into two electrically equal halves, each end going to a grid of a separate valve, as shown in the theoretical diagram; grid bias being connected between the centre



The instrument forms a universal amplifier suitable for use in all cases where loud-speaker reception is required.

The L.F. transformers can be mounted well out of the way as shown, leaving the rest of the board clear for the valve holders and other small components, and for the wiring, which is thus made extremely simple to carry out.

Super Quality with any Set—*continued*

point of the secondary and the negative filament.

The two plates of these valves are joined to the two ends of the primary winding of the output transformer, the high-tension positive being connected to the centre point. The secondary then feeds the loud speaker. It enables us to obtain a great increase of volume without overloading the valves, and, in fact, by using two valves in this way we can get with a moderate voltage a distortionless amplification which would otherwise mean twice the voltage, and different types of valves, while owing to certain electrical conditions we obtain other advantages. I have asked Mr. W. James to write an article describing push-pull amplification in detail, and I must refer you to this when it appears.

Constructional Details

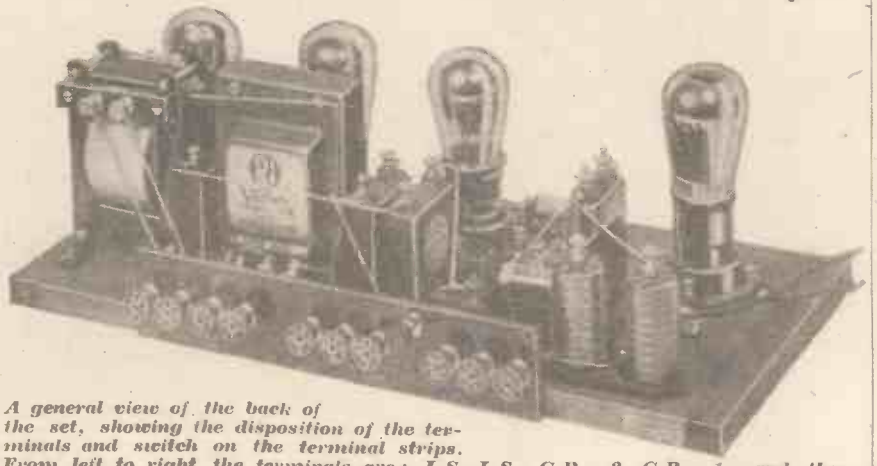
And now for constructional details. The set, as you will observe, is built up on a board, and no front panel is used or needed. The amplifier can be used on a board as shown, or inserted in any suitable box such as that illustrated on the front cover. This is merely an ordinary standard cabinet with a black wood or polished front. The on-and-off switch is carried on the terminal strip, and if you look you will see that there is no high-tension negative terminal. This is due to the fact that the amplifier is designed to work with the same battery and accumulator as the receiver with which it is used, and as the high-tension negative connection is already made in the existing set there is no need to provide a terminal for it here. Incidentally, such an arrangement makes it unnecessary to inquire which low-tension terminal is connected to high-tension negative.

The plug itself can be made from any old valve base. If you have a burnt-out valve, take hold of the base firmly in the left hand and the bulb in the right, and give it a sudden twist. You will probably break away the valve from the base, and can then chip out the plaster or other securing material. It is then a simple matter to solder three leads to the two filament pins and the grid pin. The plate pin is left unconnected.

Simple Arrangement

The two flexible leads which go to the filament pins can be ordinary twisted flex, but the grid lead should be kept separate and not twisted up with the others. This lead should not be made longer than is necessary to extend to the present set.

Examining the set in detail we see that on the left we have the socket for the detector valve, the filament and grid connections of which go to the existing receiver. The plate connection goes to a small shunting condenser of ·0001 mfd. (joined to the negative filament), and to a radio-frequency choke, the other side of which is connected to the coupling resistance of 100,000 ohms, and to the coupling condenser, which is of the mica type. No filament resistance is provided for the first valve, as this is already contained in the existing set. A fixed resistor is provided for the second valve, and no resistors whatever for the two push-pull valves. If desired, the fixed resistor can be dispensed with for the first audio-frequency valve.



A general view of the back of the set, showing the disposition of the terminals and switch on the terminal strips. From left to right the terminals are: L.S., L.S., G.B.− 2, G.B.− 1, and then the H.T.+ 3, + 2, and + 1 in a group, followed by an on-off switch and G.B. +, L.T.+ and L.T.−. The input is made via the flex on the first valve holder.

The Last Stage

The plate connection of the first audio-frequency valve goes to the primary of the push-pull transformer, and the output side of this transformer feeds the two grids of the last two valves. A ·0005-mfd. fixed condenser is connected across the primary winding of the transformer shown, as the capacity of this condenser is taken into account by the designers when working out their curve. To get the best reproduction with the particular transformer shown (the R.I.-Varley) this condenser should be included, but if you use the Ferranti push-pull transformer, then *do not* use this condenser, as a suitable condenser is built into this make of transformer.

You will notice that the two plate connections of the last two valves go to the push-pull output transformer, and that the output side of the latter is connected to the output terminal of the amplifier. Notice, too, that 1-mfd. Mansbridge condensers are shunted across each high-tension positive connection and are placed in convenient positions in the amplifier itself. The ¼-megohm grid leak which is connected between the grid of the last valve and the centre tap of the secondary of the push-pull transformer is only used when one is using ordinary small-power or general-purpose valves. For super-power valves it should be removed from its clips.

Suitable Output Transformers

The push-pull *output* transformer should be chosen with a 1 to 1 ratio if the amplifier is designed to use with an ordinary high-resistance type of loud speaker, such as one of the excellent cones or some moving coils. If a low-resistance moving-coil type loud speaker (such as that described in the last issue of the WIRELESS CONSTRUCTOR) is used, then a 25 to 1 type should be chosen.

Excellent push-pull input and output transformers (the latter also in 25 to 1, or 1 to 1, as desired) are also sold by Messrs. Ferranti, Ltd.

It is not essential that the layout be very closely followed, but the general layout and disposition of parts shown

(*Continued on page* 412.)

Using the Thirty-One Tested Circuits

In this article, the first of a new series, the Editor discusses practical points relating to the "Thirty-One Tested Circuits" Gift Book presented free with the "Wireless Constructor" for February, 1928.

The Crystal Receivers

ALTHOUGH many crystal circuits have been published from time to time, the three given in "Thirty-one Tested Circuits" represent the pick of all the various methods which have been tried in the WIRELESS CONSTRUCTOR laboratory. One of these three will suit practically every need, and, of course, there are sundry modifications in practical make-up which will give a still wider variety of uses.

Importance of Good Aerial

No wireless receiving circuit can be considered apart from the aerial and earth connections with which it is used. Aerial connections and earth connections vary enormously, the former more than the latter. Few people are in the position to erect exactly the kind of aerial they would like to possess, and even those who are so fortunate may happen to live in a locality where a normally good aerial will give poor results.

Generally speaking, one should aim at having an aerial at which the top portion is suspended well above the receiving instrument, with the earth connection made as close as possible to the receiver itself. In a crystal receiver, where we are dependent entirely upon the energy we pick up without further amplification, we must take more than usual pains, and it should be the aim of the listener to get the best possible aerial for the given conditions. A single vertical wire, 100 ft. long, would, of course, give excellent reception, but the expense of erecting a suitable support for such an aerial rules it out in practically all cases. A good practical compromise is to have an aerial about 30 ft. high and about 70 ft. long, the vertical and horizontal portions thus totalling 100 ft.

A Simple Circuit

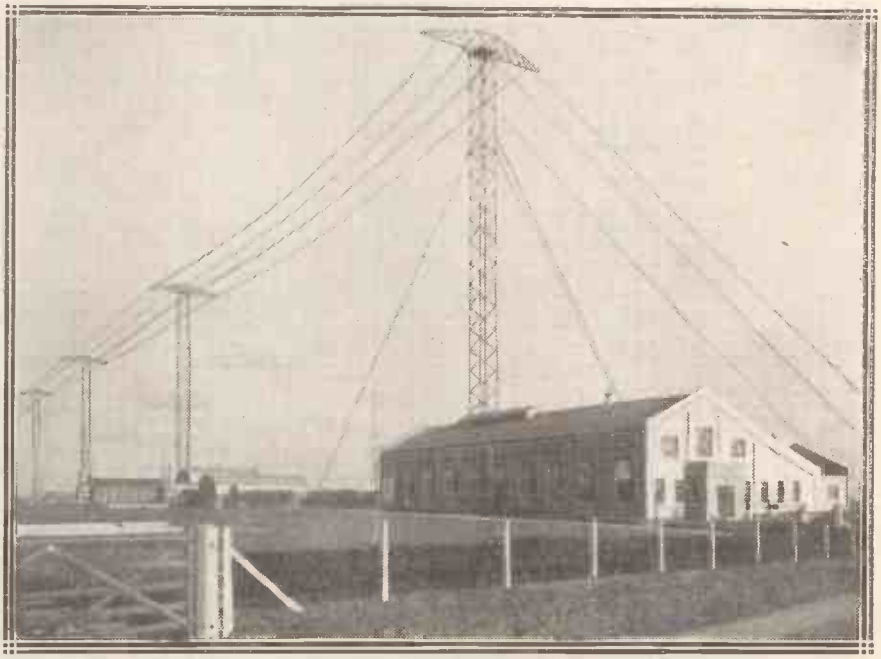
Now consider circuit A1. Here we have a coil connected directly to the aerial, and shunted by a variable condenser. The size of this coil cannot be exactly specified to suit all conditions. A crystal receiver will at the best receive but three stations at what may be termed "programme" strength". (I am excluding weak reception of distant stations on extremely favourable occasions); the three being the local, 5 X X, and perhaps 5 G B. In all cases where the aerial is connected directly to the tuning coil, as in circuit A1, the larger the aerial the smaller the coil L to tune to a particular wave-length.

For this reason, in the explanatory text of circuit A1 it is suggested a 25, 35, or 50 plug-in coil or a single-layer coil of the same number of turns should be used. On an average aerial the 50 coil will only be used for stations at the top end of the lower wave-length band, such as 5 G B, Aberdeen, and perhaps Glasgow. The 25 coil will be used for the shortest English wave-length, such as the relays, or with a very large aerial.

Condenser Capacities

The question is sometimes asked with regard to the condenser C_1, is it essential that it should be ·0005 mfd. maximum? A reader sometimes writes to say that he has a ·0003 mfd., and will this do? The answer is dependent upon the station you want to receive, your aerial, and the size of coil you are using. If, for example, you are using a ·0005 mfd. maximum and only ·0002 mfd. of it is used to tune your coil to the station you want to receive, then any size of variable condenser which has enough capacity to reach ·0002 mfd. will give exactly the same results as a ·0005 mfd. tuned down to the ·0002 mfd. you are using. The strength of signals will be

Where the "Beam" Begins



Britain leads the way in short-wave transmitting services, high-speed communication being possible between this country and all the main points of our far-flung Empire. This photo shows the Beam transmitter aerial system at Dorchester, whence messages are sent to Rio de Janeiro and New York.

Using the Thirty-One Tested Circuits—*continued*

exactly the same in all cases, providing the condensers are of equal efficiency. Practically all the variable condensers now sold are quite efficient.

A Popular Circuit

My own favourite circuit is A2, and while receivers had been brought out with arrangements to tap the aerial down the tuning coil, and also to tap the crystal down separately, I think I was the first to show a circuit which combined both the aerial and the crystal tap as shown. The circuit A2 is far less dependent upon the aerial than is the circuit A1, and a given variable condenser will cover a greater range of wave-length with a particular coil than will the arrangement A1.

The circuit A2 is exceedingly sharp in tuning—far sharper than most readers would imagine who have not tried it—and very careful measurements have shown that with many aerials the signals received are even stronger on A2 than on A1. In the case of a few aerials the signals may be slightly stronger with the circuit A1, but the difference is scarcely appreciable.

Circuit A3 acts exactly as circuit A2 on the shorter wave-band, and is merely a modification to enable a change-over switch to add the coil L_2 so as to enable the 5 X X range to be included. Whichever circuit you use, A1, A2, or A3, be very careful in your choice of the crystal detector. I have often been asked which is the better, the galena crystal with cat's-whisker or the double crystal combination using a fairly firm contact between the two crystals (generally called permanent and semi-permanent detectors). It is difficult to give a short answer as conditions vary so much in different cases, but a fairly simple explanation can be given if we consider sensitivity and reliability.

So far as sensitivity is concerned the galena crystal and cat's-whisker is the better combination *provided* (and this is very important) the galena crystal is very carefully selected, and most carefully searched with the utmost delicacy, using a suitable size of cat's-whisker expertly handled.

The "Sensitive Spot" Snag

Wonderfully sensitive spots can be found on a good galena crystal (by "galena" crystal I mean practically all of those sold under fancy names ending in "ite," looking like little blocks of crystallised silver), but once these marvellously sensitive spots have been found it is by no means easy to keep them, and a slight vibration in the room or a jerk of the instrument may lose the good spot, and require a good deal of searching to find it again. At the same time it must be remembered that a good galena crystal has a very large number of sensitive spots of quite a high order, and while extra sensitive spots can be found, it is usually not worth the trouble to look for them.

Combination Crystals Certain

I am not particularly keen on the double crystal combinations which are so arranged that one has to take the contact made by the maker, with no possibility of variation. Most of the better double crystal types are now sold with a small plunger which can be lifted up, giving different points of contact between the two crystals. For general use these double crystal semi-permanent types are far more satisfactory than the cat's-whisker types, for they maintain their adjustments over very long periods (my family set with a crystal and two note-magnifiers following it, operating a loud speaker, has sometimes been left untouched for two months) and are, in general, thoroughly reliable. The sensitivity of a good double crystal combination is at least as good as the average good spot on the galena cat's-whisker combination.

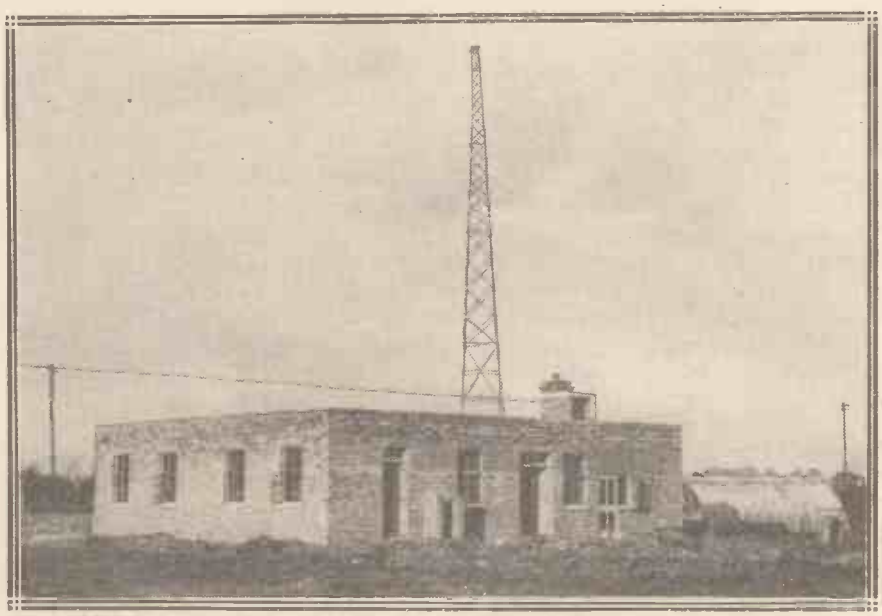
In the circuit A3 a switch is shown, but those readers who have not a switch handy may care to use a flexible lead from the centre contact, terminating in a Clix or Eelex plug, the two side contacts (one connected to the coil L_2 and the other to the lower part of the condenser C) being Clix or Eelex sockets. The flexible lead can be brought out through the front of the panel, and the two sockets mounted on the front so that by plugging in to one side or the other one can receive on the short or the long-wave band.

Don't Forget the Earth

If you want the best results with a crystal set, be sure you have a good earth connection. If your set is in use near a ground-floor window it is comparatively simple to run a lead through the window frame and to join it to one of the many excellent earth tubes now sold.

By the way, a very interesting modification of the circuit A3 is that used in the "Localong" receiver published in the October issue of the WIRELESS CONSTRUCTOR.

The Ether—and the Air



Radio constitutes both the eyes and the ears of the Air Force, and this new station under construction at Mitcham for the Air Ministry will play a great part in the future development of aviation.

A MEETING OF THE MASTERS

A Fantasy.

By a Special Correspondent.

THERE was no doubt about it, I was lost. The street seemed to be a cul-de-sac; and only at the far end a single lamp cast a fitful glow over an open doorway beneath the portals of which I noticed a tall porter in uniform. I walked up to him intending to ask my whereabouts, but, to my surprise, he gave me a cheerful greeting, took off his cap, and waved me into the open doorway.

I don't know why, but somehow I found myself obeying the invitation and climbing some stairs, dimly realising that the porter was giving me instructions.

The Abbé Liszt.

"Room 1, sir. First on the right."

"I suppose I shall be kicked out," I said to myself, half irritably and half in amusement, for I had no business there, and cannot analyse the impulse which made me accept the porter's mistaken invitation, for obviously he had mistaken me, perhaps for someone who was an expected visitor.

Masters Only!

I arrived at the top of the stairs and found a door on my right which was labelled "Room 1," and beneath it a small printed card which bore this legend:

"Broadcasting Conference—Masters Only."

Now, I am fairly well known at Savoy Hill, and I thought perhaps I had stumbled on a meeting which I was expected to attend. So I turned the handle of the door and slipped quietly into the room.

A single lamp stood in the middle of a big, round table, and provided the only light; the rest of the room being almost in darkness. I took advantage of this and slipped quietly into a chair near the door. And only then, as my eyes grew accustomed to the dimness, did I notice the queer collection of people sitting round the table.

The Speakers

There must have been nearly twenty of them, and all seemed to be in fancy dress. There was one old man with silver hair and a clerical collar—a very handsome old gentleman indeed, except for a large wart on his cheek. There was a slim, foppish young man, with delicately pale cheeks and long hair, who constantly coughed into his handkerchief. And there was a stout, sturdy, jolly looking little man dressed in a costume of the seventeenth century, with wig and all.

To my bewildered eyes, the others all seemed dressed quite as incongruously, and yet, curiously enough, somehow they all seemed familiar. As I sat down a man with wild storm-tossed hair and an ugly but powerful and intellectual face stood up and thumped heavily on the table.

"Ach!" he said. "I do not agree. My works do not sound well when broadcast. It is sacrilege. It must and shall be stopped. To me these horrible loud speakers give but a mutilated rendering of my sonatas and symphonies. Why, the other evening they broadcast my Ninth Symphony. Ach! How horrible it sounded!"

Grumbles and Growls

"Come, come, Ludwig," said the stout, jolly little man in the seventeenth-century coat and wig. "Come, come, liebe freund, you know you are very deaf; you could not hear the broadcast of your Symphony. I did, and it was good. Distinctly good; better, indeed, than I had expected. And they played my Italian Concerto quite well. I am inclined to be friendly and to help them."

Richard Wagner.

The angry man called Ludwig grumbled and growled to himself.

"Ah!" he sneered. "I admit there are some who think their Bach is worse than their bite."

There was a slight uproar at this,

A Meeting of the Masters—*continued*

and it then dawned on me that I was present at a very queer meeting. A very queer meeting indeed. Quite suddenly I recognised nearly all the people at the table, and very nearly fell off my chair in amazement.

The angry gentleman I now recognised as Ludwig van Beethoven; the jolly little man in the wig as the great Bach; the silver-haired benign-looking old man sitting next to Richard Wagner was the Abbé Liszt; and beside him, in the pale-faced, rather foppish young man I recognised Frederic Chopin.

Bach and the B.B.C.

Again I rubbed my eyes in amazement, but listened with an increased interest to this meeting of the Shades of the Great Masters. I had not realised I was psychic before, but this meeting seemed to leave no doubt about it in my own mind! And, curiously enough, what interested me all the more was that the subject was obviously a debate on broadcasting.

I could not help wishing I had brought my friend, Mr. Percy Scholes, with me!

When the slight hubbub caused by Herr Beethoven's rather rude remark had died down I noticed with interest that Herr Wagner had risen to speak.

"My friends," he began, in a guttural but rather pleasant voice—and then, pausing, he bowed in the direction of Herr Bach and added: "My master"—(at which Herr Beethoven sniffed loudly)—"as a comparatively modern master I would like to support Herr Bach's motion that we help broadcasting, and that we do all we can—and that is much—by wishing the B.B.C. well, and by inspiring the artistes who perform our works for the great listening public."

Ludwig van Beethoven.

There was quite a ripple of applause at these remarks. Herr Wagner continued:

"Myself, I suffered many years of neglect when on earth; knew poverty and the bitterness of dislike. Here, in London, when I conducted my own works, few gave me encouragement. To-day millions hear my works and learn to love them. Even street boys whistle my *leit motifs*. Indeed, there is hope for Sir Thomas Beecham's Opera scheme when such an institution as the B.B.C. exists with the object of giving the public something a little better than it wants. What do you say, Papa Liszt?"

The Benign Liszt

The benign Abbé smiled very sweetly at his friend—the man whom he had championed so nobly when alive—and replied: "My dear Richard, I agree. It would be strange indeed if I did not, seeing how much of my time I once devoted to helping the world to appreciate genius—and yours in particular. Broadcasting is, indeed, our ally, and perhaps it will teach the public one day to realise that I wrote other things besides my Hungarian Rhapsodies and the rather hackneyed Liebestraume. Perhaps, indeed, one day my Sonata in B Minor will be more widely heard instead of that little tour de force I named La Campanella."

Frederic Chopin.

"F 5"—?

See Next Month's "Wireless Constructor"

"And perhaps my sonatas, too," broke in a little man with an Italian type of countenance, who I recognised as Scarlatti—and he cocked his eye rather roguishly at Beethoven.

Broadcasting Beethoven

"And perhaps people will learn that all my music is not the outpourings of a neurasthenic sentimentalist," added Chopin in a voice which, had it not been for a bad bout of coughing, would have been very melodious and pleasant to listen to. "Consumption and Georges Sands have been the curse of my compositions, but I think the B.B.C. artistes will teach the public to realise that my works should not be played with morbid sentimentality. Indeed, I agree with Herr Bach that we should support the B.B.C."

"I still maintain," grumbled the rugged Beethoven, "that my works do not broadcast well. That Ninth Symphony they played the other evening, why it was——"

"You must have listened to Bela Bartok by mistake," broke in Mozart with a rather silly giggle, and Beethoven glared at him so angrily that I thought a row was inevitable.

But the Chairman, Herr Bach, quickly moved the motion: "That we Great Masters approve and promise to support the broadcasting of our works"—and it was easy to see by the show of hands that the motion was carried almost unanimously.

Just at this moment the porter put his head round the door and addressed the Chairman:

The New Master

"Excuse me, sir," he said, "but there's a gentleman down below who says he's a New Master. Can he come up?"

Herr Bach looked at his friends in surprise and some puzzlement.

"What's his name?" he asked.

"Well, sir," the porter said. "I understands as 'is name is Mr. Jazz and——"

But he got no farther, for Beethoven, with a mighty fist, knocked over the table and roared with a bull's voice:

"Throw him out!"

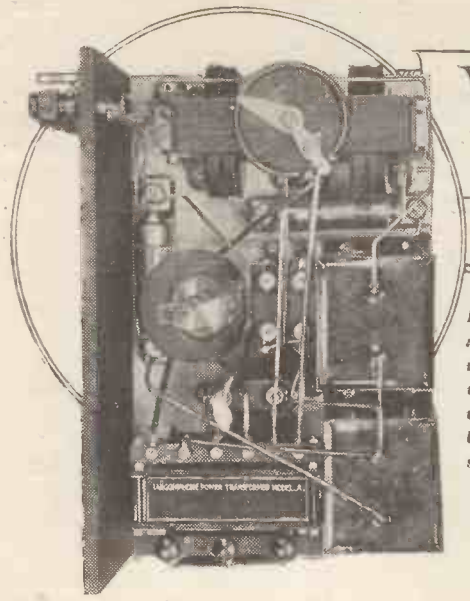
The lamp went over with a crash, the room was plunged in darkness and I felt myself whirling round and round and round.

Herr Bach.

* * *

"Wake up, George," said an irritable voice in my ear, and I opened an eye to see the accusing face of my wife. "It's nearly two o'clock in the morning and you've still left the wireless switched on. We shall want a new accumulator to-morrow."

I didn't say anything, but went meekly and switched off. But I wish I had dreamed a bit longer, for I would have loved to have seen what happened when Mr. Beethoven laid his hands on Mr. Jazz!



WHAT IS A MAINS UNIT?

For the first time a really comprehensive survey of modern "battery eliminators" and such devices is made in a way that the ordinary amateur can understand. Here the Editor is at his best and, even if you have only a crystal set, we know you will thoroughly enjoy reading this article.

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

IT is noteworthy that, while the consumption of filament current for valves has steadily diminished during the last few years, the demands made upon the high-tension battery have risen out of all proportion. Still more disconcerting are the signs that these demands will rise to still further heights and, indeed, even now, if one wishes to get the very best possible reproduction when using the moving-coil type of loud speaker, the high-tension consumption of one's set is greater than can be economically taken from any size of dry high-tension battery.

Where "Power" is Needed

It is true, of course, that only a minority of listeners will care to avail themselves of such types of reproducer, but even with the more ordinary kinds of speaker the improved quality given by a super-power valve in the output stage is so marked that all who possibly can should use this type of valve. Any loud speaker which will reproduce the low tones can only do so adequately if sufficient power is fed into it, and it is an easily demonstrable fact that far more energy is required to reproduce the low tones than the high. From this it follows that it is a needless extravagance to buy a first-class modern loud speaker if we cannot supply it with sufficient energy to reproduce the tones which make for natural rendering. The valves to give such an output all require a very considerable high-tension current.

What, then, are we to do about our supply? At the present time there are only four practical ways of getting a steady flow of high-tension for a reasonable period, with sufficient intensity to feed the modern super-power valve. The first is the largest size of high-tension dry battery, sold in 45-volt units, each unit measuring about 8½ in. long by about 4½ in. deep by 8 in. high. Typical good examples of these are the Columbia, the Siemens and the Burgess.

A Question of Cost

As they cost 25s. approximately each the cost of acquiring suitable high-tension of this class for a super-power valve set is roughly £3 15s. This size of battery, however, will supply a set using a super-power valve in the last stage for about nine months of average use. Cheaper and smaller batteries will also run these valves, but the life of the battery will be much shorter and the cost of running will not be so economical. (See Mr. Hallows' article in this issue.)

"Wet" Batteries

The second source of supply is the high-tension accumulator, which if you have facilities for charging, either at home or at a reliable charging

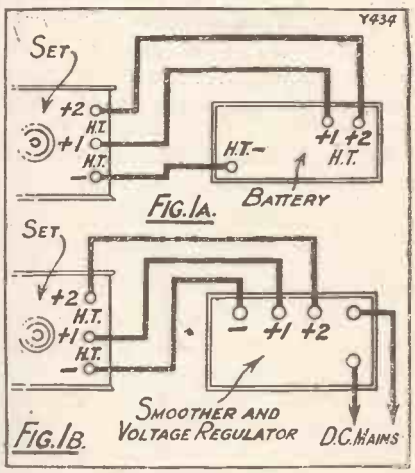
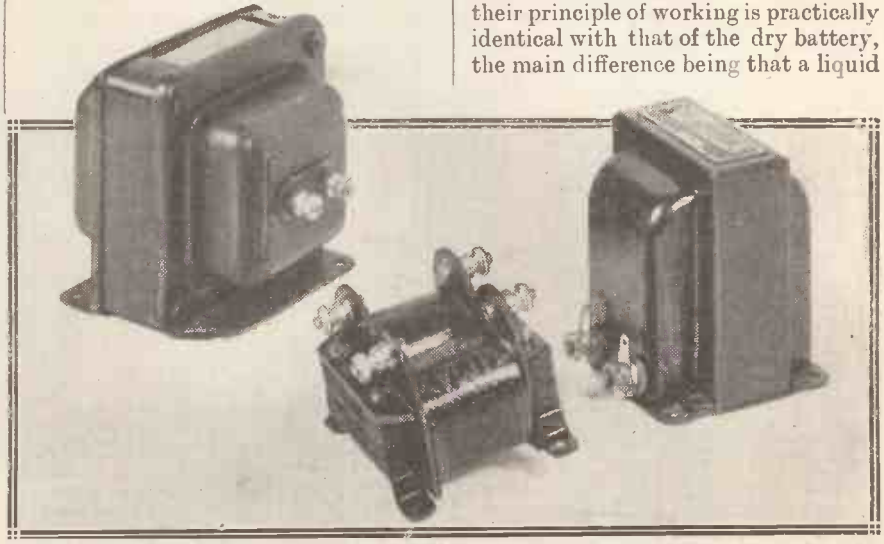


FIG. 1A.

FIG. 1B.

station, is a thoroughly satisfactory way of supplying your valves. The third method is by the wet Leclanché type of cell, of which several good examples exist. These fall intermediate between the dry battery and the accumulator, for on the one hand their principle of working is practically identical with that of the dry battery, the main difference being that a liquid



An international group of L.F. chokes. The Croix, a French choke, is shown on the left; in the centre is a British choke, made by Climax; and on the right is the American, a Thordarson.

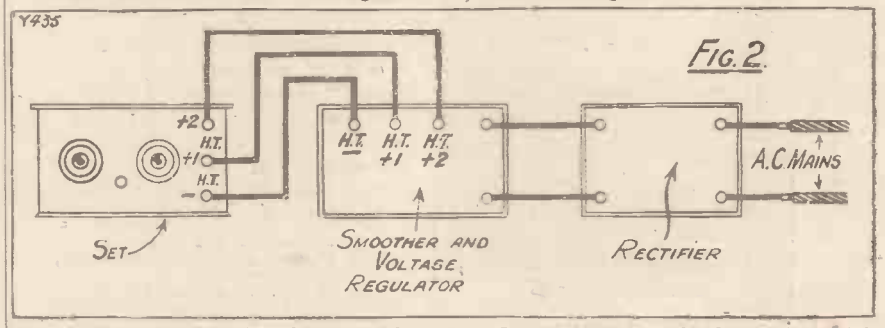
What is a Mains Unit?—*continued*

electrolyte is used in place of the paste form of electrolyte in dry cells, while the parts which wear out (the zinc and the chemicals) are easily and cheaply replaced. You will thus see that it is not so much a rechargeable battery as a battery which is inexpensively renewable in its consumable parts.

