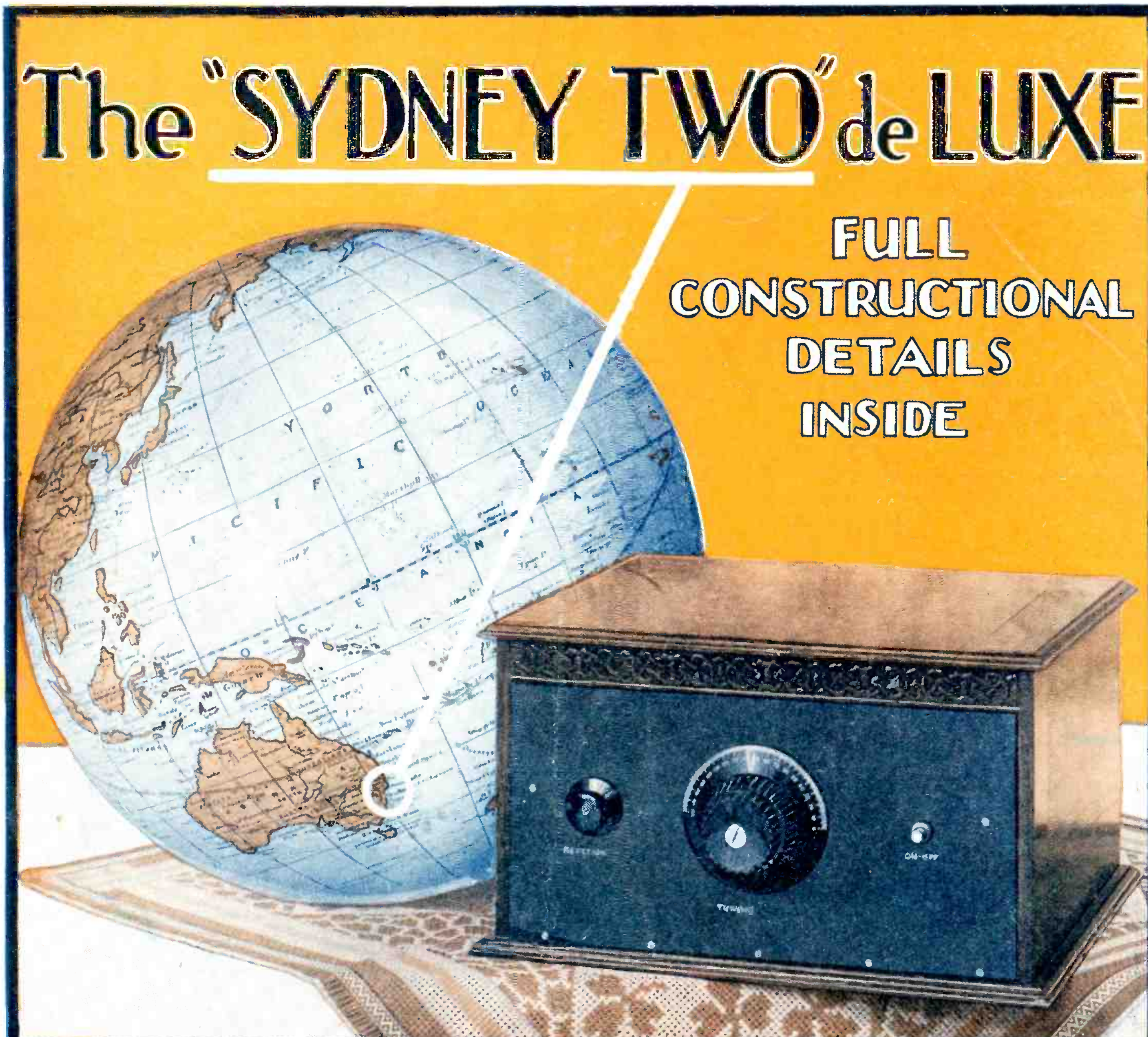
BUILD A MOVING-COIL LOUD SPEAKER

MODERN WIRELESS

1/- MONTHLY

Edited by
NORMAN EDWARDS

Vol. IX. No. 18. JUNE, 1928.



CONTENTS

Vol. IX. No. 18. MODERN WIRELESS JUNE, 1928.

As some of the arrangements and specialities described in this Journal may be the subject of Letters Patent the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

Edited by NORMAN EDWARDS.
Technical Editor: G. V. DOWDING, Grad.I.E.E.
Scientific Adviser: J. H. T. ROBERTS, D.Sc., F.Inst.P.

MODERN WIRELESS

Vol. IX. No. 18 June, 1928.

The "Sydney Two De Luxe"—"Regional" Rumours—"Radiotic" Farmers

The "Sydney Two De Luxe"

Few sets have gained such rapid popularity as the "Sydney Two." Originally designed as a two-valve receiver for short-wave reception only, it quickly became a "favourite" circuit, and thousands of amateurs throughout the country have from time to time testified to the "Sydney Two's" extraordinary efficiency.

Consequently, it is not out of place to give in this issue of MODERN WIRELESS a de luxe version of this receiver, and we feel sure that the improvements made in this "M.W." version, together with the high reputation of the set, will make it very welcome to our readers.

This de luxe version of the "Sydney Two" has special features which should enhance its appeal. For instance, the de luxe model is suitable for reception of all wave-lengths; the set is not confined to the reception of stations operating only on the short-wave band.

Constructors will also notice that the set is agreeably free from hand-capacity effects on short-wave adjustments, and that the system of reaction control is extremely smooth and free from those "threshold" noises which so often completely ruin reception on so many short-wave sets.

Needless to say, we strongly recommend this "Sydney Two De Luxe"—hence its "starred" position in this issue! And as "M.W." is not in the habit of bawling exaggerated and super merits for *every* set it publishes (although it must be pointed out that all sets, according to their class, have to pass a stringent "O.K." test before seeing the light of day), we feel sure that many of our readers will build this set with pleasure and ultimate profit. We hope they will write to us in due course and let us hear how they have fared with the "Sydney Two De Luxe."

"Regional" Rumours

The P.M.G.'s sudden decision in approving the new North London regional transmitter came as a great surprise. After something like three years' dilly-dallying a definite move has at last been made, and, if all goes well, within the next eighteen months the new twin wave-length high-power station should be operating.

Various rumours regarding sites for the new station have circulated from time to time, and Potters Bar has been a prime favourite, with Barnet a close second. The real site is most likely to be in the neighbourhood of Brookman's Park, which is nearer to London than the other sites suggested. In any case, the station will have to cover most of the area at present served by the Daventry Experimental station, and a power of at least 25 kw. seems indicated.

Even now, however, it must be remembered that the Regional Scheme, as a whole, has not been sanctioned by the P.M.G. The next twin wave-length high-power station may be held up, just as the new North London one was, and many years may pass before the ten stations are complete. That may seem a pessimistic view to take, but experience has shown that when dealing with the Post Office it is best and safest to take a pessimistic view. But if, by some lucky chance, the scheme is proceeded with without undue delay, then in about four years' time the ten Regional transmitters should be in full working order.

In the meantime, amateurs and listeners—and especially Captain Eckersley—will rejoice that at last a definite move can be made.

"Radiotic" Farmers

"Radiotic" is the latest term used to describe people who have been badly bitten by the "wireless bug." It has been coined by Mr. Geoffrey Mitchiner, a young boy formerly of Croydon, Surrey, who emigrated with a party of juveniles to Canada six weeks ago. Mr. Mitchiner is a wireless enthusiast, and before emigrating asked the Canadian National Railways officials to make special efforts to place him with a farmer who would co-operate with him in his wireless experiments.

He has since written to an official of the company in London stating that he is now working with Mr. William McLaughlin, a "radiotic farmer" of Burketon, Ontario, and that he hopes to be able to pick up, with a special set he is erecting, short-wave broadcasts from a friend in Croydon each Sunday morning. This is believed to be the first occasion on which the radio has been used by an emigrant to keep in touch with his friends in England.

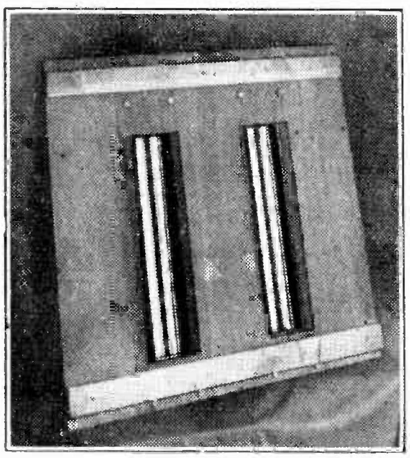
Mr. Mitchiner is a close friend of Mr. H. L. O'Heffernan, of 2, Chepstow Road, Croydon, Surrey, an experimental wireless amateur broadcasting under the call-sign 5 B Y. His is an official contact station for certain radio stations in the United States. Mr. O'Heffernan broadcasts by short wave across the Atlantic at certain stipulated times, and Mr. Mitchiner will try to pick up these broadcasts each Sunday morning.

For this purpose he took with him to Canada a two-valve short-wave set which he built himself. It is especially arranged for receiving short-wave broadcasts, and on it Mr. Mitchiner, while in England, has picked up Schenectady and Pittsburg.

MICROPHONES IN MUSIC HALLS

By DR. ALFRED GRADENWITZ.

The general tendency of the modern stage to profit on an ever-increasing scale by the resources of twentieth-century engineering is strikingly exemplified by the recent installation of a compre-



One of the pairs of plaited diaphragm loud speakers mounted on a common board.

hensive set of loud speakers at the Berlin Municipal Opera House.

Elaborate Equipment

Though the need for a loud-speaker transmission to the stage was at the time only apparent in exceptional cases, this complete plant was installed at the outset, and was for the first time taken into operation in connection with the recent first night of E. Krenek's popular opera, "Jonny spielt auf" ("Johnny is playing up"). The composer, for instance, in the second act asked for the noise of an avalanche to be represented by a choir. This choir being installed on the third-floor, its singing had to be made audible by loud speakers throughout the auditorium. Band microphones installed in the music-hall were used for recording purposes, the necessary amplifier installations being accommodated on the fifth-floor. The machinery for generating the anode current was installed in the engine-room (basement), where all the remaining engines and machines of the house are likewise found.

Eight Loud Speakers

Eight narrow-plaited diaphragm loud speakers were used on the stage for rendering the singing, and were installed by pairs in the ceiling of the auditorium in a practically invisible position vertically above the orchestra.

In another scene of the same opera the composer desired a broadcast transmission to be performed, in connection with which a violinist, among other things, was to recognise his own instrument that had been stolen from him. A horn loud speaker, as the theatre management would have it, failed to ensure a reproduction of sufficient faithfulness to make the recognition of the violin plausible.

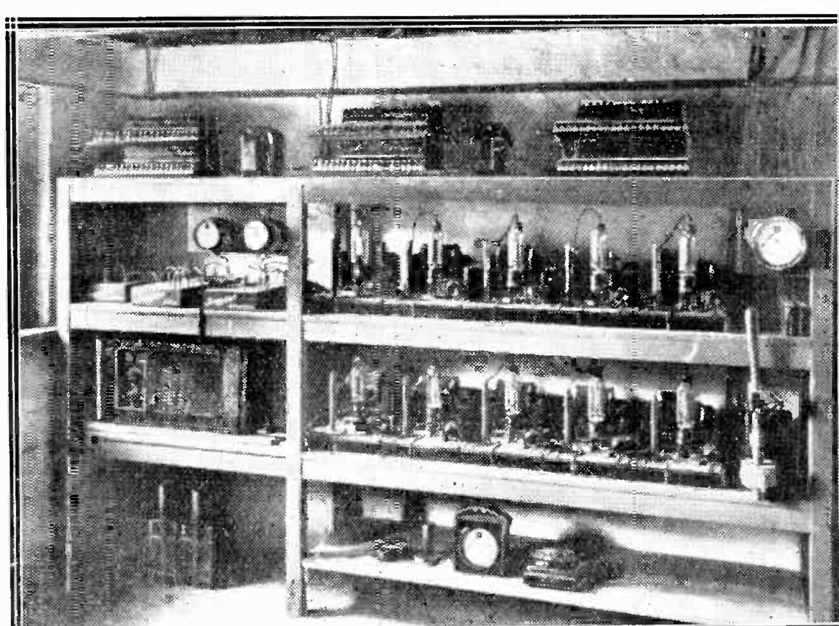
A compromise was made by placing beside two narrow-plaited loud speakers, mounted on a common base-plate, a dummy horn, thus giving the illusion of a voice coming out of the horn. However, the very faithful rendering of the two loud speakers was purposely impaired to the extent of obtaining some of the timbre characteristic of horn loud-speaker reproduction, while making it still plausible that the violinist's instrument was actually recognised by its owner.

Clear Reproduction

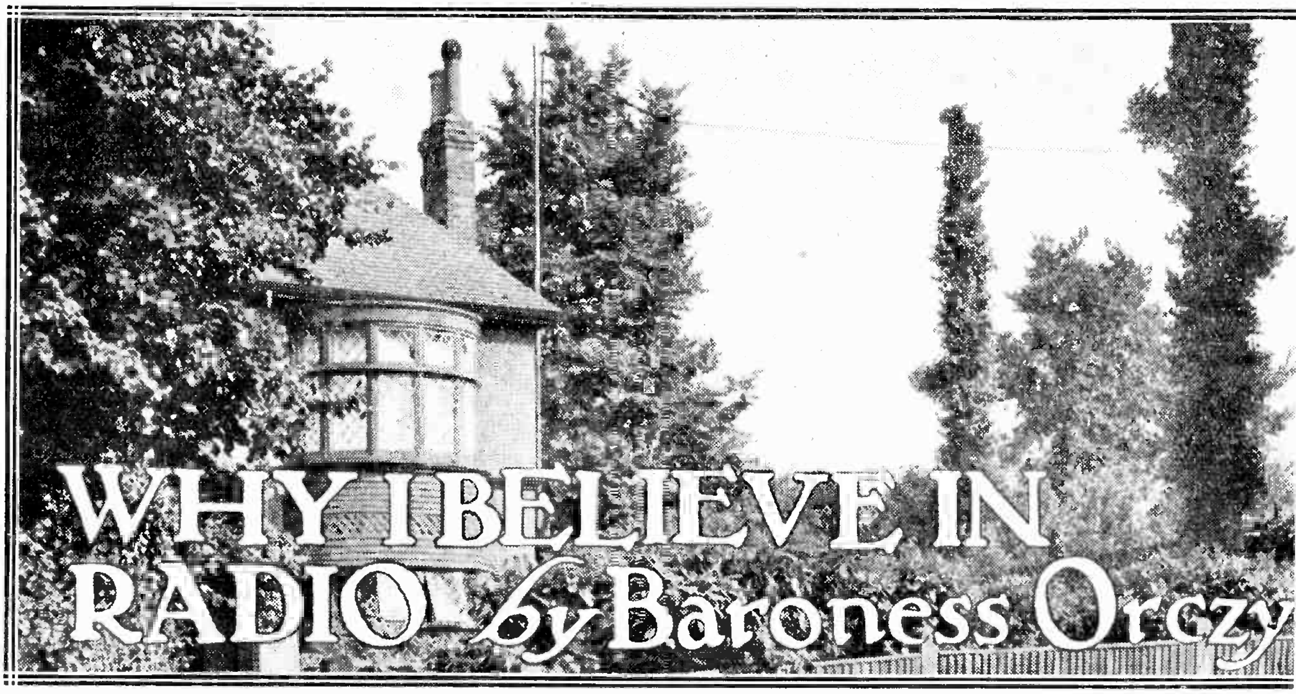
The reproduction of the voices was extremely distinct, and entirely free from the characteristic defects of the average loud speaker, so that even trained spectators failed to realise whence the voices were coming.

After this promising beginning the same plant is to be used in other operas in connection with any special effects.

The installation was made by the Siemens and Halske people, of Berlin.



The amplifiers which are installed on the fifth floor of the Berlin Municipal Opera House.



WHY I BELIEVE IN RADIO by Baroness Orczy

Here the author of the famous "Scarlet Pimpernel" gives strong reasons why she is one of the keenest supporters of broadcasting.

THERE was recently an amusing complaint that the modern general use of wireless was affecting the weather in Great Britain, and causing rainy summers and severe winters. How this rumour started I do not know, but the amount of credence it gained proves what an amazing amount of superstition is left in our natures after all these centuries of civilisation! Say there is a mystery in a thing whose workings are not yet fully understood, and thousands of people will see something akin to witchcraft in the simplest phenomena!

There have been more serious criticisms of radio, however, since Senator Marconi gave the fruits of his research to the world. Men and women really qualified to judge have thought and said that it is, for example, killing all that is best in drama all over the world.

They argue that patrons of the theatre will not go to the trouble of venturing out of their homes on cold or wet nights when they can be given good music and other forms of entertainment at home merely by turning a switch. This, they contend, will mean the gradual extinction of one of the noblest arts for the expression of human emotions, and incidentally the throwing out of employment of thousands of men and women.

Alleged Damage

Other critics have levelled their attack on radio because they state that it is damaging literature. No longer are we left with leisure to read widely, and gain the inestimable comfort and companionship of good literature. Instead, we are given a few fragmentary facts now and again by wireless, and with these we content ourselves, like travellers who mistake mirages for real oases in an arid desert.

Baroness Orczy, the well-known novelist.

Then we are told that the growing habit of decreasing our allowance of exercise will be so increased by the chance of having our amusements—now almost our only means of physical activity in many cases—brought to us in our homes will devitalise the races of the world, leaving a nerveless, incapable creature in course of time which will lose the greater part of the use of its limbs, and the joy that comes from glowing health.

"Immense Potentialities For Good"

But all these arguments are, in the first place, quite powerless to stop the Juggernaut advance of progress. Much the same things were said in the advent of railway trains, of aeroplanes, of the telephone and of the motor-car. There have been protests against everything calculated to speed up the world. Yet they have not succeeded, and the things that were complained of have seldom done much harm. In the case of wireless, I believe its effect will not be merely passive, but that it has immense potentialities for good!

In the first place, will it not help, rather than harm, drama? An immense new public will be interested in the theatre by hearing the broadcast extracts of plays, and the interesting facts about them and the great players of the past which are frequently given. Employment will be given to a new class of actor, who will make a specialised study of radio drama, which itself has great future possibilities.

Literature should certainly gain from the new interest which will be aroused in it by the introduction of constant references to it which are always made in cultured conversation. Moreover, debates between famous

GRID BIAS—

How to avoid distortion

The object of the grid-bias battery is to keep the grid of the amplifying valve always negative. relatively to the filament. What is not sometimes borne in mind is that although there may be 3, 4½, 6, or even 7½ negative volts on the grid when signals are not being received, this may not be sufficient to keep the grid negative when the set is in operation.

Large Grid Swing

The effect of the incoming signals is to swing the normal grid voltage up and down about its normal or fixed setting. In a four-valve set with a power amplifier, the "swing" on the last stage may easily rise to between 15 and 30 volts, or even more if powerful signals are required. In the earlier stages the swing is, of course, less pronounced.

The Early Stages

Generally speaking, if the grid of the H.F. amplifier is connected to the negative terminal of the filament battery, no other grid bias is necessary. The incoming signals at this stage seldom exceed a small fraction of a volt.

For the detector valve, the swing may rise to 2 or 3 volts, so that one cell (1½ volts), or two cells at most, of the biasing battery will be sufficient. The same amount will usually suffice for the first low-frequency stage, though it may be increased to 4½ volts if the high-tension is above 80 volts.

Power-Valve Bias

For the power stage, using a plate voltage of 120 or more, the grid bias may be at least 15 volts (ten dry-cell units), if good reproduction and an economical use of the high-tension batteries are points worth consideration.

FROM FAR AND NEAR

His Majesty The King of Afghanistan recently purchased an eight-valve super-heterodyne receiver with a gramophone pick-up and amplifier, and he intends to take this back with him to Kabul.

* * *

A recent investigation into the efficiency of school wireless sets shows that the schools of the County of Kent hold the record for satisfactory reception.

* * *

When two of the inhabitants and the resident nurse on the island of St. Kilda were taken ill, a wireless S.O.S. for medical assistance was sent out, a doctor and nurse were despatched to the island, and the patients were brought to the mainland in the lighthouse commissioner's steamer "Hesperus."

* * *

£4,000 Award

The Royal Commission of Awards to inventors recently awarded £4,000 plus royalties to the Metropolitan Vickers Company, Ltd. (Metro-Vick), in respect of wireless reception apparatus.

* * *

The call-sign of the new German experimental short-wave transmitter at Goeberitz is A F K, and the wavelength 37·8 metres.

WHY I BELIEVE IN RADIO

—continued from page 581

writers are arranged, and books of importance so frequently discussed that a new vista will open out before thousands who have always previously been accustomed to avoid the masters of literature in case they should prove boring.

The complaint on grounds of harm to physique is manifestly absurd. The human body demands a certain amount of exercise, and that we all give it whenever we can. Besides, it does not need skilful argument to show whether the average young man or woman would rather choose to sit and "listen in" if there was an alternative choice of any such active game as cricket, tennis, or hockey!

Wonderful Advantages

In addition to all this, think of the wonderful new advantages which radio has brought to us. Ships can put out to sea now without the knowledge that they are to be cut off for a space from all human kind. Wrecks and fires there are still, but the stricken ship can now at least fling a cry of agony crackling across the waves, and be sure that rescuers will immediately turn from all points of the compass and come as fast as steam can hurry them to the scene of the disaster.

Imagine what an immense advantage has been brought by wireless to the outposts of our vast Empire—to people who for days and weeks see no other human beings, perhaps, or have no means of amusement save what they can themselves invent. The Canadian Government is already doing all in its power to stimulate the interest of farmers in radio, so that their little kingdoms, carved from the rolling prairie, may no longer be isolated islands in the grass, but may be given a close link with the happiness of community spirit from the cities.

More than these, even, is radio a boon to those lonely white people who are isolated from their kind in the heart of some land where even the colour of the inhabitants is different from their own. Loneliness—nothing else—has in the past driven such men to drink, drugs, and worse. Now they have but to erect a portable mast, switch on a button, and they hear the voices of their kind, dance-music lilting from a ballroom, or the soothing croon of a violin to steal away their pain.

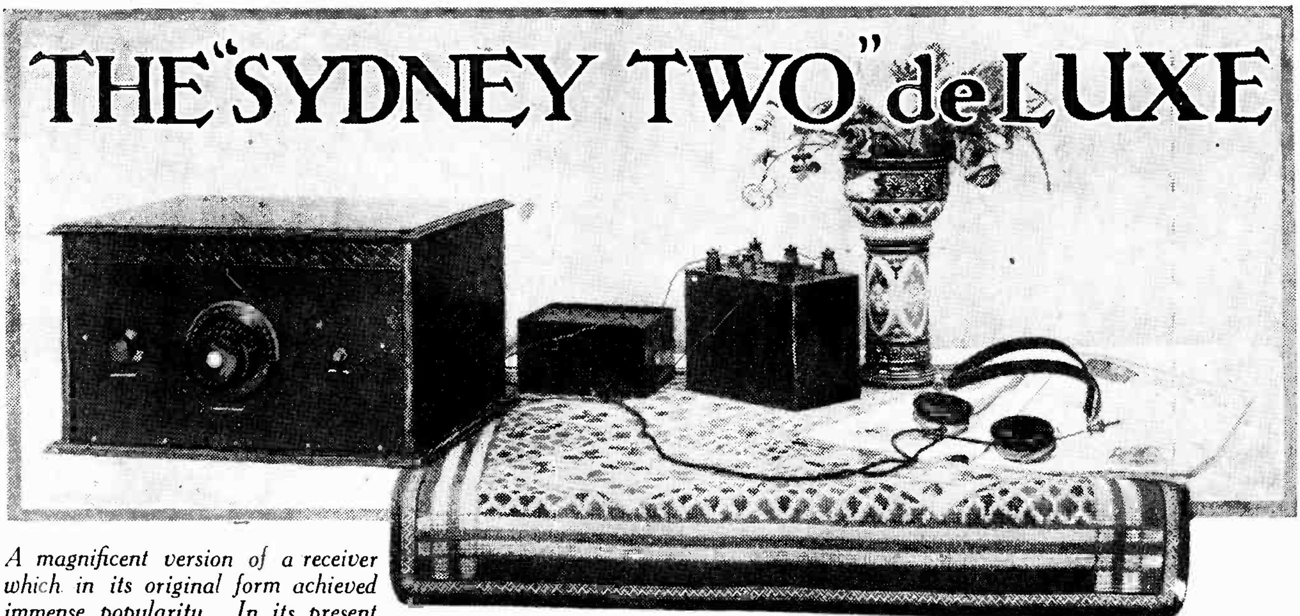
Boon to the Sick

Think alone, I say, of the great boon to the sick and suffering in hospitals and elsewhere, that they can now have music and many other hitherto impossible pleasures brought to them where they lie, so that they may for a while forget their unhappiness and join again in the mirth of the healthy world.

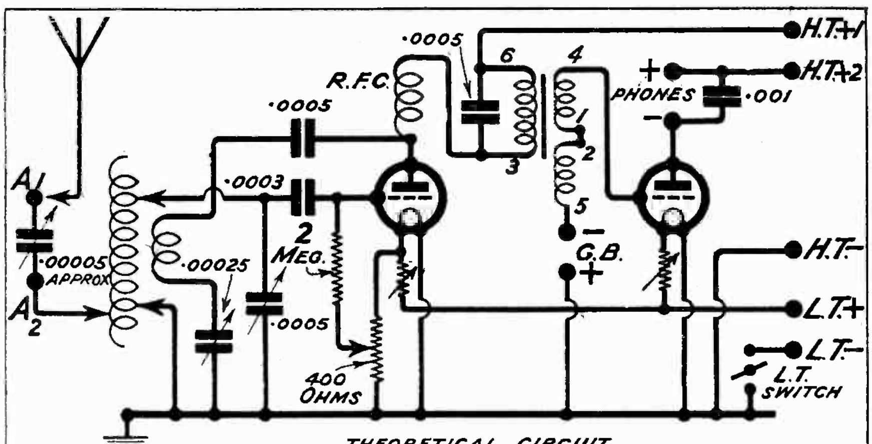
Yet these are but single instances of the great gifts which wireless brings us. Besides these, there are all the marvellous utilities of it—the incalculable speeding up of world communications, the increased possibilities of international exchange of opinions, and consequent increase in trust, and the marvellous future of television and telephotography which as yet are still in their infancy.

Yes, emphatically I believe in radio! I foresee that it will bring vast advantages to our struggling world. I believe that in time it will be ranked as perhaps the greatest of all modern factors that have added to the progress of humanity.

THE "SYDNEY TWO" de LUXE



A magnificent version of a receiver which in its original form achieved immense popularity. In its present guise, the set preserves all its efficiency on the short waves, the ease of handling is enhanced, and it can also be used for ordinary broadcast reception. Designed, built, and described by the "M.W." Research Department.



THEORETICAL CIRCUIT

If you have not yet made for yourself a short-wave receiver you are missing one of the few things remaining in radio capable of giving a real thrill to even the most hardened long-distance enthusiast. Until you have tried it, you can have little idea of the intense satisfaction to be derived from an experience such as the following. One of the first tests which the writer carried out on the "Sydney Two" was when the B.B.C. was relaying the transmissions from one of the well-known Australian stations, and on one of these Sunday afternoons it was noticed that the B.B.C. was having considerable

COMPONENTS AND MATERIALS REQUIRED

- 1 Ebonite panel, 14 in. × 7 in. × 1/4 or 3/16 in. (Any good branded material, Becol, Ebonart, Radion, Red Seal, Trelleborg, etc.).
- 1 Cabinet, 14 in. × 7 in. × 12 in. deep, with baseboard and brackets (Artcraft, Bond, Camco, Caxton, Makerimport, Pickett, Raymond, etc.).
- 1 L.F. transformer (R.I. & Varley "Straightline" in set. Any good make).
- 2 Sprung valve holders (Benjamin, Bowyer-Lowe, Burndept, Burne-Jones, B.T.H., Igranic, Marconiphone, Pye, Redfern, W.B., etc.).
- 2 Baseboard rheostats (Lissen in set. Any similar type, Igranic, etc.).
- 1 Baseboard 400-ohm potentiometer (Lissen in set. Any similar type. 200 ohms will serve).
- 2 ·0005 fixed condensers (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C., etc.).
- 1 ·001 fixed condenser (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C.,etc.).
- 1 ·0003 fixed condenser (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C., etc.).
- 1 ·0005 variable condenser (Ormond in set. Any good make with a sound positive connection to the moving vanes). Note: If you intend to use the set only on short waves choose a ·0003-mfd. condenser).
- 1 Vernier dial for above (Must be of a really good smooth type. Not necessary with some condensers which actually incorporate a slow-motion mechanism).
- 1 ·00025 variable condenser (miniature type). (Peto-Scott in original set.)
- 1 L.T. on-off switch (Benjamin, Igranic, Lissen, Lotus, etc.).
- 1 Baseboard neutralising condenser (Any standard make of fairly large capacity. Bowyer-Lowe, Burne-Jones, Igranic, J.B., Peto-Scott, etc.).
- 10 Indicating terminals (Belling & Lee, Eelex, Igranic, etc.).
- 1 2-meg. grid leak and holder (Dubilier, Igranic, Lissen, Mullard, etc.).
- 1 Piece of tubing, 2 in. diameter by 3½ in. long, for low-wave H.F. choke (Any good insulating material, Pirtoid, Radion, etc.).
- 2 Pieces of ebonite, 3½ in. × 1½ in. × 1/4 in., for H.F. choke mounting.
- 4 Sockets with nuts (Clix or similar type).
- 4 Standard plugs (Clix or similar type). (Two for G.B. and two for connections to reaction coil.)
- 2 Valve pins for H.F. choke.
- 1 Piece of ebonite, 8 in. × 2 in. × 1/4 in., for terminal board.
- 1 Piece of ebonite, 3 in. × 2 in. × 1/4 in., for terminal board.
- 1 Sheet of copper, 12 in. × 6 in. × 1/32 in. thick.
- 1 Standard Becol former, 3 in. long, for short-wave coil (See text).
- Small quantity of No. 18 plain copper wire for coil, also No. 34 S.W.G. D.S.C. wire for H.F. choke, and material for wiring set.
- Cardboard tube for reaction coil.
- 3 Spring tapping clips.
- Quantity of single flex, sundry pieces of wood for coil supports, etc.

NOTE.—The extra components and materials for the adaptation of the set on the upper waves are given in the text.

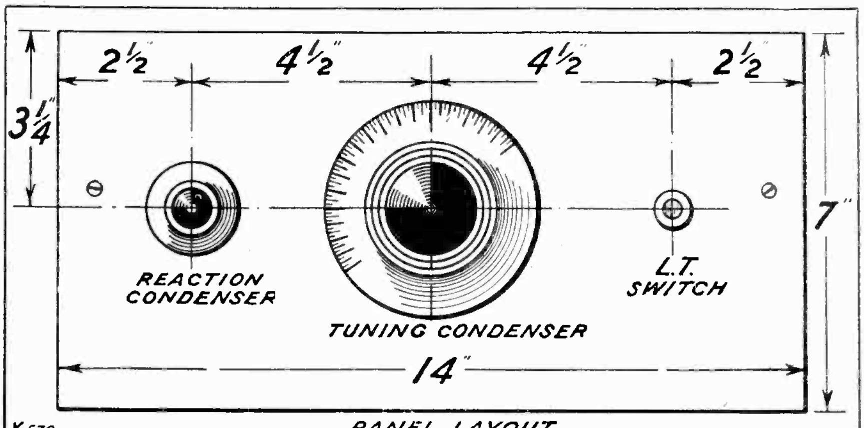
difficulty, conditions apparently being very bad at their receiving station. What was coming out from 2 L O was almost unrecognisable and scarcely a word could be heard of the Australian announcer's remarks.

Superiority!

Accordingly, it was thought that it would be interesting to see whether conditions were as bad in the locality where the "Sydney Two" was being tested, and it was therefore connected up to an *indoor* aerial and search made for the short-wave signals from Australia. Imagine the sense of superiority which resulted when it was found that the station could be picked up quite readily, and received at good strength for considerable periods with little or no interference or fading! Of course, one told oneself that it was simply that conditions for short-wave reception vary from one locality to another to an extraordinary degree, but it must be confessed that whatever one tells oneself there is always a sort of sneaking feeling that "those B.B.C. fellows don't know anything about short-wave reception. My set is a *real* set."

Fascinating Possibilities

Seriously though, the fascination of short-wave reception is really extraordinary, and it must be experienced to be realised. Probably it comes in large measure from the fact that a quite small and simple set gives all that is needed, even a one-valver being capable of picking up such transmissions as those of the famous short-wave broadcasting station K D K A at Pittsburgh, U.S.A., this station being audible practically every night in the winter, while 2 X A D, 2 X A F and other American short-wave broadcasting stations can also be heard whenever conditions are at all favourable, often even in summer. With a two-valve set, again, one or other of the Australian stations can also be picked up on many occasions, and one can experience the rather extraordinary sensation of hearing the Australian announcer say something about the station being about to close down on a fine Australian morning, the listener all the time being aware of the fact that it is, to him, a particularly dreary British Sunday afternoon and that the morning to which the Australian is referring is Monday morning! Again, if you can read a little Morse there is the never-ending interest of picking up signals from amateurs from almost every part of the inhabited globe. Transatlantic reception on the newer wave-lengths of 45 metres and below is now quite commonplace, and is easy with even the simplest of receivers.



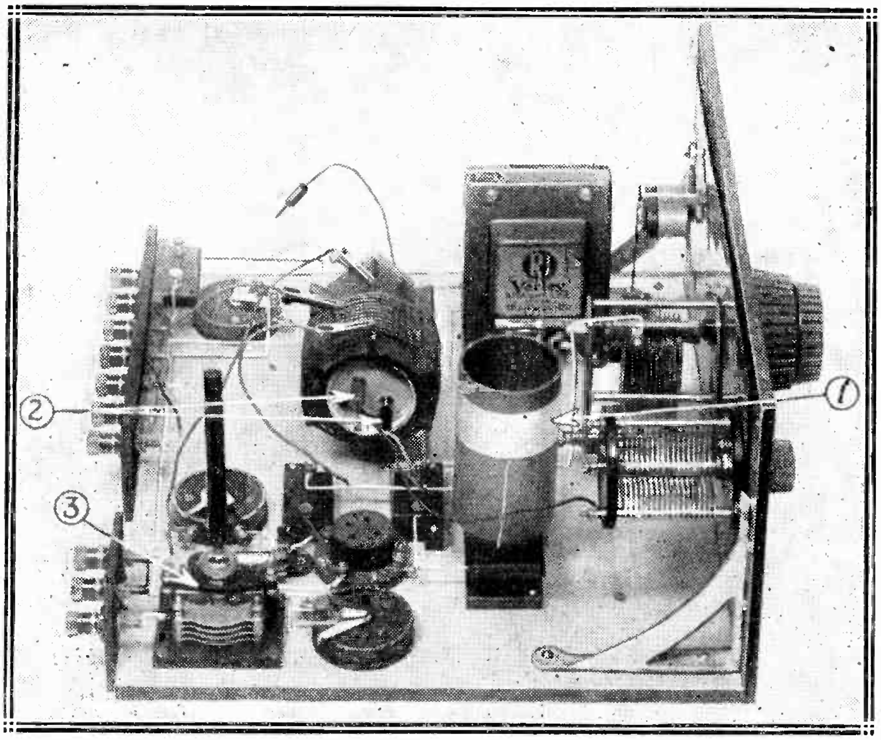
PANEL LAYOUT

A Mistaken Idea

It seems that the fascination of short-wave work is at last beginning to be realised by the ordinary broadcast enthusiast, and short-wave sets are being built in greatly increased numbers. No doubt in the past it was natural that some listeners should rather fight shy of them, probably partly because there were few regular short-wave telephony transmissions and very largely because there was a general impression that short-wave sets were very mysterious and difficult to handle—an idea largely fostered by the more advanced short-wave enthusiast, who made a practice of talking a rather horrible jargon and loved to foster the idea that only the real expert could make and operate a short-wave set successfully.

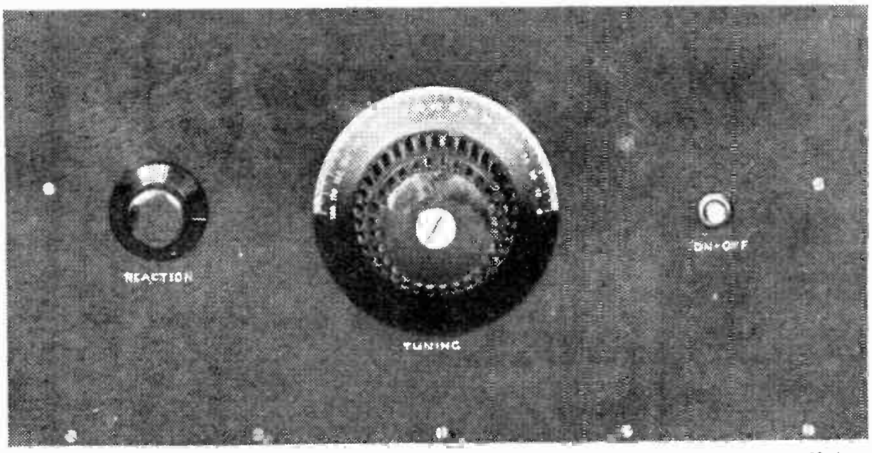
Not Difficult

It was only natural that the plain constructor should get the idea that something very special indeed was needed in the way of construction and layout to get any results at all on short waves, especially when he saw the extraordinary lengths to which the enthusiasts went, sometimes dispensing with a cabinet because of



This photo was specially taken to show three of the characteristic features of the set. (1) Is the special home-made H.F. choke for the short waves, which can be replaced in a moment by an ordinary standard one for longer waves; (2) indicates the plug and socket connections to the reaction coil, and (3) is the small series condenser.

possible losses in the wood, standing their skeleton sets on empty bottles to lift them off the table, and so on. One even seems to have heard of the man who had the horrible experience of finding that his new short-wave set simply would not give any signs of oscillation or reaction, the reason being that one of the bottles on which he had placed it was made of glass containing a high proportion of lead! (Slightly exaggerated for the sake of effect, perhaps, but we have all heard something like this at one time or another!)



Neatly balanced! The panel layout is unconventional, but produces a very efficient arrangement of the wiring.

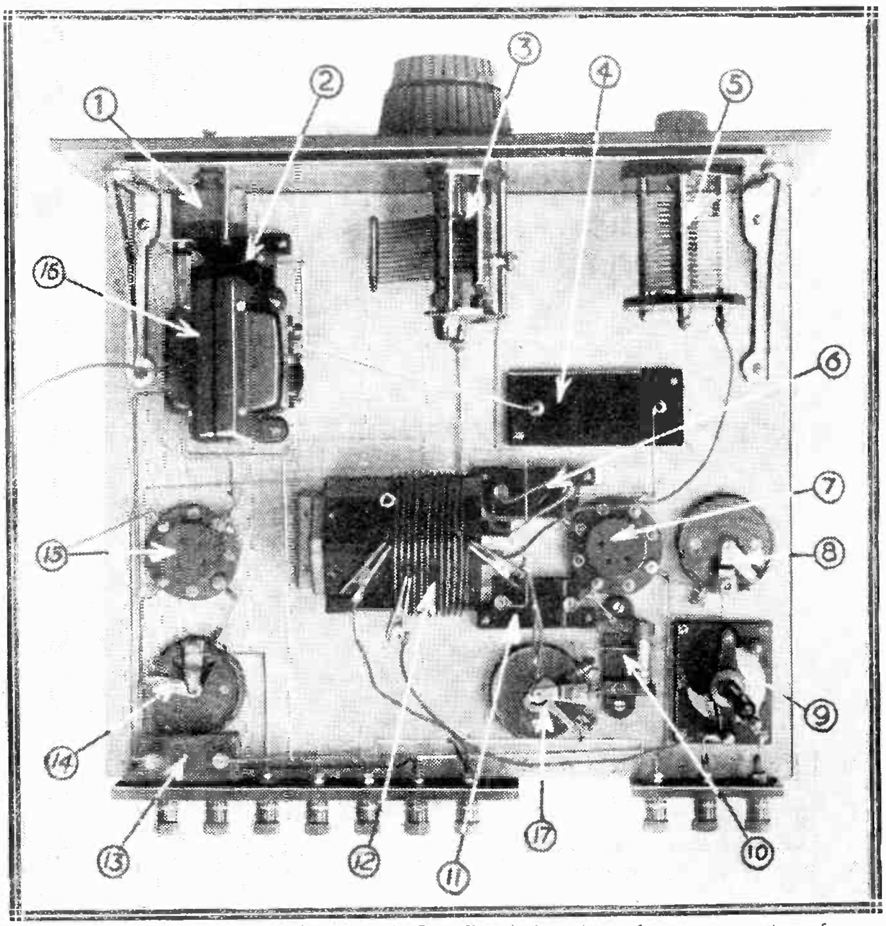
Combined Sets

It has been realised of late that the original idea that a separate special set was needed for short-wave reception was a great drawback from the point of view of the home constructor, who often did not feel that he could afford to build an entirely separate set and keep it going in addition to his usual broadcasting equipment, so that a good deal of ingenuity has been expended of late in devising sets capable both of short-wave reception and of work on the ordinary broadcast waves, a combination which has been shown to be perfectly feasible, thereby exploding one of the earlier shibboleths of the game. The "Sydney Two" de Luxe, for example, the design which we shall be considering in the pages which follow, has been designed primarily as a highly efficient short-wave set, yet by including suitable coils it will also work well as a plain "detector and L.F." receiver for ordinary broadcast purposes.

This set in its original form of the "Sydney Two" was first published in "Popular Wireless," and has proved to be probably the most popular of all the short-wave receivers published in either that journal or MODERN WIRELESS. Its special points are high efficiency resulting from certain special features of construction, ease of operation resulting from the fact that by the use of a simple tapping scheme a very wide range of waves can be covered without coils being changed, and considerable ease of construction, chiefly a result of the use of a very easily-made special coil. A really remarkable series of appreciative letters have been received from readers who built the original set, quite a number of these reporting success in receiving the Australian transmissions.