Various Descriptions

The fourth source of supply is what is generally termed a "mains unit," sometimes a "high-tension eliminator" (quite an incorrect description), and in America a "socket power unit," "B eliminators," "power pack," etc. These forms of high-tension supply take the current from the mains and supplies to the set as a pure smooth direct current of the intensity we require. The cost of running a mains unit, while not negligible as is sometimes suggested, is still much cheaper than any of the other forms of supply giving the same amount of current.

This article is an attempt to explain in some detail just what mains units are, how they work, how some of them can be improved, and some of their limitations which are too frequently glossed over by enthusiastic advocates. It will also indicate what the home constructor can and cannot do in providing his own mains supply and, incidentally, the risks he takes in experimenting without adequate knowledge.



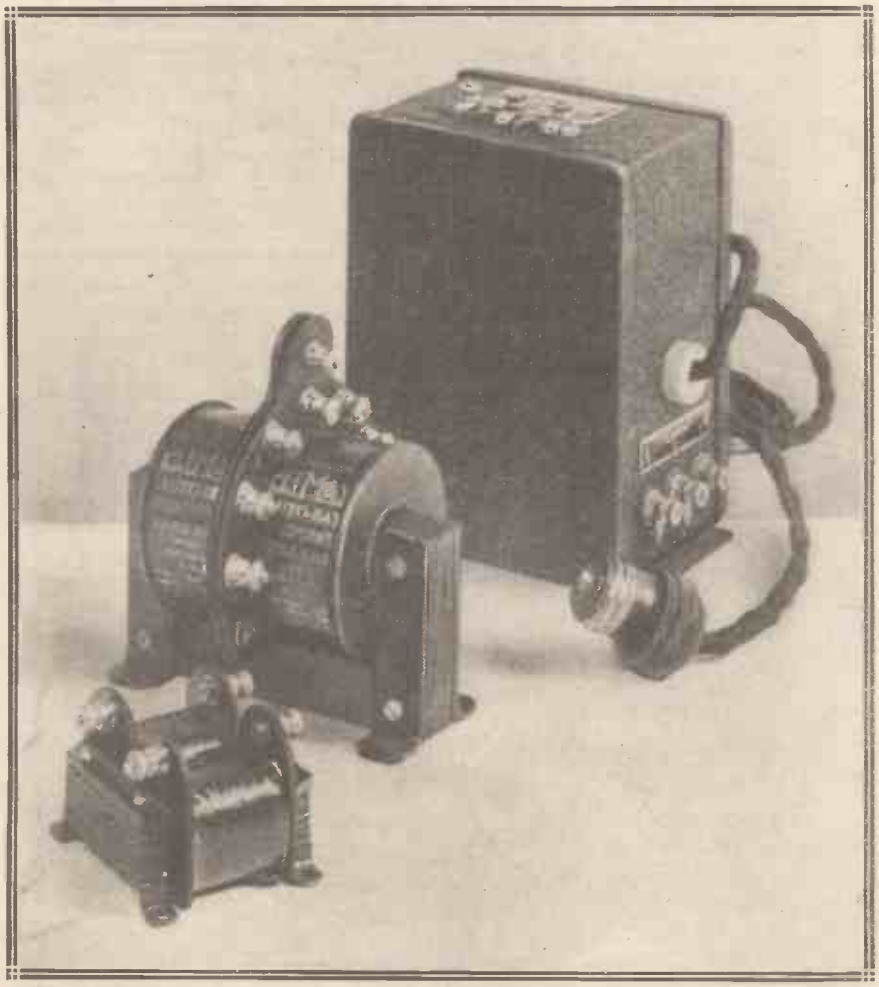
Let us start at the beginning with a few diagrams which will help to explain the fundamental principles. Take Fig. 1 for example. In Fig. 1a we have diagrammatically shown a set on the left with a high-tension negative and two high-tension positive terminals, and on the right a high-tension battery with terminals for high-tension negative and high-tension positive 1 and 2. We need not worry about the details of the set; we are simply taking a set which requires two high-tension positives, and this is how we arrange our battery.

D.C. Must Be Smoothed

Now look at Fig. 1b. On the left we have the set and on the extreme right the direct-current mains. Before we can apply the direct-current mains to the set we must pass the current obtained from this source through a unit which is a combined smoother and a voltage regulator. You might imagine that direct current requires no smoothing, but what we call "direct current" (which is thoroughly satisfactory for lighting and heating purposes) is not really the pure direct current we require for wireless.

The voltage regulator is merely a device which steps-down the voltage from the mains to what we require for the set. There is an important difference between the commercial direct current and the smooth direct current we require for our wireless set. This will be explained later.

Look now at Fig. 2, which shows the kind of arrangement we have to use when we have alternating current mains. On the extreme left, as before, is the set, and on the extreme right the alternating current mains. Before

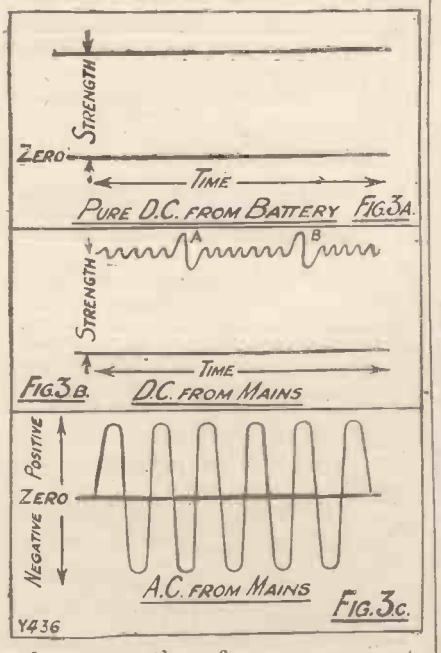


At the back is the American Thordarson unit, with a transformer embodying filament windings and a high-tension winding, together with two chokes. In front is the Climax transformer (British) which has both filament and H.T. windings. The choke to go with this transformer is seen in the foreground.

What is a Mains Unit?—*continued*

The Climax H.T. unit for A.C. mains.

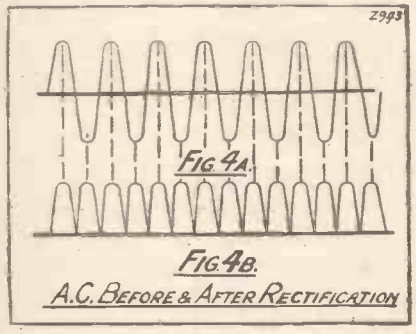
we can apply the mains current to our set we must first pass it through a *rectifier*, which changes it from alternating current to pulsating direct current; next we must pass it through a *smoother* and *voltage regulator*, which turn the pulsations into a smooth direct current and reduce the voltage to the figures we want respectively.



I have drawn the diagrams consecutively because I want readers to realise that the set is the same in each case, whether we use a battery, D.C. mains, or A.C. mains. I also want to point out that the smoother and voltage regulator is the same for both direct and alternating current supply. The only difference between a mains unit designed for operating off direct-current mains and one designed to work from alternating current mains is that the latter contains *in addition* to the smoothing and regulating device some means for rectifying the alternations.

A "Strength" Ripple

Now turn to Fig. 3. Fig. 3a shows a simple little diagram in which the space between the bottom line and the upper line represents the strength of the current and the bottom line the time. From this you will follow that a pure direct current from a battery maintains exactly the same strength and uniformity all the time (until, of course, it runs down). Fig. 3b shows roughly what the direct current from the mains is like. It is, as you will notice, only partially direct. That is to say, on top of the direct current we have a ripple—usually a steady ripple—caused by the commutator of the dynamo at the power station. Another way of looking at it is to consider that we have a tiny little alternating current placed on top of a perfectly smooth direct current.



At points A and B you will see "bumps," differing from the regular ripple and occurring sometimes frequently and sometimes only occasionally, and always at irregular intervals. These little bumps or sudden variations in current are due to a variety of causes, such as the

On the left is the Raytheon type B-A valve, the one standing vertically being a type B-H.

What is a Mains Unit?—*continued*

sudden switching on or off of a powerful machine on the same mains, or, even closer at home, the switching on or off of lights in another room. Little surges and pulsations of current are occurring all the time on the D.C. mains, and while they do not make any material difference to the ordinary supply of light, power, etc., they would make annoying sounds, such as clicks and bangs, in a wireless set. It is indeed such variations as these which cause an old high-tension battery to give those annoying crackles and bangs which are sometimes put down to atmospherics.

Alternating Current

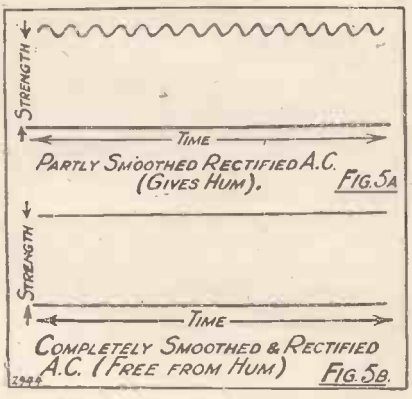
Fig. 3c shows, diagrammatically, the alternating current from the mains. From this you will see that the current starts at a given moment from zero, rises to its maximum, falls to zero, rises to maximum in a negative direction, falls to minimum again, and so on, making complete changes of direction and rising to maximum and falling to zero at perfectly regular intervals of time. The time taken for a rise from minimum to maximum, back to minimum again, to maximum in the opposite direction, and again back to minimum, is called a "cycle," and the ordinary current supplied in this country on the alternating current mains has a fifty-cycle frequency. That is to say, there are fifty complete cyclic changes in a second.

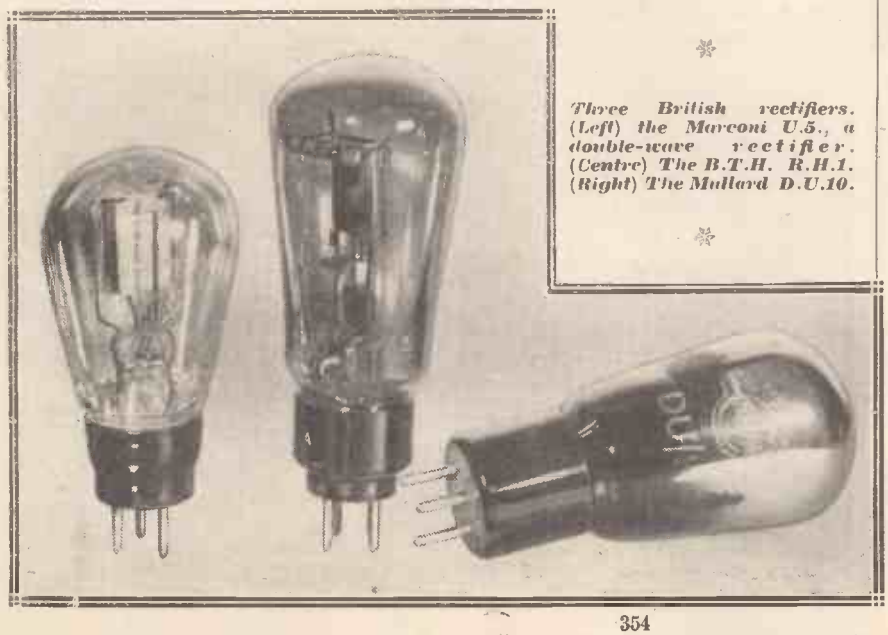
This current cannot be used directly in a wireless receiver for two reasons.

The Atlas A. C. "H. T. Battery Eliminator" with variable voltage controls.

Firstly, we require a steady positive voltage applied to our valve, whereas this alternating voltage is alternately negative and positive, and, secondly, the current is not steady but continually rising and falling. What can we do? Is it possible to use this in a modified form? Fortunately, the answer is "Yes," and in Fig. 4 diagrammatic indications are given in order to understand what can be done.

Look at Fig. 4a. Here we have as before an alternating current. If by some means we can reverse the negative current and, roughly speaking, place it "alongside" the positive, then we shall have, instead of a current which periodically changes its direction, a current which rises and falls on the positive side only. This is what is called "pulsating current." The next step, as we shall see a little later, is to smooth out or blend together all of these pulsations into one steady current.



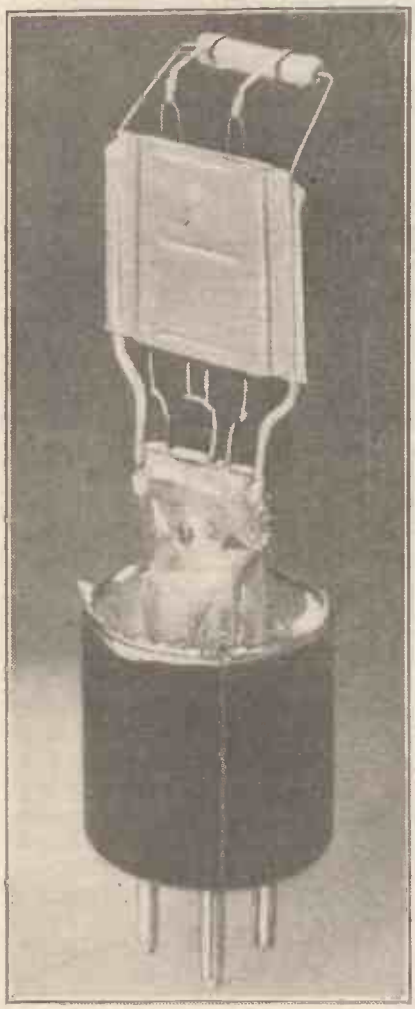


Three British rectifiers. (Left) the Marconi U.5., a double-wave rectifier. (Centre) The B.T.H. R.H.1. (Right) The Mullard D.U.10.

A Continuous "Hum"

To digress for just one moment, many readers will have already used mains units, and some will have found that they get a hum in their receiver—a continuous hum, which perhaps is only just audible when the station to which you are tuned is not transmitting. Incidentally, I may say that practically all mains units give a slight hum, although in nine cases out of ten the hum is not objectionable,

What is a Mains Unit?—*continued*



Rectifying valves have large plates and generous filaments. The size of a typical anode will be seen from this interior view of the D.U.10 valve.

and is not noticeable when the transmission is on. Fig. 5a shows that if we have a current which is only partially smoothed, there is still a ripple left, and it is this ripple which gives the hum. Fig. 5b shows a completely smoothed or rectified current having no variation. This is free from hum, and therefore it is practically the same as the current received from a pure D.C. source such as a high-tension battery or an accumulator.

A "Half-Wave" Rectifier

These preliminary considerations are perhaps a little boring, but having been through them we shall be in a much better position to follow the practical side of the article. Dealing first of all with alternating current, which requires rectifying, let us see the various ways in which this can be done.

Fig. 6a shows what is called a half-wave rectifier, consisting of a two-electrode valve, with plate and filament, and a transformer with an iron core and three windings. The winding L_1 is the primary and is connected directly to the mains. The winding L_2 is the high-tension winding, raising the mains voltage to the voltage we require for the valve, and the winding L_3, which has a centre tap, is a low-voltage winding which will supply alternating current to the valve filament. Fortunately, our amplifier will work quite satisfactorily with alternating current on the filament, for all we require here is heat, and if the filament will only maintain its heat we shall get the emission of electrons which we desire. If the filament were to become hot and cold with each cycle, then the working would be unsatisfactory. But, fortunately, the filament loses its heat slowly and thus maintains a fairly uniform temperature.

How it Works

All three windings, L_1, L_2 and L_3, are actually wound on the same iron core, but they are separated out in the diagram for clearness.

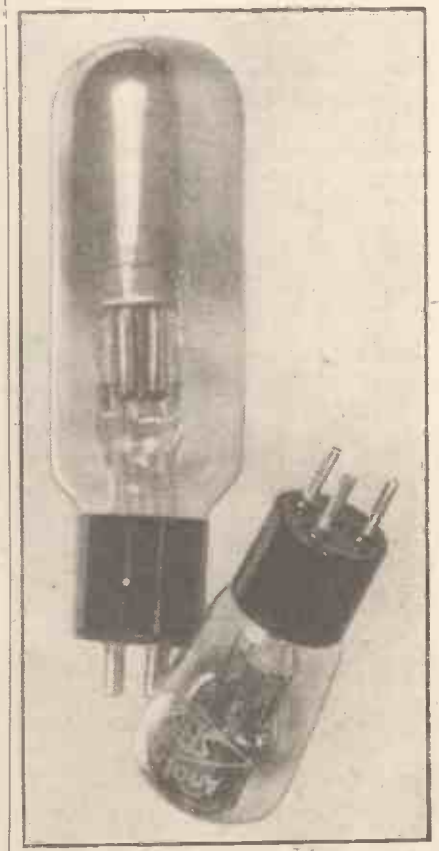
The valve itself is very much like the ordinary type of receiving valve except that it has no grid and is generally larger and with a much more substantial filament and plate than in the ordinary receiving valve. The filament, when heated, gives off a copious stream of electrons, and when the plate is made positive a current flows across the intervening space with great ease. When the plate is negative the resistance of the valve is practically infinite and it acts as a pure "valve," using the word in the old-fashioned sense as a device which allows the passage of something in one way and not in the other.

Now examine the Fig. 6a carefully and you will see that when the top of L_2 connected to the plate of the rectifying valve becomes positive, current will flow across the intervening space in the valve to the filament, through the centre tap of the transformer to the wire marked "positive," which is joined to the smoothing device. The circuit, of course, is then completed through the wire marked "negative" back to the transformer secondary. Obviously, too, when the top end of L_2 is negative no current will flow, and it is thus simple to see how this single-wave rectifier operates.

The "Full-Wave" Type

The half-wave rectifier is quite satisfactory provided we have an adequate smoothing device for use with it, and when we have an alternating current of fifty cycles the output of such a half-wave rectifier is fifty pulses of current per second. A much better scheme, but slightly more expensive, is that shown in Fig. 6b, which shows a full-wave rectifier. Here, again, we have a similar transformer with a winding L_1 joined to the mains, a winding L_2 for high voltage, and a winding L_3 for the filament supply.

In this case, however, we use two valves, the filaments of which are run in series and each end of the winding L_2 is connected to the plate of a rectifying valve. Obviously, each end of L_2 will become alternately positive and negative, and when the



Two gaseous rectifiers. Standing, the Q.R.S.—400 milliampere; on side, the Seibt Anotron rectifier, a continental valve resembling the Raytheon.

What is a Mains Unit?—*continued*

top end is positive current, current will pass through the top valve to the wire marked positive, and when the bottom end becomes positive current will pass across the lower valve to the wire marked positive. The advantage of this scheme is that we utilise both halves of the alternating current, and with fifty-cycle current and a double-wave rectifier we get a hundred pulses a second. It is twice as easy to smooth the current with a hundred pulses a second than one with fifty pulses a second.

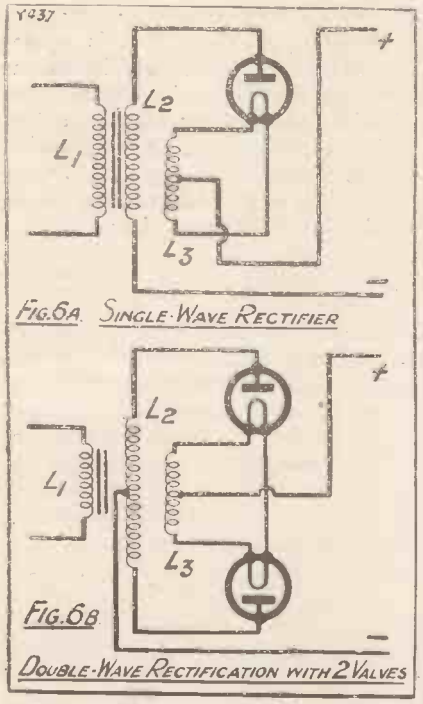


FIG. 6A. SINGLE-WAVE RECTIFIER

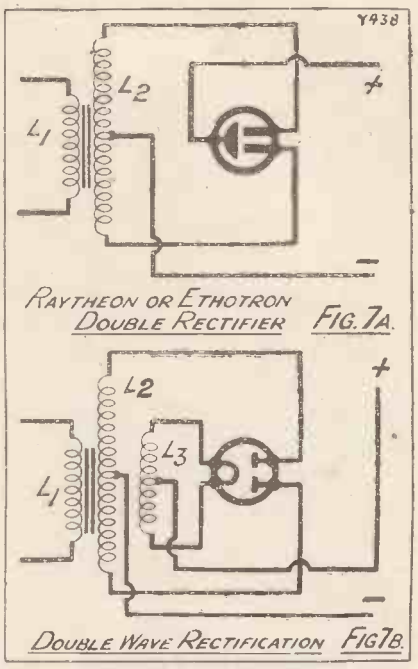
FIG. 6B

DOUBLE-WAVE RECTIFICATION WITH 2 VALVES

So far we have dealt with valves which have a heated filament and a cold plate in a vacuum space, but there are other forms of valve which can give quite satisfactory results as rectifiers. Fig. 7a shows a rectifier using the Raytheon double rectifier. This is a filamentless valve working on quite a different principle from the filament valve so far described. In the ordinary types of rectifying valve we have, as previously explained, a filament which is heated and a cold plate in a vacuous space. In the Raytheon type of rectifier we have two electrodes which are made very small indeed and one electrode which is made very large.

Gaseous Valves

The two small electrodes are placed extremely close to the large electrode and the whole bulb is filled with a special gas, such as helium, at low pressure. The first surge of voltage from the transformer ionises the gas between the electrodes and the current starts across the vacuous space. The atoms of this gas in the tube are struck by the travelling electrons and caused to emit other electrons by ionisation. The small electrodes are positive and the large ones negative, and it is found on test that when the small electrodes are made negative, and the plate positive, that only a few microamperes will flow, whereas when the small electrodes are positive and the plate negative a very high current will flow, that is, high when we consider what we require for high-tension battery replacements. One type of the Raytheon tube passes 60 milliamperes when the small electrodes are made positive, another type passes 125, and another type 350 milliamperes. All three have been tested in my laboratory. There are several makes of gaseous rectifying valves similar to the Raytheon.



RAYTHEON OR ETHOTRON DOUBLE RECTIFIER FIG. 7A.

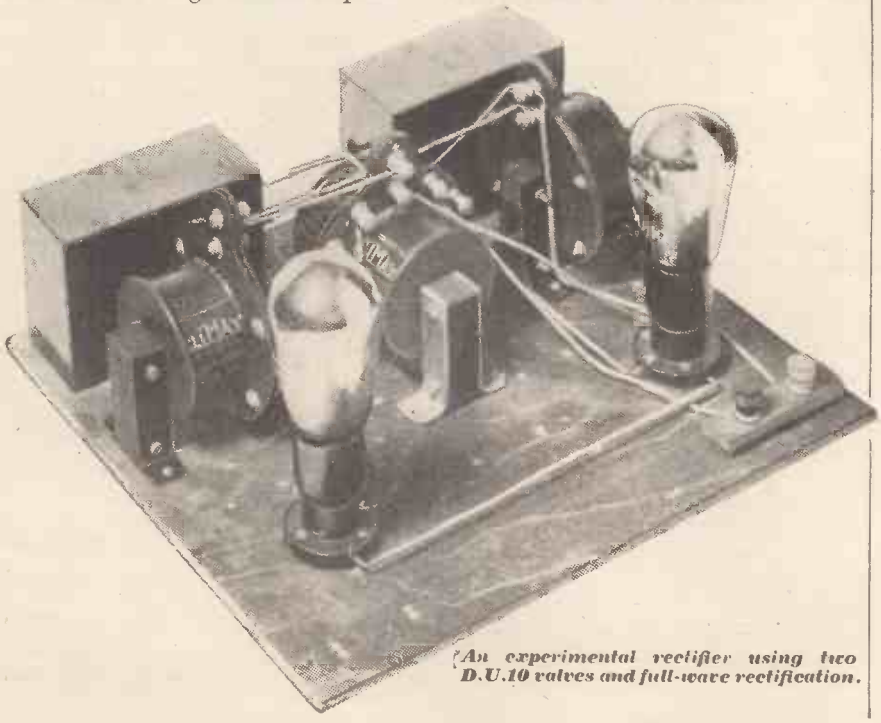
DOUBLE WAVE RECTIFICATION FIG 7B.

No Filament Current

Fig. 7a shows the circuit and it will thus be seen that the two smaller electrodes take the place of the two separate plates of the double-wave rectifier shown in Fig. 6b, while the plate itself replaces the centre tap on the filament transformer. One advantage of these gaseous rectifying devices is that we require no current to heat the filament, and a very large number of American high-tension mains units are fitted with the Raytheon type of tube.

Fig. 7b shows a double-wave filament rectifier consisting of a valve with *two* plates as well as the filament. The circuit shown is practically the same as that of Fig. 6b, except that there is only one filament instead of two, and the two ends of the winding

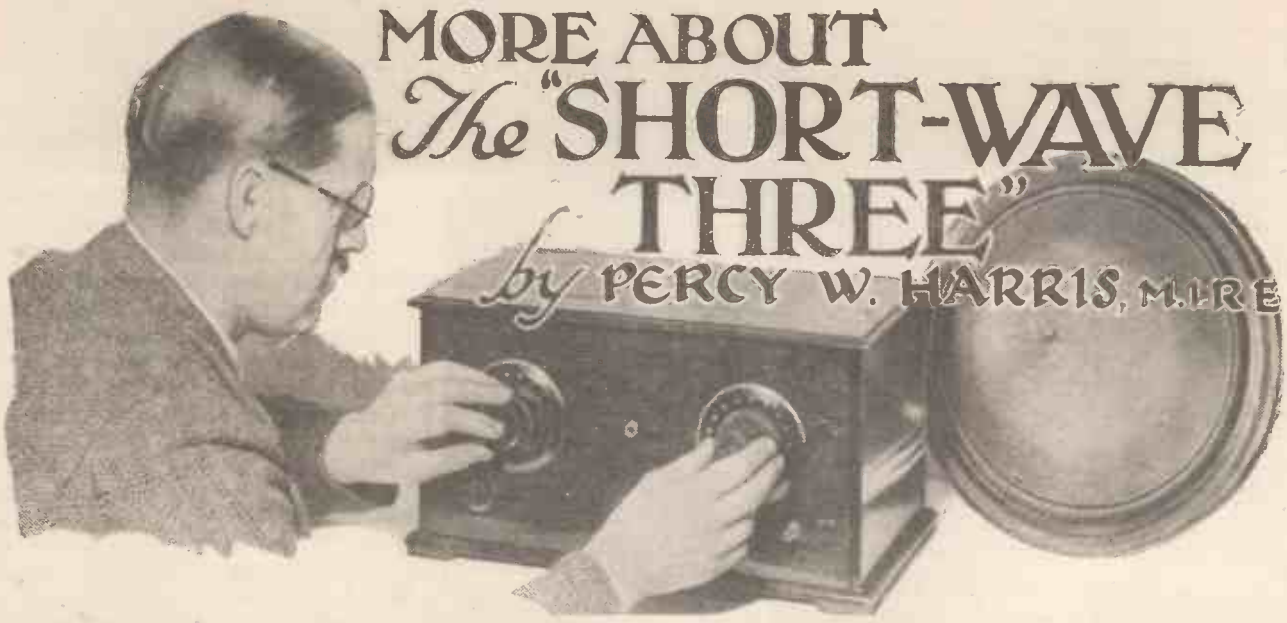
(*Continued on page* 410.)



An experimental rectifier using two D.U.10 valves and full-wave rectification.

MORE ABOUT The "SHORT-WAVE THREE"

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



Full constructional details of the "Short-Wave Three" were given in our January issue, but, in order to enable constructors to make their own coils, further directions are given in this article.

IN reply to a very large number of letters, asking for particulars of how to make the tuning coils, the following particulars are made available. No exact dimensions for the base and pin spacing are given, as these can be varied within reasonable limits to suit the convenience of the reader, and in any case a reference to the original article on page 188 of the January issue, where a full wiring diagram is given, will show a scale by which the exact dimensions of the original base can be quickly worked out.

The aerial coil for all wave-lengths can consist of a coil of eight turns of No. 24 D.C.C. wire wound on a temporary former 2½ in. in diameter as a single-layer coil. The application of a little "dope," made of celluloid dissolved in amyl-acetate, on three or four parts of the coil, will secure the turns together, and will enable the coil to be slid off the former as soon as the celluloid solution has set. This aerial can be then gripped at the base between two small strips of ebonite or wood, and fitted on some kind of hinge, so that the angle to the main coil can be varied at will.

Only Three Coils

Three interchangeable coils, containing both the grid and reaction windings, will cover practically all the wave-lengths the reader is likely to wish to receive on this set, and will give a similar service to the original coils described. This double-coil arrangement needs to be very carefully made if the same high efficiency of the original coils is to be obtained.

The coils are numbered 1, 2, and 3, for the purposes of this description. Coil No. 1 has three turns grid winding and two turns of reaction; coil No. 2, eight turns of grid winding and three of reaction; and No. 3, nineteen turns of grid winding and six of reaction.

The base has four sockets, three at one end and one at the other, and each interchangeable coil assembly must have four corresponding pins. These may be valve pins, Clix or Eelex plugs, or, in fact, any interchangeable plugs and sockets which may suggest themselves as convenient.