Wide Wave Range

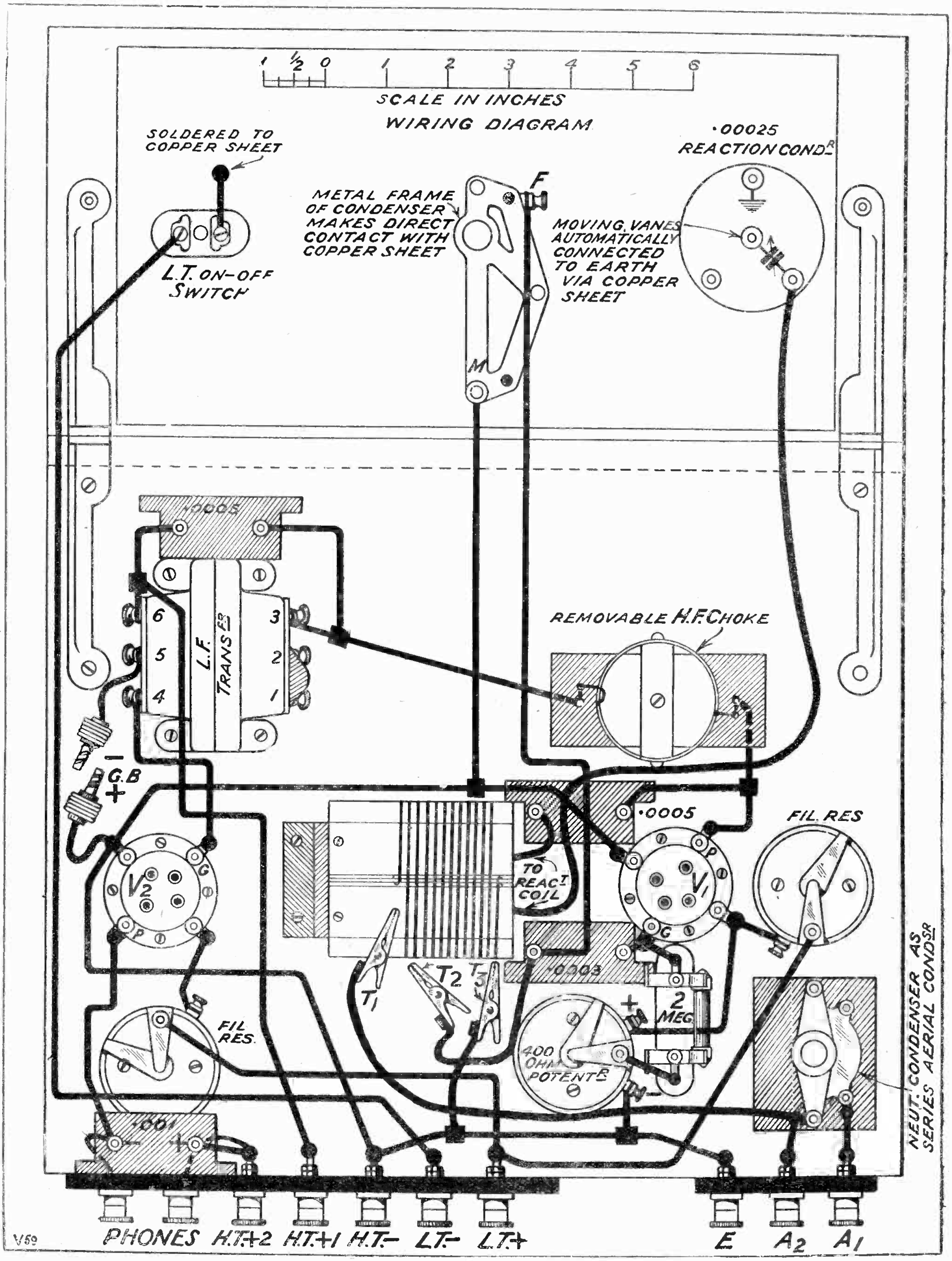
In its original form the set was only intended for reception of wavelengths between about twenty and forty metres, so that it was essentially a short-wave set, but in producing the "De Luxe" edition for publication in MODERN WIRELESS, provision has been made for extending the wave-length range upwards to cover the ordinary broadcast wave-lengths in addition, and thus you can employ the set as a standard equipment for broadcast work likewise. Furthermore, quite a number of special refinements have been added, such as the use of a neutrodyne condenser in series in the aerial circuit, so that you can use this as the series capacity when desired instead of the home-made condenser called for in the original design, the provision of metal screening behind the panel to minimise hand-capacity effects, and so on.



Here is a general key to the layout. (1) On-off switch; (2) condenser across transformer primary (to be omitted if R.I.-Varley type not used); (3) tuning condenser; (4) H.F. choke socket; (5) reaction condenser; (6) "safety condenser" in reaction circuit; (7) detector valve socket; (8) detector rheostat; (9) series condenser; (10) grid leak and holder; (11) grid condenser; (12) tuning coil; (13) condenser across 'phones; (14) L.F. valve rheostat; (15) L.F. valve socket; (16) L.F. transformer.

In its latest form it probably represents something like the ideal in a really simple but efficient shortwaver, and it is equally suitable as a combined broadcast and shortwave set, or as a good standard receiver for the more experienced shortwave listener who has been looking for an up-to-date design for use on the lower waves exclusively.

The circuit originally chosen was one of the best of those available for



short-wave work, and no alteration has been made here in producing the "De Luxe" edition.

It will be seen that by connecting the aerial to one of the alternative terminals a neutrodyne condenser is brought into circuit in series with the aerial lead, and a suitable adjustment here is very helpful in getting proper reaction effects on the short waves (it is not intended for use on the longer waves, of course).

The Short-Wave Coil

The short-wave coil is wound with spaced bare wire, and three flex leads with tapping clips are provided for making connection to it. Of these leads (T_2 on wiring diagram), one comes from the grid condenser, and one (T_3) from a point on the wiring of the earth terminal, and these are normally attached to the extreme ends of the coil. The practical tuning range is then from a little below 40 metres to about 70 metres.

For waves below this the two clips are shifted a few turns inward at each end, so leaving the end turns out of circuit.

The third clip (T_1) is on the end of a flex lead from one of the aerial terminals, and this will usually be placed one, two, or three turns away along the coil from the earth clip, the best position being found by experiment. (Remember that considerable re-tuning is required each time.)

Separate Reaction

A separate reaction winding is provided, and this is wound on a little piece of cardboard tube of a size to slip easily inside the tuning coil former, and about $\frac{3}{4}$ in. long. Connection is made to it with two flex leads bearing Clix plugs on their ends, these being inserted in two sockets in a wooden cross-piece fixed in the cardboard former.

The same reaction coil is used for all short-wave work, and it is wound with 7 turns of No. 34 D.S.C. or S.S.C. wire, and if you have any difficulty in getting a piece of tube of the right size you can easily make one with a strip of stiff paper and some Seccotine.

The tuning coil consists of 12 turns of No. 18 bare copper wire, the turns being spaced roughly $\frac{1}{8}$ in. apart. The former is one of the standard 6-ribbed type, the diameter over the ribs being 3 in., and the length about 3 in.

Securing the start and finish of the winding is quite easy; the wire is quite stiff, and will be firmly held if the end is passed through a small hole drilled in one of the ribs and the end turned up, half an inch being left projecting for the attachment of the clips.

The mounting of the coil is very simple, since all connections are made by means of clips and there is thus no need to arrange for any plug and socket base. A wooden cross-piece is fixed inside one end of the former by means of two small brass screws passing inward through holes in the walls of the tube, and to this is screwed a wooden upright piece $3\frac{1}{2}$ in. long. The lower end of this latter is arranged to fit tightly between two wooden strips screwed down upon the baseboard. The coil can thus be pulled out and replaced with one for the broadcast waves in a few moments.

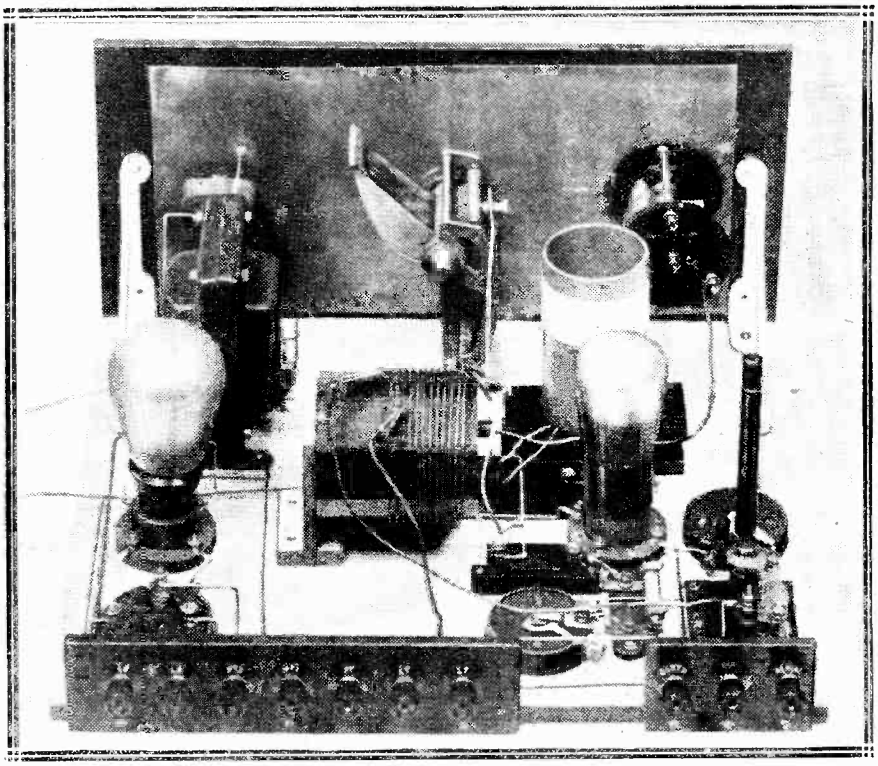
This latter coil is to be wound on a similar former, and the winding consists of 60 turns of No. 24 D.C.C. wire, with taps at 10, 15, and 20 turns (counting from the end to which the earth clip will be attached) for the aerial clip. The reaction coil will also require to be changed and replaced with one carrying 35 turns of No. 34 D.S.C. wire, the length of tube this time being about $1\frac{1}{4}$ or $1\frac{1}{2}$ in., and the ends being taken as before to a couple of sockets in a wooden cross-piece.

The arrangements for the H.F. choke are also a characteristic feature of the "Sydney Two" de Luxe. For the short waves a special choke is used consisting of a winding of 75 turns of No. 34 D.S.C. wire on the piece of tube mentioned in the list of components. In one end of this tube a wooden cross-piece is fitted, and to this is screwed an ebonite base-piece in which are mounted two valve pins or plugs such as the Clix and Eelex types, to which the ends of the winding are taken. These pins are placed $2\frac{1}{2}$ in. apart and they are to be inserted in two corresponding sockets in another piece of ebonite screwed down upon the baseboard.

The Long-Wave Choke

For work on the ordinary broadcast waves you will need to replace this special choke with one of the ordinary type (any standard make, Bowyer-Lowe, Burne-Jones, Climax, Colvern, Igranic, Lissen, R.I. and Varley, etc.), mounted up on a piece of ebonite with two pins exactly as before.

The thin copper backing to the panel is a rather essential feature, since if this is omitted the wiring scheme will be upset considerably.



In this view, and in one of the others, a special arrangement of the tapping clips is shown. The usual one is given in the text.

LOUD-SPEAKER POSITIONS

How you should place the instrument to get good results.

By J. R. W.

WHEN a large orchestra is to be broadcast special precautions have to be taken so that each instrument will sound at its best. The cornet player must not sound as though he and he alone constitutes the band. The players are so arranged that the microphone is in a position to pick up each instrument at its correct strength.

At the receiving end the loud speaker must be placed so that friends listening to the programme do not appear some to be in the orchestra stalls and others at the farthermost heights of the gallery. It is a good plan, once the most suitable position for the loud speaker has been found in any particular room, always to place it on this particular spot and to point it in the same direction.

Vibrating Objects

Sometimes it is noticed that on particular nights the loud speaker appears to be very tinny on certain notes, yet at other times results are quite O.K. Very often this is due to placing the speaker upon an object which also carries porcelain or glassware. These peculiar sounds are not always due to the loud speaker, but to the vases, dishes, or whatever they may be, responding to a certain note issuing from the loud speaker.

Humming can be exceedingly irritating and can spoil many excellent programmes. But frequently, after careful search, it will be traced to the loud-speaker extension leads running parallel to electric light mains, especially if alternating current is in the house. Mysterious clicks every few minutes is another fault which can be traced to a similar source, and is due to the sudden surge which takes place in the mains when a circuit is made or broken, i.e. on closing a switch.

A Peculiar Effect

If the room in which the loud speaker is giving trouble is much longer than it is broad, point the loud speaker so that it is facing the longer way of the room. In certain types of loud speakers, notably the cone type, a peculiar effect is often set up due to the fact that the speaker has been placed so as to face close to an opposite wall of the room. This causes a partial reflection back on to the diaphragm and may even cause very serious distortion.

In some of the newer houses built to-day, in which thin slate asbestos over a wooden framing is used as dividing walls, it may often be found that the whole wall tends to vibrate when the loud passages are being reproduced; in this case the loud speaker should be placed in the corner on a firm pedestal and some form of fairly heavy drapery located at the rear of the speaker. It is remarkable the effect that this drapery has on any tendency to wall vibration.

Easily Tested

Should the room have an extra high ceiling, place the speaker a little higher than usual. It is surprising how distance from the floor effects results. Rough tests may easily be carried out in this direction with a pair of steps placed against the wall, when by placing the speaker on each step in turn the most suitable height may easily be found.

Very good results can be obtained by employing two loud speakers placed at different heights. One, perhaps, very near the ceiling and the other rather lower than usual. This scheme gives an excellent sound distribution.

OVERSEAS RADIO ITEMS

Using a power of only four watts, three Dublin amateurs recently got into two-way touch with Victoria, Australia. This is claimed to be the first two-way amateur communication between the Irish Free State and the Antipodes.

* * *

Part of the celebrations marking the tenth anniversary of the Republic of Czecho-Slovakia will take the form of a wireless exhibition to be held at Brunn from June 3rd to September 30th.

* * *

Denmark's first short-wave broadcasting station has recently been testing on 78·5 metres on Mondays, Wednesdays and Fridays, between 11 p.m. and 1 a.m.

* * *

The Copenhagen station recently installed a new transmitter for broadcasting its regular daily programmes upon 327 metres.

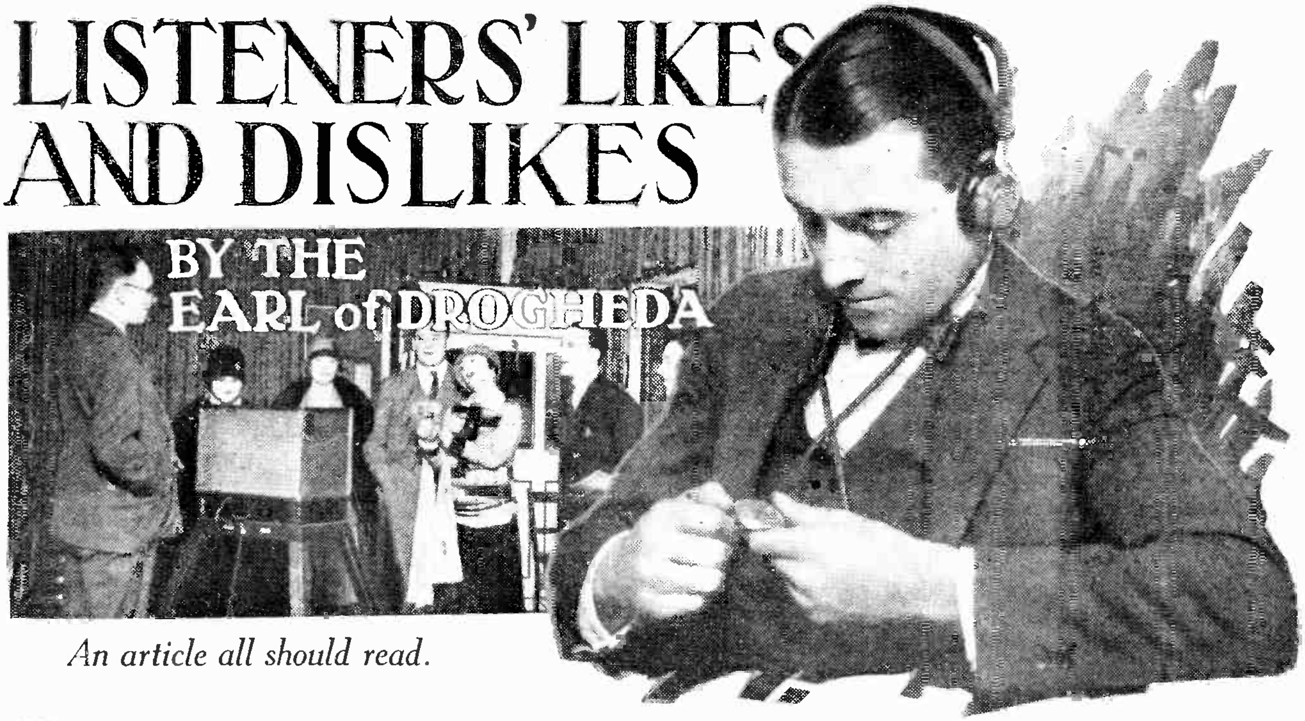
* * *

Wireless signals from American amateurs were first received direct by the amateurs of Great Britain in 1921.

THE G.O.M. OF RADIO

The above is one of the latest photographs of Sir Oliver Joseph Lodge, who celebrates the 77th anniversary of his birthday on June 12th. Everyone knows that Sir Oliver is our greatest living scientist, and the radio public in particular has learnt to appreciate the fine radio pioneer work carried out by Sir Oliver long before Marconi was heard of. The coherer and the first tuning apparatus for radio are but two of his many contributions to the science of wireless. We are sure our readers will join with us in wishing him hearty congratulations and many happy returns on his 77th birthday.—The Editor.

LISTENERS' LIKES AND DISLIKES



BY THE EARL of DROGHEDA

An article all should read.

CRITICISM of the broadcast programmes is so easy and so general that it is not surprising if we come to cherish the fond delusion that we could vastly improve the programmes if their selection were put into our hands.

And, indeed, we should undoubtedly have no difficulty in making them suit our own individual tastes much better than can the B.B.C. But there our success would probably end; and when it came to compiling, week in, week out, programmes which the public as a whole would appreciate, most of us would, I fear, soon have to confess to ignominious failure.

The Earl of Drogheda.

The Earl of Drogheda is particularly fitted to write an article upon the likes and dislikes of listeners, for since the inception of The Wireless League he has been closely identified with its work. He has had a distinguished career in the Foreign Office and served in the Irish Guards.

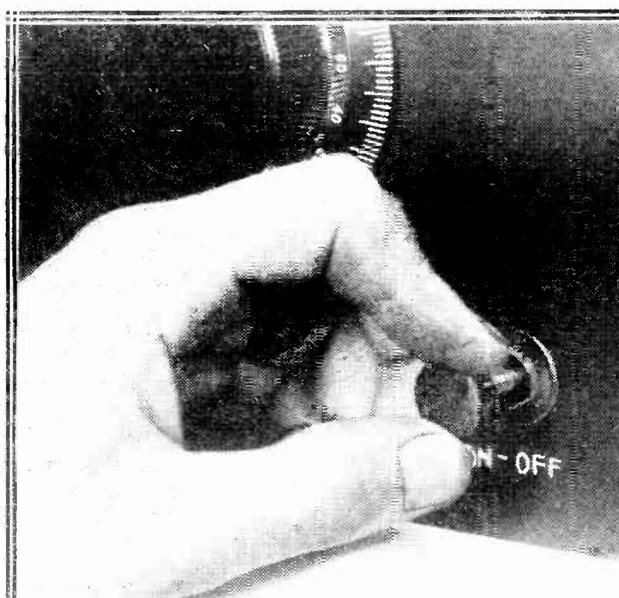
It is very easy to expect too much from broadcasting. Science and organization have enabled us to listen during the greater part of the day and evening to a continuous programme brought into our own homes. And, having accepted this miracle as part of our everyday life, it is but a short step farther to demand that at whatever hour we care to switch on our set we shall hear something that will give us pleasure, or entertainment, or instruction, or whatever we happen to be in the mood for at the moment.

That is, of course, asking for too much. It might be practicable if we all thought alike, but fortunately our tastes are extremely diversified, and hundreds of high-power transmitting stations would be required if we were all to be given exactly what we want.

"One Man's Meat . . ."

Naturally we find it difficult to realise that our own favourite items may be other people's pet aversions, and that what we dislike intensely may be giving pleasure to thousands. And yet that is undoubtedly the fact, however catholic our tastes may be.

There is one particular feature in recent programmes which seems to me to be utterly stupid and inane. Yet I am told, and I fully believe it to be true, that after every broadcast of this item hundreds of appreciative letters are received from every part of the country. I do not doubt



DON'T NEGLECT THE ON-OFF SWITCH. A good deal of criticism arises from what the author aptly terms "the unpleasant habit of keeping one's set continually switched on."

that everyone who made inquiries would have the same experience.

Nor should it be forgotten that a good deal of programme criticism arises from what, for want of a better phrase, I can only call indiscriminate listening. By that I mean the casual switching on of one's set without taking the trouble to refer to the paper to see what is being broadcast at the moment, or the unpleasant habit of keeping one's set continually switched on.

In the first case one is liable to hit upon a time when something of no interest to oneself is being broadcast, to switch off with or without an imprecation, and often to miss a particularly pleasing item which may be following immediately afterwards.

In the second case, apart from laying oneself open to justifiable homicide by other members of the household, one is completely deadening one's powers of appreciation. Admittedly it is nobody else's business what use one makes of one's set, but in either case one is not giving the programmes a fair chance.

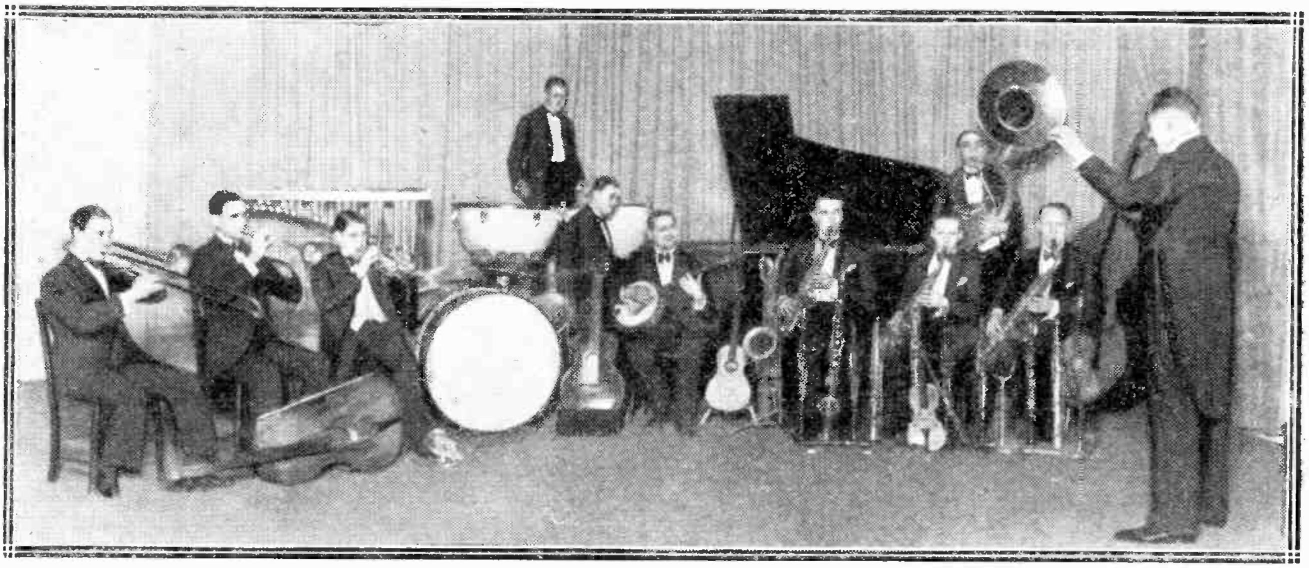
whilst not ignoring the claims of the various sections of the minority.

To what extent the B.B.C. has succeeded in doing this it must be very difficult for the authorities themselves, and it is next door to impossible for any private individual, to estimate. For the immense audience—running into many millions—of which we are all a part is, in the main, a silent audience. It is a very small minority which troubles to express its views on the entertainment offered to it, and one can only guess at what the dumb majority is thinking.

Join a Society

The result may well be that the vocal minority gets what it wants in opposition to the wishes of the majority. But one presumes that the B.B.C. is well aware of this danger, and, after all, it is a risk which silent majorities always run, and a result for which they have only themselves to blame.

The moral of all this seems to be that the only way in which we as individual listeners can attempt to improve the programmes—or perhaps I should say, can attempt to make them more representative of the wishes of the public as a whole—is to take the trouble to express our views on them more often. How are we to do so? Well, the most obvious way is to write to Savoy Hill letters of praise or denunciation, as the case may be, whenever an item particularly pleases or displeases us. That is the most direct, but rather a troublesome method.



One of the most popular items in the programmes—Jack Payne and his B.B.C. Dance Band.

Let us assume, however, that we use our wireless sets with a reasonable amount of thought and moderation. The question still remains, "Do the programmes need improvement and, if so, what can we as individuals do to improve them?"

To the first part of this question most people will return an unhesitating affirmative. How far that affirmative is justified it is hard to say, for, as I have already explained, it is impossible to judge the matter in the light of our own private feelings.

B.B.C. Still Learning

Still, it is a fair assumption that, even after several years' experience, the staff of the B.B.C. have probably not achieved a perfect interpretation of the wishes of the public. I do not think that they would themselves lay claim to any such achievement. Rather would they, I imagine, admit that they are still learning, in the same way that the listening public itself is still learning what to ask of broadcasting.

The business of the broadcasting authorities is obviously to strike a balance between conflicting opinions, and to compile their programmes in accordance with what they believe to be the wishes of the majority of their public,

Another way—and a very good one—is to take part in any ballots on the subject organised by the Press. A third, and perhaps the best, way is to join one of the societies formed to promote the interests of listeners. By this one gains the advantage of consultation and concerted action with others.

The largest of these societies is the Wireless League, which has its head office at 7, Southampton Street, Holborn, London, and an enquiry addressed to the Secretary of the League at that address would no doubt elicit any information desired as to its numerous activities, amongst which is the frequent submission to the B.B.C. of programme reports based on correspondence from its members and on suggestions received from its representatives throughout the country.

WHAT ARE CATHODE RAYS?

This easy-to-understand article makes clear the nature of these extremely interesting rays which figure so largely in the latest scientific developments of to-day.

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

In describing the nature of cathode rays I suppose most scientific men would begin by outlining what takes place in a nearly evacuated glass vessel when a high-tension electric discharge is passed through it. This is, no doubt, because cathode rays were first discovered in some such way, and also because, strictly speaking, cathode rays must necessarily (as their name implies) be associated with the discharge from a *cathode*.

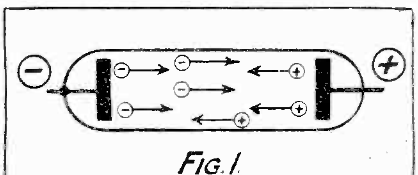


FIG. 1

This simple diagram illustrates the motion of electrons away from the cathode and of positive ions away from the anode in a discharge tube.

I think, however, that it will be much simpler, especially as my readers are radio experimenters, to begin at a different point in the story and to state at once that cathode rays are none other than our old friends the *electrons* which perform such useful service in their passage between the filament and anode in a wireless valve. In other words, you know now that in dealing with cathode rays you are dealing with none other than the familiar electrons or fundamental negative particles of electricity.

Suppose that owing to some violent shock or disturbance an atom of matter loses one of the electrons from its electronic system, then there is an unbalanced positive charge equal to the negative charge which has been carried away by the escaping electron. The result is that the atom as a whole has become positively charged. In the same way, in certain circumstances an atom may *acquire* an *additional* electron from outside, in which case the atom becomes *negatively* charged as a whole.

Causing Ionisation

Now let us see in what circumstances atoms of matter (and with atoms I include, of course, combinations of atoms called molecules) may gain or lose electrons and so become negative or positive ions.

There are a considerable variety of so-called "ionising agencies." For example, if X-rays or ultra-violet light, or for that matter even ordinary sunlight, fall upon matter, there is usually some degree of ionisation produced; in other words, some of the atoms exposed to the radiation have their electronic systems upset. Usually the ions produced in this way are positive ions, but in certain circumstances the electrons so set free may wander about and eventually attach themselves to other normal atoms, so forming negative ions.

The raising of a substance to a high temperature has the effect of producing ionisation, and the hot gases drawn from the neighbourhood of flames or incandescent substances are very strongly ionised.

Without, however, discussing further the various methods by which ionisation is produced, let us now deal particularly with the ionisation which takes place in a vessel which is nearly evacuated and through which an electric discharge is passed. Tubes

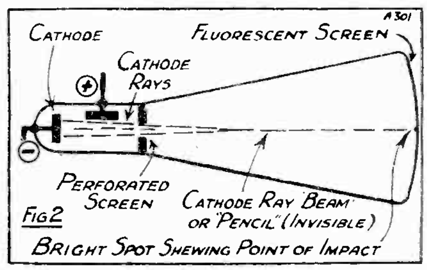


FIG 2

Showing how cathode rays are produced, and may be allowed to shoot through a perforated screen, producing a bright spot on a fluorescent screen.

of this kind are probably familiar to almost everyone, some of the earliest forms being known as Geissler tubes.

If we have an almost completely exhausted glass tube through which two metal electrodes are sealed, and we apply to these electrodes the output from a high-voltage generator (such as the secondary of an induction coil), the following effect takes place: First of all there will be a few wandering ions present in the small amount of residual gas in the tube (there are always a few ions present even in the atmosphere, these being probably produced by the effect of sunlight and other weak ionising agencies), and under the powerful electric field between the electrodes in the discharge tube the negative ions will be driven away from the negative electrode and towards the positive, whilst the positive ions will be driven in the opposite direction.

If the electric field is sufficiently intense the few residual ions initially present in the gas will acquire considerable velocities and in their progress they will collide with some of the uncharged normal gas molecules or atoms. If the collisions with the atoms or molecules are sufficiently violent, an electron (or electrons) may be shaken out from atoms or molecules which are struck in this way, with the result that a further supply of ions immediately becomes available.

These newly-born ions will instantly proceed to move in their appropriate directions under the influence of the electric field and will again strike normal molecules or atoms of the gas and produce still further ions.

"Ionisation By Collision"

The negative electrons, as you know, are of very small mass as compared with the positive ions, and consequently they acquire a velocity under the influence of the electric field which is enormously greater than the velocity acquired by the positive ions. The negative electrons in the discharge tube will proceed away from the negative electrode (or cathode). We may regard them as proceeding from the cathode and as striking the anode, and as a matter of fact the impact of the negative particles upon the anode sets free further supplies of positive ions, whilst the impact of the positive ions upon the cathode sets free further supplies of electrons. Thus, although the presence of a certain amount of gas in the discharge tube is necessary to give the discharge a start, the supply of electrified particles to carry on the discharge may come also (once the discharge has started) from the electrodes themselves.

We have seen, then, that there is a stream of rapidly-moving electrons proceeding from the cathode and striking the anode. If we drill a small hole through the anode as shown in the figure, some of the rapidly-moving electrons will shoot through this hole and will form a pencil or tiny beam of electrons in another part of the tube. Electrons produced in this way are known as cathode rays, and owing to their exceedingly small mass they are susceptible to rapidly-changing electric and magnetic fields.

Exceedingly Light

As to the actual velocity of the cathode rays, this, of course, depends upon the potential difference or voltage between the electrodes, but in a fairly high vacuum the cathode rays may attain a velocity of 100 million feet per second, or about 20,000 miles a second, which is approximately one-tenth of the velocity of light.

The mass of the electron or cathode particle is also exceedingly small, and is only about 1/1,800 of the mass of the hydrogen atom, which is the lightest of all atoms.

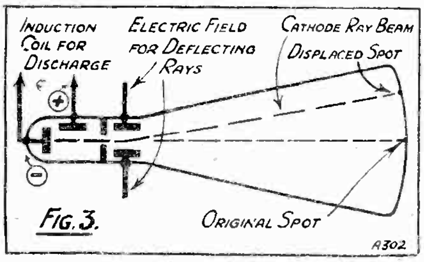


FIG. 3.

This figure illustrates how a cathode-ray stream may be projected between metal plates at different electrical potentials and so deflected by the electric field.

Finally, a word or two as to the way in which a cathode-ray system may be used as an exceedingly delicate indicator of electric or magnetic variations. If we look at the diagrams herewith we see that if the cathode stream is allowed to pass between two plates across which a transverse electric field is set up, the stream will be deflected from its original course, since the cathode particles, being negatively electrified, will be repelled by the negative plate and attracted by the positive plate. If the cathode stream is falling at its destination upon a fluorescent screen, it will mark a bright spot at the place where it impinges on the screen; therefore any shift of the point of impact (due, for instance, to the application of a transverse electric field, as just mentioned above) will be immediately evident by a shift in the position of the bright spot on the screen.

Can be Rapidly Controlled

If the electric field through which the rays are shooting is one which is varying in its voltage characteristics with great rapidity, the cathode-ray beam will be subjected to a rapidly-varying shifting influence and the faithfulness with which the bright spot on the screen will follow the fluctuations in the transverse or displacing electric field will depend upon the lightness in weight (smallness in mass) of the particles of the cathode stream, and also upon the quickness with which they reach their objective.

We have already seen that the cathode particles are exceedingly light, and we have further seen that in the conditions under consideration they may attain a velocity of about one-tenth of the velocity of light, which is exceedingly high as compared with the velocities attained by mechanical objects with which we are ordinarily familiar.

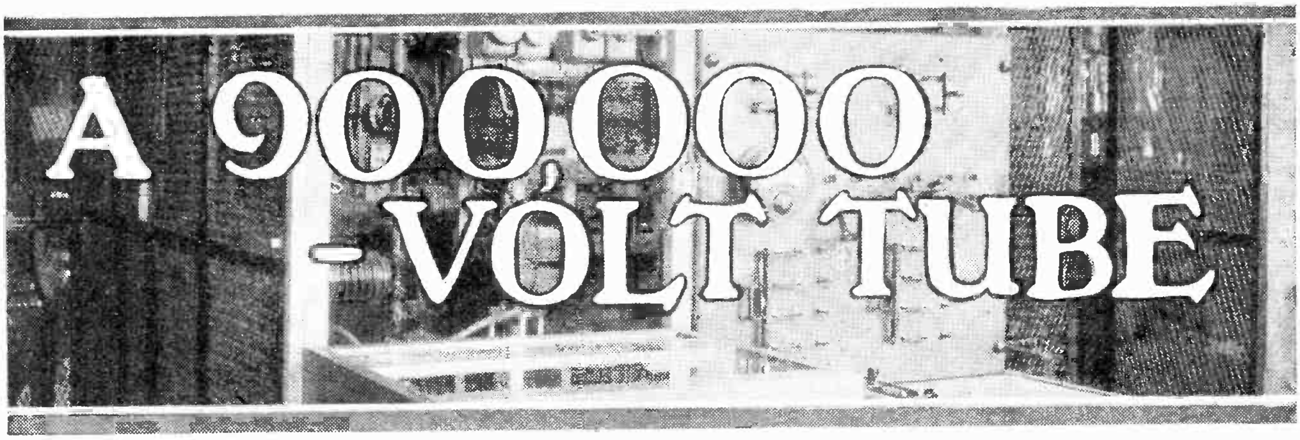
Therefore, the cathode stream represents virtually a "weightless" or "massless" beam, and is eminently adapted for following and indicating exceedingly rapid variations in electric voltage. In the same way, if a magnetic field be applied to the rays during their passage towards this fluorescent screen the rays will follow exceedingly rapid variations in the characteristics of the magnetic field. If both electric and magnetic fields are used the rays will similarly give an extremely faithful indication of the combined or resultant of the effects due to the two fields.

The Oscillograph

Instead of the fluorescent screen, which is comparatively insensitive, a highly sensitive photographic plate may be used, in which case a permanent record of the movement of the point of impact of the cathode beam with the screen may be obtained.

One of the most successful uses to which the cathode-ray beam has been put is in the so-called "cathode-ray oscillograph," which gives a very faithful record of exceedingly rapid variations such as the characteristics of telephone speech currents, high-frequency oscillatory currents, and so on.

Owing to the enormously rapid "response" of cathode-ray devices, attempts are being made to apply this principle to television, and I hope that the foregoing explanation of the nature and general properties of cathode rays will enable readers to understand, in a general way, why cathode rays are being tried for overcoming some of the tremendous mechanical and manipulative obstacles of television.



A 900,000-VOLT TUBE

Producing a high-speed electron stream by means of vacuum tubes.

From a Special Correspondent.

Two years ago very considerable interest was evinced in the remarkable results achieved by Dr. W. D. Coolidge, of the General Electric Company of America, with a Cathode Ray Tube. It will be recalled that the tube was said to be a vacuum in which it was possible to generate as much electricity or as many electrons in one second as it was calculated could be produced by one ton of radium.

Dr. W. D. Coolidge

Peculiar Effect

The word "calculated" was then used advisedly, because the productivity then, as now, of a ton of radium was a matter of theoretical multiplication rather than of practical proof, there being, so far as we now know, only about a pound of radium in the world. In any case, in the cathode ray we had that bombardment of the atmosphere which caused crystals of mineral calcite to assume the appearance of red-hot coals and remain a glowing mass of incandescence whilst being perfectly cold.

We were told of acetylene gas being transformed into a solid yellow mass when subjected to a short exposure; of bacteria withering under the influence of the rays; of small animal bodies being disintegrated without sign of burning or charring. These and other wonders were effected by a tube operating on 300,000 volts.

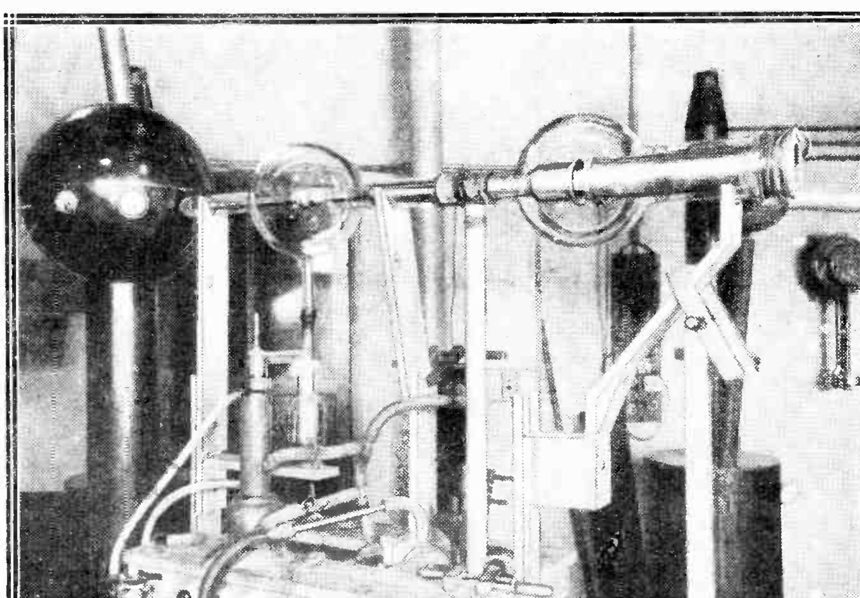
A True Prophecy

Dr. Coolidge at that time declared that he had by no means said his last word in regard to this tube or its possibilities. He has just now announced a development which in its way is as remarkable as his first discovery. For he has produced a triple-cascade cathode-ray tube operating not on 300,000 volts, but on no less than 900,000 volts, and capable of sending out into the air a stream of electrons at the almost incredible velocity of 175,000 miles per second!

The New Tube

The new tube is a sort of three-in-one arrangement of the first. After his work with the 300,000-volt tube he commenced to build larger individual tubes, but he soon discovered that there were limitations to the voltage which could be applied. He then conceived the notion of adopting the cascade arrangement, whereby the rays from one tube could be fed into another, which would speed them up and feed them along farther to still another tube. The plan worked, and in this way Dr. Coolidge succeeded in applying the 900,000 volts.

The electrons expelled from the tube appear as in the previous case as a purplish haze ball. The velocity



A double sectional cathode-ray tube employed by Dr. Coolidge during his researches.

of their expulsion is so stupendous that it can only be comprehended by a trite comparison. The figure of 175,000 miles per second, probably the fastest speed ever attained, is about three hundred and fifty thousand times faster than the speed of a bullet shot from an army rifle.

What Use Are They?

Naturally enough everyone interested is now asking: "What will be the use of the high-speed waves or particles thus projected?" Dr. Coolidge himself is not prepared to dogmatise in the matter. He is content to declare his intention of experimenting with them in the convinced belief that they will before long be used for therapeutic, chemical, bactericidal and other practical purposes. That they will assist our knowledge of radiation laws and of the atomic nucleus is tolerably certain.

The Cathode Ray Tube itself is about 95 in. long, and has three bulbs, each 12 in. in diameter. The window from which the electrons are emitted is of thin metal foil but one ten-thousandth of an inch, or one quarter that of an ordinary piece of writing paper, in thickness.

This is absolutely holeproof, and is so constructed as to withstand a total atmospheric pressure of more than 100 pounds, the difference between the outside air and the almost perfect vacuum within the tube. A heated tungsten filament, originally used by Dr. Coolidge in his X-ray tubes, furnishes the supply of electrons. The glass tube is shielded with a copper tube so that the stream of electrons cannot strike the glass and cause punctures.

Harder Rays

"In our earlier attempts to build experimental X-ray and cathode-ray tubes for voltages appreciably in excess of 250,000, we have seemed to be continually contending with and limited by the 'cold cathode' effect," Dr. Coolidge said.

"More recently we have found that we can remove this limitation by subdividing the total potential difference applied to the tube between different pairs of tubular electrodes. The electrons are then given successive accelerations as they pass between successive pairs of electrodes.

"Acetylene gas is transformed into a solid yellow mass, while small animal bodies are disintegrated without sign of burning or charring."

"This, in effect, divides the tube up into sections, each of which may be good for as much as 300,000 volts. We have already successfully operated such a cathode-ray tube with three sections on 900,000 volts.

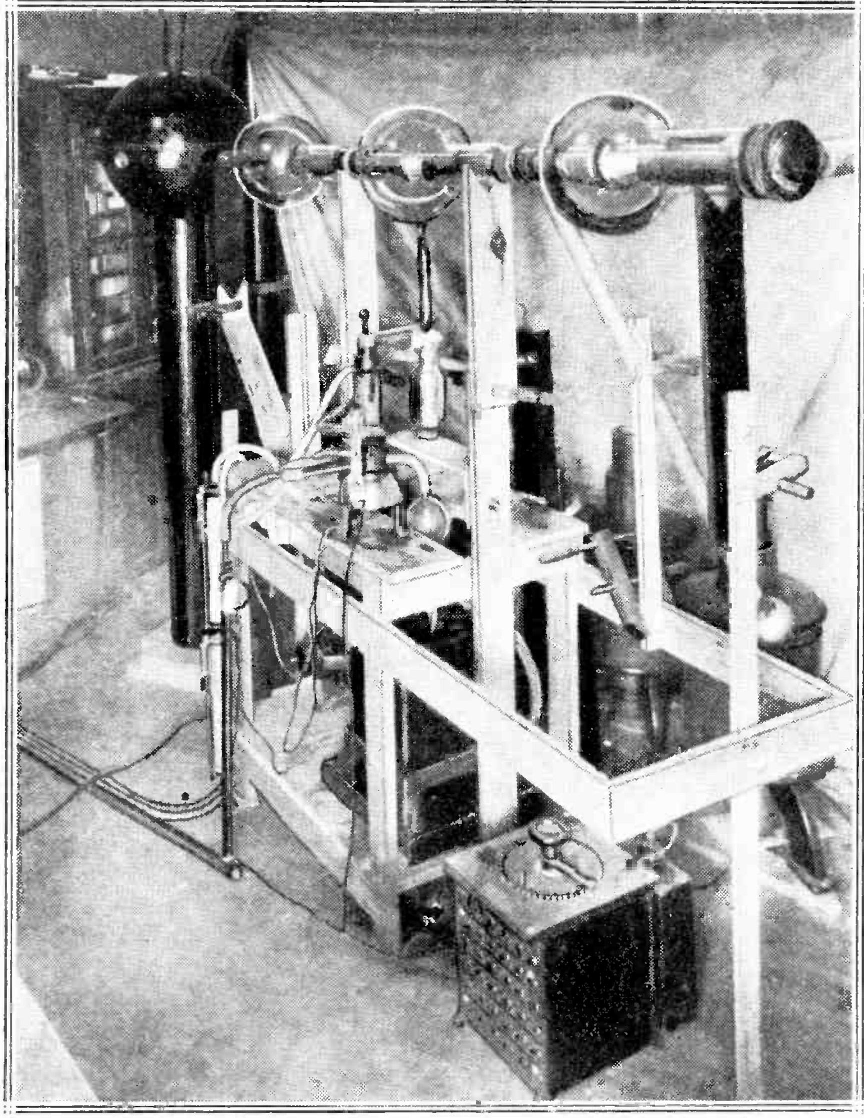
"This cascade or multi-sectional system promises to let us build vacuum discharge tubes for as high voltages as we can produce. This applies as well to an X-ray tube as to a cathode-ray tube, as the latter may be converted into the former by the addition of a suitable target. It also applies equally well to a high-voltage kenotron.