As a former, a Pirtoid or Paxolin tube, 3 in. in diameter, may be used, although it is better to use a finned ebonite tube with as much ebonite as possible cut away. The Becol people sell such formers. A fairly heavy gauge of wire should be used for winding these short-wave coils. No. 20 S.W.G. enamelled copper is very suitable, and the turns should be spaced by about the thickness of the wire or more. As there are comparatively few turns in these coils it is not too much trouble to file little niches in the fins so that the turns lie snugly and properly spaced. A triangular file will be found to do the job very quickly, and the finished coil will then be much easier to handle.

The Reaction Winding

It will be observed that when the coil is in the base the three pins which are together come nearest to the aerial coil. Considering the coil from the aerial end, both grid and reaction windings are anti-clockwise. The first pin nearest the aerial coil is connected to one end of the grid coil, the other end of which is connected to the pin at the opposite end to the aerial (that connected to the grid condenser).

The second and third pins are the beginning and end of the reaction winding. This winding should be of fine wire, such as No. 28 D.C.C. wire, and the winding should be made with turns touching in a slot which is cut deeper than the slot for the grid coil, so that the coil when wound in place comes at the aerial end, concentric with the grid coil, but of a diameter slightly less. In all the coils this reaction winding starts at the aerial end, and a few touches of the celluloid solution already mentioned will keep it in place. Both grid and reaction windings are anti-clockwise viewed from the aerial end.

Typical faults and remedies reviewed.

By P. R. BIRD.

The Long and Short Of It!

IF you are fond of puzzles, try to solve the one outlined below, before reading the explanation.

The set was a straight three-valver, which had been giving perfect results, and one day its owner decided to utilise the mains for his high-tension supply. It appeared to be a simple job. He bought a D.C. eliminator (the mains were D.C., 230 volts), and connected it up exactly as per instructions. But no sooner did he plug-in the lamp-adapter than the main fuse went!

As luck would have it, it was a Sunday, and the house was in darkness for several hours until an electrician could be obtained!

Resolved not to be "had" again, the owner of the set waited till the following week before attempting to connect up again, and in the meantime he had the eliminator tested. It proved to be quite O.K.

He then joined it to the set in the correct manner, and for safety's sake put an extra large fixed condenser in series with the earth lead. To make assurance doubly sure he removed the valves, and then, making certain all was well, he cautiously plugged in the flex lead to the mains, and blew the fuse again!

Was it the Aerial?

Being thoroughly on his mettle now, he filled in the interval before the fuse was put right by testing the leads used—all O.K. He then tested for a break in the insulation of the condensers used to isolate the set from earth—all O.K.

Thinking there must, therefore, be a leak to earth via the aerial insulators, he connected the lead-in to a flash lamp, the other side of the flash lamp to a dry cell, and the other side of this cell to earth. The lamp did not glow, as he expected, so he took off the dry battery and put on a *high-tension* battery.

Evidently the aerial insulation was good because there was still no sign of leakage. And just to check up the connections and lamp he tried putting 4½ volts straight across the latter, when the bulb lit brilliantly!

So he was faced with the fact that with no path via the aerial, and no path via the earth, his mains persisted in shorting every time he plugged in the eliminator!

Determined not to be done, he overhauled and *carefully* inspected every single wire in question—and, good man, he found the fault! Can you guess what it was?

If you have to "give it up"—and, quite frankly, I expect you will have to do so, for it was a fault in a thousand—you will be interested in the explanation below.

His final inspection revealed nothing wrong with the earth, eliminator, condensers, indoor leads, nor the lead-in, but when he came to the aerial he noticed that his outdoor earthing-switch had a stray strand of aerial wire almost touching the earthed side of the switch. And right opposite to this strand was a black mark on the earthed metal, where the full voltage of the mains had caused a spark to jump across to earth!

The trickiness of the fault lay in the fact that the gap between the strand of aerial wire and the earthed part of the switch was only just large enough for the full mains voltage to spark across. Consequently it was much too large to pass anything from smaller voltages, and his tests with a dry-cell and high-tension battery had shown up the aerial insulation as being apparently O.K., when actually it broke down at about 230 volts!

Pulling away the offending strand of wire, he went indoors, plugged in boldly, and was rewarded by full volume on the loud speaker!

A Point To Watch

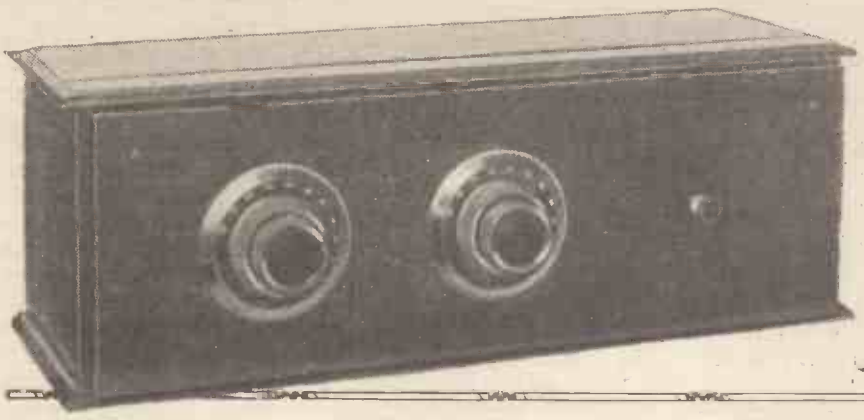
"It's the little points that cause the most trouble"—as the man said when he trod on some tin-tacks. And in radio the little points are not always too obvious!

Flex leads, for instance. Who amongst us has not succumbed to the temptation of cutting up old flex for further use as grid-bias leads, etc.? Generally, it works all right; but an old flex lead can cause no end of trouble if its continuity or insulation is at fault.

In one case which came to my notice recently, a two-valve amplifier (the one described in WIRELESS CONSTRUCTOR last December) had been almost completely re-wired in the hope of improving results. But when completed for the second time there was still a lack of the full, round tone expected, until someone noticed that grid bias appeared to have no effect at all.

This led to the discovery that an old piece of flex (complete with red

(*Continued on page 409.*)



A "THREE" FOR SPARE PARTS

by L. H. Thomas

An inexpensive, easily made three-valver which can be constructed from the various parts that litter the enthusiast's workshop.

IN spite of the undoubted advantages of the new screened-grid valves and screening boxes, and the enormous steps that have been made in radio reception since broadcasting first commenced about five years ago, we often hear of "die-hards" who are still using one of the ancient circuits, and usually obtaining very creditable results from it. The receiver described in this article consists of a modification of a very old favourite circuit, but it can be justly claimed for it that it has been brought up in accordance with modern practice, and will yield results that compare excellently with most sets of the present day which do not incorporate the newest components.

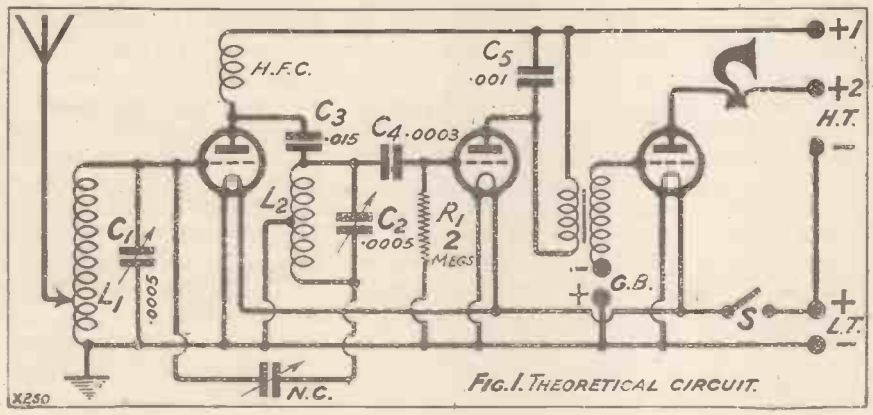


FIG. 1. THEORETICAL CIRCUIT.

Probably the greatest advantage of this set from the point of view of many readers is that it does not use or need any special components; that is to say, it can in most cases be built up—as indeed the set described has been—from the ordinary stock of wireless parts which most enthusiasts possess.

The "DX-hunter" generally is found to have some type of 3-valver—unless he is one of those who wants every station on the loud speaker—and the combination of one H.F. stage, a detector, and one note-magnifier is generally the most useful as well as the most popular for the average man.

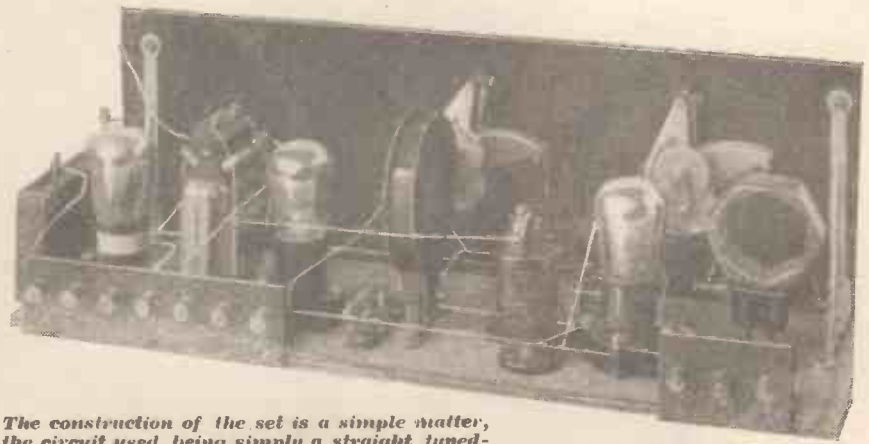
A Simple Circuit

The construction of the set is very simple indeed, since the circuit that has been used for the H.F. stage is simply a straight "tuned-anode," and the detector and note-magnifier are, of course, also perfectly "straight." The H.F. stage is neutralised by means of a split coil; parallel feed is employed, since it is generally acknowledged that this arrangement gives greater stability, and this was, in practice, quite definitely found to be the case. Thus we have a centre-tapped coil as the tuned-anode coil, and the H.F. valve is neutralised in the conventional way. This will be

COMPONENTS USED.

1 Panel, 21 in. × 7 in. × ¼ in.
Cabinet for same with baseboard, 7 in. deep, and pair of brackets.
2 ·0005 slow-motion condensers.
3 Non-microphonic valve holders.
1 L.F. transformer.
1 H.F. choke.
1 Neutralising condenser, baseboard mounting.
1 ·015 fixed condenser, 1 ·0003 fixed condenser, 1 ·001 fixed condenser.
1 2-megohm leak.
2 Baseboard-mounting coil sockets.
1 On-off switch.
1 Three-terminal strip and 1 seven-terminal strip.
Centre-tapped coils, grid-bias battery, tinned copper wire or Glazite, Junit, etc., woodscrews, etc., etc.

NOTE.—This is a set for those who wish to use existing components. Any good makes can be utilised, so that no special parts are mentioned.



The construction of the set is a simple matter, the circuit used being simply a straight tuned-anode neutralised H.F. stage followed by a detector and one note-magnifier. The above photo gives an idea of the interior of the set, with valves and coils on board ready for test.

A "Three" for Spare Parts—*continued*

dealt with later in connection with the general operation of the set.

Fig. 1 shows the theoretical circuit.

With reference to the "parallel feed" circuit, it is best described in a few words as follows. Instead of taking the H.T. to the anode of the H.F. valve through the anode coil, it is taken to the same point through a high-frequency choke. The anode coil is now connected in series with a fixed condenser C_3 to the neutralising condenser in the usual way, the centre-tap also being taken to the filament just as usual. The condenser C_3, if made small, has a considerable stabilising effect upon the set, but it has been found preferable to keep this at a fairly large value, and to stabilise the set in the normal way by neutralising the H.F. stage. The value chosen for C_3 is accordingly ·015 mfd. It can be made bigger still if desired.

Easy to Construct

With careful design and careful operating there is not the least difficulty in making the set completely stable over the whole of the range which it covers, and a very pleasing constancy of feed-back can be obtained. For this reason no reaction has been introduced on the detector, and the set is thus deprived of one control, which is not lamented in the least.

The most suitable valve for use in the H.F. stage is one of the fairly high-magnification factor valves intended for resistance-capacity work, having an impedance of about 60,000 ohms. This, in conjunction with the tuned-anode circuit used, and a fairly high value of H.T.—about 80–100 volts—enables a very high degree of amplification to be obtained.

The construction of the receiver, as will be seen from the photographs, should present no difficulty. The components are well spaced out; if it is examined it will be seen that the H.F. stage occupies nearly half the baseboard space, and the detector and note-magnifier share the other half. The aerial coil is well away from the anode coil, and is placed at right-angles to it. This is very important, since, no screening being employed, interaction between the coils is possible, and very undesirable. With the actual layout used, however, no trouble whatever was experienced in this direction.

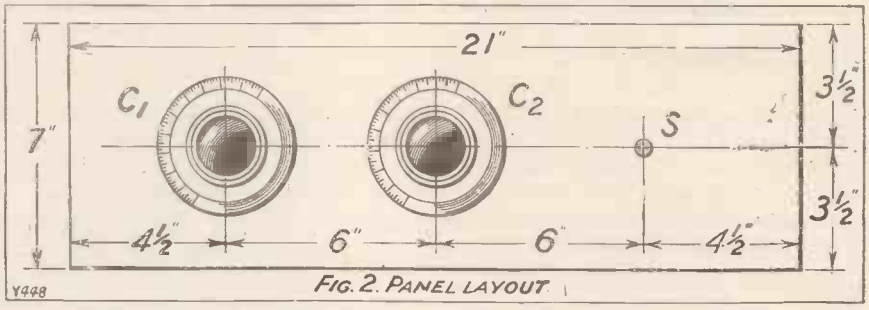


FIG. 2. PANEL LAYOUT.

The Balancing Condenser

The condenser at the left-hand end of the panel is that which tunes the aerial coil, and the other the anode-circuit condenser. The only other component on the panel is our old friend the on-off switch.

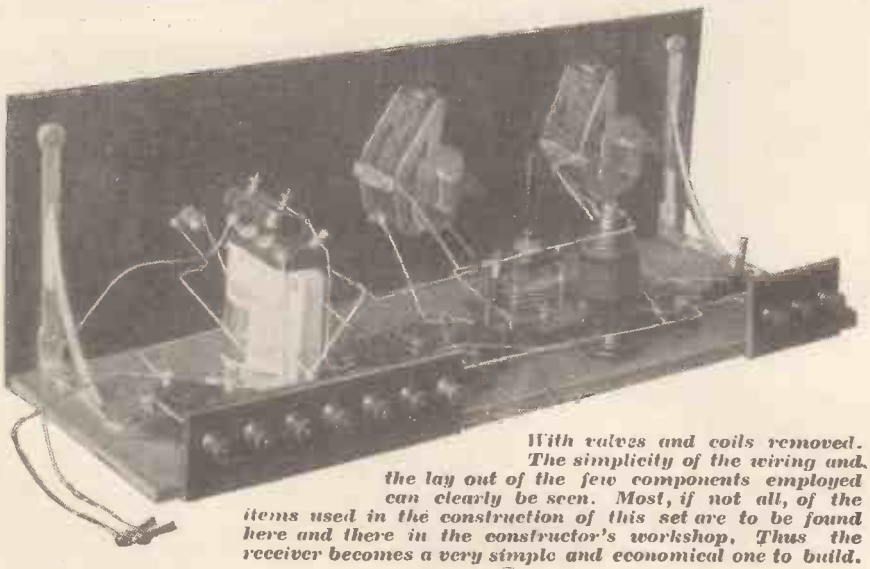
The neutralising condenser has been kept inside the set, but there is no reason why one of the panel-mounting type should not be used if it is preferred. As a matter of fact, if a panel-mounting type of the same manufacture as that in the set were employed, and placed low down on the panel between the two variable condensers, hardly any alteration in the wiring should be necessary, since the two terminals would come at almost the same positions as do those of the baseboard condenser.

The aerial terminals have been left blank. Two were provided, but there are such a number of different methods of coupling the aerial to the set that it was thought advisable to leave the actual choice to the reader. The writer is of the opinion that out of about six alternative methods there is generally one which gives very definitely better results with a certain type of aerial.

The reader, of course, knows his aerial, and may already have met the type of coupling which suits it best, in which case he will doubtless employ that method in this set. The alternatives which may be used with little or no alteration are as follow. "Auto-coupling" may be arranged by using an "X" coil in the aerial socket, and taking a lead from the aerial terminal to one of the tappings on the coil.

Suitable Valves

As a second test a centre-tapped coil may be inserted in the socket and the aerial taken by a flex lead to the centre tap. This will not give such good selectivity as the "X" coil, but if a ·0002 condenser is connected between the aerial and the centre tap results should be very satisfactory. In the case of readers using very small or indoor aerials it may even be found possible to connect the aerial direct to the grid of the H.F. valve, but this method is not advised unless



With valves and coils removed. The simplicity of the wiring and the lay out of the few components employed can clearly be seen. Most, if not all, of the items used in the construction of this set are to be found here and there in the constructor's workshop. Thus the receiver becomes a very simple and economical one to build.

A "Three" for Spare Parts—*continued*

it is definitely found to give good results. The grid leak is shown as connected to L.T. negative, this having been found to give perfectly good results without sacrificing stability.

Having completed the wiring as in the diagrams the set should be connected up to the batteries, aerial, and earth, and the valves inserted after the final check of the wiring. A high-mu valve should, as previously stated, be used in the H.F. stage, and, as detector, an H.F. valve with an impedance of 20,000 to 30,000 ohms is suitable. For the note-magnifier a small power valve should be used.

Neutralising

The first H.T. positive terminal is common to the detector and the H.F. valve, and about 80 to 110 volts should be used. For the note-magnifier the same voltage is quite suitable, although it will sometimes pay to go even higher. The grid-bias battery, which is fixed inside the set at the end, and connected up by flex leads, should be of about 9 volts, and 4½ to 6 volts should be a sutiable value for normal working, although this is, of course, one of the adjustments that must be made individually. A No. 50 coil should be inserted in the aerial socket, and about a No. 60 in the other.

Without connecting the aerial the set should be switched on. It should be found, if the neutralising condenser is placed in a position approximately "half-in," that it will oscillate when the condenser readings are somewhere nearly equal. It will probably be found that it will oscillate over a band of about 30 or 40 degrees on each. Now connect the aerial, remove the filament lead from the H.F. valve (the lead nearest the panel is conveniently taken off the terminal), and carefully search round for the local station. It will, naturally, not be strong, but it should be found. Now adjust the neutralising condenser carefully so that no trace of the local station remains, at the same time making slight alterations in the setting of the aerial condenser.

Good Selectivity

When the local station cannot be found at all, connect up the filament of the H.F. valve again, and the set should be correctly neutralised and ready for use. *Do not* remove the H.F. valve instead of switching out its filament!

Now, if the two dials are rotated so that they keep fairly well "in step" the local station should be found to be quite sharply tuned. Unless a movement of the anode condenser of about 7 or 8 degrees, and about 10 or 15 degrees of the aerial condenser, practically cuts the local station right out there is something wrong.

The writer tested the set out at a distance of six miles from 2 L O, and these figures sufficed to cut out every trace of that station. For the guidance of readers, the writer's aerial is 65 ft. long and 38 ft. high, and gives quite good selectivity when connected directly to the centre tap of the aerial coil. On the WIRELESS CONSTRUCTOR laboratory aerial, however, which is somewhat larger, it was found necessary to use an "X" coil in the aerial circuit to give the same degree of selectivity.

Increasing Sensitivity

Having ascertained on the local station that the set is really working well, another slight adjustment may be made before searching is begun. It will probably be found that the capacity of the neutralising condenser may be increased by a minute amount (i.e. the vanes may be turned farther into mesh) without causing the set to oscillate.

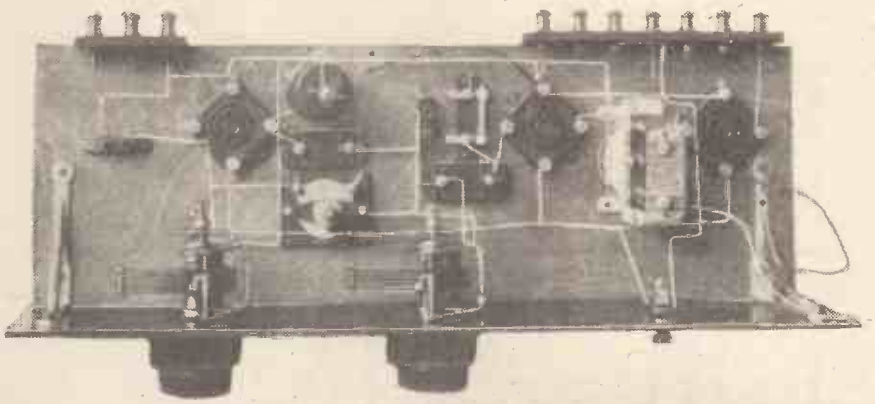
The adjustment should be made with the greatest care, advancing the neutralising condenser by almost infinitesimal amounts, at the same time slowly rotating the dials to make sure that the set still does not oscillate at any point of the tuning range. If it is found that it suddenly starts oscillating at the top or bottom of the scale the capacity of the neutralising condenser must be reduced again, but only by the most fractional amount.

The correct position for it is that at which the set is quite near the oscillation point without actually oscillating at any point on the dials.

Operating Details

It is worth one's while to spend a little time and trouble in bringing the set to this condition, for searching is now an extremely simple matter. When the two dial readings nearly correspond a slight "hiss" or "mush" will be heard, indicating that the two circuits are correctly in tune, and the dials should be rotated very slowly, just keeping this hiss tuned in over the whole of their travel.

It is rather difficult to explain on paper, but as soon as one has got hold of the set it will be understood. Analysing the movements of tuning-in, probably the aerial condenser will be advanced by about half a degree, then the anode condenser by a similar amount, then another half degree on the aerial condenser, and so on. As soon as one circuit is out of tune the familiar "hiss" will disappear. This noise resembles the "background" of the Continental stations.



A bird's-eye view of the receiver taken before the wiring was completed. It will be noted that exceptionally short grid and plate leads have been arranged, thereby greatly increasing the efficiency of the set. The components are so placed that the maximum accessibility for wiring-up is obtained.

If this test is being carried out in the evening, numerous stations should now be heard at points round the dial. On headphones, with the original set, stations are heard at about every 15 degrees. Langenberg, Hamburg, Stuttgart, Fraukfurt, Toulouse, and others are excellent on the loud speaker most nights, and Langenberg is generally received quite well in the

(*Continued on page* 362.)

THE SIGNAL BOX IN SOUTH AMERICA

Some interesting experiences from an overseas reader.

SIR,—I have just completed the "Signal Box," described in the May issue. It is without doubt one of the best sets yet described in your paper; the selectivity is wonderful, being able to tune in about a dozen stations by just tuning the first two condensers, the other stations being completely eliminated.

I ought to be able to hear Daventry with this set, I should think, as I have heard that on board ship here they can receive Daventry very well on a one-valve set.

As to the volume of the set, it is tremendous. I use the same valves as stated (P.M.5X, P.M.6, and P.M.256), with an accumulator of 6 volts, 100 amps. I also use an eliminator for the H.T. I find that the set works better with one grid battery with 4½ volts throughout. As to the components, the only difference I have made is with the neutralising condenser, also Peerless fixed resistors and T.C.C. condenser instead of the McMichael for the aerial tuning. I use an Amplion Junior loud speaker, which gives very good results.

Yours truly,
A. NEILSON.

Buenos Aires,
Argentina.

F 5—?

See next month's "Wireless Constructor"

A SIX-PIN COIL TIP

Poor contacts often cause no end of apparently untraceable trouble.

READERS who are in the habit of using six-pin coils and interchanging them frequently so as to tune in the lower and upper wave-bands, should make a point of examining the pins from time to time, as imperfect contacts are sometimes caused by the two halves of the split pins being pinched too close together. It is not always realised that a faulty contact may bring about a considerable reduction of signal strength without indicating its presence by a complete "dis." This is particularly the case in sockets connected to grid circuits.

To remedy matters remove the coil and open up the pins by inserting a thin knife in the cut. If the coils are used in exposed places without a box or cabinet, the base should be kept well free from dust.

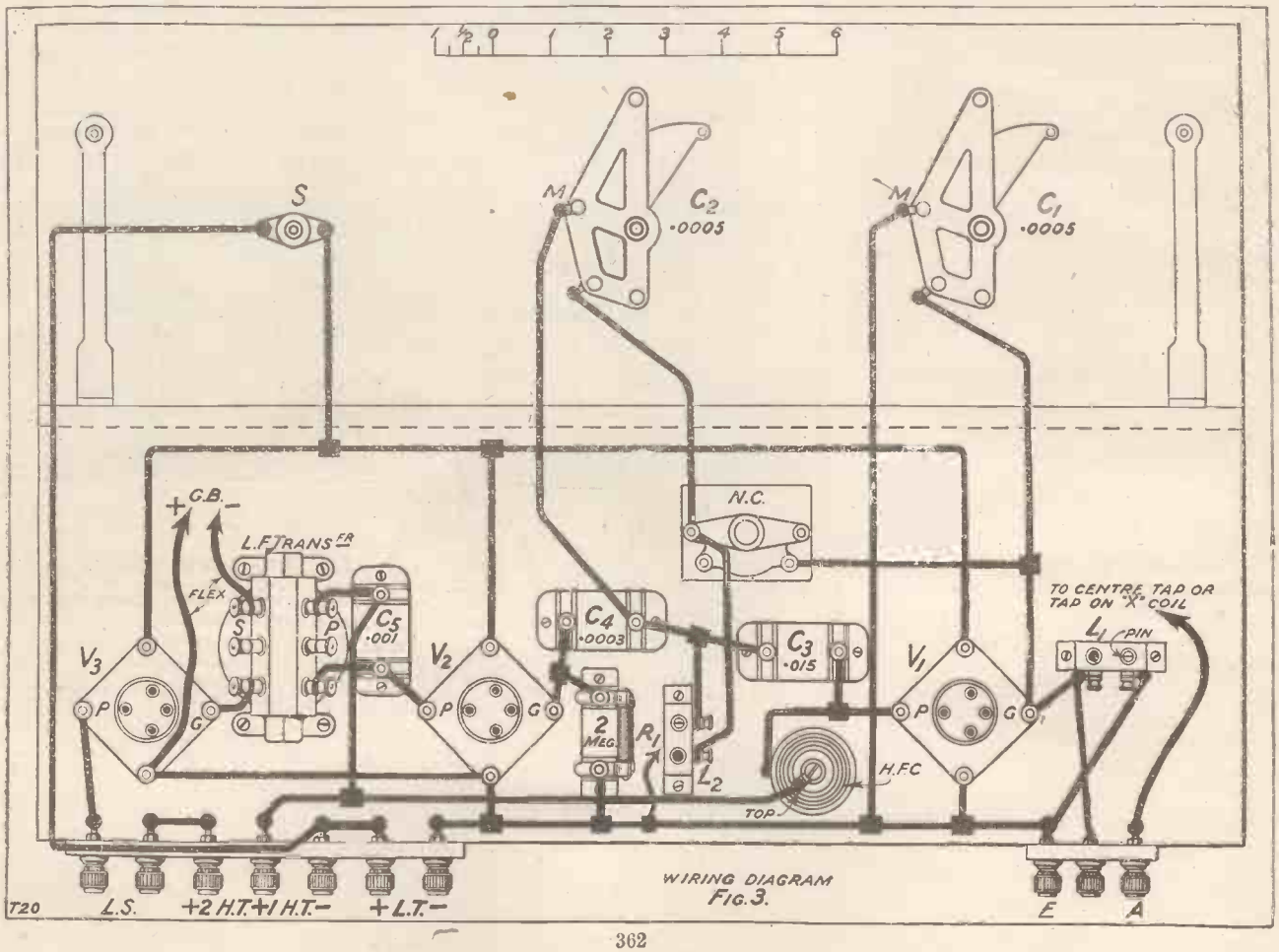
H. P. W.

A "THREE" FOR SPARE PARTS

—continued from page 361

middle of the morning. He can hardly then be called "real loud speaker strength," but can certainly be heard 4 ft. or 5 ft. away from the speaker.

5 G B is, of course, amply strong for loud-speaker work, and on headphones some twenty-four other stations have been received.



WIRING DIAGRAM
FIG. 3.

THE "RADIANO THREE"

As a result of widespread demand, full constructional details of this famous set have been published in Envelope Form together with a full-size Blue Print.

READERS of the WIRELESS CONSTRUCTOR will be very interested to hear that the famous "Radiano Three" is being republished in the form of a complete "how-to-make" envelope, containing full constructional details, photographic reproductions of the set in various stages, and a full-size blue print of the wiring (the Radiano chart), together with other necessary diagrams.

Thousands of constructional envelopes from the pen of Mr. Percy W. Harris have already been sold in this country and abroad (the "All-Concert de Luxe" and the "Four-valve Family" receivers are two world-famous sets which appeared in envelope form), and a further envelope from his pen will, we are sure, be widely welcomed.

A World-Famous Set

The present issue will be the first of the WIRELESS CONSTRUCTOR series of new constructional envelopes published at the highly attractive price of 1s. 6d. The "Radiano Three," which was first published at the early part of 1927, immediately roused universal interest, and thousands were successfully constructed and operated in every part of the country and abroad. Such was the demand for details that the issue containing the description went out of print at once, and as the result of thousands of inquiries from readers who are anxious to build this famous set the new envelope has been prepared.

Much of the success of the "Radiano Three" was due to the greatly simplified method of construction first described in connection with that set. The "Radiano System" includes the following features:

Some Special Features

1. Full-size diagram showing all components in place but without wiring.
2. Choice of all components with terminals, so that the necessity of soldering is obviated.
3. The publication in chart form of every wire shown full-size, the wires being lettered and numbered to correspond with letters and numbers on the terminals.
4. Use of flexible rubber-covered wire to facilitate wiring-up and to enable a wide range of first-class components to be used.