"This opens a vista of alluring scientific possibilities. It has tantalised us for years to think that we could not produce in the laboratory just as high-speed electrons as the highest velocity beta rays of radium, and just as penetrating radiations as the shortest wave-length gamma rays from radium.

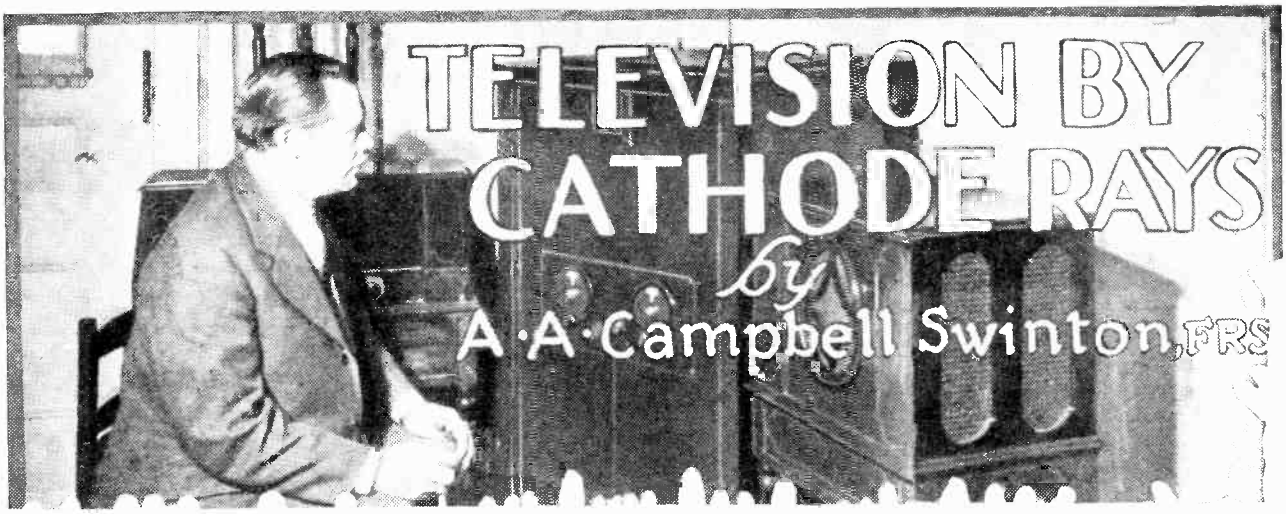
Powerful Penetration

"According to Sir Ernest Rutherford, we need only a little more than twice the voltage which we have employed already to produce X-rays as penetrating as the most penetrating gamma rays from radium and three million volts to produce as high-speed beta rays. The intensity factor would be tremendously in our favour, as with twelve milliamperes of current we would have as many high-speed electrons coming from the tube as from a ton of radium in equilibrium with its decomposition products.

"Another factor in our favour would be the control which we would have of the output. This would be quite different from our position with respect to radium, in which case no physical or chemical agency at our command in any way affects either the quality or the quantity of the output."



The triple tube from which the high-speed electrons are shot out into space.



TELEVISION BY CATHODE RAYS

by A. A. Campbell Swinton, F.R.S.

The power to "see at a distance" has for long been one of the greatest desires of scientists, and the author of this informative article was one of the pioneers in the search for television. As early as 1897 he was devising schemes for the use of the cathode ray in this connection.

No less an authority than Sir Oliver Lodge has recently given his considered opinion that, for really efficient television, mechanical contrivances are likely to fail, for the reason that they are already about at the end of their tether from the point of view of rapidity and accuracy of movement, and that for real success still more is necessary of them.

Sir Oliver Lodge goes on to mention cathode rays or moving electrons as "the only things likely to be sufficiently docile and controllable to be used as the agents for television. No material things are likely to be able to move quickly enough, but electrons respond so instantaneously that if devices can be invented for utilising them the theoretical difficulties with the required rapidity of motion would begin to disappear both from the sender and the receiver, especially as photo-electric response is almost infinitely rapid."

Early Investigations

Sir Oliver ends by mentioning that suggestions to the same effect were made long ago by me on several occasions, and gives reference to some of these. Under the circumstances, it has been proposed that I should give some account, not only of my suggestions of the past, but also of my present views and my ideas as to the future.

It was only a very few years after the introduction of the Cathode Ray Oscillograph, by Braun, in 1897, that I first thought of the possibility of producing practical television by means of instruments working on this cathode-ray principle, and, in order to study the matter, I obtained from Germany one of Braun's tubes, with which I made many experiments showing the rapidity and precision with which the cathode-ray beam could be deflected both magnetically and electrostatically.

Alan A. Campbell Swinton, F.R.S., M.Inst.C.E., M.I.E.E.

The idea had occurred to me that with two similar cathode-ray beams, controlled and deflected simultaneously by magnetic or electric forces due to the same electric currents it should be possible to obtain absolute synchronism in the motions of the two cathode beams at speeds however rapid, and with a degree of accuracy that could not be expected from any material objects. My plan was, in fact, to employ two of Braun's oscillographs, one at the transmitting and the other at the receiving stations, the two cathode-ray beams to be simultaneously and synchronously deflected by the varying fields of two electro-magnets placed at right angles to one another, and energised by the same two alternating electric currents of widely different frequencies, so that the moving extremities of the two beams would be caused to sweep synchronously, over and over again, over the whole of the required surfaces at both the transmitting and receiving stations, each complete sweeping being within the small fraction of a second required to take advantage of visual persistence.

A Real Difficulty

All this being arranged, so far as the receiving apparatus was concerned, it is evident that the moving extremity of the cathode-ray beam had only to be allowed to impinge on a sufficiently sensitive fluorescent screen, and given from the transmitter at the right moments suitable variations in its intensity, to produce the required picture.

The real difficulty, however, lay in devising an efficient transmitter which, under the combined influence of the impact of the transmitting cathode-ray beam on a suitable screen, and the effect of light and shade in the picture to be transmitted, thrown on the same screen by a lens, should sufficiently vary a transmitting electric current to produce the necessary timed alterations in the intensity of the cathode-ray beam of the receiver.

Some actual experiments were tried in this direction about the years 1903-1904, in which I was helped by my then assistant, Mr. J. C. M. Stanton. What was tried was based on the known variability of the electrical resistance of selenium under light. A metal plate, one surface of which was covered with selenium, was mounted in a vacuum tube, so that the end of a cathode-ray beam from a suitably placed electrode could, by electro-magnetic deflection, be caused to traverse the coated plate, while, at the same time, the bright image of an electric arc was thrown on the selenium surface by means of a lens.

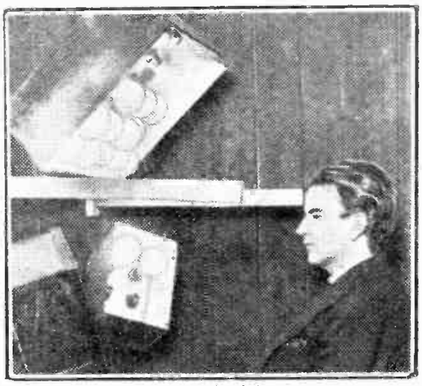
The Complete Scheme

It was hoped that the variation in the resistance of the selenium under the influence of light would cause the electric current passing in the circuit of the coated plate and the cathode rays to vary to an extent that could be shown on a sensitive galvanometer or electrometer suitably connected. It was found, however, that with the apparatus used no reliable results could be obtained, and this in spite of the fact that we received the personal assistance of the late Professor G. M. Minchin, who was the then leading authority on the subject of light-sensitive electric cells, in preparing the selenium-covered plate.

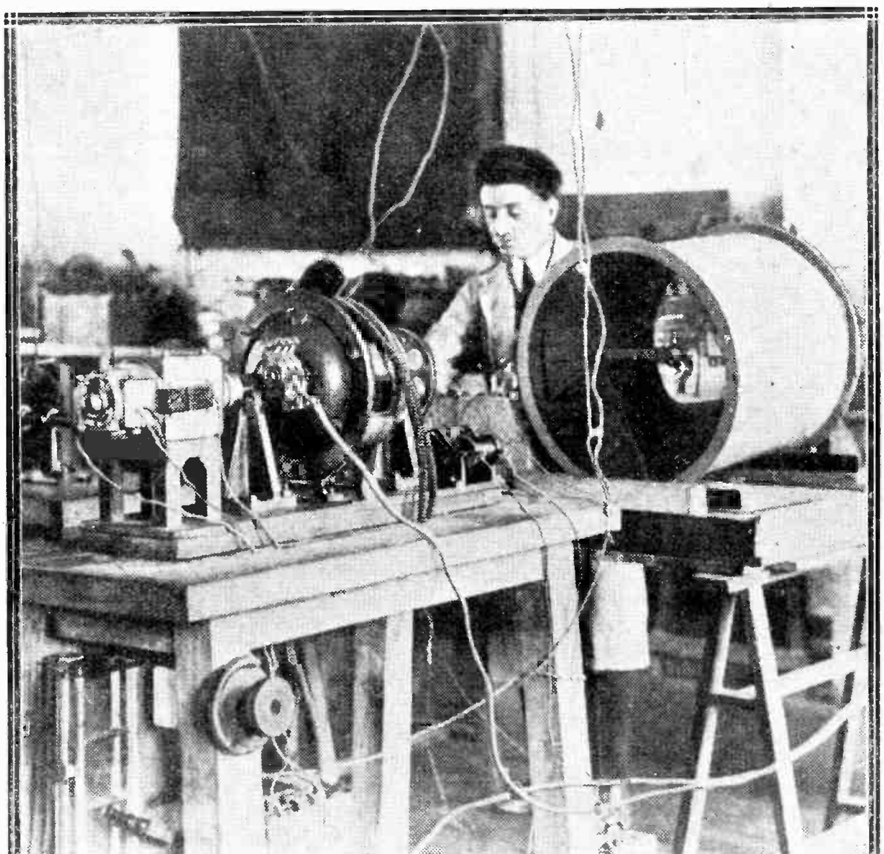
It must be remembered, however, that at that time, which was more than twenty years ago, the application of heated cathodes were unknown. and these latter could only be obtained for operation by very high voltages which were very difficult to obtain in a steady form, while thermionic amplifiers and such-like devices were also quite unknown.

Further experiments were therefore for the time abandoned, and when I published in "Nature" for June 18th, 1908, what is believed to be the first published suggestion of the use of cathode rays for television, no particular method as to how the cathode-ray transmitter was to be constructed was suggested; while later, when, in 1911, my paper was read before the Rontgen Society, in which was given a complete scheme for a cathode-ray television system, what was proposed was the adoption of a transmitting screen, not covered with resistance-varying selenium, but one made of a fine mosaic of photo-electric cells, which would probably prove a more sensitive and efficient arrangement.

Here attention should be drawn to the fact that the British patent of the Russian, Boris Rosing, applied for on December 13th, 1907, No. 27570, which suggested a cathode-ray oscillograph as a television receiver, but used mechanically rotating mirrors for transmitting, was not accepted and published till after the publication of my letter in "Nature" for June 18th, 1908, suggesting the use of cathode-ray oscillographs both for transmitting and for receiving, and that no one else, except myself, appears to have published the idea of both transmitter and receiver being worked by synchronously-beating cathode rays, as described above, till long after my detailed and illustrated account in my paper to the Rontgen Society of November 7th, 1911, which was printed in full in the Rontgen Society's own journal, and very fully reported in "The Times" for November 15th, 1911.



Mr. J. L. Baird, the television experimenter, who has received much publicity of late.



Carrying out experiments in M. Edouard Belin's laboratory, where oscillating mirrors are employed to cause a beam of light to traverse the picture.

Drawback of Mechanical Devices

Now, if the use of cathode-ray electrons, in place of moving material parts, is to be the method by which successful television is ultimately to be obtained, it seems clear that this will best come about with electrons used both in the transmitting and in the receiving apparatus, as if mechanical devices are still retained for transmitting, the final result must be governed by the speeds obtainable with the material moving parts of these devices, and it is only by avoiding altogether the use of material mechanism that the extreme mobility and tractability of electrons can fully be taken advantage of.

Then, again, if electrons can be adopted as the only objects in motion, both for transmitting and receiving, they can also be used in suitable triode thermionic oscillating valves to supply, from batteries, or from a public electricity supply, the two alternating currents of largely different frequencies required to actuate the two deflecting magnetic or electrostatic systems at both the sending and at the receiving stations, used for the purpose of causing the synchronous combined oscillating and traversing movements of the two cathode-ray beams, while the exact synchronisation of these could be maintained by special wireless signals on a wave-length different from that of the main transmission.

A Great Improvement

This would obviously be a great improvement on the mechanically moving alternate-current dynamos suggested for this purpose in my paper of 1911, and in a further fully illustrated paper on "The Possibilities of Television" I read before the Radio Society of Great Britain on March 26th, 1924. It would get rid of all mechanical motion whatever, and the whole of the transmitting and receiving apparatus would become reduced to instruments with no material moving parts whatever, not much more complicated than those now used for modern wireless broadcasting and receiving.

The diagram shows my apparatus, both for transmitting and for receiving, as figured in my paper of 1924, but modified as employing triode thermionic oscillators instead of rotating dynamo machines.

For those who have not my paper of 1924 before them, it may be well to give a short description of how the apparatus is designed to operate. At both ends the two cathode-ray beams impinge on screens, which they are caused by the deflecting systems to sweep over rythmically and in complete synchronisation in parallel lines backwards and forwards from end to end.

The Photo-Electric Screen

In the transmitter the screen is composed of a very large number of minute photo-electric cells which are each activated, more or less, by the amount of illumination each receives from the image thrown upon the whole screen by the lens. The end of the transmitting cathode beam explores each of these cells in turn, and as to whether it finds it illuminated and thus activated or not, an electric impulse of varying intensity, proportional to the amount of local illumination, is transmitted to the neighbouring gauze grid.

The varying electric current thus originated, after amplification and conversion into wireless waves, is transmitted to the receiver, where, after further amplification and detection, it varies the strength of the receiving cathode-ray beam, which, in turn, affects the brightness of that particular portion of the fluorescent screen on which the end of the cathode beam is at that instant impinging.

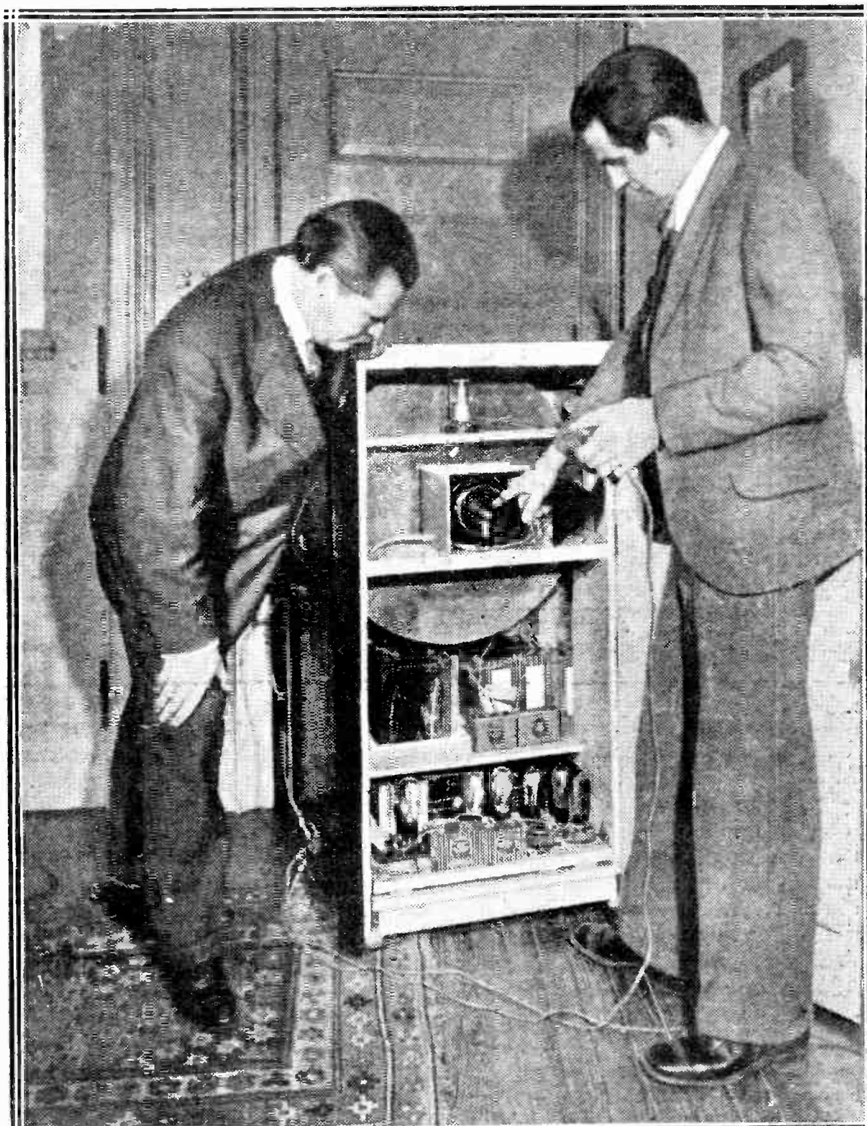
Selenium Too Slow

Thus on the receiving fluorescent screen a replica of the picture thrown by the lens on the transmitting screen is reproduced.

Very possibly with modern knowledge and arrangements the transmitting method in which selenium is used might be got to work, though probably it would be too sluggish for showing rapid movements in the picture transmitted. It is, however, interesting to note that many years after my experiments and publication, in their British patent applied for on February 28th, 1924 (No. 234,882), Mr. G. J. Blake and Mr. H. J. Spooner describe a television transmitter using cathode rays, with a selenium resistance arrangement designed on exactly the same lines as I had tried, the other details of both transmitter and receiver being the same as that which I described in my Rontgen Society paper of 1911, but with the addition of thermionic amplifiers and wireless arrangements, such as I suggested in my Radio Society paper of March 26th, 1924, which appears to have been published prior to Messrs. Blake and Spooner's patent specification, which was not accepted till May 26th, 1925.

Colour Television

Possibly, however, another transmitting arrangement employing cathode rays, still better than either the one using selenium or the particular class of photo-electric cells described



One of the most nearly successful attempts at practical television has been made by Dr. E. W. Alexanderson, of the American G.E.C., but here again mechanical methods put a definite limit upon the detail with which pictures can be transmitted.

in my papers of 1911 and 1924, is what is described in V. K. Zworykin's British patent specification No. 255,057 of 1925.

This is a patent applied for by the Westinghouse Electric & Manufacturing Company, of the U.S.A., the convention date of which is July 13th, 1923, and the complete specification of which was accepted on March 31st, 1927. In this, where a gauze grid is employed, and a large number of very small photo-electric cells, similar to my suggestions of 1911 and 1924, the cells are composed of minute globules of specially prepared potassium hydride in an atmosphere of argon.