The circuit, chosen after much experiment, consisted of a detector with Reinartz type of reaction and two stages of note magnification. The choice of this circuit as most suitable for the average reader for general loud-speaker work has been amply justified by the remarkable results obtained and published from time to time in this journal. Testimonials of the success of this set, giving a long list of stations received, have poured into the WIRELESS CONSTRUCTOR offices since the first week of publication, and a careful analysis of these letters has shown that the set is equally successful with a wide range of components.

It is interesting to note that within the last few months other constructional schemes, claiming to be "new," have been brought out showing how to build three-valve sets using a detector with Reinartz reaction and two stages of note magnification, while the "abolition of soldering" through the choice of all components with terminals has been featured as entirely new. The WIRELESS CONSTRUCTOR is proud that it was the first journal to describe this very simple method of overcoming one of the difficulties which faces the new constructor, and the Radiano scheme, complete in all its details, ante-dated its imitators by many months.

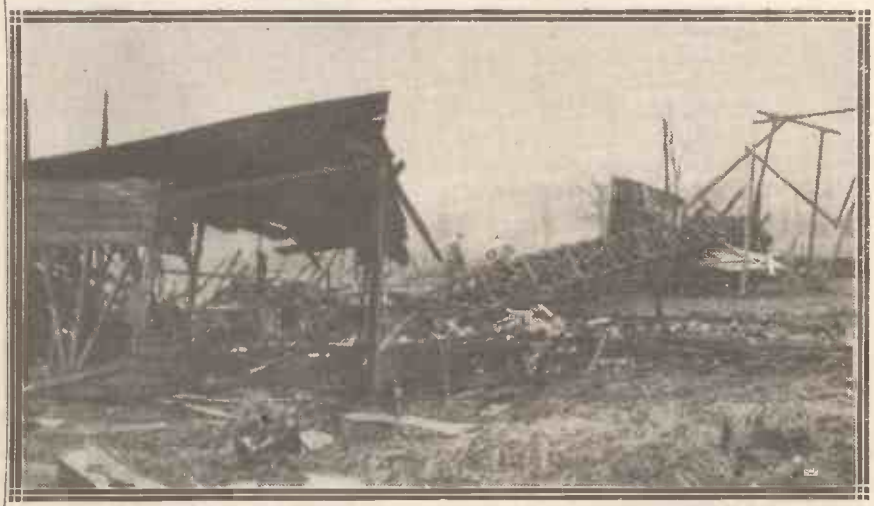
It should be particularly emphasised that the "Radiano Three" has been carefully designed to work excellently with *all* the leading makes of valves, with *any* good low-frequency transformers, and indeed with any sound components of good make. The special and unique scheme of using flexible rubber-covered wire for wiring up completely obviates the difficulties which have to be faced in some sets using stiff wire, for with them unless the exact components illustrated and named in the original design are used the wiring system falls to the ground.

Standard Parts Suitable

Indeed, in designing the original "Radiano Scheme" it was the particular aim of the Editor to evolve a system which would enable any existing components of good makes to be used, as nothing is more irritating to the home constructor to find, when he desires to build a set, that he cannot get the particular transformer or condenser required and that other equally good first-class makes cannot be substituted.

Readers of the WIRELESS CONSTRUCTOR—and they are many thousands—who have already built and successfully operated the "Radiano Three" should tell their friends that complete constructional details are now available in envelope form at the price of 1s. 6d. from any newsagent or bookstall. Be sure you ask for the "Radiano Three" Envelope, by Percy W. Harris, M.I.R.E. It is a three-valver which works splendidly with any good valves and components.

200-ft. Pillar of Flame



The result of a disastrous fire that broke out at the Ditton Park laboratories of the Radio Research Board. The station was completely gutted and the 210-ft. mast crashed in a sheet of flame.

Continental Broadcasts

A review of the present-day conditions in DX reception.

By 2 D A.

I SUPPOSE no two amateurs, even if they live in the same street and operate almost identical sets, could ever quite agree on the subject of long-range reception, or even on the subject of logging Continental broadcasting stations.

A few days ago, a friend of mine who spends quite a lot of time listening to various Continental stations delivered himself of a long and critical survey of present conditions, and because he grumbled at the fact that he found some of his favourite stations difficult to receive these days, whereas a few months ago he enjoyed their broadcasts with ease and regularity, and because he mentioned, in the course of his diatribe, stations which he had not been hearing satisfactorily but which I had received quite well, I spent the next evening making a sort of investigatory tour of the possibilities of Continental reception to-day.

The Two Sets Used

I don't expect for a minute that any two readers of the WIRELESS CONSTRUCTOR will completely agree with my report, if it may be called such, but perhaps a good number will admit that, after making allowances for geographical position, aerial efficiency and atmospheric conditions, etc., the report is fairly comprehensive and reasonably fair and accurate.

I used two sets, one being the "Black Prince," a 4-valve neutrodyne receiver designed by Mr. Percy W. Harris, which covers the ordinary broadcasting wave-band, and another set, also a 4-valve neutrodyne, for the long waves over 1,000 metres. I might add that for several nights running I carried out these tests, with the result that I came to the following conclusions.

Among the "Long-Wavers"

Over and above 1,000 metres there are quite a number of stations which one can receive very well just now. Reception from Hilversum, on the whole, is good, although now and again interference is pretty pronounced. An interesting station is the new Danish one at Kalundborg. These signals come through quite strongly, and the station is quite easy to tune in. I was surprised to be able to pick up the Turkish station at Constantinople at quite good strength, and, of course, Koenigswusterhausen, on 1,250 metres, may be relied on for a good transmission almost any evening in the week.

An Uninteresting Russian

I had a chance the other evening, too, of receiving direct the programme from Witzleben, which Koenigswusterhausen usually relays. As a rule, 5 G B interferes so much with Witzleben, that it cannot be put down on the list as a station which can be received with average regularity. On 1,450 metres it is quite easy to pick up Moscow, but the station's broadcast is enough to turn one's hair grey—it is absolutely devoid of interest. Personally, I plumped for Radio Paris as the best of the Continental transmissions, although 5 X X again has a certain amount of "wipe-out" effect—as far as I am concerned.

By the way, I understand that a new Dutch station at Huizen will shortly be on the air just below 2,000 metres. Tests which I have heard from this station are indicative of some very good broadcasts to come as regards quality of transmission.

It will be remembered that when 5 G B first came on the air there was a lot of talk and a lot of controversy about interference with Langenberg, but as far as the writer is concerned—and he listens just on the outskirts of London—Langenberg's transmissions may be received quite easily these days without any interference. If any interference is noticed by my readers, I think it is of such a nature that an ordinary straightforward wave-trap will meet the case quite satisfactorily.

Farther Down the Dial

Another good station to listen for is Berne, while Frankfurt, of course, has quite a reputation, despite spark interference. Toulouse and Hamburg want separating a bit, but Stuttgart, which a few months ago gave me a lot of trouble, is now received with ease.

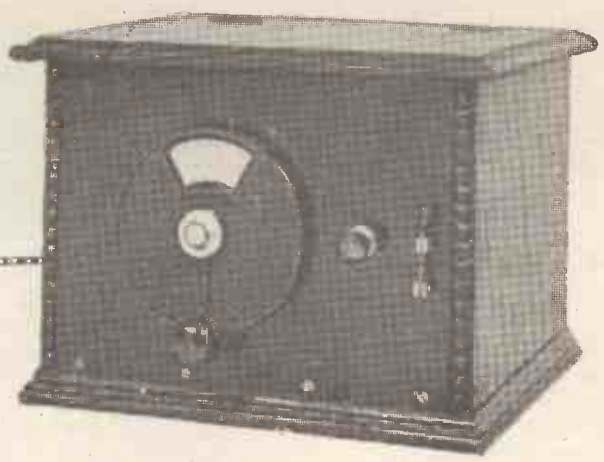
Madrid was another station which I used to receive quite well, but these days, for some reason or another, I find it difficult; and the same applies to Rome. Another station, however, which comes in well, is Barcelona, while the station at Milan, now working on 7 kilowatts, is not difficult to pick up.

Other stations below 300 metres which are quite easy to receive include Lyons, Dortmund and Muenster, and, of course, higher up the scale, Berlin is fairly easy.

The great trouble on the 200-600-metre wave-length band is the lack of co-ordination and lack of discipline among the stations. When the new system of wave-lengths was adopted in 1926, it was hoped that there would be a considerable falling off in interference and jamming, etc.

Mr. Gerald Marcuse adjusting his short-wave super-heterodyne which he uses for picking up Sydney and other ultra-DX transmissions.

THE "SENTRY" WAVE-METER IN ACTION



Some suggestions for calibrating and using this handy instrument, which was described in the "Wireless Constructor" last month.

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

BEFORE your new wave-meter can be of any service to you, you must calibrate it, that is to say, you must establish the relationship which exists between the settings of its tuning dial and the wave-length range over which it will tune. There are two simple ways of doing this; whichever you adopt, you will need to draw up a calibration chart. The chart of my own "Sentry" wave-meter is shown below, and if you have followed the instructions given in the previous article, the chart which you make will be very similar.

Large Chart Best

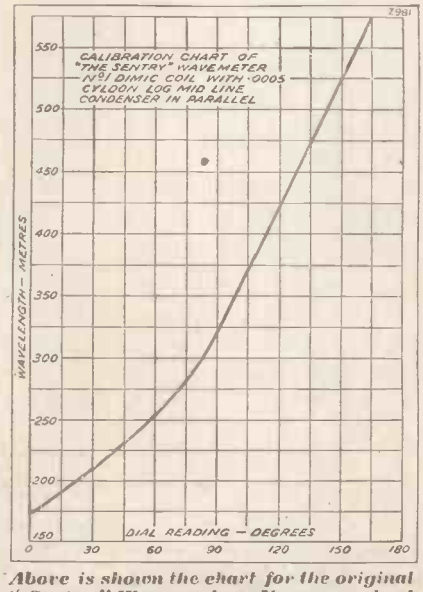
For the chart you will need a sheet of squared paper. Choose your zero point, and along the horizontal axis mark the scale of the condenser in degrees, 0–100 or 0–180, as the case may be. Plot the vertical axis in metres, from 150 to 550. Do not make your chart too small.

The larger you make it, the greater accuracy you can expect when you come to take readings from it. You may prefer to adopt the modern convention and plot your chart in kilocycles rather than in wave-lengths. The procedure is exactly the same, but remember that frequency "goes the opposite way" to wave-length, so that the higher figure must come at the bottom of the vertical axis instead of at the top.

The easiest and most satisfactory method of calibrating a wave-meter is to check it against a friend's instrument which is already calibrated. To avoid disturbing the connections of the wave-meter for the purpose of inserting headphones in its circuit, the receiver may be used to assist in the calibration, in the following manner.

Easily Calibrated

Switch on the two wave-meters and the receiver. Set the calibrated wave-meter to some noted reading, about 20 degrees from one end of the scale, and listen with the receiver headphones. Rotate the dial of your own wave-meter, whose knife-switch should be closed, until the beat note is heard, produced, of course, by the combined oscillations of the wave-meters. Tune your own wave-meter exactly to the silent point and note its condenser reading. Now set the calibrated wave-meter to a second reading at the other end of its scale and check with your own wave-meter as before.



Above is shown the chart for the original "Sentry" Wave-meter. Your own chart will be very similar, if you make it on the lines described in this article.

You will then have two points to mark on your chart, as you will be able to read off from the chart of the calibrated wave-meter the wave-lengths of the two selected points. Join these two points with a line. Take a few more readings at intervals between these two points, to check the accuracy of your line. Also take careful readings a few degrees apart at the lower end of the scale, where the calibration line will be found to be curved.

If you are unable to borrow a calibrated wave-meter, you must proceed as follows. Have your blank chart ready as before, and pick up with the receiver as many known stations as you can. As you find each station, switch on the wave-meter, and rotate its dial until you hear the beat note produced with the carrier-wave of the station. Adjust to the silent point and note the condenser reading on the wave-meter.

Sufficiently Accurate

If you have any difficulty in finding the setting on the wave-meter for the beat note, open the switch temporarily, closing it before finding the silent point. On referring to a table of wave-lengths, you will be able to mark a series of points on your chart. These points should lie on a straight line, and you can join them up with a line. You will probably find that some of the points lie a bit off the line, because some stations do not always work exactly on their scheduled wave-lengths. You should be able to obtain a calibration line which is accurate enough for all practical purposes.

We now come to the practical use of the wave-meter. One method of using it has already been mentioned, in the previous article. When you pick up an unknown station with the receiver, switch on the wave-meter and adjust it till you hear the beat note. Find the salient point, note the wave-meter condenser reading, and you can read off the wave-length of the station from the chart. Identification should then be possible.

Finding Required Stations

On the next occasion when you wish to listen to that station, or to find any other whose wave-length you know, set the wave-meter to the correct point as determined from the chart, switch it on with the howl working,

(*Continued on page* 366.)

A TIP FOR THE AERIAL SERIES CONDENSER

By R. W. HALLOWS, M.A.

WHEN the so-called aperiodic aerial tuning is used it is always a sound practice to have a series condenser which can be used or not at will. On very short waves it is quite essential to have this condenser available, for one is bound to find certain places at which the set will

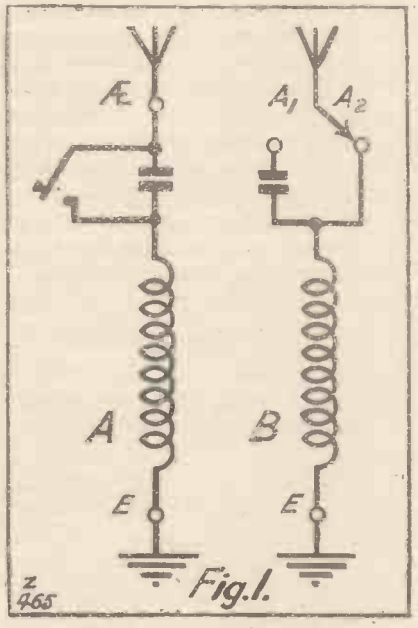


Fig. 1.

not oscillate owing to its being tuned in resonance with the aerial's natural wave-length or one of its harmonics. When such a spot is encountered with the condenser not in use one throws it into circuit, and the set oscillates readily once more, since resonance no longer exists. Similarly, if a "dead patch" occurs with the condenser in series, oscillation can be secured again by cutting out the condenser.

Three Methods

Fig. 1 shows how the condenser might be placed in circuit or cut out by means of a short-circuiting switch placed on the panel of the receiving set. Though exceedingly handy, such a switch is for two reasons not advisable on apparatus designed for reception of the very short waves.

In the first place, one part of the switch must be connected to the aerial, which means that body capacity effects are likely to be met with as the hands are brought near the panel for tuning purposes. Secondly, to bring connections from both sets of plates of the condenser to a switch on the panel means adding not a little to the total length of the wiring, and in a short-wave set it is always advisable to keep the wiring as short as possible. The second method, illustrated in Fig. 1B, shows how the condenser may be thrown into or out of circuit by using two aerial terminals. This is quite a satisfactory method, except that it entails the bother of changing over the aerial lead-in whenever a bad patch is encountered.

A method which the writer has found most handy is illustrated in Fig. 2. The series condenser is of the clip-in type, with a capacity of .0001 mfd., and a simple short-circuiting device is provided which can be slipped on to it or removed in an instant.

This little device is very easily made. The foundation of it is a piece of ¼-inch ebonite, 2¼ inches in length and ½ inch in width. In one of the edges of this two 4 B.A. tapped holes are made, spaced ⅞ inch from centre to centre. The only other parts re-

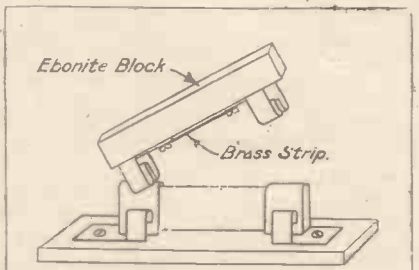


Fig. 2. The Shorting Device.

quired are a pair of condenser clips and a brass strip 1¼ inches in length and ¼ inch wide, in which are drilled two 4 B.A. clearance holes ⅞ inch apart. The clips are mounted as shown in the drawing, with their tangs inwards, the screws being passed through the holes in the clips and those in the brass strip.

Easily Made

If you do not care about tapping, make clearance holes in the ebonite, countersinking them on what will be the upper edge. Use ¾-inch countersunk screws, and clamp up the clips and the strap by means of nuts, afterwards trimming off the protruding ends of the screws with a file.

Bringing in or cutting out the condenser is now the easiest business in the world. To throw it into circuit, the device is removed; to cut out the condenser it is slipped on.

THE "SENTRY" WAVE-METER IN ACTION

—continued from page 365

tune the receiver to the required point of the howl, and switch off the wave-meter. You should then hear the station which you want, though a slight final adjustment of the receiver may be necessary for maximum signal strength.

You should find it quite easy to pick up the note of the wave-meter when it is some feet away from the receiver, though it is not then very convenient for use. If you experience any trouble in picking up the wave-meter on the receiver, do not bring the wave-meter too close to the receiver itself, but place it somewhere near the aerial lead-in or the earth.

Altering the Note

Avoid using the wave-meter in close proximity to the receiver or the leads for long spells during broadcasting hours, since with a heterodyne wave-meter used in this way energy can be radiated from the aerial almost as strongly as when the receiver itself is oscillating.

With the component and H.T. values given in the previous article, the howl produced by the wave-meter will be of medium pitch. If you prefer to have a higher note, try, lowering the value of the grid leak.

If you give it too low a value, uninterrupted oscillations will be produced. A variable grid-leak is useful for experimenting with the note, though it should be noted that the calibration of the wave-meter will be affected to a certain extent by the value of the grid-leak. You will probably have noticed already that when you change over from the loudest point of the howl to the heterodyne note when tuning in a station the setting of the wave-meter has to be altered slightly to find the silent point.

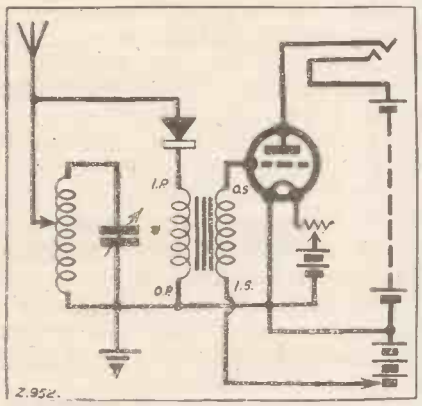
"THE COTTAGER"

by

HARRY P. WOOTTON

A Long-Felt Want Supplied.

AMONG the many designs of receiving sets which appear from time to time comparatively few nowadays cater for the user of headphones. The general cheapening of valves and component parts, and in particular the very low demand now made upon one's accumulator by the valve filaments, have done much to popularise loud-speaker sets, but there still remain many people who prefer, for some reason or other, to "stick to headphones," and, it must be admitted, headphone sets have several advantages.



The circuit, as this diagram shows, is a very simple, straightforward one.

"The Cottager" grew up as a result of a conversation with an elderly reader who spends much time alone in a small house well away from rural bustle. He put his case very much in this way:

How the Idea Originated

"I am living," he said, "some twenty miles from the nearest broadcasting station, and my garden aerial is quite a moderate one. The ordinary type of crystal set gives, my friends tell me, quite good signals, but my hearing is not what it was, and the strength of an ordinary crystal set is certainly not good enough for my old ears. A single-valve set with reaction would, I know, give me quite enough strength, but I do not want to have to bother with reaction settings, and I want my wife to be able to use the set just as easily as I can. I want the quality to be as good as can be got, and the set must be very economical to run. What do you suggest?"

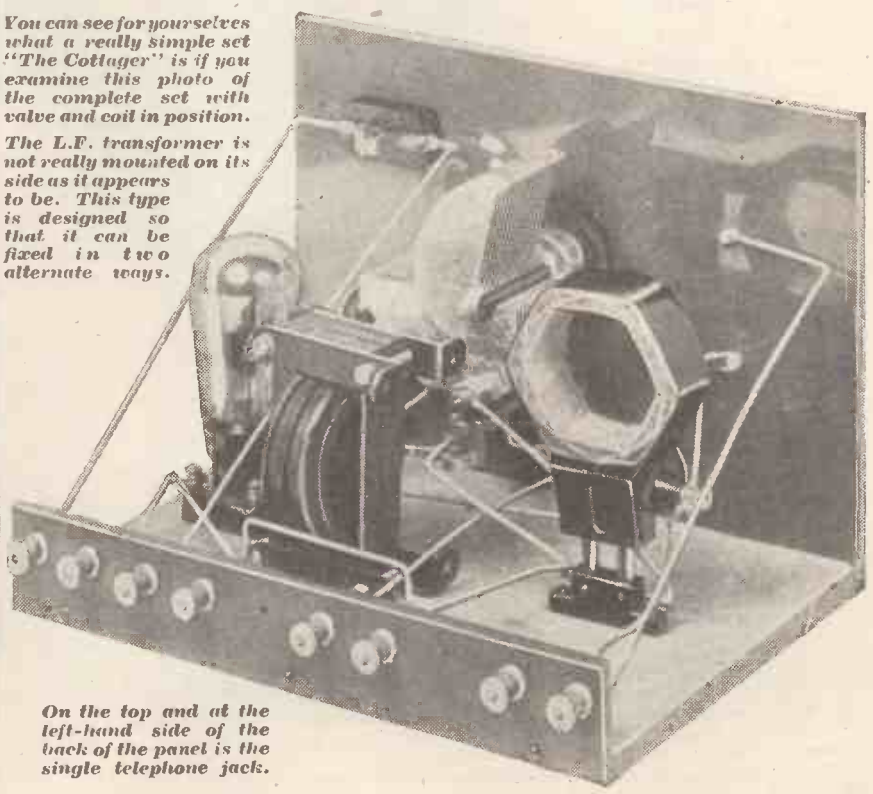
A few days later another friend, who lives only seven miles from the London station, in a busy and thickly populated area, put another question:

"Our aerial is very low and badly screened," he said, "can you suggest something which will give a little more 'kick' than our present crystal receiver and would be just as easy to operate? I want my mother to use it during the day, and she is a little deaf."

The result of these two conversations suggested to the writer that there was much to be said for a *combined* crystal receiver with a single note-magnifier. Of course, a separate note-magnifier could be added to any existing crystal set, but it is scarcely a neat arrangement, and a built-in scheme is decidedly preferable.

An Efficient Circuit

"The Cottager" set, in its circuit, has nothing new—it is, in fact, the very sharp tuning and efficient crystal circuit originated by the Editor of this journal, in which both crystal and aerial are tapped on the centre



You can see for yourselves what a really simple set "The Cottager" is if you examine this photo of the complete set with valve and coil in position. The L.F. transformer is not really mounted on its side as it appears to be. This type is designed so that it can be fixed in two alternate ways.

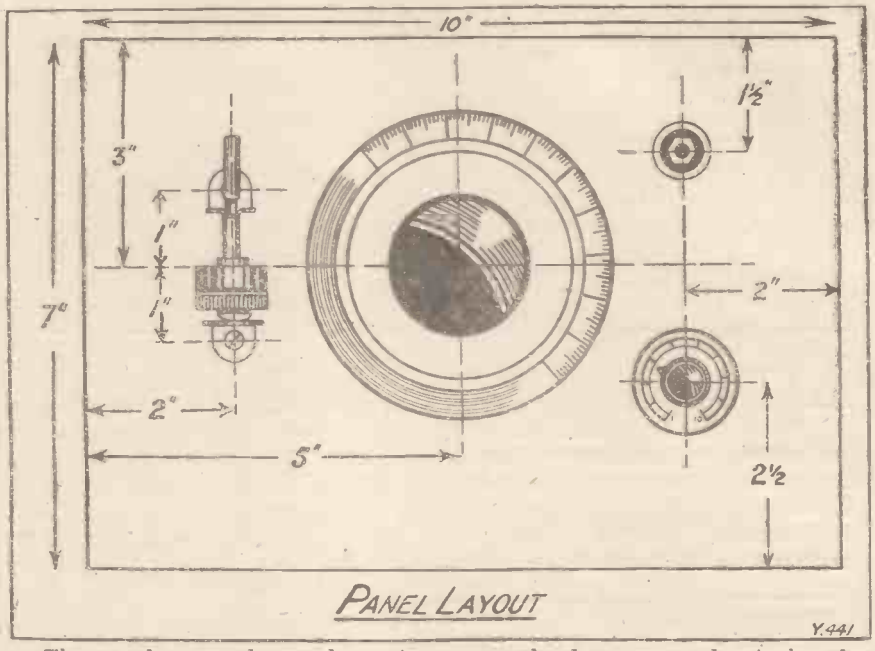
On the top and at the left-hand side of the back of the panel is the single telephone jack.

"The Cottager"—*continued*

point of the tuning coil, plus a high-ratio low-frequency transformer and note-magnifying valve. One or two practical points make for great ease of operation, one being the provision of an open-circuit jack so that the listener can leave the set at a moment's notice, without trouble of taking the headphones from the head—simply by withdrawing a plug—and a variable filament resistance instead of an on-and-off switch so that the filament of the valve need not be run brighter than is necessary, thus to some extent prolonging the life of the valve. At the same time, as 2-volt valves are recommended the valve itself cannot be injured by the filament resistance being turned to the "full-on" position.

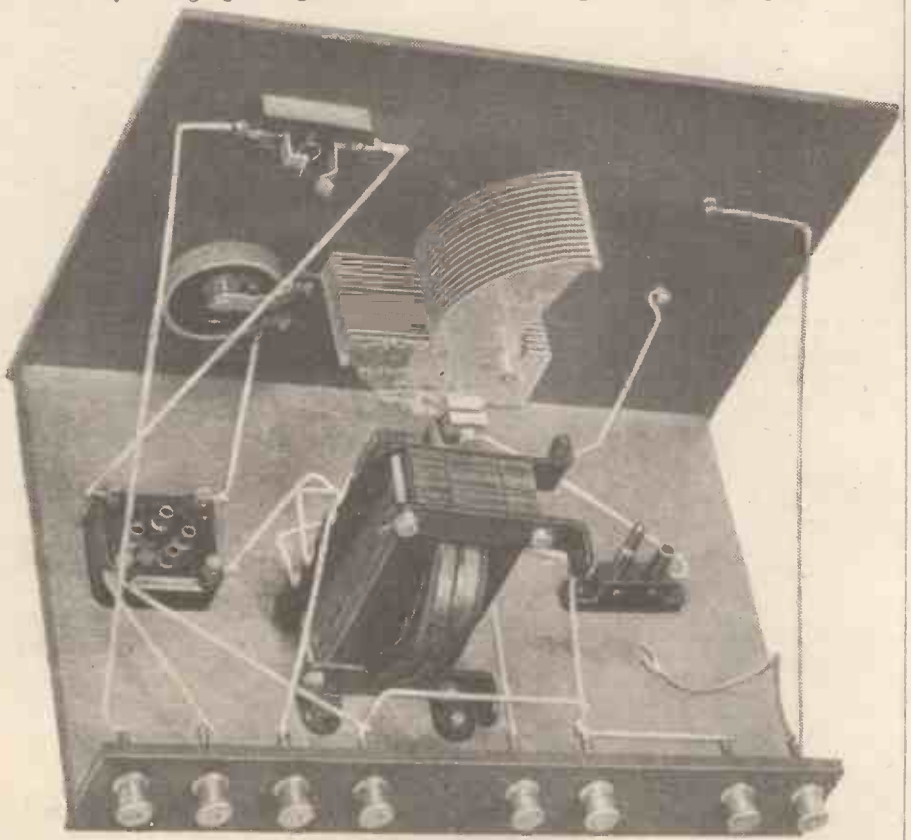
Reliable Crystal

The crystal detector is of the semi-permanent type which maintains its adjustment over very long periods, and can be very simply reset without lifting the lid of the cabinet, as it is fixed to the front of the panel, while the change to the 5 X X band is made by changing a single coil.



The set when tested proved surprisingly sensitive—far more so than had been expected from the combination. Experimenters have rather overlooked the undoubted efficiency of this particular arrangement of crystal detector and single-valve magnifier, particularly as modern transformers and modern valves are vastly superior to those in use a few years ago.

The particular circuit makes the receiver very selective, there being not the slightest difficulty in separating 5 G B from 2 L O at even four or five miles, and in the London area 5 G B and 5 X X come in at very good strength on quite a small indoor aerial. After dark, on a good outside aerial, Langenberg, Hamburg, Frankfurt and Madrid have all been heard clearly in the headphones. While it is not intended that such a set should be used for receiving these distant stations, the fact that they have been received is a good index of the sensitivity of the set and shows what a good reserve of power there is for those who wish to listen to the local station on quite a small aerial, or to receive that station at better strength than an unaided crystal set would give.



You can see practically every lead in this back-of-panel photograph. The terminals from left to right are H.T. plus, H.T. minus, G.B. minus, G.B. plus, L.T. plus, L.T. minus, earth and aerial.

Simple Circuit

The circuit is shown in Fig. 1. High-tension negative is joined to low-tension negative, so that in the case of high-tension batteries such as the Lissen, which are tapped at one end for grid bias, this one high-tension battery can supply both the high-tension and the grid bias. It is, however, just as simple to use a separate grid-bias battery, and so positive and negative grid-bias

"The Cottager"—*continued*

LIST OF COMPONENTS.

1 Panel, 10 in. × 7 in. (The mahogany finish looks well, such as Mahogany Ebonart, Radion Mahoganite, Becol mahogany finish, or any of the ordinary black polished panels will be just as good electrically).
1 Cabinet to take same, with baseboard 7 in. deep (Artcraft, Bond, Cameo, Caxton, Digby, Makerimport, Pickett, Raymond, etc.).
1 Ebonite strip, 7 in. long × 1½ in. deep, carrying eight terminals as marked.
1 Variable condenser, ·0005 mfd. (Any of the good makes advertised in this journal can be used. That shown is the Formo).
1 Open-circuit jack with plug (The Lotus is shown. There are many other excellent types of jacks available, such as Bowyer-Lowe, Edison-Bell, Igranic, Lotus, Frost, Raymond, etc.).
1 Good crystal detector (That shown is the Brownie Permatector. There are numerous two-crystal permanent or semi-permanent detectors available).
1 Suitable dial, if this is not provided with the condenser (That shown is the Radion).
1 Anti-phonic valve socket (Benjamin, Bowyer-Lowe, B.T.H., Burndept, Burne-Jones, Igranic, Lotus, W.B., Ebonart, etc.).
1 Baseboard-mounting coil socket.
1 High-ratio low-frequency transformer.

SPECIAL NOTE.—To get the best efficiency out of this arrangement it is essential that there should be a big step-up in the transformer. That shown in the illustration is the Pye, 6 to 1 ratio. Other makes of high-ratio transformer, not less than 6 to 1, can be used, but do not expect to get the same results if you use a transformer designed primarily for ordinary intervalve coupling.

1 Centre-tapped No. 60 coil for ordinary broadcast band, or one centre-tapped 200 coil for the 5 X X range, or both, as desired.
Wire for wiring up.

In addition you will need the following accessories :

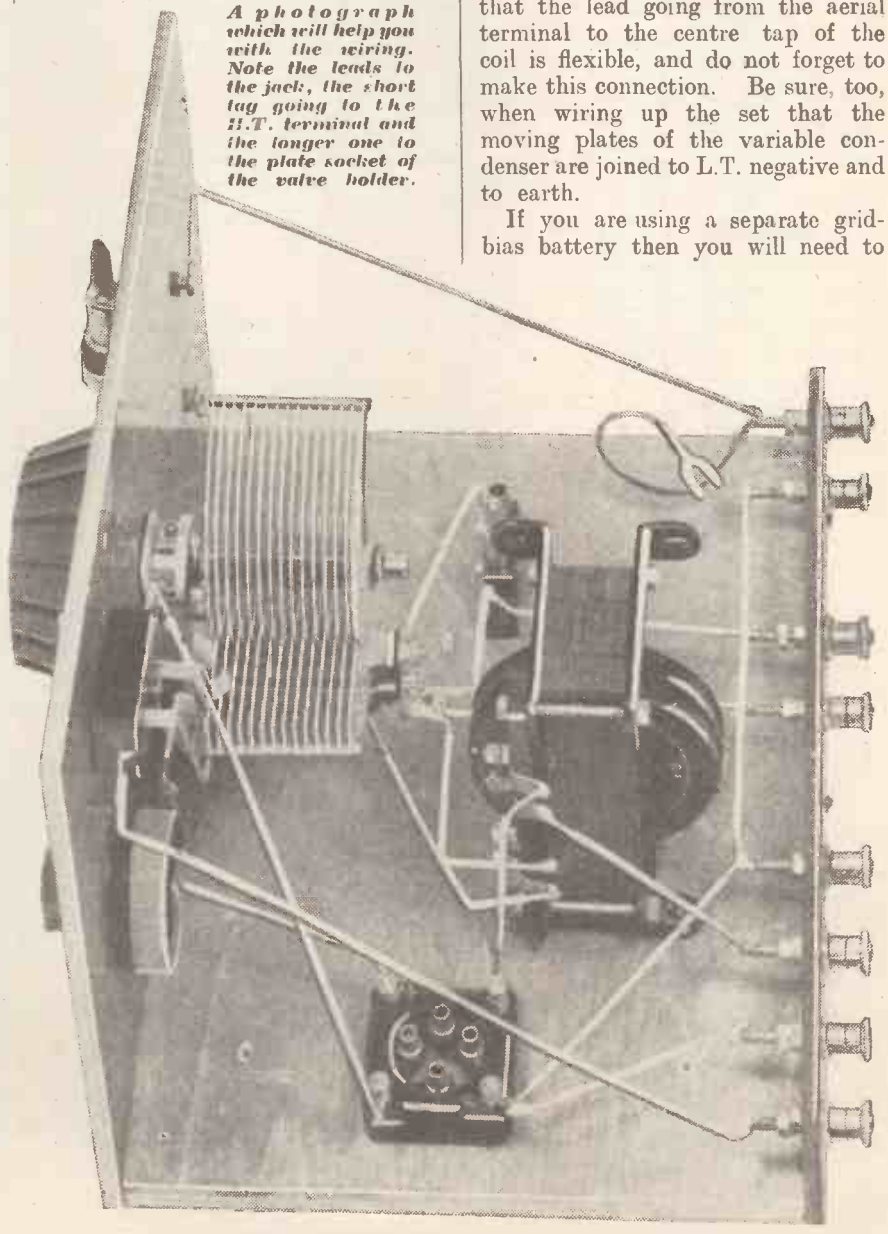
1 Pair telephones.
1 2-volt accumulator.
1 High-tension battery, 60-volt.

NOTE.—The Lissen H.T. battery is tapped at one end for grid bias. If you do not use such a battery you will require an additional grid-bias battery of 4½ volts.

1 L.F. valve, 2-volt (Any good make. Choose the L.F. type rather than the power type, as the L.F. valve will give louder signals than the power. The power valve is only for use when you have very strong signals operating a loud speaker. In such cases the power valve will handle the energy without distortion, but will not give quite so high a magnification. In this case we do not get strong signals for a loud speaker, and therefore it is much better to use an L.F. or general-purpose valve).

terminals are provided. A small two-volt accumulator, a high-tension battery, and a valve are the only accessories over and above those required for an ordinary crystal set.

The parts should be mounted on the panel first of all, then fit the terminal strip, valve holder, transformer and coil base on the baseboard. Having done this, attach the front panel to the baseboard, and wire up according to the drawings and photographs. The holes for mounting the crystal clips will vary with different makes, so be careful to follow the maker's instructions. The condenser, jack and filament resistance are all of the one-hole fixing variety, as indeed are some of the crystal detectors that can be used in this circuit.



A photograph which will help you with the wiring. Note the leads to the jack, the short tag going to the H.T. terminal and the longer one to the plate socket of the valve holder.

H.T. and Grid Bias

When constructional work has been completed, join the accumulator to the two terminals marked and the high-tension battery to the two terminals on the extreme left (looking from the back). If you are using the Lissen H.T. battery with incorporated grid bias, follow the instructions on the label of the battery. In such a case it will not be necessary to make any connection to the grid-bias positive terminal on the set. Notice that the lead going from the aerial terminal to the centre tap of the coil is flexible, and do not forget to make this connection. Be sure, too, when wiring up the set that the moving plates of the variable condenser are joined to L.T. negative and to earth.

If you are using a separate grid-bias battery then you will need to

"The Cottager"—*continued*

use both grid-bias positive and grid-bias negative terminals. The choice of H.T. should be the maximum of your battery, say, 60 volts, and the grid bias should be arranged according to the instructions given by the valve maker in the leaflet sent out with the valve. When connecting your telephones to the jack, be sure that the positive lead of the telephones is joined to the terminal of the jack which makes contact with the lead going to H.T. positive. In the case of the Lotus jack you will see easily which connection to make, as the contacts are marked "ball" and "stem," the stem going to H.T. positive.

Remarkable Purity

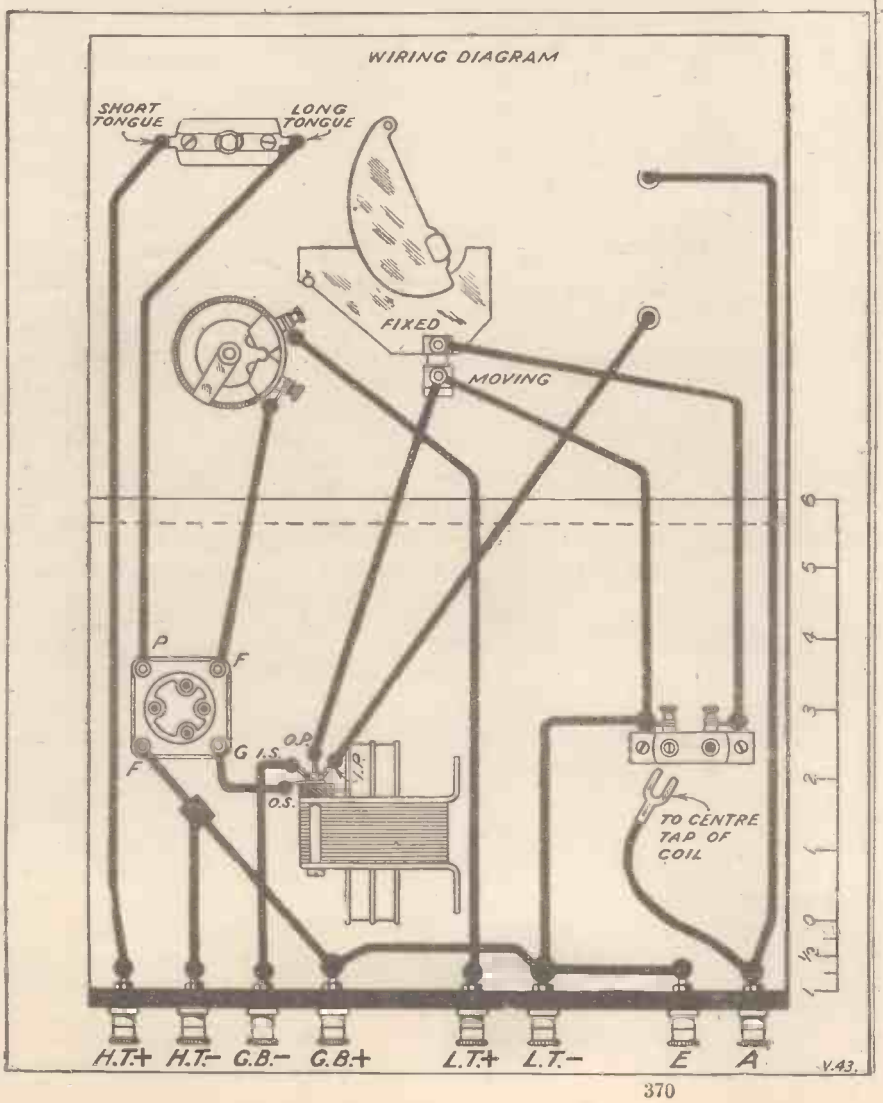
When aerial and earth are joined, and the 'phones plugged in, turn the filament resistance full on (as far as it will go), and slowly turn the condenser dial. You will soon pick up the local station and will find what astonishing strength and purity is obtainable from this set.

Two-volt Valves

It is quite possible to run the low-tension or filament supply from two dry cells connected in series, but in this case care must be taken not to overrun the valve filament by burning it too brightly. It must be remembered that two new dry cells will give three volts, and the maximum that must be applied to the filament of a 2-volt valve is, of course, two volts. When using two dry cells to heat the filament (this method is not recommended when accumulators can be charged) only turn the filament resistance just on, or, better still, use a 30-ohm filament resistance instead of a 10-ohm, and do not turn it more than two-thirds of the way on. In any case, only turn it far enough on to get good reception.

The writer would be very pleased to hear from readers who build this set, giving the distances over which they are able to receive the nearest station, and also the strength of signals on small indoor aerials, and the like, since this information is very valuable to other readers.

Queries on the set should be addressed to the WIRELESS CONSTRUCTOR Query Department, according to the instructions given on another page.



THE RADIANO THREE
"41 on the L.S."

SIR,—It may interest you to know the results I have obtained with the "Radiano Three," which I constructed two months ago. With this set I have identified in all 41 stations on the loud speaker at good strength. These include Schenectady on 379·5 and East Pittsburg on 62·5 metres, and have received several others unidentified. From these results you will agree that it must be an excellent set.

Quality is as good as can be desired. I use Ormond condensers and Igranic (1st stage) and Brandes (2nd stage) transformers.

Stations Received

Long Waves—Norddeich, Radio-Paris, 5 X X, Motala, Koenigswusterhausen, Kalundborg, Warsaw and Hilversum.

Medium Waves—Vienna, Brussels, 5 G B, Berlin (Witzleben), Langenberg, Frankfurt, Glasgow, Cadiz, Cork, Hamburg, Toulouse, Manchester, Stuttgart, Schenectady (W G Y), Madrid (E A J Y), Leipzig, London, Cardiff, Barcelona (E A J I), San Sebastian, Bournemouth, Almeria, Breslau, Dublin, Newcastle, Belfast, Nurnberg, Hanover, Dortmund, Bremen, Stettin.

Short Waves—East Pittsburg (K D K A).

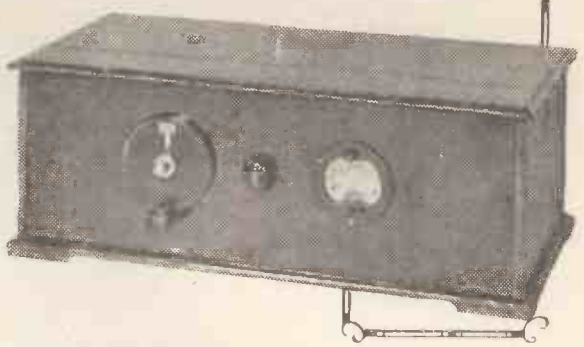
Wishing the WIRELESS CONSTRUCTOR continued success.

Yours faithfully,

Middlesex. JOHN B. BARNARD.

More about the Business Man's Four

by PERCY W. HARRIS M.I.R.E.



THE "Business Man's Four" made its first public appearance on the evening of January 12th, when the Editor demonstrated the complete receiver before the Kensington Wireless Society. The meeting-place of this society is roughly two miles from 2 L O, and as an outside aerial was used, of a size comparable with that adopted by most listeners, an excellent opportunity was afforded of demonstrating the good selectivity of this instrument.

The Editor invited a B.B.C. engineer to hear his latest and best set, and a special B.B.C. message on the subject is one of the features of this important article.

Without Interference

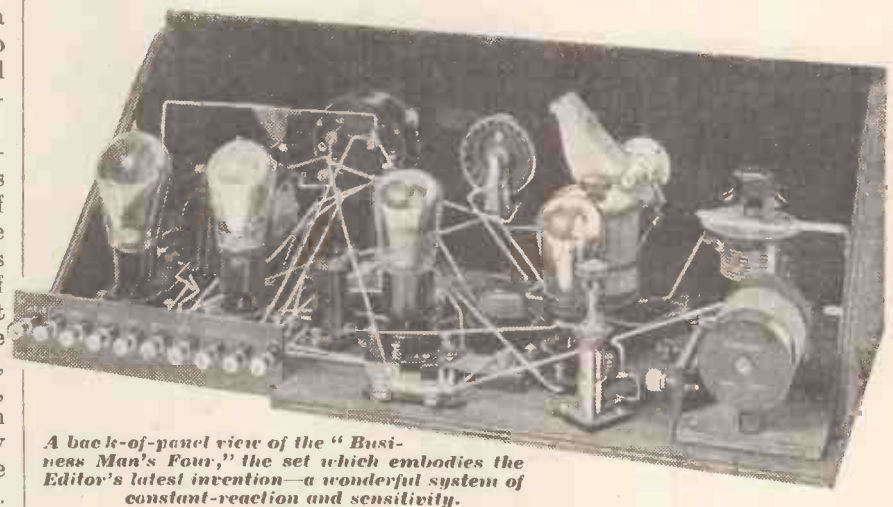
The incorporation of a wave-trap accounts largely for this, and it is interesting to observe that full loud-speaker strength from 5 G B with excellent quality was possible without any trace of 2 L O. When the wave-trap was cut out 2 L O came in "all over the dial," but with the trap in circuit 5 G B and Langenberg could be heard quite free from any interference from London.

During the lecture the great simplicity of the reaction adjustment was demonstrated, and two valves of different types were inserted in the receiver and the two reaction controls adjusted very rapidly. It was, of course, impossible in such a short space of time to show the same experiment with all makes of valves, but, as explained in last month's issue, such tests have been conducted in the laboratory, which show that every make of resistance-coupling valve will give the constant-reaction effect.

Many Stations Heard

The remarkably good quality of reproduction given on a cone loud speaker by the "Business Man's Four" was widely remarked upon, and a number of different stations were picked up at varying degrees of strength—all, of course, on the loud speaker. After the meeting members had an opportunity of trying out the set for themselves.

One of the most important features about the "Business Man's Four" is the fact that, once adjusted, a variety of stations can be picked up and general searching can be carried out without any oscillation and, therefore, without any radiation which would cause interference with neighbouring receivers. The preliminary adjustments of the set are made without aerial and earth connections, so that the listener, in making these preliminary adjustments, will not radiate squawks and screeches, which too often occur when a reaction receiver is tried for the first time. Half an hour in trying-out the circuit itself without aerial and earth connections will be amply sufficient to show any reader what to do, and once he has found the adjustments all he has to do is to connect aerial and earth and turn the single tuning dial, whereupon he will pick up several stations, the number depending upon his aerial, his local conditions, and whether it is daytime or night.



A back-of-panel view of the "Business Man's Four," the set which embodies the Editor's latest invention—a wonderful system of constant-reaction and sensitivity.

The experience is already "in the instrument," and, therefore, the beginner gets just as good results as the more advanced student.

A B.B.C. Test

The importance of a simple receiver which can be used for general purposes, and which does not oscillate, cannot be over-estimated, particularly at the present time, when several designs have been put out without the slightest warning to constructors that turning one of the dials too far will cause a great deal of interference. Bearing this in mind, an invitation was issued to the B.C.C. to send an engineer to witness a demonstration. This invitation was accepted. The instrument was set out with batteries, valves, loud speaker, etc., on the table and the B.C.C. engineer was invited to switch it on and to turn the tuning knob. On doing so, he immediately picked up, on the loud speaker, fifteen different stations (not including, of course, those on the 5 X X range), and remarked upon the amazing simplicity of handling, and the general sensitivity of the circuit. The next step was to completely upset all adjustments and to invite the visiting engineer to name any make of

More about the "Business Man's Four"—*continued*

resistance-capacity-coupling valve now on the market. A certain make was named at random; the valve handed to him, whereupon he himself made the adjustments described in the article, and in a few minutes put the receiver in the state of constant reaction.

The B.B.C. engineer was obviously impressed by the evidence of the rare combination of sensitivity and stability. Anything that can be done to reduce the risk of radiation when searching for distant stations is a matter of intimate concern to all listeners and consequently to the B.B.C. itself.

The Daventry Range

With regard to the long-wave side, it must not be forgotten that when one reaches the 1,000- to 2,000-metre range the efficiency of resistance-capacity amplification has risen very considerably, and therefore a different adjustment must be made. It will probably be found that the amplification is so high in the first stage that a dimming of the H.F. valve filament by means of the baseboard rheostat will be necessary in order to obtain stability. The best way of arriving at this setting is to adjust both the Reinartz-condenser and the feed-back condenser from the plate of the detector valve to a minimum value, and then to set the tuning condenser with the plates "all in." With the wet finger touch the fixed plates to see whether you get the double "plock" characteristic of oscillation. It is assumed that when you do this the volume control is at the "full on" position (as far as it will go to the right) and that the baseboard resistor is also set with its slider at the "full on" position. If you find that the set oscillates (as it probably will do) in this position, dim the high-frequency filament by means of the baseboard resistor until it just does not oscillate.

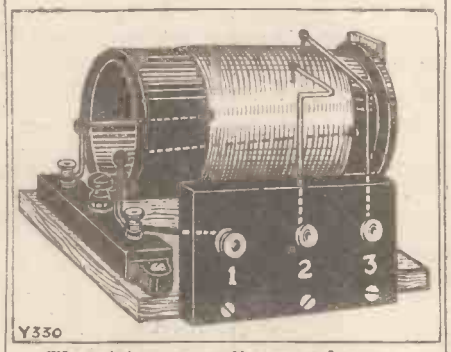
The Wave-Trap

It is best to dim it just a little beyond this point so as to have in hand a little reserve from the feed-back condenser from the plate to the first grid. You can then make the adjustments as described in last month's article for the shorter waves.

Turning now to the practical details of the construction of the standard wave-trap, it will be seen in the diagram that it is assembled upon a small wooden baseboard measuring $2\frac{3}{4}$ in. by $2\frac{1}{4}$ in. and about $\frac{5}{8}$ in. thick, the intention being that this baseboard shall be screwed down directly upon the wooden base of the receiver. The coil is mounted on this in a horizontal position, with its centre 2 in. above the lower edge of its baseboard. The coil is wound upon a piece of ebonite, Paxolin, Pirtoid, or similar good material, 2 in. in diameter and 3 in. long, and this can be mounted in any convenient fashion which does not entail the use of large pieces of metal.

In the trap illustrated the method is to fix an ebonite end disc into the tube and attach this by means of a screw to an upright strip of three-ply wood, whose lower extremity is similarly secured by means of screws to the edge of the little baseboard.

The coil consists of sixty-four turns in a single-layer of either No. 28 D.C.C. wire or, alternatively, the same



The wiring connections can be seen above.

number of turns of 9/38 Litz wire.

As the coil is wound, tappings are made in the sixteenth and twenty-fourth turns, these being the alternative positions for the aerial tap, the ends of the windings being secured by the simple procedure of passing them through two small holes drilled in the tube at the correct points, while the two tappings may be made in a variety of ways. For example, in the case of the solid wire the whole coil can be wound without making any tappings whatever, and then the sixteenth and twenty-fourth turns can be prised up slightly with the blade of a pocket knife, and two short pieces of match stick about half an inch long slipped under them.

The wires thus lifted up can be scraped bare of cotton covering by means of a knife, and the appropriate leads soldered on to them.

In the case of the Litz wire, however, a somewhat more elaborate method must be adopted since it must be remembered that in making connections to a Litz coil at any point it is essential that a good soldered joint should be made to every strand of the wire. In this case, then, the simplest way is to regard each tapping as a finishing point of the coil, cutting the wire and passing the end through two small holes as before. Then drill two more small holes farther round the tube, and secure the end of the wire from the reel as before, and carry on winding until the next tapping point is reached, where the process should be repeated. At each tapping point, therefore, the coil will be broken and two ends will be left sticking out.

Careful Soldering Required

The ends of the strands should then be bared at these points, and all carefully soldered together, the two ends next being soldered to each other and to the connecting wire.

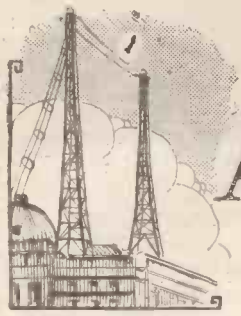
This point brings us to the question of whether Litz or solid wire should be used. The answer is that Litz should by all means be used by the constructor who feels that he has had enough experience of soldering and handling fine wire to be certain of making a really perfect joint at each point. At one time it was believed that Litz wire was not of much value on the broadcast band of wave-lengths, but more recently research has shown us that even on these waves there is a very definite advantage to be gained by the use of this material.

It is, therefore, desirable that it should be used in this case provided that the constructor is quite certain that he can guarantee a perfect joint. This is absolutely vital, and if you feel the least doubt about it by all means use the solid wire and be sure of a coil which is at least reasonably good.

The Main Difficulty

At this point it may be as well to mention that the real difficulty of using Litz is simply that of properly baring, cleaning, and soldering each strand, and this will be found a very much easier process if the type of Litz chosen is that which is silk-covered only without enamel insulation of each strand. With this

(*Continued on page* 404.)



HAPPENINGS AT SAVOY HILL

By OUR SPECIAL COMMISSIONER

THE Board Room of the B.B.C. might appropriately vary the classic inscription over its door to read: "Abandon publicity all ye who enter here." Anyway, this has always been the rule at Savoy Hill since the early days of the old Company. The recent brawling in public is decisive proof of the wisdom of the Company in these matters.

Troubled Times

During all the troubled times of the original B.B.C., when there were acute differences between both the interests and the opinions of individual members of the Board, not a murmur of these differences reached the outside world. However acute may have been the argument, it was behind closed doors. To the public the B.B.C. preserved unbroken unity; to the public it was engaged only in programme making, its proper function.

This sound tradition, established by Lord Gainford, Sir William Bull, and their able colleagues, was carried on for a period under the Corporation, but it was obvious from the beginning that there were elements in the new Board which neither understood nor agreed with this attitude of self-effacement. No one outside the B.B.C. knows what has been happening during the past year; but it is fairly obvious now that constant conflict has been in progress, and that at last the trouble has been exploited in public. Now with "ultimata" flying about, with acute personal differences freely canvassed, the position of the B.B.C. is weakened.

A Blow to Prestige

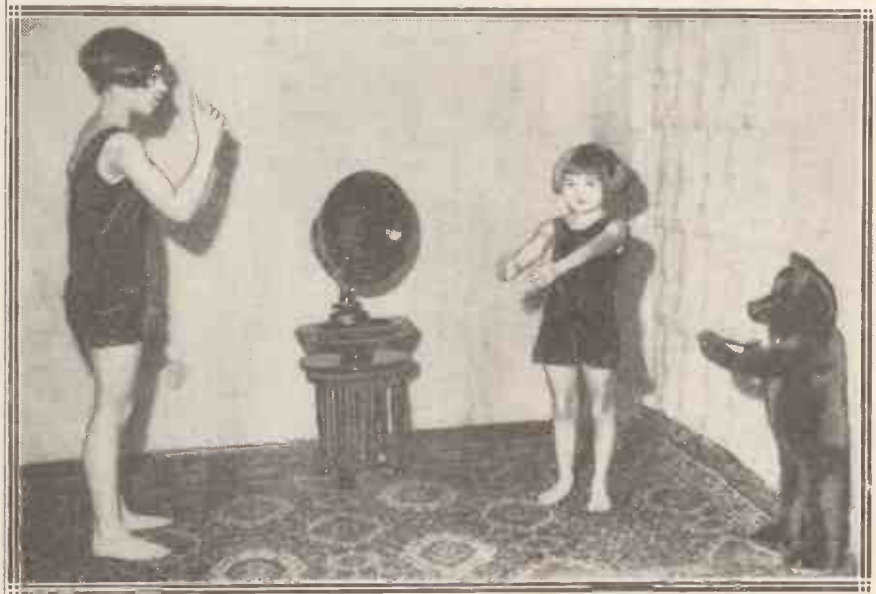
The alleged subject of the trouble is of far less consequence than the blow to the prestige of the B.B.C. If these incidents are continued, then my original contention of the folly of the change in constitution will be fully, if sadly, proved. The limited liability form of organisation, with a business board, was immeasurably superior to this elaborate compromise between State control and devitalised private enterprise.

Since 5 G B's new masts have been changed, and the power again increased, much of the trouble in the North and North-West has been met, Yorkshire has now been brought for the first time into a service area of the Daventry Junior station. But listeners in Birmingham who fondly expected that the recent changes would help them have been disappointed. On the other hand, it would be difficult to show that the service they are now getting is really inferior in any way to what they were getting before the masts were changed.

The Permanence of 5GB

The argument of the B.B.C. is that Birmingham, the West, and the South are getting just as good a service, whereas the North and North-West are brought into the 5 G B scheme of things for the first time. The B.B.C. declares that the experiment with 5 G B has been successful, and that they are learning a lot that will be of help in developing the new system of distribution. But there is a point on which Savoy Hill is not satisfactorily committed. I refer to the permanence of 5 G B.

The policy announced last year, and repeated frequently, was that 5 G B was only a temporary experiment, and that it would probably close down in August or September of 1928, when the new London Regional station might be ready. This will never do, and I hope Savoy Hill do not base any budget plans on such an unsound foundation. 5 G B has been a tremendous success, both experimentally and actually. It has taken its place as the Midland Regional transmitter, and it must not be tampered with. However difficult it may be to solve the problem of distributing wave-lengths, some means must be found to leave 5 G B alone. The washing-out of 5 G B would be followed by a storm the like of which even the B.B.C. has never encountered, and one which certainly the B.B.C. could not oppose.



The German people always have been very keen on physical training, and now that broadcasting services have been established a fresh outlet for their gymnastic energies is available. Health lessons are broadcast regularly and this photo shows two youngsters carrying out the instructions given from the loud speaker. So far no such ideas have been exploited by the B.B.C.—Why?

Who Wants Controversy?

The controversy about "controversy" has become curiously unreal. Eminent writers and leaders of

Happenings at Savoy Hill—*continued*

thought have debated the various aspects of the problem *ad nauseam.* And the one point that really matters has not been mentioned. What are the wishes of the two million people who pay the receiving licence fee?

The demand for "more controversy" means more talk if it means anything at all. No doubt some of the present talks will be made less dull and therefore more palatable, but those whose business it is to look after the so-called "serious" side of broadcasting will be quick to take advantage of the situation. It is really a golden opportunity for the "uplift" school. Mark my words, if there is presently a concession from the P.M.G. about controversy in the programmes, this will be made the excuse for an all-round increase of the proportion of programme allotted to talks and education. No sensible person in actual touch with public opinion would approve such a course, that is, if his object were to satisfy public opinion.

The crying need of the moment in broadcasting is attention to light entertainment, variety, and middle-brow music. Every penny available should be spent on these things. The B.B.C. would do well to reduce its talks by a good 50 per cent, and cut out "yapping" of all kinds.