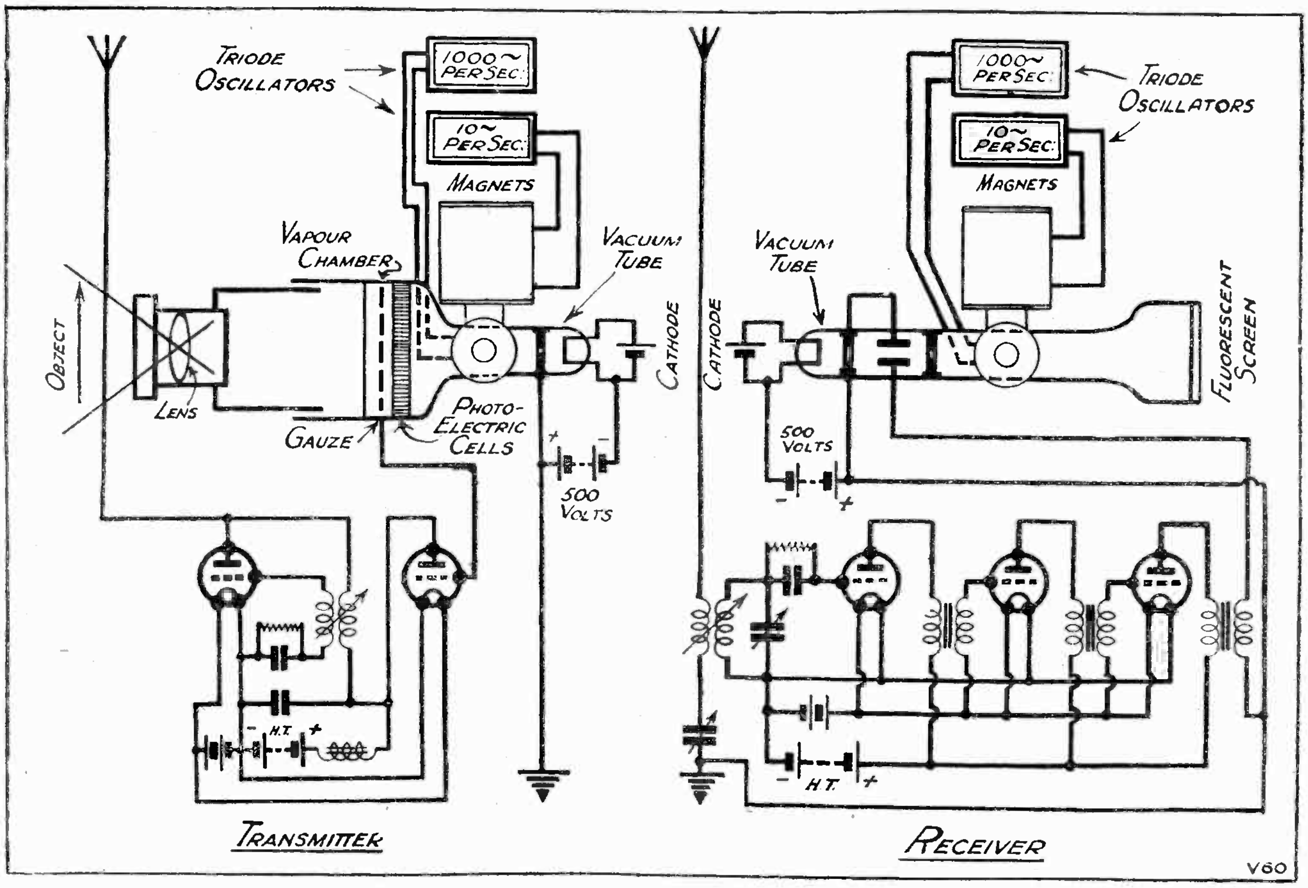
Now, to consider the chances of television by cathode rays being perfected, it must be remembered that since its original invention more than thirty years ago, and particularly during the past nine years, great practical improvements have been made in the cathode-ray oscillograph, which originally, in its " hard " form, was very intractable.

Further Research Needed

Such oscillographs are now commercial instruments in practical use, but even now they are probably capable of much still further improve-

results may be obtained. The chief matter to be settled is probably the best form of photo-electric sensitive transmitting screen which will produce the required momentary electric impulses under the combined effect of the lights and shades of an image thrown upon the screen by a lens, when swept backwards and forwards, or in spirals, by the oscillating and traversing, or the spirally moving, end of the cathode-ray beam.

High-speed synchronous deflecting systems, worked by oscillating valves, will also require working out, and it cannot be pretended but that to get



The specification, which is a very interesting one, gives full particulars, and should be studied in detail by anyone who wishes to understand Zworykin's ideas. Further, it contains the new suggestion that, by inserting both in the transmitter and in the receiver mosaic three-colour screens, like those used in autochrome colour photography, coloured pictures could be transmitted and reproduced, this extra complication increasing the difficulty of success by three times, inasmuch as three times the number of granulations would be required to form the received image of any desired quality in colour instead of in monochrome.

ment, more especially as regards the luminosity of the fluorescent screens, which should be arrived at by more experimental investigation, which a large demand would no doubt bring about.

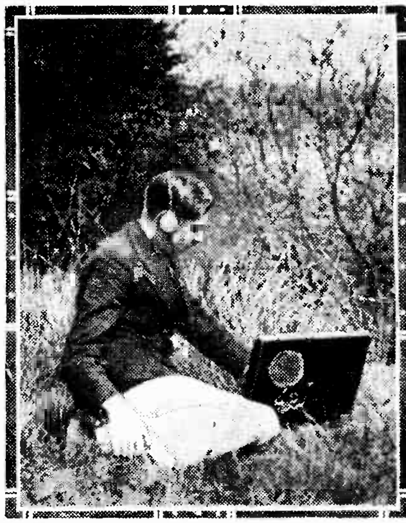
At present, so far as appears, it is only for reception that cathode rays have so far actually been used in television experiments. Cathode-ray transmitters, though suggested, and even patented, as mentioned above, so far as my information goes, have not been exhibited or even claimed as actually having been made to function.

Several workers are, however, now said to be at work upon the subject, and it may be hoped that successful

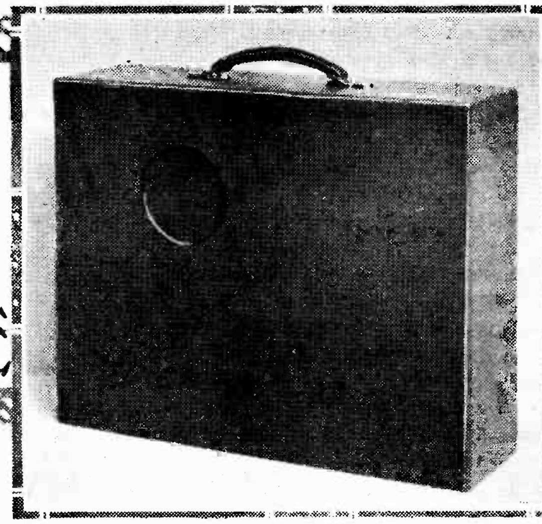
good results many and arduous investigations are likely to be found necessary, such as may well occupy skilled researchers for considerable time, and require much money.

So far as existing mechanical methods of television are concerned, I agree with Sir Oliver Lodge's view that these have probably already reached about the limits of perfection that are obtainable, and that for general purposes these are unsatisfactory.

Indeed, it was my opinion that this would prove to be the case that led me, nearly thirty years ago, to consider other than mechanical methods.



A THREE-VALVE PORTABLE



This receiver, which is completely self-contained and embodies a frame aerial and loud speaker, weighs only 20 lb. It employs a remarkably sensitive circuit and is capable of really useful ranges of reception.

By J. ENGLISH.

There is no doubt that the popularity of the portable receiver is increasing considerably, chiefly among those people who are interested in radio solely as a means of entertainment. The completely self-contained portable receiver capable of loud-speaker reproduction at some distance from the local station is one of the most popular models, and the demand for this type of portable is being encouraged by quite a number of manufacturers. Several firms are producing compact four- and five-valve sets which are, however, somewhat ponderous in weight.

COMPONENTS

- 1 ·0003 variable condenser with vernier dial (Ormond in set. Any compact good make).
- 1 Potentiometer, 400 ohms (Igranic or similar type).
- 1 On-off switch (Ormond in set. Benjamin, Igranic, Lissen, Lotus, etc.).
- 2 L.F. transformers (Mullard P.M. in set).
- 3 Valve holders (Benjamin in set. Any good sprung type).
- 1 ·0003 fixed condenser (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C., etc.).
- 1 Semi-fixed resistor, 30 ohms (Any standard make, Lissen, etc.).
- 1 Cone loud-speaker unit ("Beco" in set. A little rearranging will permit other types such as Amplion and Mullard to be used).
- 3 'Phone terminals (Eelex in set. Belling-Lee, Clix, Igranic, etc.).
- A. & E. terminals (as above).
- 7 Plugs (as above).
- 4 Spade terminals (as above).
- Quantity single rubber-covered flex (24 D.C.C., 36 D.C.C., Eureka Resistance Wire, 30 S.S.C.).
- Materials and wood for carrying case and skeleton former.

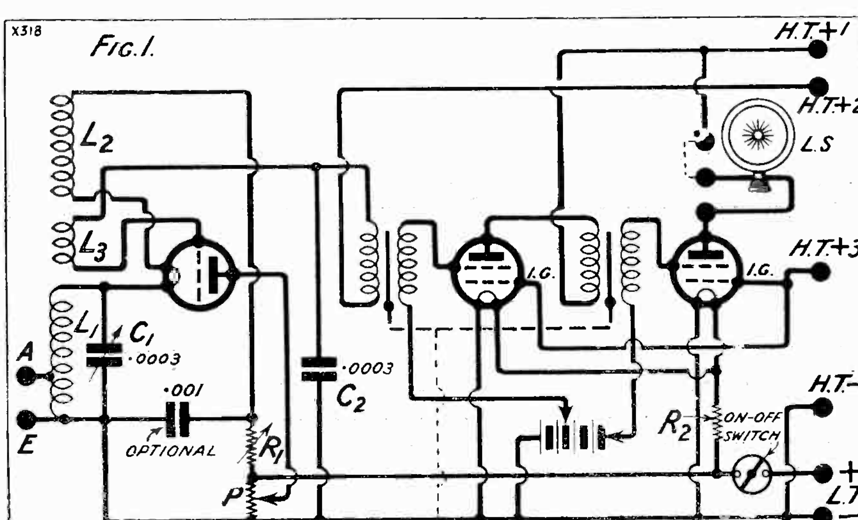
Inexpensive and Efficient

Apart from the listening public it is probably the ambition of every amateur to own at some time or other a loud-speaker portable set, but many are deterred from acquiring one by the high cost of commercial sets. When you come to look into things you find that a good five-valve set costs about thirty guineas and weighs nearly as many pounds.

However, if you are keen on constructing wireless sets, you will soon find that, with a little patience, it is possible to build yourself quite a respectable loud-speaker portable for one-third the cost of the commercial article. Of course, some sacrifice in the effective range of the set has to be made in order to reduce expense and weight so considerably, but even the type of portable I have in mind is not so very inferior to the commercial five-valver.

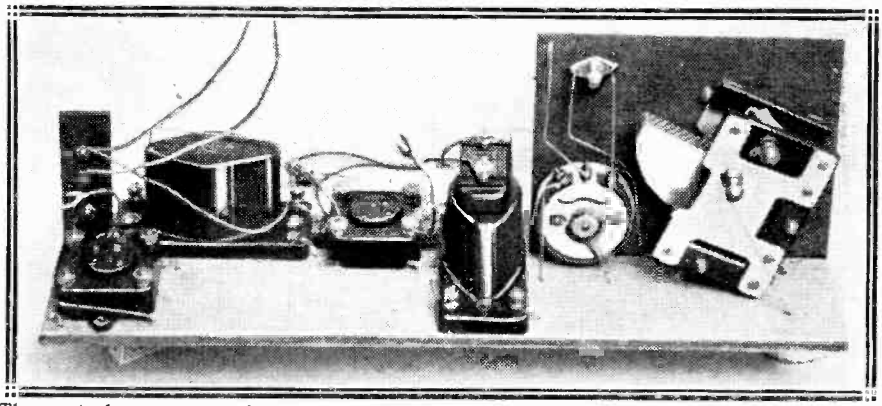
Where Constructors Score

This is because the amateur constructor is able to take advantage of technical developments, making for greater efficiency with less weight, which the manufacturers are unable as yet to incorporate in their sets.



Because the loud-speaker portable is such an attractive proposition for the man who builds his own set, I have been tempted to design a portable for loud-speaker working on a built-in frame aerial, using all the latest devices for high efficiency with the minimum of weight. The resulting three-valve receiver is illustrated in these pages, and you will see that it is reasonably compact and unobtrusive in appearance.

In full working order it weighs about twenty pounds, which is more than I should have liked, but it is possible to reduce this weight as I shall explain later. In any case, the total weight is not excessive in view of the results obtainable, which are about the average for a three-valve portable.



The controls are mounted on a small panel, the components being fixed to a baseboard which forms part of a convenient and easy-to-make internal framework assembly.

Design of the Set

One side of the case has two doors, the upper one giving access to the tuning controls and the lower to the filament, grid bias and H.T. batteries. The cone loud speaker is built in behind a grille opening on the other side of the case, the reason for doing this being that, once the set is tuned in, it can be closed up and carried about while working. This method of mounting the loud speaker also preserves the unobtrusive appearance of the outfit, in that loud-speaker reproduction can be enjoyed without the entrails of the set being in full view.

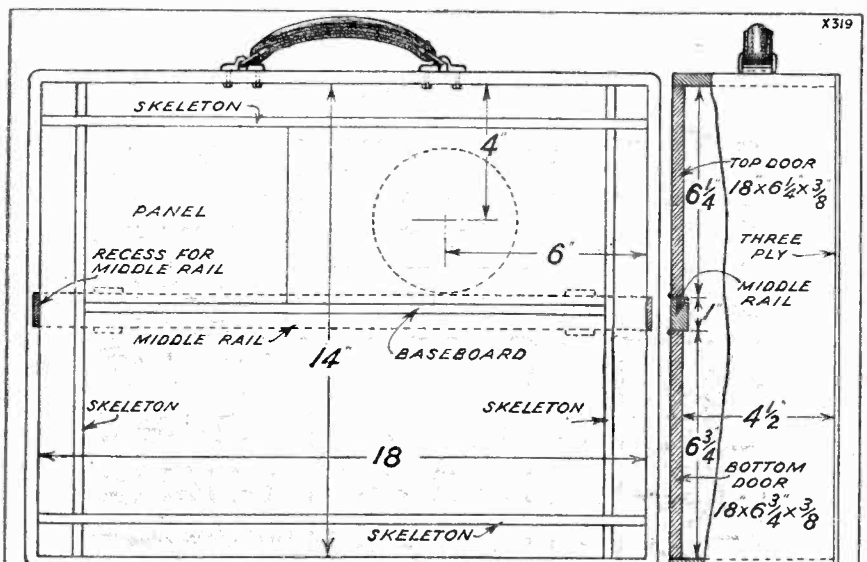


FIG. 2 DETAILS OF CASE

I am a great believer in constructing a portable so that it does not look like a wireless set when in operation, and I never feel satisfied with the appearance of some commercial portables which must reveal the entire contents of the case in order to hear the loud speaker in operation.

The built-in frame aerial, which, by the way, is specially wound for high efficiency as described below, is designed to receive on the normal wave-length band which includes such stations as 2 L O and 5 G B.

The London station is audible at very good loud-speaker strength at a distance of 15 miles, and the set should have a loud-speaker range of *at least* 20 miles from a main broadcasting station. At 12 miles from 2 L O the full loud-speaker volume is more than sufficient for comfortable audition in the average living-room, and signal strength has to be reduced. 5 G B comes in at good strength up to 100 miles away.

Provision is made for the connection of an external aerial so that the set may be used either on the home aerial or on a temporary one when taking the set with you on a country ramble. Quite a modest external aerial will increase the loud-speaker range of the set considerably, and good daylight results should be possible up to 50 miles or so from your local station. Up to 20 miles or so loud-speaker reproduction is very strong.

You can get much more fun out of the set by running it on the frame aerial, because you are not tied down to one spot as with the home receiver. Because of this the portable very soon demonstrates the versatility and fascination of radio reception in a way that the fixed receiver can never do. In order to make the set as adaptable as possible, provision is made for using 'phones in place of the loud speaker for reception of stations beyond loud-speaker range.

A Novel Circuit

Now, in order to obtain the results mentioned above with only three valves, it is obviously necessary to use a combination giving high amplification and sensitivity with pure reproduction, and requiring the least number of controls. The best combination is undoubtedly a regenerative detector followed by two stages of L.F. amplification, the control of reaction requiring to be particularly smooth for easy operation, especially where a frame aerial is used.

From long experience of the regenerative detector valve with frame-aerial input, I know that there is not much to choose between various conventional circuits provided reaction is quite smooth. However, the recent development of a new application of the ubiquitous Filadyne circuit for frame-aerial reception provided me with just the type of detector I required for this set. This particular Filadyne circuit is highly sensitive and stable, and requires very few components for its construction.

I have described this Filadyne-frame combination in some detail in a previous article, but for the sake of completeness let me give you a brief outline of its features. First of all, *two* frame aerials are used, each forming one of the tuned filament coils, a smaller winding between the two being the reaction coil L_3 of Fig. 1, the theoretical circuit of the receiver.

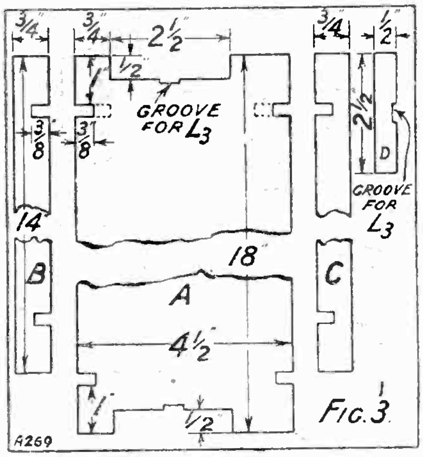


FIG. 3

The two frame aerials are wound in opposite directions, as I have found in previous experiments that less wire is required to cover a given wave-band when the two filament coils are wound side by side in opposition. Also the H.F. resistance of the tuned circuits is reduced by this method of winding, and where the two filament coils are in the form of frame aerials the double loop seems to have better pick-up qualities than the usual single winding. In this receiver the high efficiency of the Filadyne detector is largely due to the employment of the special double opposition-wound frame aerial.

Smooth Reaction Control

The degree of reaction is controlled as in the normal Filadyne circuit by the variation of anode potential, which is controlled within fine limits by the potentiometer P. This provides a remarkably simple yet very effective control of reaction, and when you have such smooth control the receiver is more easily operated at optimum efficiency.

After the Filadyne detector two stages of transformer-coupled L.F. amplification are used in order to obtain sufficient volume to operate the loud speaker satisfactorily. Here again I have been able to make use of a new development which has helped considerably in keeping down the weight of the set. This is the recent introduction of improved forms of the tetrode valve, which, as you are doubtless aware, requires a lower anode voltage than the three-electrode valve for the same degree of amplification and power output.

If we were using three-electrode valves in this set it would be necessary to apply at least 100 volts to both L.F. valves for good results. But the two tetrodes provide full loud-speaker volume on only 60 volts H.T., so that there is no loss of efficiency while the saving in weight makes the receiver a much more portable proposition.

Use of Tetrodes

It should be understood that in a portable receiver there is all to gain and nothing to lose by using tetrodes in place of the ordinary valve. Apart from the use of tetrode valves there is nothing out of the ordinary about the L.F. stages, as you will see from the diagram of Fig. 1. Note, however, that the fixed resistor R_2 is common to both L.F. valves, which do not require separate or critical adjustment of filament voltage.

The more technical of my readers may query the efficiency of the frame aerial where, as in this receiver, the whole of the receiver and batteries are inside the frame itself. But with a frame of this description the magnetic field is concentrated fairly close to the windings so that if the latter are only an inch or so from the nearest component parts no serious loss of energy will arise. In this receiver, as you will see from the photographs, the frame windings are entirely air-spaced and not near enough to any metal parts to cause appreciable H.F. losses.

Coming now to practical details, there is nothing in the design of the set that should prove difficult to the average constructor, although there is somewhat more constructional work than is met with in the usual fixed receiver. Most of the constructional work is involved in the making of the carrying case and the skeleton framework and in the winding of the double frame.

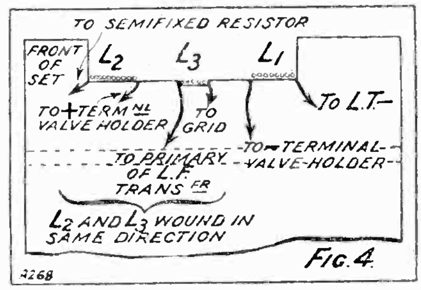
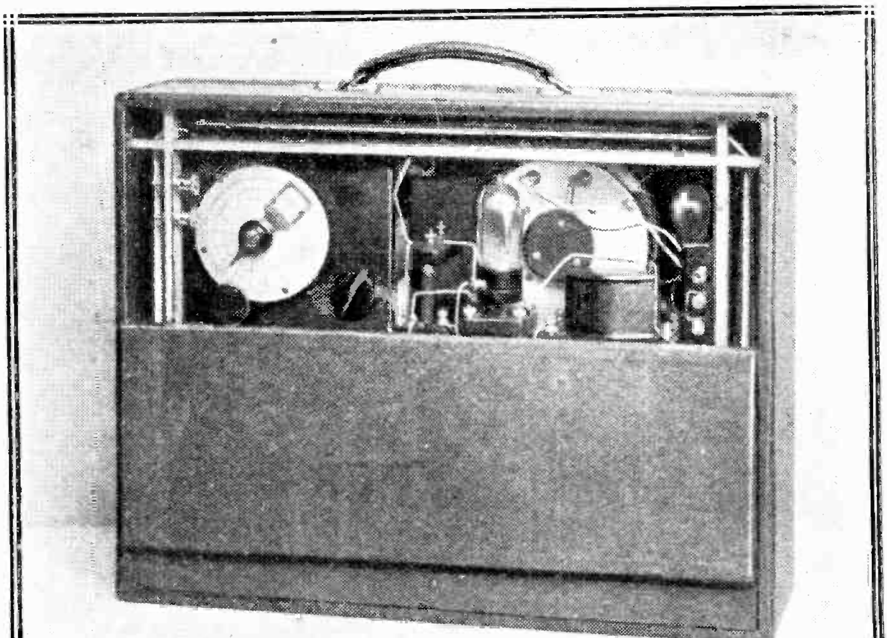


FIG. 4

A working knowledge of carpentry will carry you through this quite easily, but if you do not wish to do the woodwork yourself any reputable firm of cabinet makers will undertake the work for a reasonable charge. After all, the construction of the case is quite simple as will be seen from the diagrams of Fig. 2, which will provide all the information required by the constructor.