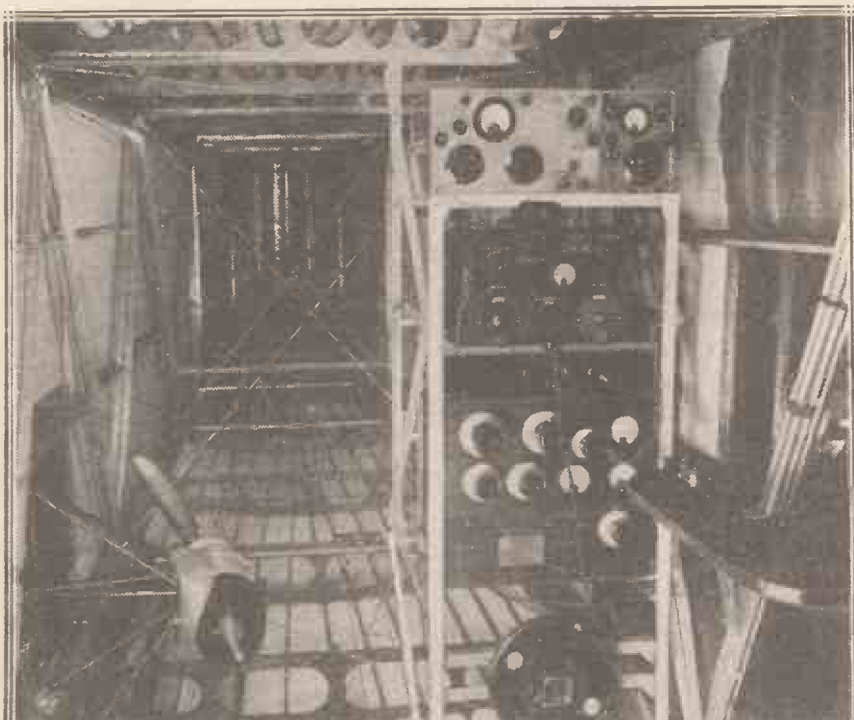
B.B.C. Unpopular in the Dominions

The B.B.C. seems to fare better with its European relations than with its Empire relations. The part taken by Savoy Hill in the Geneva Union's work is praiseworthy. The appointment of a specialist officer to look after the foreign side is justified and the B.B.C. stands well in the opinion of the broadcasters of the Continent.

So far so good. But the position is entirely different within the Empire. Canada was the first to be aggrieved. An invitation was extended to the B.B.C. to be represented at a conference in Canada this spring. The invitation was ignored for a long time and then curtly declined, according to accounts appearing in Canadian newspapers. This incident appears to have had an unpleasant effect, which subsequent apologies and explanations have not quite dissipated. Then Australia, New Zealand, and South Africa were upset about the alleged lack of graciousness on the part of the B.B.C. in failing to send a Christmas or New Year greeting over 5 S W.

The newspapers "down under" are openly charging the B.B.C. with anti-Empire sympathies. At least one of the Dominion Commissioners in London is reported as having made complaints to the British Government. I do not believe there is anti-Empire bias in the policy of the organisation of which Lord Clarendon is the titular head, but I think there is some very stupid management of the "Dominion affairs" end of the B.B.C. business. The probability is that it is no one's business in particular, and therefore goes by default.

Obviously it cannot be handled by officials engaged in the European end of the business. If the Governors are looking for odd jobs, here is one badly needing attention. Lord Clarendon and Dr. Rendall should be able to tidy up the Empire mess in about half an hour of concentration. But someone must tidy it up soon.



Elaborate radio gear is now fitted to the up-to-date air liners. Though compactness is a necessary quality a remarkable amount of gear can be stowed away in an extremely small space. Above can be seen some of the radio gear employed in a modern aeroplane. On top is a small transmitter, which has underneath it the receiver. Farther down is a large transmitter and below this the reel used for letting out the aerial wire. On the left is the motor generator which supplies the H.T. and which is swung outwards when the plane is in flight.

Progress of Radio Drama

Mr. R. E. Jeffrey, the B.B.C. dramatic producer, keeps on slogging away, constantly bringing more grist to the mill. It is no exaggeration to say that Mr. Jeffrey has done more for B.B.C. programmes than any other specialist. He discovered early on that a new technique had to be evolved and that sound effects were the first part of the problem to be tackled.

Every now and then some "idea merchant" or bright star of the theatre production world is put over Mr. Jeffrey; but this leaves his imperturbability quite unruffled. He carries on the main job, and the programmes offer a faithful reflection of his accelerating success. Thanks entirely to R. E. Jeffrey, the B.B.C. is now easily pre-eminent among the world's broadcasters in the vivid reproduction of sound and dramatic "atmosphere."

So clamp and dammy —— Let us start again. So damp and clammy is the weather at the moment of writing that moss is sprouting between the vanes of my variable condensers, and mushroom things are growing upon the high-tension battery. That battery is providing me with one of the most difficult problems that I have yet encountered. The instructions issued by its makers state that the battery must be kept in a cool, dry place. Now the only places that I possess are either cool and damp, or dry and warm.

When I consulted Professor Goop about the difficulty he was not really very helpful. The only suggestions that he had to make were that either

"Bitumen is awfully jolly stuff."

I should install a meat safe thingmejig in the drawing-room and keep the battery in that or, alternatively, that I should forswear fires for the rest of the winter, and apply blotting paper to the battery every four hours.

The "Dry" Cell

I do not suppose for a moment that the intelligent reader really understands how the dry cell functions, and I have found that every writer upon wireless, whenever he gets on to batteries, skates neatly over this part of the subject and passes hastily on to something else. For this reason I feel that a little explanation in my own lucid style will be widely appreciated. The dry battery is called dry because it is really wet. If the battery becomes really dry it ceases to bat, or, in other words, dries up.

Every enthusiast should seize the earliest opportunity of becoming acquainted with the inside of a dry cell. To do so is perfectly easy. Having chosen a time when the cook is enjoying her evening out, the kitchen meat chopper is borrowed. An old battery is then placed upon the kitchen table, and a few shrewd blows with the back of the chopper serve to splinter the bitumen sealing which covers the cells beneath. Bitumen is awfully jolly stuff.

If you give it a really good whack it flies about the place in the most satisfactory way. It treads splendidly into carpets, hearthrugs and things, and if anybody stands on it when it has got warm he either remains fixed in position or takes the carpet with him when he essays to move.

We Commence Investigations

A quaint little experience took place on the first occasion when Professor Goop and I, in the absence of both Mrs. Goop and the cook, explored the innards of a high-tension battery in the kitchen of "The Megohms." I was armed with the chopper whilst Professor Goop wielded a coke hammer. Between us, we fairly made things fly.

Wearied at length by our labours, we sank into chairs and proceeded to examine the cells that we had laid bare. Having recovered our wind, we decided to take the remains down to the potting-shed—I should say, the laboratory—for further investigation, since, as the Professor pointed out, Mrs. Goop was about due to return. The Professor and I rose simultaneously to our feet. The chairs upon which we had been sitting rose with us. The bitumen had done its deadly work.

Sir K.N. is Annoyed

We thought of climbing out of our trousers and leaving them behind, but the dictates of modesty prevented the carrying of this scheme into effect. After some discussion we decided that the only thing was to use violent measures. I placed my foot firmly upon the Professor's chair, whilst he heaved. With a sound like a super atmospheric he came free, leaving the entire seat of his nether garments behind him. However, by contriving a kind of ballet skirt out of a pair of dusters and two clothes pegs, he soon made himself perfectly presentable. Myself, I refused to do any heaving, and insisted upon the Professor fetching a saw from his workshop, with which he cut off the legs and the back of the chair. I was then able to assume an upright position without further ado.

On my way home I encountered Sir K. N. Pepper, who tackled me in a nasty kind of way about a ridiculous little matter of a couple of geared variable condensers that I had borrowed from him only a couple of years before. To show my utter disgust at the violent language that he was using, I simply shrugged my shoulders and turned my back upon him. Thinking that his opportunity had come, Sir K. N. launched a mule-like kick. The ambulance removed him to hospital with two broken toes.

The Various Ingredients

But to return to the dry cell battery. Having removed a cell, the next part of the business is to cut it in two in order that we may inspect its little inside. There are, of course, heaps of ways of doing this, but by far the most sporting is to place the thing upon the chopping-block and to have shots at it with sabre, cutlass, or battle-axe taken from the walls of your ancestral halls. The unsporting who don't like

"The chairs upon which we had been sitting rose with us."

to use such manly weapons can obtain a longitudinal section by fixing the cell in the vice and working away at it with emery cloth.

Whichever method is employed it will be found that when the cell has been cut in twain along its long axis

In Lighter Vein—*continued*

there is disclosed to view a rather beastly mess. Just inside the zinc pot is a nasty sticky compound which looks and feels rather like bird-lime, but is really sal-ammoniac mixed with whatyoumaycallit and thingmetite. Immediately surrounding the carbon positive element (or anode, said he with a condescending smirk) is a horrible black mince composed of manganese dioxide (quite distinct from ordinary oxhide such as is used for the manufacture of boot soles and restaurant steaks) and powdered carbon. Should you happen to be going to a fancy dress ball you will find that a little of this rubbed on the face and hands will turn you into a nigger far more quickly and more permanently than burnt cork.

Why Positive is Negative

Having followed my directions so far you are now thoroughly familiar with the interior of the dry cell. The next process is to use Monkey Brand and hot water. If Monkey Brand fails try glass paper. If glass paper fails I would advise you to consult a beauty specialist, who for a trifling consideration will remove the worn-out surface skin and make you look ten years younger. If the reader is under ten years of age he should stick to the glass paper.

Now that you have examined the inside of the dry cell let us proceed to see how it works. You know, of course, that current travels from the positive pole of a cell through a circuit to the negative. You really do know that. It is one of the things learnt at school

"Sir K.N. launched a mule-like kick!"

that you have not forgotten. I am rather sorry about this, because the first thing that you have to do now that you have placed yourself for instruction in the hands of the ultra-modern Wayfarer is to forget it as rapidly as you possibly can, or even more quickly than that.

Really, the whole thing is absolutely simple. Just regard the positive pole as a kind of tank raised some feet above the surface of the earth and filled with water. When you turn the tap on water flows from the tank down to earth, doesn't it? Well, just imagine the process reversed and water flowing from the ground into a tap in a high tank and you will not have the slightest difficulty in seeing how the battery really functions.

A "Practical" Illustration

When I first learnt about this reversal of the so-called facts that one learnt in one's younger days I was fearfully bucked. Since positive is represented by a plus sign and negative by a minus sign it became perfectly clear to me that the overdraft about which my bank manager was doing so much silly talking was really a credit balance.

Full of the new knowledge, I went round to see him at once. It is curious to find how obtuse some people drawing big salaries can be at times. When I demonstrated to him quite clearly that it was now known that negative was really positive and *vice versa*, and therefore his blessed bank owed me quite a lot of money, I completely failed to convince the fellow. After all, what can you expect of people like accountants and others of that kidney who when you make £100 shove it on to the Dr. side, and when you spend the same amount push it on to the Cr. side? They simply do not understand the fundamental meaning of plus and minus and you can't argue with them.

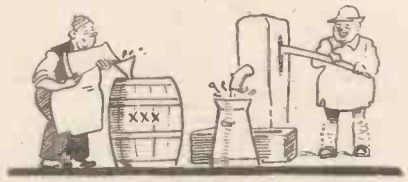
How the Battery Works

But about these funny old dry cells. The electrolyte consists of sal-ammoniac and water. Now water, as was long ago discovered by brewers and dairymen, has an extraordinary effect upon the solution of which it forms part. If used in sufficient quantities it enormously increases the dividends. In the dry cell it serves an entirely different purpose. You probably know, or if you did not you do now, that the chemical symbol for water is H_2O. In the words of the poet:

Young Wilkins was a thirsty lad
And now he is no more,
For what he took for H_2O
Was H_2SO_4.

The symbol H_2O merely means that water consists of two thingmebobs of hydrogen and one of oxygen. Each thingmebob is made of a central thingmetite, which is positive, plus one or more thingmejigs, which are negative. Water, though froth-blowers may find it hard to believe this statement, is an exceedingly active liquid. It has the effect of ionizing solids dissolved in it, which means in plain language making them go all muzzy.

They go on, in fact, just anyhow. Some of them chuck electrons away and become positive, whilst others pick up any stray electrons that may be knocking about and become negative. Thus the bird-lime stuff in a dry cell plays all sorts of funny games, part of it becoming, so to speak, overdrawn, whilst another part



"Now water was long ago discovered by brewers and dairymen."

is heavily in credit. Anyhow, it goes for the zinc just as you and I go for the fellow who digs his foot into the front-door, and tries to sell you the works of Dullbore in thirty-five volumes, with indexes and appendices.

The Zinc Succumbs

The poor old zinc, though, is much less hardy than you and I. It succumbs to the attack, and it does so with certain reservations, just as you and I, if we *do* sign the order form, date it February 31st, 1958.

The electrolyte—a neat little word, this, derived from the Greek elektron, meaning amber and luo, meaning I untie (if anybody can untie amber I will award him, here and now, with the Most Noble Order of the Biscuit)—the electrolyte attacks the zinc just as we attack a steak when we are feeling peckish.

Chunks of metal, which it does not seem to find tough, are torn out and masticated by the bird-lime stuff. But just as the steak always looks rather better than it really is, so the zinc is able to place—metaphorically, of course—its fingers to its nose as the electrolyte gets to work. It may part with chunks, but they are not complete chunks. Each one, as it is engulfed, leaves behind a proportion of its electrons.

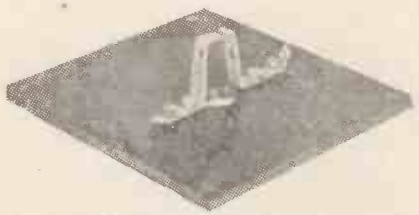
(*Continued on page 402*)

A Simple Plug and Jack

Details of a little gadget that can easily be made by the home constructor.

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

THOSE pins which are fitted to the ends of your 'phone cords were never designed to stay under the heads of ordinary terminals. You can, of course, provide them with special 'phone terminals, but there is a great attraction in being able to

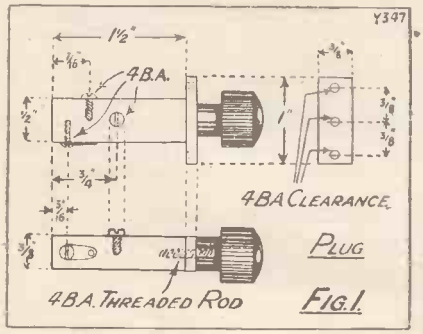


Two strips of brass form the jack portion of the gadget.

plug the 'phones, or the loud speaker, straight into the set which you are going to use.

Made from "Scrap"

The plug and jack shown in the photographs can be made of materials taken from your box of scrap. The body of the plug is a piece of $\frac{3}{8}$-in. ebonite, and the jack contacts are two strips of stiff, springy brass. The remainder of the assembly—bolts, soldering tags, the knob, and so on—you can adapt to suit the materials which you have by you.



Drill the four holes in the plug first of all, and tap them all 4 B.A. The contacts at the sides are round-headed bolts. This shape is chosen so that the plug will slide easily in and out of the jack. The cheese-headed bolt on the top of the plug is a refinement, designed to ensure that the plug is always put in the same way round. The H.T. positive cannot then fail to be connected to the correct side of the 'phones (Fig. 1).

Between the knob, which is held by a short length of 4 B.A. threaded rod, and the body of the plug is a strip of $\frac{1}{8}$-in. ebonite. This has two holes at the ends and is meant to keep the leads in position. The ends of the leads are soldered to tags under the round-headed bolts.

Making the Jack

When you have finished the plug, mark on the panel with a punch the centre of the hole behind which the jack is to be mounted. Scribe a line through the punch mark parallel to the top edge of the panel, and drill the hole with a $\frac{3}{8}$-in. drill. Round this circle scribe a rectangle with sides $\frac{1}{2}$ in. and $\frac{3}{8}$ in. long, and file out up to your lines with a small flat file, till the end of the plug will just fit into the hole (Fig. 2).

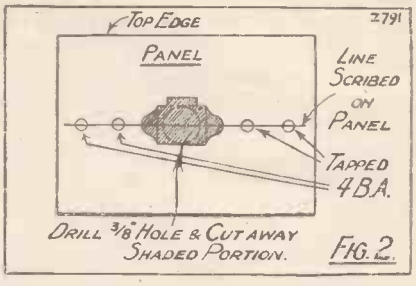
Next take a "rat-tail" file, and cut away the recesses at the sides till the round-headed bolts on the plug will pass through. Finally cut away a piece at the top of the hole to clear the cheese-headed bolt. The plug can then be pushed through the hole one way up only.

The Jack Contacts

The dimensions of the brass strips for the jack contacts are given in Fig. 3. Before bending their tips, place each one on the side of the jack in its correct position, with the round-headed bolt resting in the hole in the strip. Then bend the tip of the strip over the end of the plug. These bends prevent the plug from being pushed too far in.

Mount the jack contacts on the panel as close as possible to the edges of the hole and bend them in slightly. The holes for the bolts which secure them should be on the line previously scribed on the panel.

When you put in the plug, the

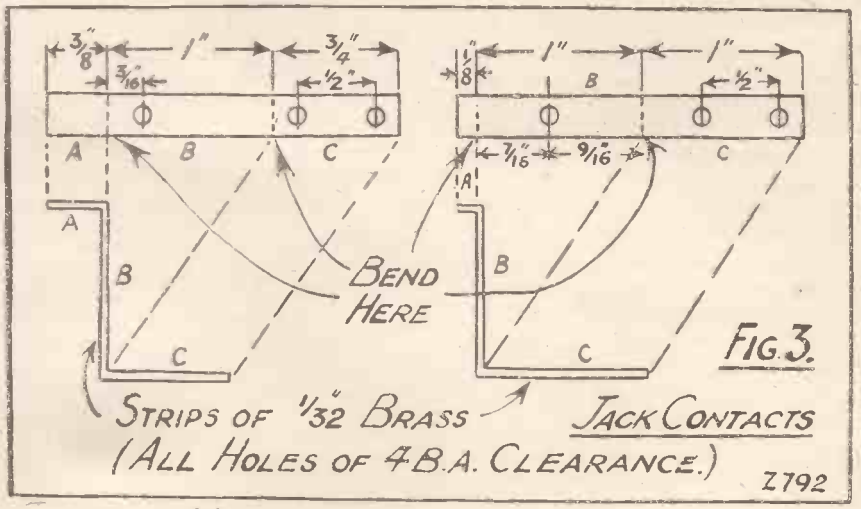


round-headed bolts will slide along the contacts and drop into the holes at the ends, making a firm contact, while no difficulty will be experienced in pulling it out again.

You must fix the 'phones securely to the plug, but that is no disadvantage. When you put away the 'phones

Inserting the plug in the hole in the panel.

with the plug attached, you can be certain that no "unauthorised" member of your household will be able to use the receiver.



Another highly important article specially prepared for the "Wireless Constructor," which should be studied by every set user.

More Light on the H.T. Battery

By R. W. HALLOWS, M.A.

IN a preceding article the results were given of actual tests made upon "standard capacity" high-tension batteries of different makes with a nominal 10-milliampere load. I say "nominal" because since the resistance used for the tests is fixed the current naturally falls as the voltage declines. Actually, resistances of 150 ohms per cell were employed, which means that when the battery was up to its full E.M.F. of 1·5 volt per cell the discharge was at the rate of 10 milliamperes, falling off gradually to rather under 7 milliamperes as the potential declined to the neighbourhood of 1 volt per cell.

This is a typical high quality dry battery such as is used by thousands of set owners all over the country.

A Convenient Scale

As in the preceding article, the "life history" curves are reduced to a percentage basis in this. Thus, irrespective of the number of cells in a battery under test, an initial voltage of 1·5 per cell is shown as 100 per cent, and the "cut off" in all cases is taken at 70 per cent, which is a little more than 1 volt per cell. The percentage method is exceedingly convenient for several reasons. It enables batteries of different E.M.F.'s to be compared as regards their performances; 100 volts is a commonly used potential for wireless receiving sets; whatever the initial E.M.F. of his battery, the user can work out its probable life by reference to the curves, and, last but not least, the current passing at any point in the curve is always exactly one-tenth of the voltage.

Suppose, for example, that you use a nominal 150 volts of high-tension and wish to see how your batteries, whatever their capacity, are likely to behave, you have only to redraw the appropriate curves, adding 50 per cent to each of the readings. Or, again, should you rely upon a single 66-volt battery, its probable life history under a 10-milliampere load may be plotted out from the appropriate curve by taking 66 per cent of the voltages shown at the various points.

Very Short Life

In the previous article it was shown that, no matter how good it may be, the standard capacity battery made up of cells of the same size as those generally used for flashlamp refills is too small to be able to deal economically with a load of more than about 5 milliamperes. Claims are sometimes made that these small batteries will stand up to much larger drains, but actual tests show that they cannot be substantiated.

Fig. 1 shows the life chart of a battery upon the case of which it was stated that the normal discharge rate was 10 milliamperes. Run for three hours a day upon week-days only, and kept at a constant temperature of 62 degrees Fahrenheit, this battery proved to have a useful life of just under eleven days, or thirty-two and a half service hours! The chart itself well repays attention, for it shows how distortion may gradually spoil reception if the battery is not up to its work.

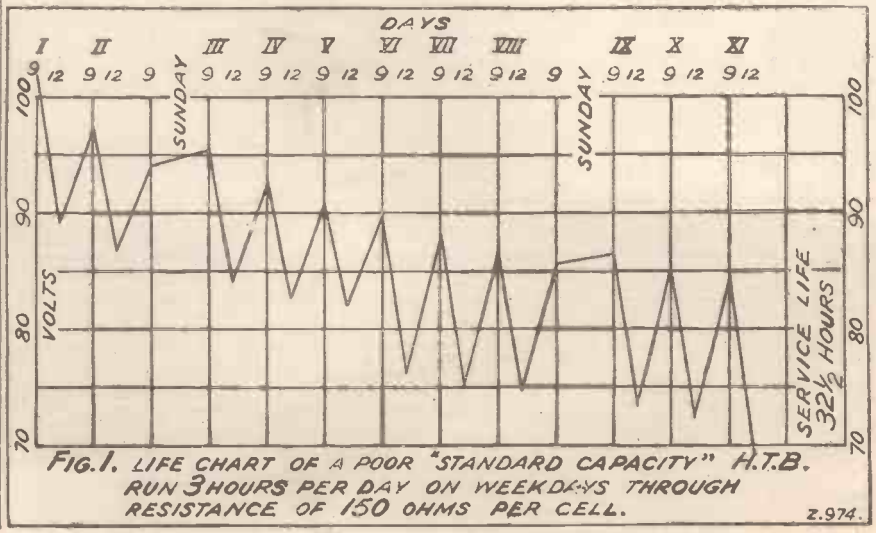


FIG. 1. LIFE CHART OF A POOR "STANDARD CAPACITY" H.T.B. RUN 3 HOURS PER DAY ON WEEKDAYS THROUGH RESISTANCE OF 150 OHMS PER CELL.

More Light on the H.T. Battery—*continued*

The average potential drop of this battery during its daily three hours' run was nearly 12 volts. Reference to a family of valve curves will show that unless the grid bias is reduced to correspond, the working point will sink before the end of the evening far too low down, with the result that bottom bending is likely to occur.

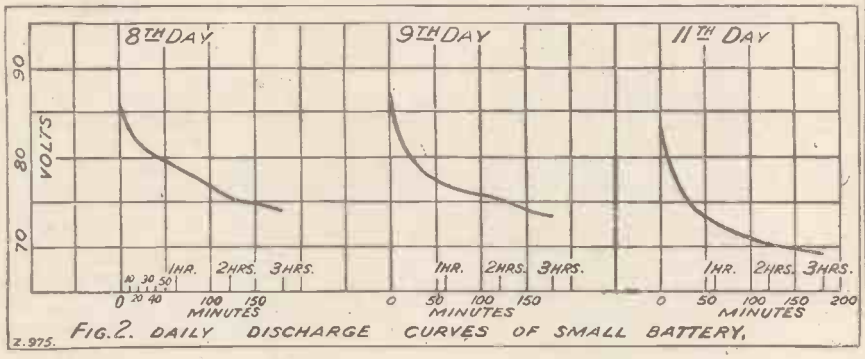


FIG. 2. DAILY DISCHARGE CURVES OF SMALL BATTERY.

The actual rate at which the voltage drop occurs during a three hours' run is also a matter of considerable importance. It might be thought that it would take place quite regularly, but this is not the case. During its period of rest the battery recuperates, the potential rising to a reading much above that obtained at the end of the previous working period.

Grid-Bias Adjustment

As soon as the battery is placed under load again a rapid falling off is seen owing to rising internal resistance. The current declines in proportion, and when a point is reached at which the discharge rate is such that the battery can cope with it fairly well the reduction of potential becomes much more gradual. Fig. 2 shows discharge curves for a small battery on the eighth, ninth and eleventh days of its service, the voltage readings having been taken every fifteen minutes during the three hours' run.

It will be seen that a heavy fall is to be expected during the first hour, a smaller one during the second, and a still smaller one during the third. When, therefore, small batteries are used under a fairly heavy load, a reduction of the grid bias may be desirable at the end of the first and second hours of each run. It should, however, be remembered that any such reduction will mean an increase in the current and, therefore, a still more rapid fall in the voltage.

Another point worth attention is the amount of recuperation shown by the battery. On some days, in the case of the one whose history is plotted in Fig. 1, this was as much as 12 volts, or rather more. Now, rapid recuperation, especially if it means a quick fall in the voltage at the beginning of the next working period, is not altogether a virtue; in fact, one would much prefer a battery which showed a smaller temporary recovery, and a subsequent voltage drop of less amount.

Another point which emerges from a study of Fig. 1 is that voltage readings taken after a rest period, and before the battery is placed under load, may be entirely misleading. On the eleventh day, for example, a reading taken prior to the working period would have shown a voltage of 84·2; one might, in fact, have thought that the battery was by no means in bad condition.

Batteries of Larger Type

At the end of the first hour, however, the voltage was 72·8 and at the end of the second, 70·4. A reading should never be taken until they have been for at least an hour under their normal working load.

In addition to the standard capacity battery two other sizes are upon the market. These are the "large capacity," made up of cells 1¼ in. in diameter by 2¼ in. in height, and the "super capacity," whose cells measure on the average 1¼ in. in diameter by rather less than 3½ in. in height. What performances are to be expected from these under a load of 10 milliamperes? In Fig. 3 is plotted the life history of a good quality large-capacity battery (by no means the best of those tested) over a period of eighteen weeks, the conditions of the test being the same as those previously described, that is, discharge through a resistance of 150 ohms per cell for three hours daily on week-days.

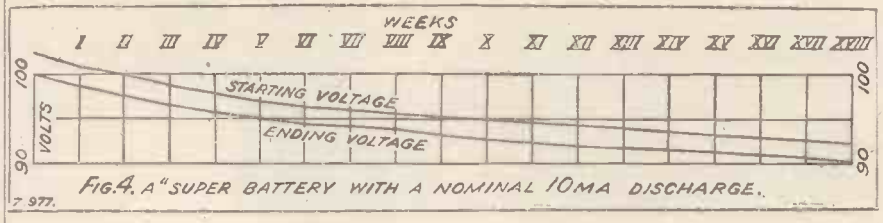


FIG. 4. A "SUPER BATTERY WITH A NOMINAL 10MA DISCHARGE.

Heavy Initial Drop

This curve is most instructive. It shows that, as might be expected, a fairly heavy fall takes place during the first week, after which the battery settles down and maintains a comparatively steady E.M.F., with a very gradual falling off. The point at which it begins to steady down is approximately 93 volts, thus showing that about 9 milliamperes is a load with which it is well able to deal.

At the time of writing, none of the many large-capacity batteries under test is anywhere near the cut-off

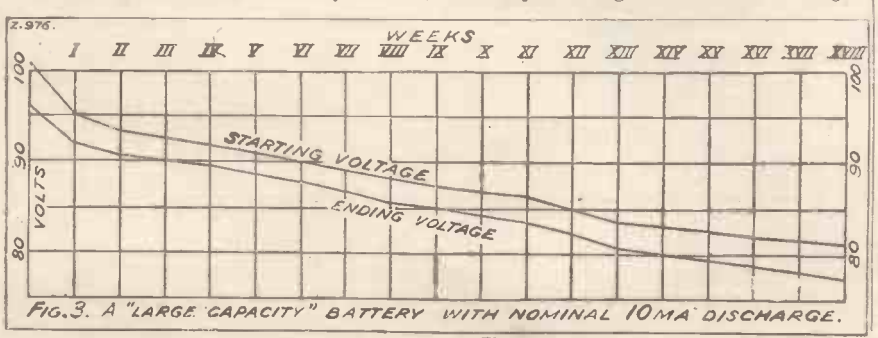


FIG. 3. A "LARGE CAPACITY" BATTERY WITH NOMINAL 10MA DISCHARGE.

More Light on the H.T. Battery—*continued*

voltage after eighteen weeks of service. On a conservative basis their average useful life may be estimated as at least six months. This means

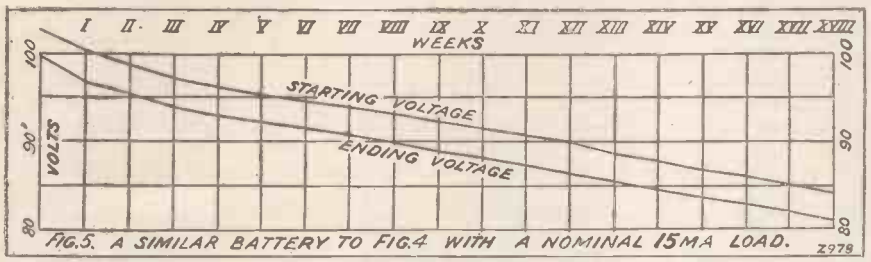


FIG.5. A SIMILAR BATTERY TO FIG.4 WITH A NOMINAL 15MA LOAD.

that two renewals will be required in the course of a year at a cost of roughly fourpence per volt. The annual cost thus works out for 100 volts at £3 6s. 8d., or ·8 penny per hour for 1,000 working hours.

An Important Point

A very important point to notice about the life curves of the large-capacity battery is the small fall in E.M.F. which takes place during a working period. On the last day of the first week, for example, the average fall during the three hours' run was just over 3 volts out of the 100, and matters were very little worse after eighteen weeks.

It follows that no noticeable distortion is likely to occur during an evening's reception if the low-frequency valves are properly biassed at the beginning; it will be seen that there is very little need to bother about the grid bias, provided that it is correctly adjusted at the end of the first ten days or so. The life of the average small grid-bias battery is about nine months, and its own fall in E.M.F. will be almost sufficient to allow for that which takes place in the high-tension battery.

The "Super" Class

We come next to the super battery, usually made up in nominal 45- or 50-volt units weighing from eleven to twenty pounds apiece. The actual weight depends largely upon the nature and amount of solid insulating material used. These batteries entail rather a large initial outlay, but my experience is that whenever the average load is 10 milliamperes or more they are well worth the extra money.

During the last eighteen months, using these large units, I have only had to buy two lots of batteries, and mine come in for a very great deal of heavy work. When experiments are in progress the loads imposed upon them, as the milliammeter shows, are often of the order of 25 or 30 milliamperes for long periods on end, and it not infrequently

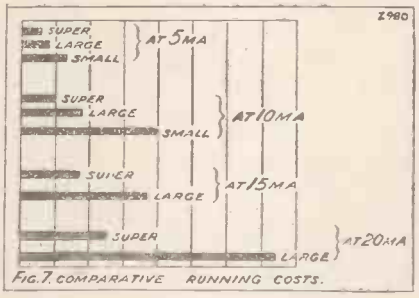


FIG.7. COMPARATIVE RUNNING COSTS.

happens that the battery is in use for six hours or more out of the twenty-four with a load of from 8 to 15 milliamperes.

One of their great virtues is that they very seldom become noisy even when their voltage has fallen to something very low indeed. Recently I made an interesting test with a number of old batteries of this kind which had been discarded either by myself or by friends some time previously, and had been standing idle ever since. They were given an hour's preliminary run to steady down the E.M.F. after their long rest, and were then connected to a receiving set.

Average Cases

The average voltage for each 45-volt unit was something under 10, or rather less than ·3 volt per cell. There was some noisiness on first switching on, but this was tracked down to one half of a particular unit, which showed 3 volts instead of its original 22½. When this had been cut out of circuit it was found that the remainder gave perfectly quiet working.

The average life of a battery of this kind under nominal 10- and 15-milliampere loads is seen in the graph which appears in Figs. 4 and 5. It will be noticed that even under the larger load the temporary fall in voltage is quite small, whilst the permanent fall is even and gradual. In such circumstances it is a simple

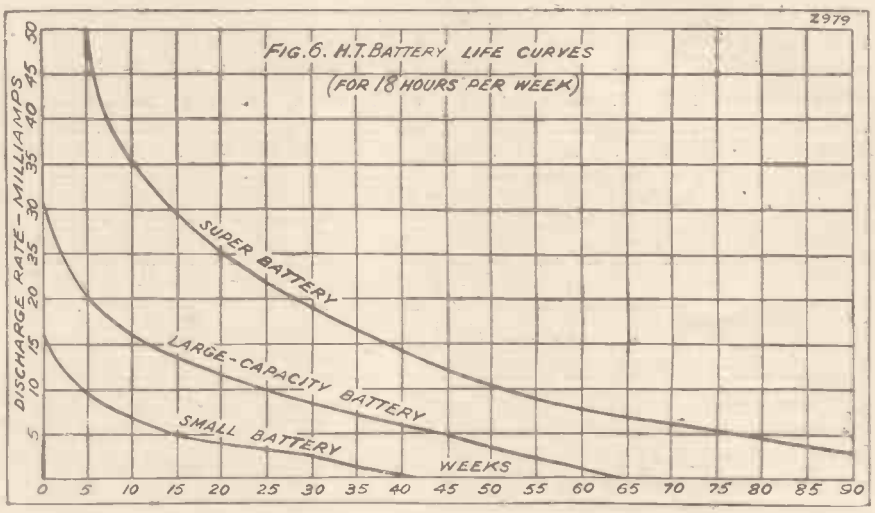
An H.T. battery consisting of a group of wet Leclanche cells. This type of anode battery is becoming very popular.

More Light on the H.T. Battery—*continued*

matter to avoid distortion due to bottom bending, for the grid battery needs scarcely any attention.

The provision of super batteries represents an initial cost of about sixpence per volt. Under a 10-milliampere load at least a year's working on an average of three hours a day is to be expected. The annual cost for 100 volts, therefore, works out at £2 10s., or 6-pence an hour for a thousand hours of work.

It will be realised that the life of any size of battery depends (provided that it is of reasonably good quality and is kept in a suitable place) mainly upon the number of hours per week that it is run and the average load imposed upon it. In Fig. 6 are seen curves from which the life normally to be expected from any kind of battery under various loads can be found.



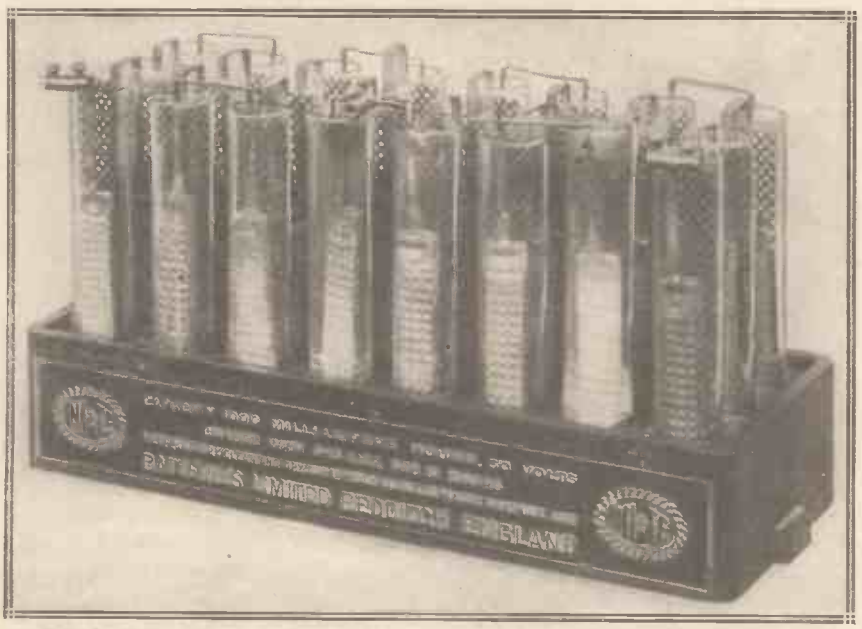
Cost Comparisons

If the average amount of H.T. current taken by the set can be measured by means of a milliammeter it is easy to work out from these which type of battery will be the most economical in the long run. A comparison of the running costs under loads of 5, 10, 15 and 20 milliamperes, using batteries of different sizes, is seen in Fig. 7. Beyond 10 milliamperes only the two larger sizes are considered, since small batteries cannot possibly stand up to a greater load for more than a very short time.

The reader may wonder how he can best determine, if he does not possess a milliammeter, whether batteries of the size that he is in the habit of using are suitable for his own receiving set. A method that I can recommend is this. Ten days or so after a new battery has been installed take a voltage reading at the beginning of the evening's run and others at half-hourly intervals.

If the fall in E.M.F. exceeds 3 volts per cent at the end of the first hour, or 5 volts after the three hours' working, then it will pay to install, when the next renewal is made, a battery of larger capacity. Should the fall be very great—10 per cent, for example, or more—the wisest course will probably be to purchase a super battery on the next occasion.

Another method of economising in high-tension costs is to use two batteries instead of one. It might seem at first sight that any such course would be most uneconomical, but this is not so. In the average set containing high-frequency, rectifying and note-magnifying valves and provided with a common high-tension battery the heaviest load is borne by the portion of the battery lying between the negative end and, say, 45 volts, for this has to supply current to all three kinds of valves.



An H.T. battery of the secondary type which functions on the Edison principle. An alkaline electrolyte is employed. One set of plates is formed of nickel and the other of iron.

Unequal Loads

The next hardest-worked portion is that between about 45–60 volts, which provides current for the H.F. valve or valves and the note-magnifiers. The lightest load is thrown upon the remainder of the battery, which has only the last valve or valves to look after. A glance at the life curves in Fig. 6 will show at once that even a slight increase in the drain upon any portion of a battery means a big reduction in the useful life of that portion.

High-frequency valves, especially if given a small negative grid bias, pass very little plate current, whilst the requirements of the rectifier seldom exceed 2 or 3 milliamperes; if it is resistance-coupled to a following valve it will need very much less than this. If, therefore, a small-capacity battery is used for the high-frequency valve or valves and the rectifier only, it may

(*Continued on page* 406.)

Invaluable to every Amateur and Constructor

The "POPULAR WIRELESS"

BLUE PRINTS

OF TESTED CIRCUITS

The following is a list of the "P.W." 6d. Blue Prints for Constructors in stock showing the different circuits available.

P.W. BLUE PRINT Number

1. DETECTOR VALVE WITH REACTION.
2. UNIDYNE DETECTOR VALVE WITH REACTION.
3. 1-VALVE L.F. AMPLIFIER.
4. CRYSTAL DETECTOR WITH L.F. AMPLIFIER.
5. H.F. (Tuned Anode) AND CRYSTAL WITH REACTION.
6. H.F. AND CRYSTAL (Transformer Coupled, without Reaction).
7. 1-VALVE REFLEX WITH CRYSTAL DETECTOR (Tuned Anode).
8. 1-VALVE REFLEX AND CRYSTAL DETECTOR (Employing H.F. Transformer, without Reaction).
9. H.F. AND DETECTOR (Tuned Anode Coupling, with Reaction on Anode).
10. H.F. AND DETECTOR (Transformer Coupled, with Reaction).
11. DETECTOR AND L.F. (With Switch to Cut Out L.F. Valve).
13. 2-VALVE REFLEX (Employing Valve Detector).
14. 2-VALVE L.F. AMPLIFIER (Transformer Coupled, with Switch to Cut Out Last Valve).
15. 2-VALVE L.F. AMPLIFIER (Transformer-Resistance Coupled, with Switch for Cutting Out Last Valve).

P.W. BLUE PRINT Number

16. H.F. (Tuned Anode), CRYSTAL DETECTOR AND L.F. (With Switch for Last Valve).
17. CRYSTAL DETECTOR WITH TWO L.F. AMPLIFIERS (With Switching).
18. 1-VALVE REFLEX AND CRYSTAL DETECTOR, with 1-VALVE L.F. AMPLIFIER, Controlled by Switch.
19. H.F. DETECTOR AND L.F. (With Switch to Cut Out the Last Valve).
21. THE 2-VALVE LODGE "N."
22. "THE GUARANTEED REFLEX."
23. THE 1-VALVE "CHITOS."
24. THE "SPANSPACE THREE." Three-Valve Receiver employing 1 Neutralised H.F. Valve, Detector with Non-Radiating Reaction Control, and 1 L.F. Valve.
26. A "STRAIGHT" 4-VALVER (H.F., Det., and 2 L.F. with Switching).
28. A "MODERN WIRELESS" 5-VALVER (H.F., Det., and 3 L.F.).
29. AN H.T. UNIT FOR DIRECT-CURRENT MAINS.
30. A REINARTZ ONE-VALVER.
31. A STANDARD TWO-VALVER (Detector and L.F.).
32. The "CUBE SCREEN" THREE (H.F., Det and L.F.).

ALL "POPULAR WIRELESS" BLUE PRINTS 6d. EACH

All orders for these Blue Prints should be sent direct to the "Popular Wireless" Queries Department, Fleetway House, Farringdon Street, London, E.C.4, enclosing a stamped addressed envelope and a postal order for 6d. for each Blue Print ordered.

WITHIN THE VACUUM

Do you ever test your own valves? It is quite an easy procedure, and besides being interesting will provide valuable information of the "characters" of the particular specimens you have in your possession. A suspected "dud" can easily be checked up in this way.

By KEITH D. ROGERS.

I HAVE just finished carrying out a large number of tests with valves, noting the various irregularities in their characteristic-curves, and where they differ from those "average" curves given by the makers.

It occurred to me therefore that some of my Constructor readers might like to do some tests for themselves, and so I propose briefly to give descriptions of the various tests that can be carried out with just a couple of voltmeters (L.T. and H.T.) and a milliammeter. A potentiometer is also useful to give accurate grid-bias voltages.

The filament voltage is measured by connecting a voltmeter across the filament terminals of the valve holder in which the valve to be tested is placed.

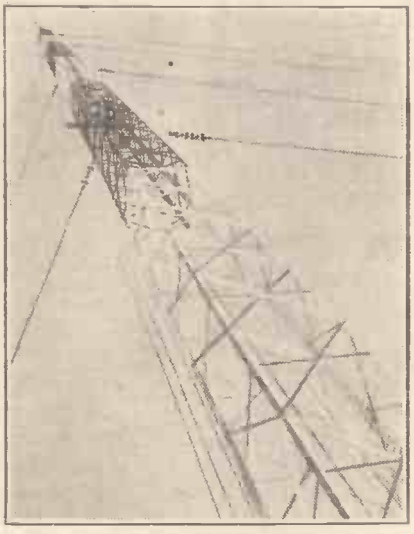
Simple Calculations

The plate voltage is tested by connecting the H.T. voltmeter across the plate and L.T. negative filament terminals. It is best to connect the H.T.— to L.T.— in this case, so that we have L.T.+ to filament, L.T.— to H.T.—, H.T.+ to plate, grid to slider of potentiometer connected across a grid-bias battery, the positive of which is taken to L.T.—. A voltmeter between grid and L.T.— will give the grid-bias voltage.

The circuit now requires a milliammeter between H.T.+ and the plate of the valve, when the arrangement is ready for most purposes. With this hook-up it is possible to take the usual characteristic curve (grid-voltage-plate current) of any valve, and this is done as follows:

The H.T. voltage is fixed and a series of grid voltages are tried, the corresponding readings of the milliammeter being noted. This gives readings for the curve. Different H.T. voltages give different curves, and so with voltages of about 50, 75, 100, 120, or so, a series of curves truly indicating the static properties of the valve under test are obtained.

Now, if the amplification factor is required we proceed as follows: Set the grid voltage at some negative value (G_1), and then fix the plate voltage at some convenient voltage (P_1). Then there will be a certain plate current flowing (C_1).



An unusual photograph taken of one of the masts of the most powerful broadcasting station in the world—Zeesen (near Berlin). With stations of this description on the air small inefficiencies in valves do not appear in their right proportions. Weak signals are far better for testing suspected valves, or for comparing efficiencies.

Now increase the plate voltage to a higher value, P_2, and note that the plate current has *increased*. Next alter the grid voltage, making it more negative until a value is reached when the milliammeter in the plate circuit reads the same as it did before (C_1). Take the grid voltage now being applied and call it G_2.

Amplification Factor

Now subtract G_1 from G_2 and call the answer G_3. Subtract P_1 from P_2 and call the answer P_3. Now divide P_3 by G_3 and the answer is the amplification factor of the valve. In other words, we have the amplification factor representing the relative effect of grid voltage changes and plate voltage changes in their control of the current.

Thus, if $G_1 = 4$, and $G_2 = 6$,
and if $P_1 = 60$, and $P_2 = 80$,
then we have

$$G_2 - G_1 = 2,\ P_2 - P_1 = 20;$$

$$\text{and thus, } \frac{P_3}{G_3} = \frac{20}{2} = 10.$$

The impedance of the valve can be simply calculated by noting the change of plate current for a given change of plate voltage—the grid volts being kept at zero as a rule.

Thus, if we have a plate voltage of 40 giving a current of 2 milliamps, and a voltage of 60 giving 4 milliamps, we have a change of voltage of 20 giving a current change of 2.

Thus we have

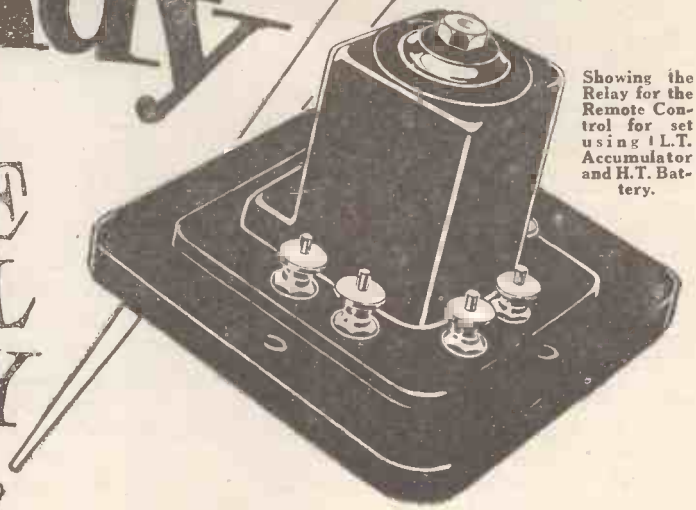
$$\frac{\text{Plate voltage change}}{\text{Current change}} = \frac{20}{2} = 10$$

The Plate Impedance

But the 20 are volts, and to correspond with those volts we must change the milliamps into amps, for we are dealing with Ohm's law, pure and simple. In other words, we can either *divide* the milliamps by 1,000 or *multiply* the volts by 1,000.

(*Continued on page* 408.)

Now ready A REMOTE CONTROL FOR ANY SET



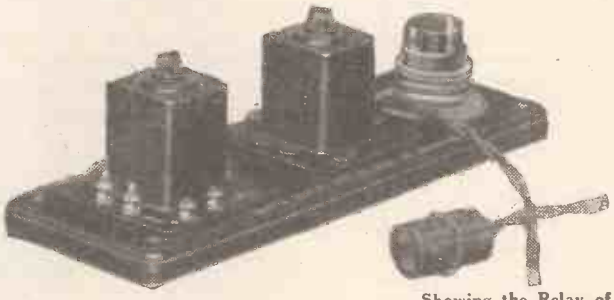
Showing the Relay for the Remote Control for set using L.T. Accumulator and H.T. Battery.

BECAUSE Lotus Remote Control has proved itself such a great convenience to thousands of users of the ordinary H.T. and L.T. wireless set, we are now making it to suit *any type* of receiving set.

No matter what sort of set you are using, you can have simultaneous reception and control. No more going from one room to another to switch on and off—no more crowding into one room to hear the wireless. Never mind where the set is; listen-in in every room by installing a Lotus Remote Control.

FREE Blueprints and instructions showing how you can fit it up easily and quickly will be sent by return on request.

Showing the Relay of the Remote Control for an "ALL MAINS" Receiving Set.



Showing the Relay of the Remote Control for set using L.T. Accumulator and H.T. Eliminator.

LOTUS REMOTE CONTROLS

PRICES:

Complete outfit for two rooms for a set using L.T. Accumulator and H.T. Battery, including one Lotus Relay, 2 Filament Control Wall Jacks, 2 Jack Plugs and 21 yds. special 4-strand wire 30/-

Complete outfit for two rooms for set using L.T. Accumulator and H.T. Eliminator 45/-

Complete outfit for two rooms for any make of circuit using All from the Mains set 47/6

In each case, each additional room 7/6 extra.

Made by the makers of the Lotus Buoyancy Valve Holder, Lotus Vernier Coil Holder, Lotus Jacks, Switches and Plugs.

Garnett, Whiteley & Co. Ltd., Broadgreen Rd., Liverpool

A MONTHLY REVIEW OF TESTED APPARATUS

(NOTE: All apparatus reviewed in this section each month has been tested in the Editor's private laboratory, under his own personal supervision.)

A Good Rheostat

FROM the General Electric Co. we have received a new type of filament resistance, two patterns being made, one for panel mounting and the other for baseboard mounting. Both patterns are provided with a well-finished moulded knob with an indicating arrow, contact between the moving arm and wire being made by means of a spring plunger which bears against the resistance wire wound on a former *inside* the

In this ingenious rheostat a spring contact presses against the inside of the resistance winding.

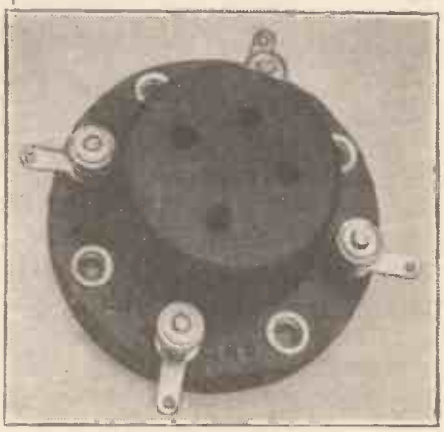
circular moulding. The accompanying illustration shows the construction of the baseboard mounting type which was very successfully used in the "Business Man's Four." The current-carrying capacity proved to be adequate and the movement is particularly smooth and positive. It is a very well-made component and is up to the high standard set by the company for their other components.

An Interesting Valve Socket

From Messrs. Redferns Rubber Co., makers of the Ebonart panels, etc., we have received a new Ebonart valve socket which at first glance appears like the old-fashioned rigid ebonite holder, but on closer examination is found to be made of soft rubber with an air-cushion effect, so that when the valve is inserted the usual anti-phonic effects are obtained, the valve swinging from side to side at quite a low period when inserted. This feature, of course, is common to all of the anti-phonic sockets now sold, but in most of them the effect is obtained by some sort of spring. In the Ebonart socket the springiness is due to the rubber, and the connections between the soldering lugs and the valve sockets themselves play no part in this, being of flexible stranded wire soldered to the sockets and terminals.

Submitted to high-frequency tests the socket proved to be particularly good, showing lower losses than several of the well-known makes of anti-phonic sockets now on the market.

Terminals of the size usually fitted to valve sockets and a good size of soldering lug are provided. The colour chosen for the rubber is of dark brown, and appears to be of excellent quality, so that a good life can be expected. The holder is thus of sound design and can be thoroughly recommended.



This novel valve holder is made of soft rubber, thus ensuring a perfect "cushioning" of the filament.

An Excellent Trickle Charger

Readers of the WIRELESS CONSTRUCTOR will remember that in the November issue we published an article dealing with dry rectifiers, in which a description was given of some of the latest discoveries in rectifying units. Messrs. Ferranti are now marketing an excellent British-made trickle charger incorporating

This trickle charger is capable of giving half an ampere charging current to either a 2-, 4-, or 6-volt accumulator.

What's New—*continued*

one of these " dry rectifiers " capable of giving half an ampere charging current to a 2-, 4- or 6-volt accumulator, according to the terminals used. The unit, which is quite compact, as will be seen from the illustration, is perfectly silent in working, and on test over a considerable period was found to be thoroughly reliable and to give the rated charging current

This coil holder is fitted with a switch so that there is no necessity to alter the coils when changing over for 5 X X.

without variation. This little accessory should commend itself to a wide circle of users, for it is perfectly silent in working, there are no liquids to spill, no bulbs to replace, and no appreciable heat is generated during the charging process. At 55s. it represents excellent value and can be thoroughly recommended to all readers. Operation is simplicity itself, it being merely necessary to join the positive and negative terminals of the accumulator to positive and negative terminals of the charger and to plug the flexible lead into the nearest convenient electric lamp socket. The device must, of course, be used with alternating current mains. When ordering, the voltage of the mains should be specified.

The new " One-Der " loud speaker (Ediswan).

Double-Range Coil Holder

The L. & P. coil holder, which is illustrated in the accompanying photograph, is designed for the convenient use of plug-in coils in a receiver designed for both the ordinary 250-550 band and the 5 X X range.

In most plug-in coil sets it is necessary to remove both the reaction and tuning coil and to substitute for them other coils when changing from one range to the other, but in this ingenious coil holder both long and short-wave tuning and reaction coils are kept permanently in position, the change-over being made by means of a switch which can be fixed to any convenient part of the set.

A good vernier movement is provided and fine adjustment is facilitated by the very convenient dial clearly marked in degrees from 0 to 90. Even the largest make of plug-in coil can be taken in this holder, the movement of which is very smooth without any backlash.

The moulded material used for the socket is of a high grade, and high-frequency tests show that it is of good quality and quite suitable for the purpose for which it is used. A particularly well-made component, which can be thoroughly recommended.

The Ediswan "One-Der" Loud Speaker

From the Edison-Swan Electric Co., Ltd., we have received for test and report a sample of their " One-Der " loud speaker, a horn type, which is selling for the very low figure of 50s. The horn, as will be seen from the accompanying photograph, has a particularly large flare. Tested on a number of sets the tone was surprisingly good for a horn-type loud speaker, and it is quite evident that particular pains have been taken in the design to get rid of the irritating resonance effects which too often mar the reproduction of this type of instrument. It is a very good horn-type of loud speaker, and represents exceptionally good value.

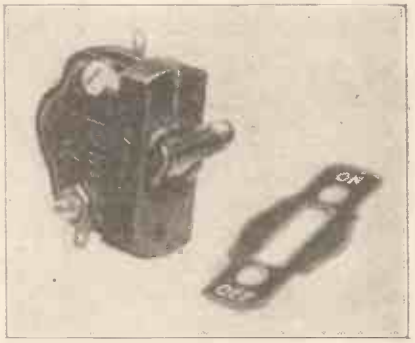
Two American Components

From the Rothermel Radio Corporation we have received two " Pilot " components, one a tumbler switch and the other a " Micrograd " variable condenser The tumbler switch is a very well-made component, capable of carrying far more

A compact variable condenser, the " Micrograd."

current than the wireless experimenter will ever put through it for filament switching; a clear indicator shows on and off, while the movement is positive and " clean cut," leaving no doubt as to whether the contact is properly made or not.

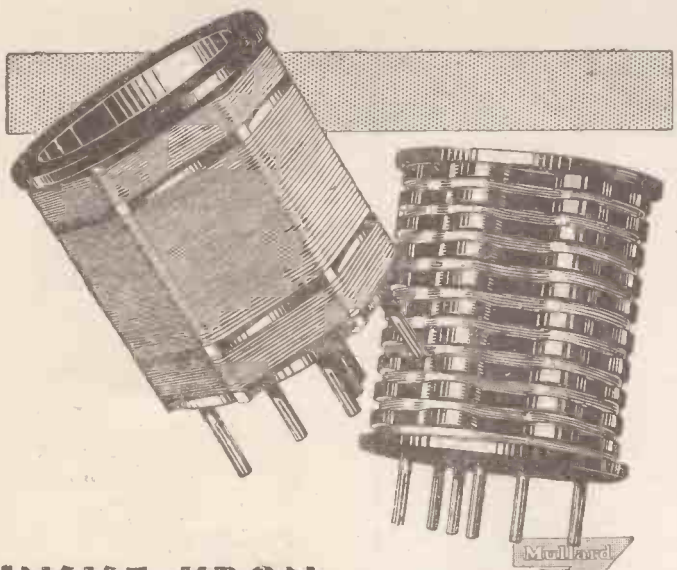
The Micrograd condenser, illustrated above, has a very smooth movement by means of an adjusting knob. A range of these condensers is made and the particular specimen submitted to us for test shows a maximum of ·00053 mfd. and a minimum of ·00018 mfd., the limit of variation thus being ·00035 mfd., which is



An efficient tumbler switch of unusual design.

about the average for this type of adjustable condenser.

It should be noted that the specimen submitted to us was marked " ·002 mfd.," a figure which obviously bears not the slightest relation to either the maximum or the minimum.



Mullard
The Master Three

INSIST UPON SPECIFIED COILS IF YOU WANT MAXIMUM EFFICIENCY

IF you are about to construct the Mullard Master Three Receiver you should remember that there is every reason why you should adhere to the author's specification.

SELECTIVITY to the desired degree is easily obtained with Colvern Coils. A few turns to requirement should be removed from the aerial winding and the end of the wire reconnected to Pin No.4.

RANGE depends to an extremely high degree upon efficient coils and it is very important that these should have a very low high-frequency resistance. To obtain this Colvern Coils are accurate space-wound. Experience proves that the use of Colvern Coils increases the range of a radio receiver. In the case of the Master Three Colvern Coils give maximum range.

VOLUME is similarly dependant upon the efficiency of coils. Logically, the signal strength of distant stations is greatly increased by Colvern Accurate Space-Wound Coils.

Therefore be advised—adhere strictly to the author's specification, you will be most satisfied.

Prices :—

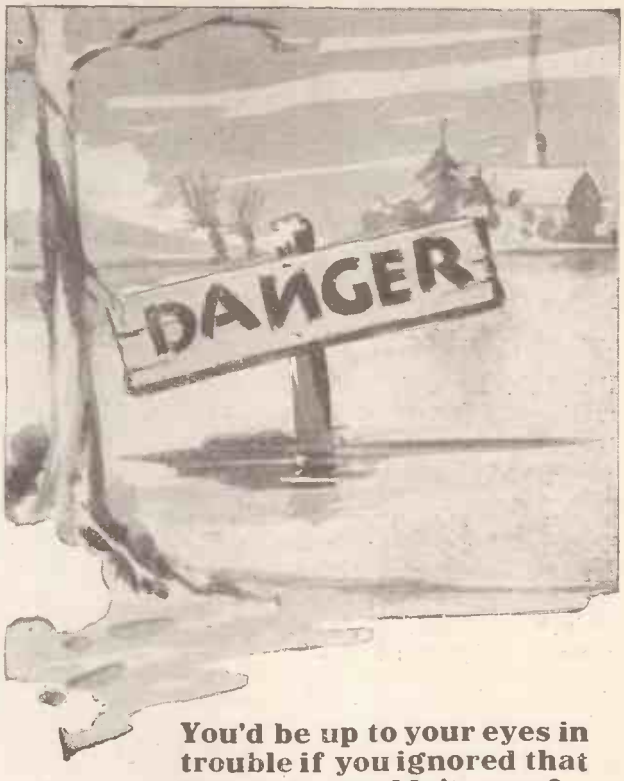
Broadcast Wave.
Accurate Space-wound to give maximum efficiency. 7/6

Long Wave.
Sectional wound to give lowest high-frequency resistance. 8/6

Colvern Aluminium Panel.
is also specified for the Mullard Master Three Receiver 18" x 7"; 14 gauge; sprayed instrument black; drilled for variable condensers switch and panel brackets. 7/6

COLVERN
ACCURATE SPACE WOUND
COILS

Colvern Ltd., Mawney's Road, Romford.



You'd be up to your eyes in trouble if you ignored that warning, wouldn't you?

THERE would be a zip, a crack, a splash, and you would disappear from view. But then you would not be so foolish as to ignore such a warning.