The Original Case

I may mention here that it would have been possible to design the outfit to fit into a smaller case, but by allowing more room we have the additional advantage of a larger and



As will be seen, when the upper door is dropped open both the controls and the majority of the components become visible. The back of the small cone-type loud speaker can be seen between two of the valves.

more efficient frame aerial. Even here the case is not over-large for a loud-speaker portable.

The original carrying case weighs about seven pounds, but if you can obtain a fibre case of similar dimensions it should not weigh more than two or three pounds. The wooden case is somewhat heavy, but it is certainly very strong and will stand much hard usage.

The four sides of the case of ⅜-in.-thick wood are first joined together, and then the back piece of three-ply nailed and glued into position, the 4-in. hole for the loud speaker having been already cut out. This is best done with a small fretsaw, finishing the edge with a file and sandpaper.

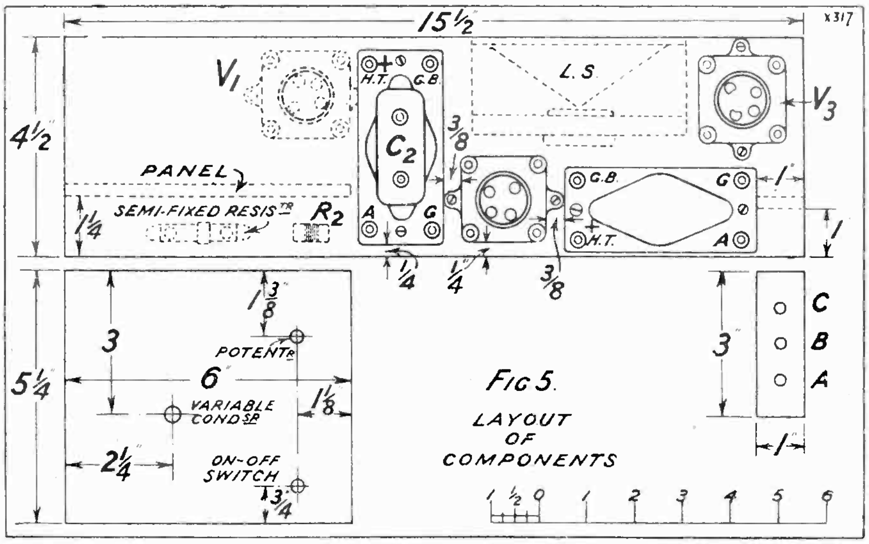
The middle rail, on which the two front doors are hinged, is slightly recessed into the side pieces. This rail, with doors already hinged, is only screwed into position after the receiver proper has been finally placed in the case. A pair of 3/16-in. ball-catches at the top of each door is sufficient to prevent them jarring open.

A Cloth Covering

A very pleasing appearance is imparted to the case by covering it, as in the original, with thin book-cloth, this material being obtainable quite cheaply in a variety of colours. The cloth is put on with thin glue, and with careful workmanship the final surface is more durable and pleasing than staining and polishing the wood. Also, if you are not very skilful at wood-working, it hides up any deficiencies in your carpentry. This cloth covering can be waterproofed by lightly coating with french polish. The leather handle, with fittings, is obtainable from any shop repairing trunks and suit-cases and is quite easily fitted.

The next step is to construct the skeleton former on which the frame aerials are wound. Into this skeleton the receiver proper is eventually built, and the batteries accommodated, so that the set, as a whole, is complete without the case.

All wood required is ¼ in. thick, and the various pieces are cut out according to the diagram of Fig. 3. You will require two of each of the three pieces A, B, and C, and four of the pieces D to fit between the ends B and C. The bottom and top pieces



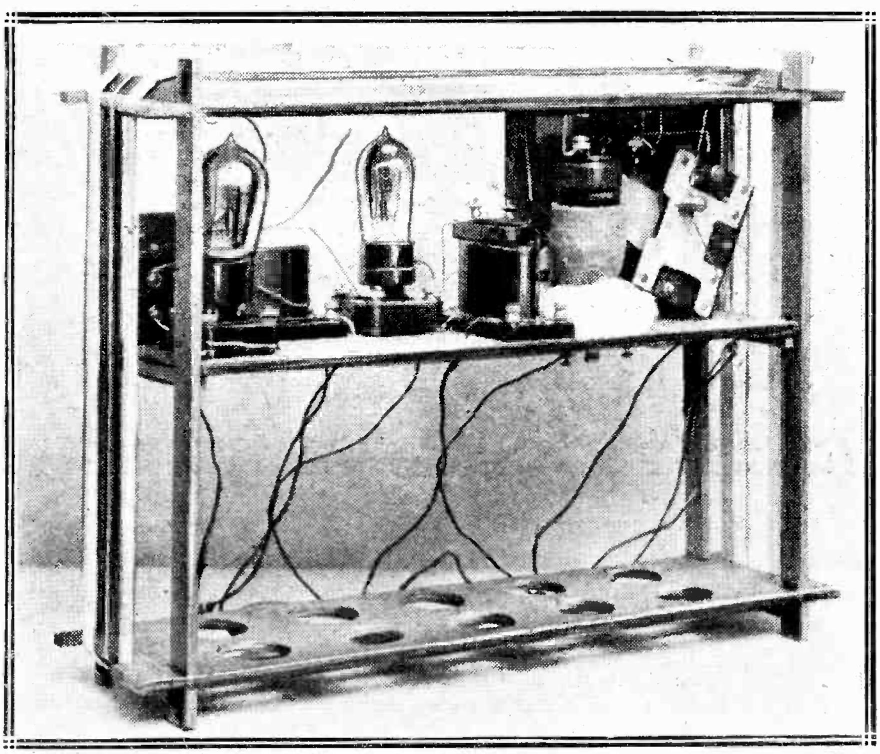
A can have a number of 1½-in. holes drilled in them to reduce weight, as in the bottom board of the original set. The skeleton is then put together, gluing each joint, and the whole bound up with string and laid aside for 24 hours on a flat surface, so that when the glue is set the skeleton will be truly square on all sides.

In the meantime, the panel and baseboard can be prepared. The panel need not be ebonite, because the difference of potential between the panel components is so small that no leakage will occur if well-seasoned wood is used. For the same reason the aerial and earth terminals are mounted on one of the side strips of the skeleton, as you will see from the photographs. I have used for the panel a piece of ¼-in. mahogany, stained and polished, which gives a presentable appearance.

Winding the Frame

The panel and baseboard are cut to the dimensions of Fig. 5, where the position of mounting the panel on the baseboard is shown in dotted lines. The panel, after drilling the necessary holes, is best glued to the baseboard and held in place by two thin ⅜-in. brass screws, screwed from the underside of the baseboard.

When the skeleton is properly set you can wind on the frame aerials, which consist of two closely-wound layers of 18 turns No. 24 D.C.C., with the smaller reaction winding of 5



The set is built into a simple but robust framework, and on this it is an easy matter to wind the frame aerial. Note the wood cut away in order to reduce the weight.

turns No. 36 D.C.C. between them, as shown in Fig. 4. This diagram also indicates the connections for each winding.

Notice that the frame winding nearest the front is tapped at the tenth turn from the L.T. battery end, this tapping going to the aerial terminal. If the wave-length of your local station exceeds 400 metres, it would be advisable to make each frame winding 20 turns instead of 18. The smaller tuning capacity then required adds slightly to the efficiency of the receiver on higher wave-lengths. The winding of the frames is much simpler than it sounds and actually takes less time than winding an ordinary 60-turn coil. Notice that the ends of the windings are passed through small holes drilled in the top board and secured by forcing in small pieces of matchstick.

Assembling the Woodwork

When you have finished winding the frames, you will be able to appreciate some of the points of the design. You will see that all the windings are well air-spaced at all points, and this adds appreciably to the efficiency of the frame aerials.

The panel and baseboard must now be placed in position, the baseboard resting on pieces of wood glued and screwed to the side-pieces of the skeleton. The panel-baseboard unit should be a nice tight fit, and if the panel is slightly too large, a few shavings should be removed from its top edge. When all is in order, remove the panel and baseboard, and mount the components to the layout of Fig. 5. It is very important to adhere to the exact positions indicated for every component, as in a portable of this description the final layout is necessarily the result of much thought and consideration.

Mounting the Components

Notice that the vernier dial is mounted slantwise, in which position it fits with more clearance near the operating knob. The detector valve holder is also in rather an unusual position, being mounted upside down on the underside of the top board, as this reduces the length of several connections.

The semi-fixed resistor (30 ohms) for the first valve is mounted underneath the baseboard near the panel, as can be seen from one of the photographs, and the fixed resistor common to both L.F. valves is also mounted on the underside of the baseboard. You can very well make this resistor yourself, as it is not worth while buying one. The resistor is simply a 5-in. length of No. 30 S.S.C. Eureka wire having a resistance of ·8 ohm. The wire is wound on a small piece of wood, which is then screwed in place underneath the baseboard.

Although other L.F. transformers can be used, I can thoroughly recommend those specified for this set, which are just ideal for a portable owing to their small weight and size. Although small compared with the usual run of good transformers, they put up a very excellent performance which cannot be rivalled by other small transformers.

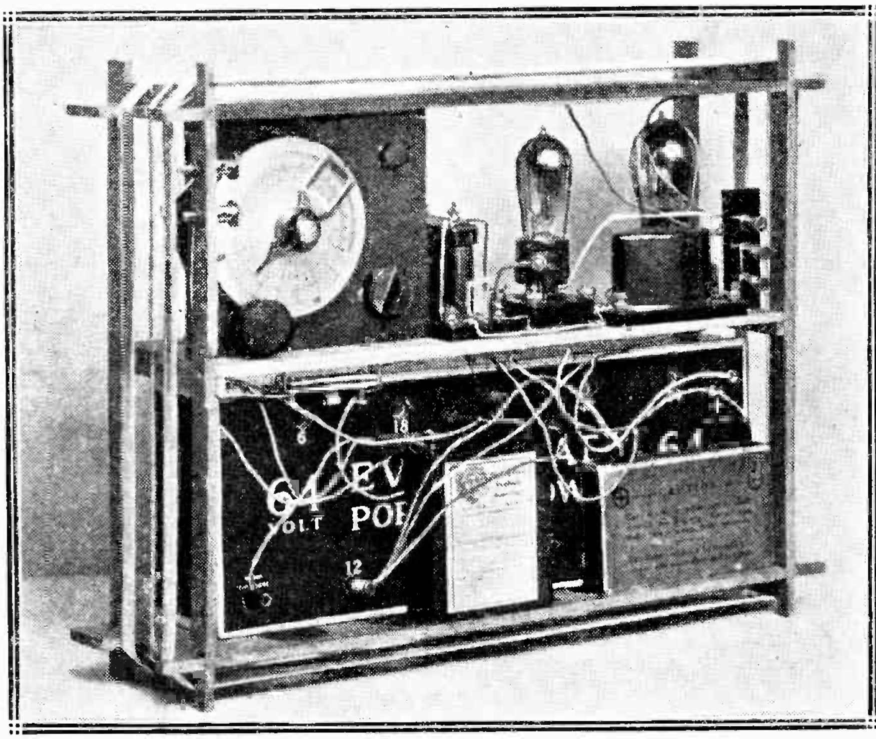
Wiring Quite Simple

With all components in position you can commence wiring up the panel-baseboard unit as shown in Fig. 6. In this diagram it has been necessary to draw the panel, baseboard, and detector valve holder in one plane, so that some leads appear longer than they really are. The connections to the detector valve holder and to the frame and reaction windings should be left until the rest is the wiring of the detector-valve and frame-aerial connections. The diagrams of Figs. 4 and 6 should help here. In wiring up you will probably use some insulated wire, such as Glazite, although bare wire can be used if well spaced. The leads to the batteries are best made with lengths of insulated flex, and the small holes in the baseboard through which these

This set embodies the novel and highly efficient Filadyne circuit which was originated by the Technical Editor and subsequently developed by the author. The receiver was thoroughly tested by the "M.W." Research Department.

and other wires pass are indicated in Fig. 6. Note that the leads to the inner grids of the tetrode valves terminate in spade terminals in order to ensure a good connection to the inner grid terminal on the valve base.

The panel and baseboard unit can now be inserted in the skeleton former, and held in place by two small screws, although these are hardly necessary if it is a reasonably tight



Here you see the complete set ready for use, but removed from its case. You will note that there is ample room for batteries of the larger capacity types.

of the wiring has been completed, as it is easier to solder up with the panel-baseboard unit out of the skeleton.

The wiring of the receiver is by no means so complicated as it looks; there are not many leads, and most of them are quite short. The only thing you want to be careful about fit. The remainder of the wiring can now be completed, and the receiver is then ready for insertion in the carrying case. Before this is done, however, the cone loud speaker must be fitted to the back of the case over the 4-in. hole already cut out in the position shown in Fig. 2. The loud speaker used here is a "Beco" unit, which the makers are prepared to supply without the usual cabinet in a form suitable for portable sets. This unit is remarkably compact and rigidly constructed, but not at all heavy, so that it is eminently suitable for a portable. The unit handles very strong signals without distortion, and puts up an excellent performance equal to that of some larger cone models.

When mounting the unit a piece of copper gauze 5 in. in diameter is placed over the hole, then one of the ring washers supplied with the unit and, lastly, the unit itself. Two 4 B.A. bolts and nuts are sufficient to hold the speaker firmly in position, the heads of the bolts being countersunk into the outside of the back of the case.

Suitable Valves

Now, before finally placing the receiver in the case it is a good idea to have a trial run on the work bench, as in this way the set is more accessible if any faults have to be traced.

First of all a word about valves. The detector can be one of the usual Filadyne valves, such as the D.E.R., D.E.2 L.F., D.E.3, etc., choosing preferably one with a low filament consumption in either the two- or four-volt ranges. The valve I found most useful was an old Radio-Micro ·06 dull emitter, which proved to be the least microphonic.

Curing Microphonic Howls

This brings me to a most important point, the reaction between the loud speaker and the microphonic detector valve. In a portable, where the two are so close together, the result of this reaction is generally an uncontrollable howl. I found this out immediately I put the set in its case and switched on! Owing to the Filadyne valve being more susceptible to sound vibrations than the ordinary detector, the problem of curing this unbearable howl seemed difficult until I tried a dodge first suggested by Mr. Harris.

This consists of covering the glass bulb of the valve with a layer of Plasticine about ⅛ in. thick. This cured the howl completely. You will notice the coating on the valve in one of the photographs, a small pad of cotton wool being used to prevent excessive vibration of the valve in its holder. In very bad cases filling up the space around the loud speaker with cotton wool helps greatly.

I was glad to find that the two tetrodes were absolutely non-microphonic and, although nearly touching the loud speaker, neither valve suffered from microphonic reaction. The two tetrodes used here are an A.P.412 H.F. and an A.P.412 power for the first and second stages respectively. Both valves have common voltages for inner grid (12 volts) and anode (60 volts). On these voltages the first L.F. stage gives a remarkably high degree of amplification, and the consequent large input to the last valve is handled by the A.P.412 power without any sign of overloading. An ordinary power valve would require more than 120 volts H.T. for these results.

Preliminary Adjustments

Having inserted the valves and connected up batteries, switch on the set and adjust the semi-fixed resistor R_1 until reaction control on the potentiometer is quite smooth. For the usual Filadyne valves not more than 30 volts H.T. is necessary, and control of reaction is smoother if the filament current is kept fairly low. In fact, reduce the filament current to the lowest value giving

(Continued on page 672.)

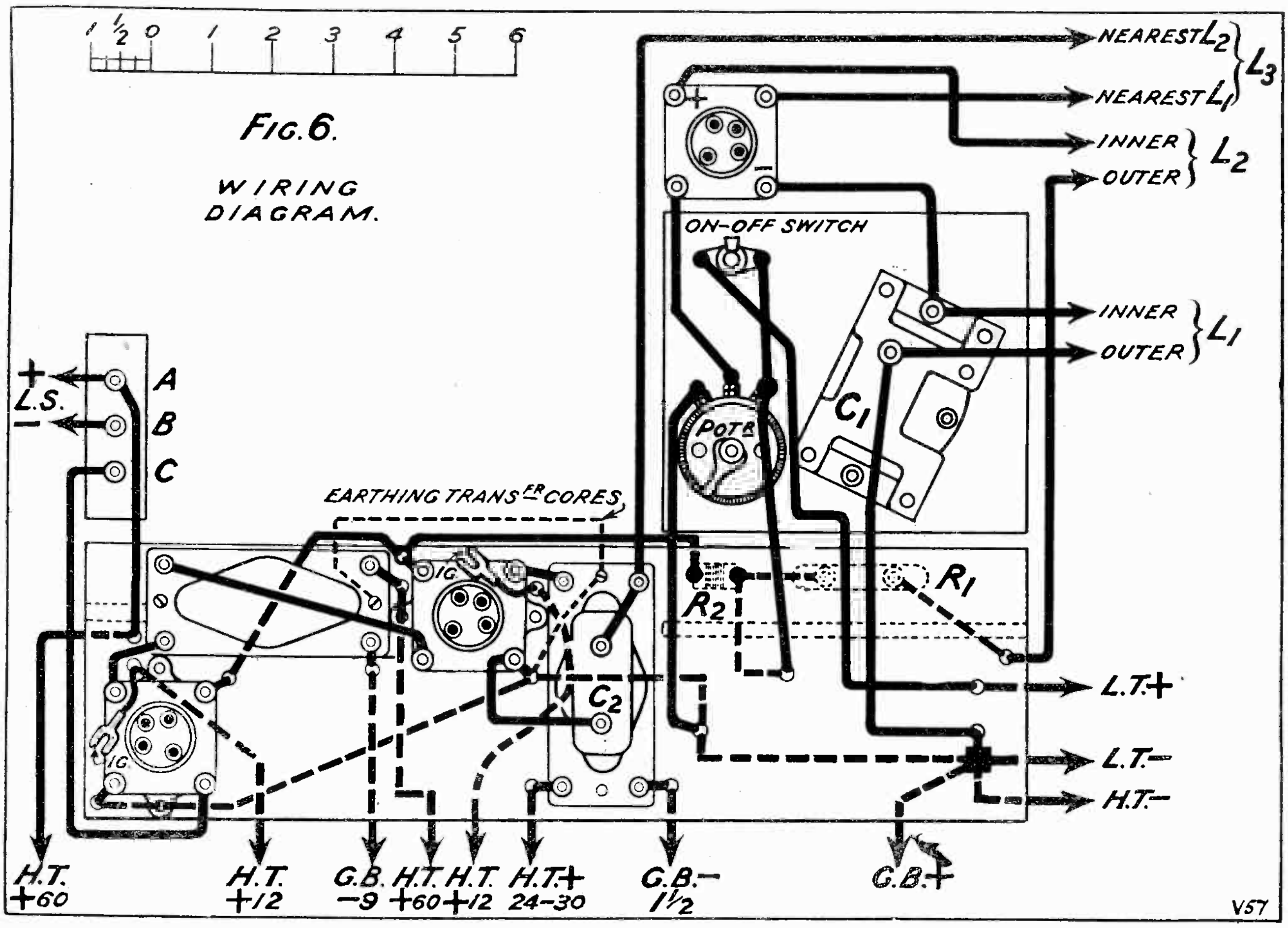


FIG. 6. WIRING DIAGRAM.

Those Classical Broadcasts

Most listeners are familiar with the procedure of publishing in musical programmes analytical notes. These notes are provided for the benefit of members of the audience who want to know a little about the technical construction of certain orchestral items, etc.; and sometimes a brief note is given in connection with the composer's life, etc.

A typical example of these so-called analytical notes—which are regularly published in the B.B.C.'s official journal—might read as follows:

"The first movement opens with sustained chords which strike a sombre note, the succeeding slow theme providing the basis, as it were, for the work as a whole. Immediately following the sonorous and majestic chords of the main theme follows a section in quick time—an exposition of the first and second themes, one in a minor key and the other in the major . . ." etc., etc. And so on *ad lib.*

These "analytical" notes are supposed to help listeners to understand and appreciate various works of the masters, old and new, which appear in the B.B.C. programmes week by week.

A large section of the listening public maintains that the B.B.C. broadcasts too much "classical" music — and another large section maintains the B.B.C. broadcasts too little. But too much or too little, the man who condemns "classical" music misses a good deal of pleasure because he does not know how to enjoy it—as this article attempts to make clear.

Music Notes

Now the experienced and cultured student of music—the man who has, to some extent, studied the technique of music, and who is generally familiar with most of the orchestral and piano "masterpieces" which are broadcast from time to time—may find these notes useful and perhaps interesting, because they supply clues to the construction and development of musical works, and although he may be fairly familiar with them, these music notes jog his memory, just as the stage prompter jogs the memory of an actor reciting lines which, although familiar, sometimes slip the memory.

But of what good are such notes to the many hundreds of thousands of non-technical musical listeners? They serve no real purpose, and certainly they do not help the listener to enjoy to a greater extent a particular orchestral or pianoforte item broadcast.

For one thing, to appreciate and understand such notes one must be familiar with the meaning of words used in the musical vocabulary—words like Andante, Scherzo, Sostenuto, Adagio, etc., etc. Unless one knows the meaning of such words, music notes of the "analytical" type are more or less unintelligible gibberish to the reader.

"Highbrow" Items

Many listeners who write to the newspapers and bitterly complain of the preponderance of "highbrow" music in the B.B.C. programmes do so because they listen to some classical composition without the slightest understanding of what it is all about. And therein lies one of the fundamental differences between so-called "jazz" music and "classical" music; the former requires no intellectual concentration; the latter, although beautiful themes may occur, does necessitate the use of one's brains—or shall we say, *intelligent* appreciation, as well as emotional.

There are, of course, many, many so-called classical (i.e. first-class) compositions which are not only intellectually first-class, but "tunefully" first-class—compositions about which one does not have to have knowledge in order to enjoy listening to them. But there are, as well, many wonderful musical works of first-class merit which the average listener would not condemn as "highbrow" if only he were given an intelligible outline as to the meaning, origin, and general plan of the work.