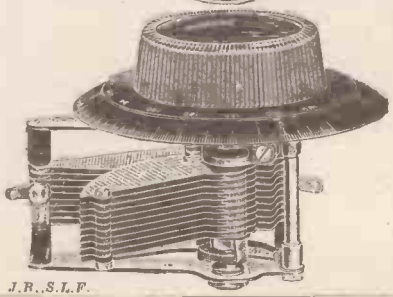
We all endeavour to avoid obvious danger, and especially in Radio, where the slightest departure from the right track leads to all sorts of endless trouble. Especially in the case of components is this true. When a person designs a Receiver and specifies the components by the manufacturers' names, he knows that those components are going to yield the best possible results. If you take home one or two alternative components, and construct the Receiver, you cannot grumble if it fails to yield the results you expected.

In that famous Receiver "The Mullard Master Three," for example, two J.B., S.L.F. Condensers are specified. Now it would be disastrous to depart from that selection when you are constructing the Receiver. The excellent and unparalleled results yielded by "The Master Three" are due in no small measure to the sharp and accurate tuning of the J.B. Condensers.

So remember, when your dealer says, "These are quite as good," you reply, "No, thank you. I must have J.B."

Then there will be no need of a Danger Signal.

JACKSON BROS.
8, POLAND ST.-OXFORD ST. LONDON - W.1
Telephone:- GERRARD 7414



J.B., S.L.F.

OUR NEWS BULLETIN

Some of the More Interesting Happenings in the Radio World this Month

THE Radio news from America during the last few weeks has chiefly been in connection with the G.E. Co.'s television experiments—experiments, by the way, which the Baird Co. should take stock of; for at any rate they do indicate the fact that real and definite attempts are being made in the U.S.A. to formulate a good practical scheme for a public television service. So far we have had only promises from the Baird Co. The G.E.C. experiment—news of which was first received in London on January 15th—has been described as the first public experiment in "home television."

The television method employed was one developed by Dr. Alexanderson—consulting engineer to the Radio Corporation of America, and to the G.E. Co. He has been studying television problems for the last eight years and his "home sets" are a comparatively recent development.

The experiment seems to have been quite successful—up to a point. The demonstrator was seen, by wireless, to move, gesticulate and to smoke; the smoke from his cigarette being "clearly seen."

If we are not careful, America will be the first country to start a regular television service, despite the fact that we have long been promised one in this country.

It is up to the Baird Co.

The Zeesen Station

The "Daily Telegraph" recently published some useful data about Zeesen, the new German high-powered broadcasting station. A power of 40 kw. is used and the station is eventually to replace Koenigswusterhausen (an 8-kw. station) on the same wave-length—1,250 metres. At the time of writing, however, Zeesen is only broadcasting in the evenings. As a rule, the programmes consist of relays of other German stations, e.g. Voxhaus, between 7 or 7.30 p.m. and 11 p.m. G.M.T. It looks as though some interesting developments between the B.B.C. and the German broadcasting people may shortly take place, for recently a deputation of German radio experts visited this country and were in close touch with Captain Eckersley. Exactly what will transpire it is hard to say, but arrangements for "swapping" programmes are hinted at.

Too Many Talks

Mr. Otho Nicholson, M.P., writing recently in the "Daily Mail" on "The Public and the B.B.C.," points out how the programme policy of the B.B.C. is definitely contrary to the wishes of the majority of listeners.

Comparison with the "Daily Mail" programme ballot, for example, shows that "whereas the expressed desire of the ballot placed talks of various kinds 5th and 11th on the list, with an allowance of 11 per cent in all of the total (programme time), the analysis shows that talks stand easily first in the point of time occupied, with 23 per cent."

(*Continued on page 400.*)

OUR NEWS BULLETIN

—*continued from page* 398

"The public may call for what it wants," concludes the author of the article, "it must take what it gets. The Corporation sits remote and beyond appeal."

That is true enough—but public agitation can make it very uncomfortable for the B.B.C. chiefs if they will persist in ignoring the definite wishes of listeners. As it is, the public is just waking up to the fact that its broadcasting service is in wrong hands—and that the present Board of Governors, without one single exception, should be scrapped, and a new board created, consisting of people who are suited for the difficult task of catering for a large and diverse public. What the B.B.C. wants is a C. B. Cochran in charge. Then things would be vastly better than they are now.

European Broadcasts

The reference I made in a previous paragraph to the recent visit of German radio experts to this country, and the possibility of "swopping" programmes with Germany is all the more likely to be true in view of the improved continental trunk telephone lines. Captain Eckersley has already told a pressman that it is hoped, by means of a combination of land lines and sea cables, that listeners will be able to hear programmes from European capitals.

New Lines

This is made possible because of the new telephone lines—of a type specially suitable for wireless relays—which are now being laid in Central Europe. It is considered likely that these new continental relays will start from Brussels—possibly Berlin—before the year is out.

More Licences

The steady increase in licence figures, month by month, is one of the B.B.C.'s best answers to adverse critics. Certainly these figures do not indicate any waning of the popularity of broadcasting, and there can be no talk of "saturation point" yet being reached.

In December, 1927, there were 2,383,726 paid licences issued—an increase of 30,000 on the figures for the previous month. In short, in 1927, 216,915 new licensed listeners were added to the B.B.C.'s unique audience.

Cheaper Valves?

A scientific discovery which, it is claimed, will greatly cheapen the production of electric light bulbs, wireless valves, and X-rays apparatus has been made by Professor G. I. Finch, professor of electro-chemistry at the Imperial College of Science and Technology, South Kensington, S.W.

Professor Finch explained to a pressman that his invention served as an extremely delicate pressure-gauge of gases. He added:

"My apparatus is simply an improved mercury vapour trap. The liquid which you see in the tube there is an alloy of potassium and sodium. I discovered that this alloy thoroughly absorbs the mercury vapour which hitherto has given so much trouble during the process of vacuation.

It is because vacuation is such a troublesome and costly business that wireless valves, for instance, and X-rays tubes are so dear. With my device it is a simple matter to secure a vacuum more perfect than has ever before been attained and far more cheaply than hitherto."

Well, let's hope this will lead to cheaper valves—and soon, too!

IN LIGHTER VEIN

—continued from page 380

The result is that the zinc, whilst being eaten away, is left with a surplus of negative electrons, exactly as you and I, when writing our cheques for the gas bill and the rates and the butcher and the grocer, are left with a surplus on the wrong side. As we become charged with a balance on the Dr. (or is it the Cr. ? I never can remember which) side, so the zinc piles up a negative charge. Very well, then.

The Electron Flow

What happens when we connect positive to negative by means of a wire ? You will answer at once that the battery is done in. You are perfectly right, except that you are entirely wrong. Remembering your school lessons, you will say at once that a heavy flow of current takes place from positive to negative. Remembering, however, on second thoughts that these must be forgotten even if they are remembered, which is doubtful, you will see that the flow of current takes place from negative to positive. The whole thing is perfectly simple if we take a straightforward analogy. Just imagine that in the unlikely event of your paying in a cheque for fifty pounds, your bank promptly debits you with that amount, and you will see precisely what happens.

Electrons dash through the circuit from the negative to the positive pole.

Depolarising

If you are still old-fashioned enough to insist upon remembering your schooldays' lessons, you have only to think of them as travelling backwards. But what happens at the positive pole ? Well, the H's get dropped. The hydrogen thingmetites sit down round the positive element, just as ladies at a tea-fight sit down round the bun-table. The latter—by which, of course, I mean the ladies and not the buns—can be dispersed only when a professional bore rises to his feet to appeal for the formation of a fund for the provision of braces for the Hottentots.

The part of the bore is played by the nasty black mess, which is known as the depolarizer. No sooner have the hydrogen bubbles got comfortably settled down round the carbon rod than along comes the manganese dioxide and simply flings oxygen at them, just as the verbose talker flings words. The wretched hydrogen atoms cannot help themselves. Under the influence of the oxygen they turn to water, precisely as you and I give way and hand out our half-crowns when we realise that the eyes of the meeting are not only upon ourselves, but also on the muffin plate in which we place our offerings.

F5—?

See Next Month's "Wireless Constructor."

The positive element is thus freed from the embarrassing swarm of hydrogen atoms. They are, in fact, neutralised or placated, even as the flapper is placated by the Government's offering of a vote. A flow of current thus takes place which you will realise as being from negative to positive, or from positive to negative, according to your degree of senility.

You find everything now as clear as mud ?

I thank you.

MORE ABOUT THE "BUSINESS MAN'S FOUR"

—continued from page 372

type of Litz it is fairly easy to get the silk off by lightly singeing with a match and then a little careful scraping of each strand will make it quite bright and fit for soldering.

Mounted upon the baseboard immediately beneath the end of the coil is a small variable condenser of the compression type which is now becoming so popular for work of this sort. The capacity of this component depends upon the wavelength of the station it is desired to eliminate. If the wave of your local station is below 400 metres, a ·00025 mfd. or ·0003 mfd. will be required, while if it is 400 metres or over, one of ·0005 mfd. should be chosen. (The alternative capacities of ·00025 or ·0003 mfd. have just been given because in some makes only a ·00025 mfd. is available, whereas in others a ·0003 mfd. is produced, either will serve.)

Using the Wave-Trap

These components have a screw-down adjustment which can be performed by means of a screwdriver, and, of course, the condenser can be left permanently set to the correct capacity once this has been found.

Screwed to the edge of the baseboard of the trap is a small piece of ¼ in. thick ebonite, 2½ in. by 1½ in., carrying a terminal and two sockets such as the Clix or Eelex types, these being for the external connections to the trap. In use, the lead from the set to the trap will be connected to the terminal, while the aerial lead will terminate in a plug which will be inserted in one or other of the sockets, according to the number of turns on the coil which it is desired to use for coupling purposes.

For the Long Waves

The selectivity of this set on the Daventry 5XX range is not good, and in many cases it will not be possible to cut out 5XX and get Radio-Paris free from the former station; but the sensitivity is so great that one can reduce the size of aerial on this range and use a small indoor aerial very successfully. Such an aerial will give much higher selectivity, and the reception results will be excellent.

A CORRECTION.

In the December issue of the "Wireless Constructor," the price of the Eureka Baby Grand No. 2 Transformer was given as 13/-. This should have been 13/6.

The question of a really efficient wave-trap for the 5XX range is now being studied in the WIRELESS CONSTRUCTOR laboratory, and as soon as a thoroughly reliable design has been produced it will be published, whereupon the selectivity on the longer range will be just as good as on the shorter.

FAULTS WITH "ONE-HOLE FIXING"

Do not assume that because a component is of the one-hole-fixing type one side of it is necessarily connected to the fixing bush. For instance, some "on and off" switches have two soldering tags at the back, neither of which is connected to the metal knob which controls the switch. Failure to notice such points may lead to mysterious faults.

A NOTE ON THE "NEW FAMILY FOUR"

A NUMBER of readers who have built, or are building the "New Family Four," described in the August issue of THE WIRELESS CONSTRUCTOR have written to ask where the four 1 mfd. condensers mentioned are used outside the set. The use of the Mansbridge type condensers of 1 mfd. capacity, or more, as shunts across the high-tension battery is often a distinct advantage particularly with batteries which are not "in their first youth." The connections are very easily made, as one simply places the four mansbridge type condensers side by side (screwed on a board for convenience), and joins one terminal of *each* condenser to a common lead, which is taken to the L.T. negative. A separate lead from each of the other terminals is then taken to its particular high-tension positive terminal. Thus one lead is teken to H.T. positive 1, the second to H.T. positive 2, the third to H.T. positive 3, and the fourth to H.T. positive 4. When connected up in this way there is a condenser of 1 mfd. capacity joined between each high-tension positive tapping and the valve filaments.

Sometimes, with almost any set using H.F. and an old high-tension battery, instability may be experienced due to battery resistance, and the shunting of such condensers across the various tappings will be found to remove this fault at once.

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RADIANO "THREE" (*March, '27, Wireless Constructor*). All parts as specified with Terminals.

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NO SOLDER—ONLY 20 WIRES TO CONNECT.

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The components specified:

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1 S.L.F. variable condenser, ·00035 mfd. (J.B.)
1 H.F. choke (Climax).
3 Anti-vibratory valve holders with terminals.
1 Pair panel brackets.
4 Terminals—A., E., L.S.—, L.S.+.
1 Set of A B C. connecting links (Junit).
2 Spade terminals—1 red, 1 black (Eelex).
1 Broadcast-wave Master Three coil (Colvern).
1 On and off switch (Bulgin).
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1 L.F. transformer, G.P. (R.I.-Varley).
1 Combined grid leak, 2 megohms, and condenser, ·0003 mfd.
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And 3 Mullard P.M. Valves.

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PERMANENT DETECTORS. Red Diamond (a topper), 2/-. Lion Micro (latest, cannot be equalled), 2/6. Brownie, 2/6. Enclosed Detectors, 1/-, 1/3. Micrometer, 2/-; Service do., 2/6 (both with crystal). Cat's-whiskers, 2d., 3d. Set of 6, 4d.

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Glazite, all colours. Also fine connecting wire, various colours, 5d. for 5 feet.

Voltmeters, 0-12, for L.T., 3/6, 3/11. Also double reading for L.T. and H.T., extremely good quality, 6/11, 7/11 each. **2mfd. Mansbridge,** 2/11.

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BROWNIE CRYSTAL SET (200/1,700 metres) Latest Model No. 3, 12/6 Pair 4,000 ohm Headphones, 7/6. Aerial and Lead-in 2/11. The above lot **18/11** NO POST.

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PERSONAL SHOPPERS

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WE HAVE THE GOODS

MORE LIGHT ON THE H.T. BATTERY

—continued from page 390

be expected to last well even in a large receiving set.

Should the first low-frequency valve, either of the "first stage L.F." or of the "R.C." type, be resistance-coupled, it may also be served by the small battery, for the total load for the whole of this portion of the set is in this case not likely to exceed 3 or 4 milliamperes. The valve in the last stage may then be provided with a battery of its own of the medium capacity type if it is of the small power kind, or of the largest type if it is a super-power valve.

Besides leading to economy in working, the use of a separate battery for the last low-frequency valve has other advantages, which cannot be dealt with here. Let us take a concrete example of the saving produced by using separate batteries. On measuring the total current taken by a three-valve set we find that the amount is, say, 10 milliamperes. On switching off the last valve, however, the current falls to 3. The high-frequency and rectifying valves are thus passing 3 milliamperes and the power valve in the last stage 7.

Annual Costs

Reference to the life curves in Fig. 6 shows that under a 3-milliampere load about half a year's working may be expected from the small battery, whilst at 7 milliamperes one of medium capacity should last for some thirty-five weeks. The small battery will thus have to be replaced twice a year, the annual cost being thus about £1 for H.F. and rectifier H.T. supply. The medium-capacity battery will need renewal about once every nine months. If, therefore, 100 volts are used, the annual cost will be about £2.

We thus get a total outlay of £3 per 100 volts, which for a thousand hours works out at ·72 pence per hour. Now, if a common battery of the medium capacity size were used to supply the 10 milliamperes needed for the set, its useful life, as the curves show, would be about half a year. The annual expenditure would thus be roughly £4, or ·96 pence per hour for a thousand hours.

There is thus a very distinct economy in such a case in using two batteries. With a super-heterodyne

(*Continued on page 407.*)

MORE LIGHT ON THE H.T. BATTERY

—continued from page 406

receiver fitted with a super-power valve in the last holder an even more marked economy would result from the use of a medium-capacity battery for the L.F. and rectifying valves and a super-capacity battery for the last.

Do not be Misled

One cannot too strongly emphasise the desirability of taking voltage readings every now and then at the end of the evening's run, and of not relying upon readings taken when the battery is under no load and has been rested for some little time. An instance of how misleading the latter kind of voltage readings may be occurred only a day or two before the present article was written.

A friend complained that 2 L O's transmissions became very bad in quality towards the end of the evening. It was suggested that the source of the trouble was probably to be found in his receiving set and not in the transmitting plant, and inquiries were made about the condition of his high-tension battery. It had been in use, it appeared, for about five months, but he assured me that it was "well up." He had, in fact, taken it round only that morning to the shop from which it was purchased in order to have it tested and the voltage reading worked out at 92 per cent of the original E.M.F.

A Typical Instance

Disgusted by the quality of the reproduction, he had not used his set for some little time, and in answer to a question it was learnt that the battery had lain idle for a week before the reading was taken. I went round that evening, taking an accurate high-resistance voltmeter with me. The open-circuit reading turned out to be not 92 but 84 per cent of the original E.M.F. The grid bias was adjusted accordingly, and for a short time reproduction was as good as could be expected.

At the end of two hours, however, only the smallest volume of sound could be obtained without obvious overloading, no matter how the grid bias was adjusted. The reading then obtained was 63 per cent, thus showing that the battery was actually at the end of its useful life instead of being in a "well up" condition as its owner had believed.

WITHIN THE VACUUM

—continued from page 392

In these cases we get the following:

$\frac{20 \text{ (volts)}}{\cdot 002 \text{ (amp.)}} = 10{,}000$ ohms, or

$\frac{20 \times 1{,}000}{2 \text{ (milliamps)}} = 10{,}000$ ohms.

Thus for the conditions under which the valve was tested the impedance = 10,000 ohms.

Now, assuming the valve was the same one whose amplification factor we have just taken, we can calculate the mutual conductance, or efficiency factor, from the figures arrived at.

We have Amp. factor = 10

Impedance = 10,000

Then the mutual conductance is the amp. factor divided by the impedance, the answer being in mhos (the unit of conductivity, and the reciprocal of resistance).

Thus we have

$\frac{M}{I} = \frac{10}{10{,}000} = \cdot 001$ mhos, or

multiplying by 1,000,000 = 1,000 micro-mhos.

Often we do not mention the actual unit (micro-mhos), but simply give the mutual conductance as a fraction of unity, so that the above becomes $\frac{10}{10{,}000} = \cdot 001$, or to give it a more convenient figure we multiply by 1,000 = 1.

Thus a valve with an M of 15 and an impedance of 30,000 ohms has an $\frac{M}{I}$ (mutual conductance) of $\frac{15}{30{,}000} \times 1{,}000 = \cdot 5$, and so on.

Measuring Mutual Conductance

The mutual conductance can be obtained practically by taking the valve and giving it a fixed plate voltage. Then vary the grid voltage between A and B (both negative values) and take readings of the plate current at the two grid voltage readings. Call them X and Y. Then we subtract A from B and Y from X and we get two readings, C and Z.

Now divide Z by C, Z being expressed in *amps* and not milliamps, and the result will be in mhos, which multiplied by 1,000,000 gives the mutual conductance in micro-mhos.

For example, if A = − 2, B = − 4 volts, X = 10 milliamps and Y = 5 milliamps, we have B − A = 2 volts, X − Y = 5 milliamps, or ·005 amp. Then the mutual conductance = $\frac{\cdot 005}{2}$ mhos = $\frac{\cdot 005 \times 1{,}000{,}000}{2}$ micro-

(*Continued on page 409.*)

WITHIN THE VACUUM

—continued from page 408

mhos = 500 micro-mhos. A corresponding unity expression for this valve's mutual conductance being ·5.

Therefore you see that with a few meters and a little patience you can find out a considerable amount about any valve you may have in your possession, and once you have commenced delving into the secrets of valves and their characteristics, and comparing them with their *practical* behaviour in a set, you will not only learn a lot but will find it a most fascinating study.

QUEER QUERIES

—continued from page 358

plug) was broken inside its rubber covering, and consequently there was no bias on the last valve. This is a good instance of the little points that need watching when hunting for a fault. It is often the very simplicity of the fault that makes it mystifying.

"Better Without an Earth"

"London is good either way, but I find that Bournemouth is better without an earth," writes a puzzled Hampshire reader.

This difficulty is one that is likely to trouble any country listener whose local station uses a fairly low wave-length.

The trouble usually arises from an over-anxiety to get a good aerial. It is not generally realised that an aerial may be *too long*, as easily as too short, so if an elastic view is taken of the 100 ft. allowed by the Postmaster-General, the minimum wave-length to which the set will tune may not be low enough.

The remedy, of course, is to shorten the aerial by a reasonable degree, making it, say, 70 ft. long including the lead-in; or else to insert a small fixed condenser (of ·0001 or ·0002 mfd.) in series between the aerial and the aerial terminal, thus giving the electrical equivalent of a reduction in length.

If this is not done, the aerial coil which was recommended for an average aerial may be too big, and consequently the removal of the earth lead may improve the tuning—an effect that never occurs with a normal aerial system.

WHAT IS A MAINS UNIT?

—continued from page 356

L_2 go to the two plates in the one valve instead of to two separate plates in different valves. Otherwise the functioning of the device is the same.

It is also possible to use certain chemical rectifiers, but generally these are messy and are rarely used nowadays. Practically all rectification for mains units is done with one of the two types of filament rectifying valves (half- or full-wave), or one of the gaseous rectifying valves of the Raytheon type.

Practical Considerations

We have now reached the point where we understand how an alternating current is turned into a pulsating electric current, and the next thing to consider is a few practical points in relation to the transformers and the valves themselves. Before proceeding farther we must consider exactly what we want at the output end of our mains units, and how far we can compromise. Questions we must ask ourselves are: What voltage we will require at the input terminals? What maximum voltage do we require at the output terminals of our device? What voltage is required to be impressed upon the plate or plates of the rectifiying valves? And what loss of voltage is there in the valve and in the devices attached to it?

Generally speaking, unless we are going in for what may be termed "super-power amplification" for moving-coil loud speakers, the maximum output voltage of 180 will be ample, and in nearly all cases 120 will serve our purpose. Quite a number of high-tension units on the market give a maximum voltage at the output end of 120. Some give 150, and some go as high as 200, while, of course, there are various lower voltage tappings. At the moment we are considering the maximum voltage.

Voltage Drop

The rectifying valve itself has, of course, resistance, and as a voltage is required to send a current through resistance the presence of this resistance in circuit means a drop in voltage. We must remember, too, that if we are using a double-wave rectifier with a centre tap on the high-voltage

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WHAT IS A MAINS UNIT?

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winding; then *each half* of the transformer must be capable of giving the full voltage we require to apply to the valve. A typical gas-filled rectifying valve in a unit giving a nominal 180 volts output maximum requires 230 volts applied between the centre tap and each extremity of the winding, so that the actual voltage across the whole secondary of this transformer is 460 volts, which leads me to the first warning!

Note this Warning

The voltages inside a mains unit are very high and extremely dangerous. For this reason the makers enclose all high voltage types inside a sound casing. Do not open up any high-tension mains unit without completely disconnecting the mains and removing the plug from the socket before you attempt it. If you do not bear this precaution in mind the WIRELESS CONSTRUCTOR *may lose a valued reader!*

Each particular type of valve has its own characteristics and maximum current which it will safely carry. The filament types of rectifying valve can be destroyed in two different ways. The first way is by over-running the filament, causing a "burn out," and the second is by passing too strong a current between plate and filament, causing the plate to become red-hot, and either to melt (in extreme cases) or to cause the valve to become soft.

The Maker Knows

The gaseous rectifying types of non-filament valves if made to pass too much current will overheat internally, and will lose their, rectifying properties. The makers of rectifying valves usually explain quite clearly just what their valves will do and their instructions should be obeyed if a reasonable life is expected from the valve. Remember that no maker wants to under-rate the capabilities of his valve, and if he says that it should not be run above a certain figure you may be perfectly certain that he knows what he is talking about!

IMPORTANT NOTICE.

The Editor will continue this interesting discussion on the subject of "Mains Units" in the April issue of the "Wireless Constructor."

ORDER YOUR COPY NOW.

SUPER QUALITY WITH ANY SET

—*continued from page* 346

will be found very convenient for wiring, and much time was spent in getting a really convenient arrangement.

The detector valve can be your existing detector valve, or if this is not an R.C. type then I would recommend you to obtain an R.C. valve for the purpose. The second valve should be any good ordinary small-power valve, and the two push-pull valves must both be of the same type and make. Which valves you use here will be determined by the high-tension supply you have available and the type of speaker to be operated. For general purposes with one of the modern types of cone speaker, two small-power valves with 120 volts on H.T. positive 3 and about 7½— volts grid bias will suit excellently. A hundred volts H.T. will generally be sufficient for the first low-frequency valve (H.T. positive 2), while on H.T. positive 1 with the R.C. valve you should use the full voltage of your battery (say, 120 volts). Grid bias is used for the push-pull valves in exactly the same way as in ordinary valves and the makers' recommendation should be followed here.

Using Super-Power Valves

If you wish to drive a moving-coil speaker and to get the best reproduction from it then the first two valves should be as already described, and the two push-pull valves should be of the super-power type with about 150 volts on the plate and a grid bias recommended by the makers for these valves. It should be pointed out, however, that the high-tension consumption of two such valves in a push-pull stage is very large and will be greater than can be economically taken from dry batteries. Each valve will take about 18 milliamperes of current, so that the total consumption of the set using 150 volts will be in the neighbourhood of 40 milliamperes. This should be taken either from high-tension accumulators or from a mains unit.

The Final Tests

It must not be thought, however, that really wonderful reproduction cannot be obtained from a moving-coil speaker without all this. The valves recommended for this purpose and the figures given are for giving really first-class reproduction without overloading the valves, thus doing full justice to the wonderful loud speakers now available.

Final tests on this amplifier to prove its suitability with a high-grade moving-coil speaker were carried out with a pair of Mullard P.M.256's, with 150 volts high-tension and 22½— volts grid bias. Used in this way the lowest notes of which the loud speaker was capable of reproducing came through without any overloading of the valve. Other very excellent valves for use in push-pull with the maximum output are the Cossor Stentor 6 and the Marconi and Osram D.E.5A., while splendid results were also obtained with the Cosmos S.P.50 Red Spot and the Six-Sixty six-volt super-power valve.

Operating Notes

There is very little to be said about the operation of this set as it is simplicity itself. As previously described, remove the detector valve from your existing set and plug it in the first socket, substituting the plug on the end of the flexible lead for the detector valve in the original set. Make sure that you have connected the correct grid bias for the first power valve and for the push-pull valves (the terminals are clearly marked) and connect up high-tension positive 1, 2, and 3 to the same high-tension supply as your existing set. High-tension positive 1 should be about 120 volts, H.T. positive 2 can be 100, and H.T. positive 3, 120 or 150, if this is available. The low-tension negative and low-tension positive are, of course, connected to the same accumulator as the set.

Loud Speaker is Protected

Note that as one uses a push-pull output transformer there is no need to use any filter following the amplifier, as no direct current flows through the loud-speaker windings, which are fully protected by the output transformer.

The set can be run quite well temporarily with only one valve in the push-pull stage, the second being withdrawn for the time being. You will not get so great an undistorted reproduction, but for general use with medium strength of signals this arrangement will prove quite satisfactory, and, of course, will affect a very considerable economy in high-tension current.

When this amplifier is used with a gramophone pick-up for the reproduction of gramophone records, one side of the pick-up should be connected to the coupling condenser terminal which is joined to the radio-frequency choke and the other to negative L.T. High-tension positive 1 is disconnected and no valve is used in the first socket, the existing grid bias on the first note-magnifying valve being used as before. This arrangement will be found to give wonderfully good reproduction on the loud speaker from the modern electrically recorded gramophone records.

Your duty towards your neighbour!

ONE H.F. STAGE

There is a large Public who are content with reception from the local Station and Daventry, whose requirements can be met by the ordinary 3 Valve re-acted Detector Set of which there are so many varieties advertised with fanciful names. To get more than this inevitably means "oscillation" with consequent howling and annoyance to your neighbours.

The B.B.C. definitely state that one H.F. stage is essential at the following ranges, if loud speaker reproduction is to be anything but "indifferent":—

100–150 miles from Daventry.	5XX.	4 Valves.	1 H.F. stage.
50–100 „ „	„	5GB.	„	1 H.F. stage.
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These figures obviously allow for that factor of safety which is so necessary if consistently pleasing reception is to be obtained under all conditions.

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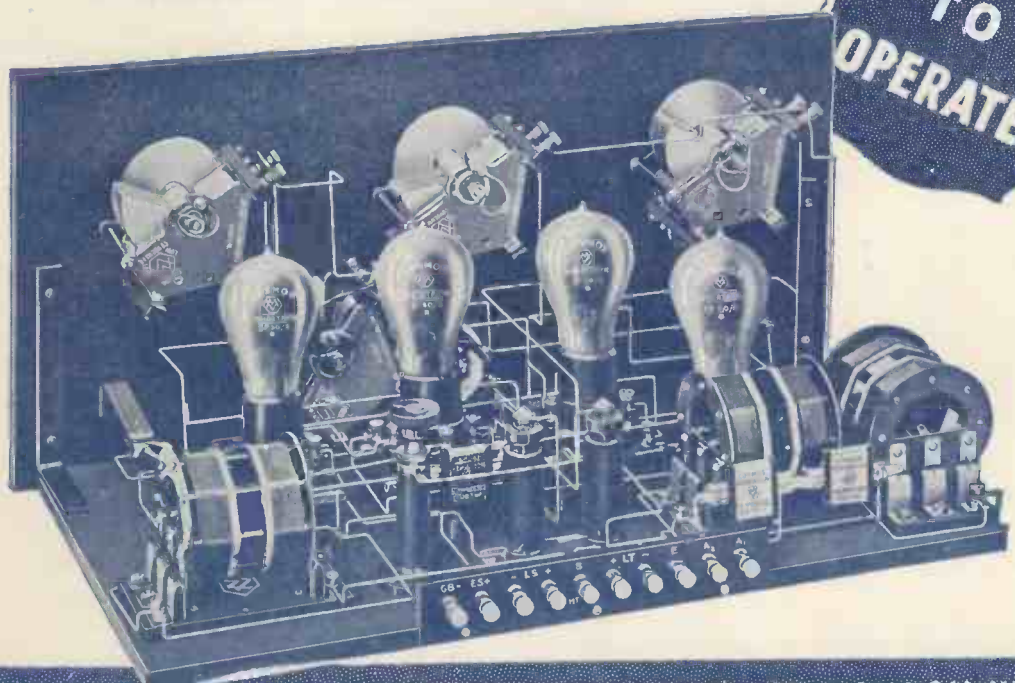

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