Many listeners have complained that, for example, Bach items in the programmes "leave them cold"; and although the B.B.C. has done much to encourage and cultivate a wider appreciation and understanding of classical music—especially in the broadcasting of musical talks by Sir Walford Davis and by broadcasting the "Foundations of Music" series—the fact remains that when, for example, a big symphony is to be broadcast, there is seldom an intelligible and explanatory broadcast preface to the work. Consequently, many thousands of listeners switch on one evening and hear the bald announcement that, say, a Beethoven Symphony will be broadcast.

That one item may last half an hour—and the listener who is not reasonably familiar with Beethoven music cannot be expected to sit and listen to a long and complicated symphony unless he has an innate appreciation of classical music.

How To Appreciate The "Classics"

Some people have the love of good music born in them so that, without any study at all, they enjoy it to the full; others find they have to cultivate the taste for good music; if they don't they realise they will not enjoy it to the full.

There is no reason why a man or woman of average intelligence, who is sufficiently musical to enjoy a good light opera tune by Sullivan, or Offenbach, should not, by means of a little intelligent application, learn to appreciate and greatly enjoy the more classical works of composers like Bach, Beethoven, Mozart, Wagner, and others.

This article was started with the idea, not of preaching or lecturing to the lowbrows, but with the idea of making a few suggestions as to how the listener with no musical training, but who is not without some musical sense—i.e. appreciation of beauty in sound, sense of time, etc.—could be helped to learn to love works which, to-day, he condemns as "dull," or "highbrow."

The writer of this article is far from being a "highbrow," but by a peculiar bit of luck he has learnt to enjoy, not only a rousing musical comedy tune, a "jazz riot," but works by composers like Bach, Beethoven, Mozart, Brahms, and others. At one time they "bored him stiff"; to-day they offer a very wonderful and enjoyable treat.

Now, the cultivation of a sense of enjoyment of classical music does not depend upon a technical study of music. There are, of course, many people who enjoy Bach purely intellectually; emotionally the genius of Bach "leaves them cold," but the almost mathematical precision of Bach's technique interests them, and arouses their enthusiastic admiration just as a difficult problem arouses the enthusiasm and admiration of a student of the higher branches of mathematics. (I remember once talking to a famous mathematician about Einstein's Theory of Relativity. From the mathematical point of view—which was beyond me—my friend found that theory a sheer joy! "It's beautiful," he said. Really, it gave him the same sort of pleasure as a beautiful piece of music gives a musician.)

This article, despite its ramblings, aims at suggesting to the listener who has not studied classical music, and does not understand it, that there are ways of learning to find great pleasure in so-called "highbrow" music without resorting to the lengthy task of studying the technique of musical compositions.

As a crude example of "semi-classical" music, let us take the famous, if hackneyed, piece by Rachmaninoff—the Prelude in C Sharp Minor.

The writer knows at least three people who were not interested in music until they heard that old story that the Prelude was supposed to be a musical representation of a man buried alive!

"Music With a Story"

When you listen to the B.B.C. orchestra playing the Prelude again, you will notice that the music *does* fit in with this story—and even with the story which suggests the bells of Moscow ringing during the great fire of 1812.

And Tschaikovsky's "1812" is another example of "Programme" music—or music with a story—which has achieved great popularity.

The "Prelude" and "1812" are not first-class works, but there are many first-class works which, if one knows a little of their history, if one gets the key to the emotions which gave them birth, cannot fail to arouse one's interest.

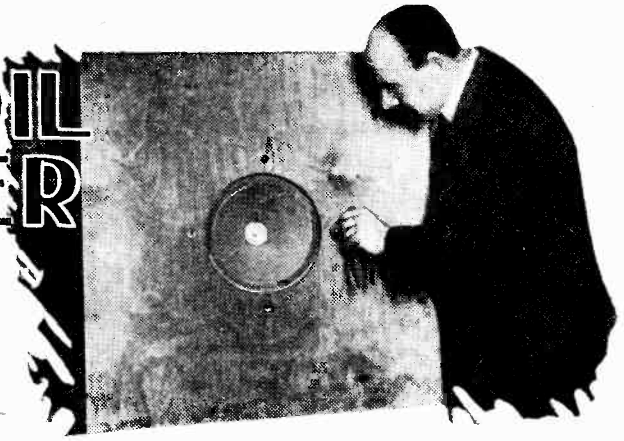
Everyone has heard, or heard about, Beethoven's "Moonlight" Sonata, but not everyone has heard his "Emperor" Concerto—written because of the composer's one-time admiration of Napoleon.

When next you hear the B.B.C. broadcast the "Emperor," listen to it, and remember that Beethoven was inspired to compose it because of Napoleon's wonderful victories; the Concerto gains an added interest and you will find your imagination helps you to take a keener interest in the work.

(Continued on page 673.)

Mr. Percy Pitt conducting the Symphony Orchestra at Savoy Hill. To this group of musicians are due many of those "classical" broadcasts which form the subject of the accompanying article.

A MOVING-COIL LOUDSPEAKER



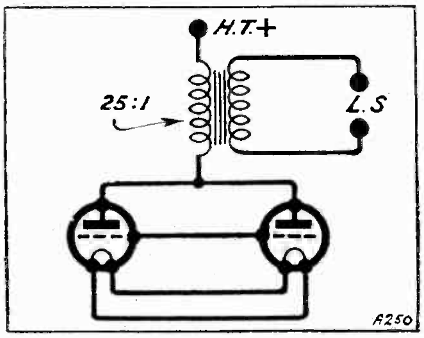
The cost of the average moving-coil loud speaker has hitherto often been prohibitive, but here is one which is capable of giving excellent results and which costs only £5.

By G. V. COLLE.

During recent months the writer has investigated the merits of a number of different makes of moving-coil loud-speaker parts for home assembly. While many of those tested were found to be good, yet it was thought that in most cases their prices were not low enough to give them a wide appeal, while in others the difficulties of construction were too great.

Recently the writer has come across a set of loud-speaker parts conforming to the standards which he had mentally set. These are (1) cheapness; (2) good quality of reproduction and reasonable sensitivity; (3) ease of assembly, and (4) low running cost (i.e. low field current consumption).

In the first case, the cost of the complete set of parts (including all



The simplest method of connecting up a low-resistance loud speaker.

the minor parts for the diaphragm) is £4 18s. 6d., with 3s. 6d. extra on the field coils for rectified A.C. mains. The quality of reproduction and the sensitivity to weak inputs without having to resort to a very small annular gap for the moving coil is, in the writer's opinion, equalled by very few.

Extremely Simple

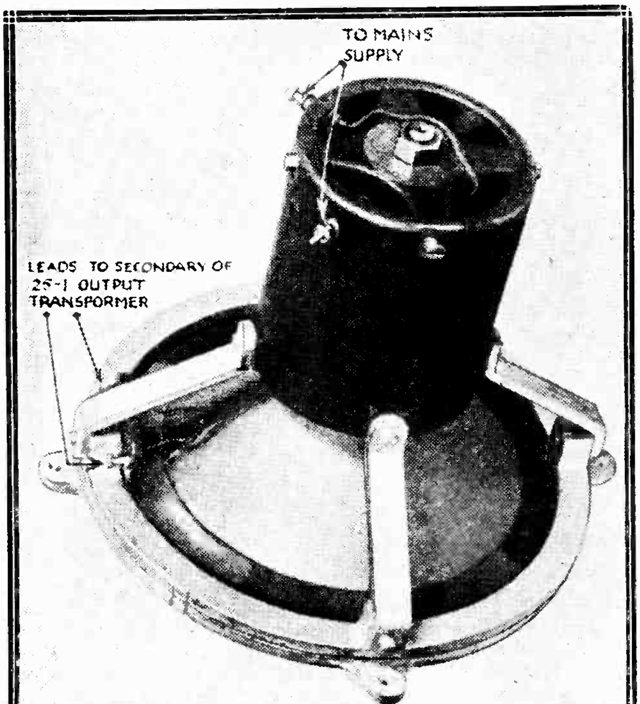
In referring to (3) it can be stated that with the exception of soldering two small pieces of flex to the ends of the moving coil, to bring leads away from the outside surface of the diaphragm, the job can be done with a tube of Seccotine, a screwdriver and a little common sense.

There is no diaphragm to be cut out, nor leather to be fashioned out to the required radius, since this is all done by the firm supplying the parts. The moving coil is ready wound and is provided with tags for sticking to the diaphragm.

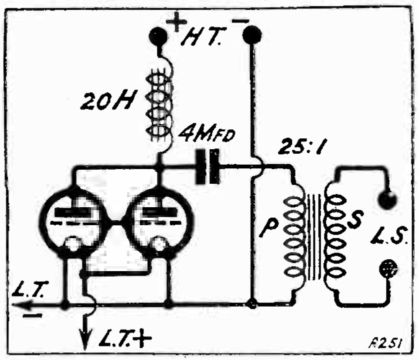
Economical

Lastly, we have a field winding to energise the "magnet pot," which should not get unduly hot and which must be economical as regards current consumed. All these contingencies are met in the model which forms the subject of this article, and on test the current consumption was 130 milliamperes at 240 volts and 90 milliamperes at approximately 160 volts.

This photograph gives a good idea of how the loud speaker appears when completed. Note the lugs on the front aluminium ring for attaching to the "baffle." Four small bolts and nuts are suitable for the purpose.



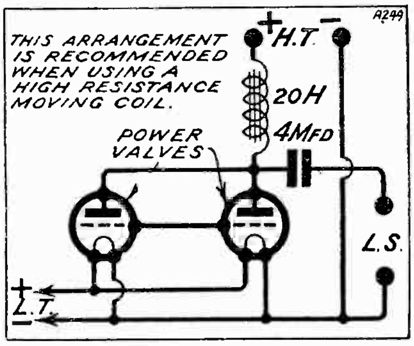
When addressing enquiries to the makers, it is necessary to give details of the mains to be employed, so that the correct field coil may be included.



Using a choke output with a low-resistance speaker.

As some readers seem to be in doubt as to which is the better, a high- or a low-resistance moving coil, perhaps a few words of explanation will be useful.

Apparently the chief objection to the low-resistance coil has been the lack of a really good transformer of a suitable ratio.

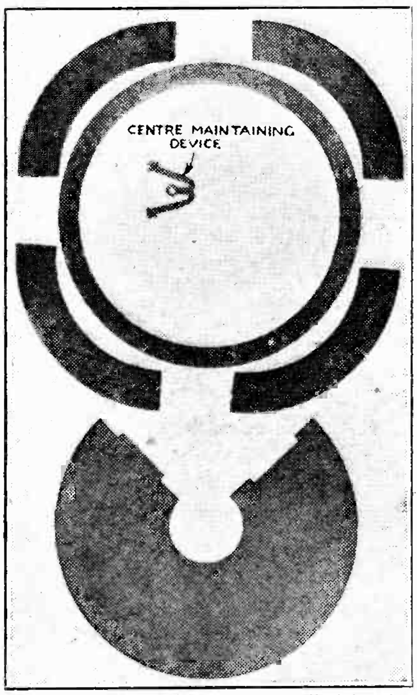


A good, large choke is essential in this circuit.

Fortunately, during the last few months, two or three good transformers having a 25 to 1 ratio have made their appearance, and among these the writer has had experience of the Ferranti. This transformer is very suitable, provided a current not in excess of 40 milliamperes is passed through its primary.

Commencing Assembly

High-resistance moving coils do not, of course, require a step-down transformer, *but* this does not infer they should be connected directly in series with the anodes of the power valves, as this will seriously reduce the voltage applied to the anodes and also increase the risk of burning out the moving-coil windings. Such coils must be connected to the set through a choke filter output.

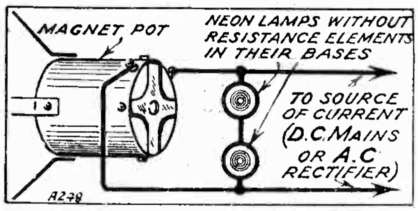


The parts shown here are supplied by the makers, and consist of the cardboard ring for holding the diaphragm, 4 pieces of special leather ready "chamfered," the diaphragm, and the centre-maintaining device.

Lastly, the writer recommends a 4-mfd. Mansbridge type condenser for use in conjunction with the L.F. choke, and it must be of a type tested to at least twice its *working* voltage, the latter being the voltage applied to the power valves.

The diaphragm and leather strips of the speaker are supplied ready cut, so there is little to cut except a little piece off one of the leather strips.

The diaphragm is arranged with three projecting pieces, two on one edge and one on the other. The one on one edge should be carefully



covered with Seccotine or any other good adhesive, and the other two on the other edge treated similarly so that, when the gum has become "tacky," they can be overlapped with two stuck on one surface of the cone and one on the other.

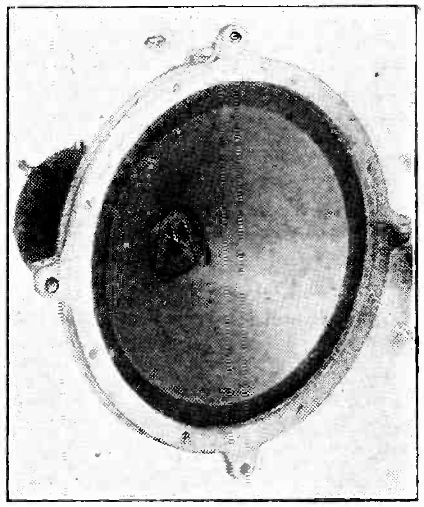
It does not matter whether the two projections go on the inside surface of the diaphragm or not, so long as they overlap firmly and neatly, and no air spaces show between the flaps. The diaphragm can now be left for the gum to "set."

Now carefully pick up the coil and very gently unroll the few turns of wire which are left for sticking to the surface of the diaphragm. See that no loose turns are left, as these will only cause a nasty vibration if not removed. The two leads should be arranged to come from the coil at ½ to 1 in. from each other.

Handle Carefully

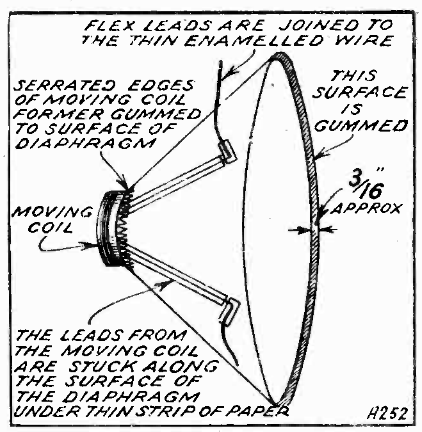
Do not hold the coil on opposite sides of its surface as the tendency will be to make it slightly oval. It is best to hold it between the first finger and thumb on the opposite sides of one wall. With the coil in this position, and its wires neatly straightened out, carefully bend each gumming tag at a sharp angle (45 degrees approx.) to the wall of the coil in an outwards direction. The coil should "sit" on the outside surface of the diaphragm at its apex, and to do this carefully gum the inside surface of the tags and allow to get "tacky."

Drop the coil on the apex of the diaphragm so that the two wires come each side of the join on the latter. Then carefully place a paperweight, or any other heavy object having an even weight, on the rim of the moving coil, so as to force the gummed tags on to the surface of the paper.



A front view of the assembled unit. Note the centre-maintaining device. The lugs on the aluminium ring are for supporting unit on the wood "baffle." It is necessary to make a hole in the baffle equal to the inside diameter of the aluminium ring. A wood board 3 ft. by ⅜ in. thick (plywood) is recommended.

While doing this, examine the coil to see if it "sits" level, and, if not, adjust before the gum sets hard. This may sound complicated, but since the constructor will find the hole at the apex of the diaphragm is perfectly level, the latter having been cut out by the manufacturers with a special tool, it will be found quite easy in practice.



The assembly of the diaphragm.

When the coil has "set" hard on the diaphragm, remove the weight, and then gum the wires from the coil down the side of the diaphragm, the two leads slightly diverging.

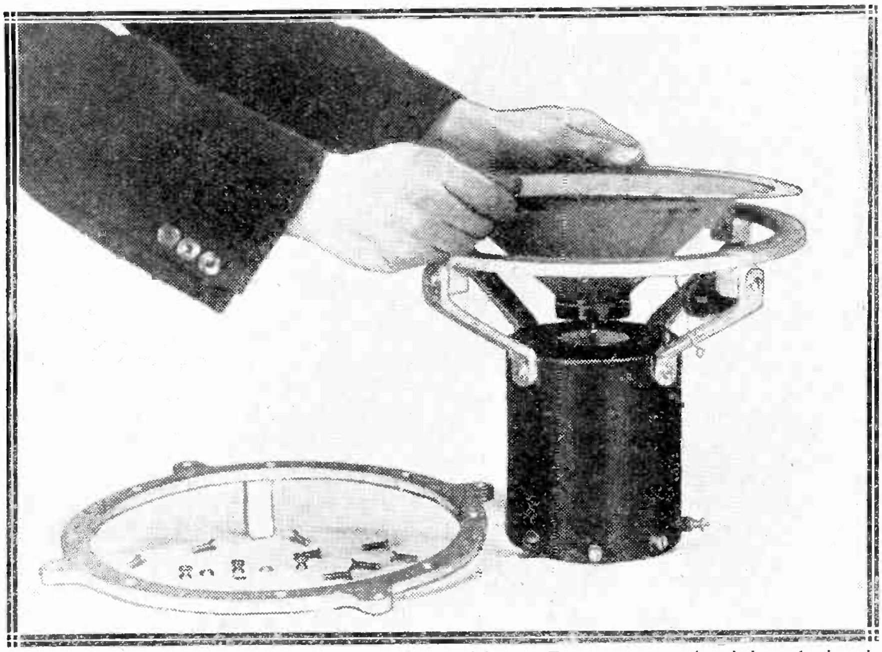
The wires can be held in position with narrow strips of paper (about $\frac{3}{8}$ in. wide) up to $\frac{1}{4}$ in. from the periphery of the diaphragm, where they can be joined to small pieces of light flex by soldering and then "gummed off" with two small pieces of paper, so that all strain on the flex is taken up by these last.

The next important step is to attach the leather pieces one at a time, but before doing so mark a light pencil line on the *inside* surface of the diaphragm, about $\frac{3}{16}$ in. from the periphery all around the edge.

Gum can then be applied to the inside surface of the diaphragm in the area between the line and the periphery. Do this carefully, making certain no part is omitted. While still "tacky," pick up a piece of the leather with the smooth side uppermost, and apply the rough side to the gummed surface at any portion of the diaphragm, taking care the leather does not go beyond the pencil line.

Avoiding Overlap

Now smear the chamfered ends of the leather strip already stuck down with gum, and apply one of the other pieces of leather so that the chamfers overlap correctly. Do this for the third piece, which should be applied to the opposite side of the first piece of leather, and then gum down the fourth piece. The whole idea is to form a leather ring, with the strips chamfered together.



Dropping the completed diaphragm into position. The centre-maintaining device is only fitted when the unit is completely assembled. Holes in the cardboard ring are made when the moving coil is approximately centred in the annular gap.

With the leather ring in position the diaphragm can be placed on a flat surface with the leather at the bottom. The cardboard ring supplied with the outfit can then be treated with gum on one of its surfaces, and, when "tacky," passed over the inverted cone diaphragm and on to the rough side of the leather ring. The leather left between the cardboard ring and the diaphragm should be uniform all the way round, so it is as well to see that the cardboard ring is fitted centrally in the first place.

Before the gum "sets" the leather can be pulled on to the cardboard ring, but not too tightly.

As the pot is supplied with the field coil ready fitted, it is only necessary to screw on the four aluminium supports and the back aluminium ring for the diaphragm to the top of these.

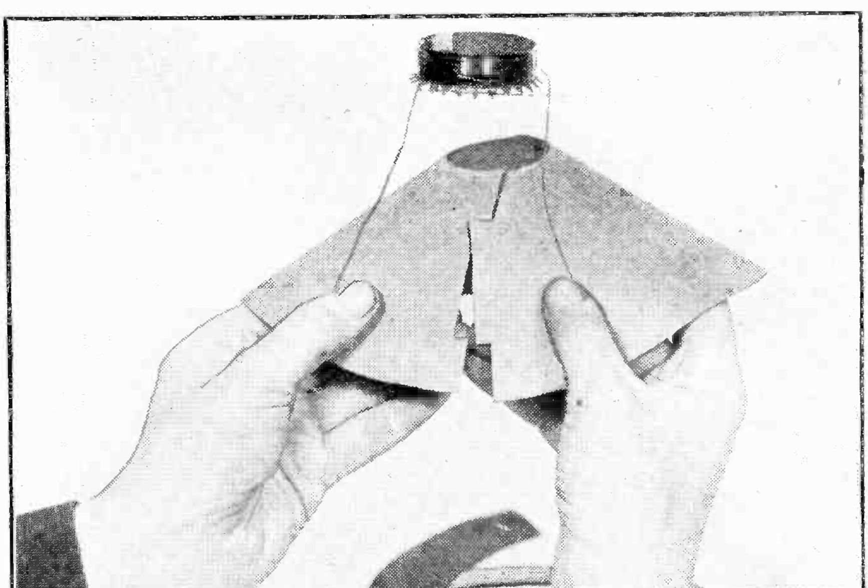
The last operation is to fit the diaphragm in position, and to do this grasp the assembly by its cardboard ring and drop the moving coil into its gap. Move the cardboard ring about until the coil is practically central in its gap, and while in position mark through the holes in the aluminium ring underneath the cardboard on to the latter with a pencil.

Centring the Diaphragm

Remove the diaphragm assembly and punch or cut holes $\frac{5}{16}$ in. diameter round the points marked. The holes will be punched both through the cardboard and leather, since the latter will be covering the ring.

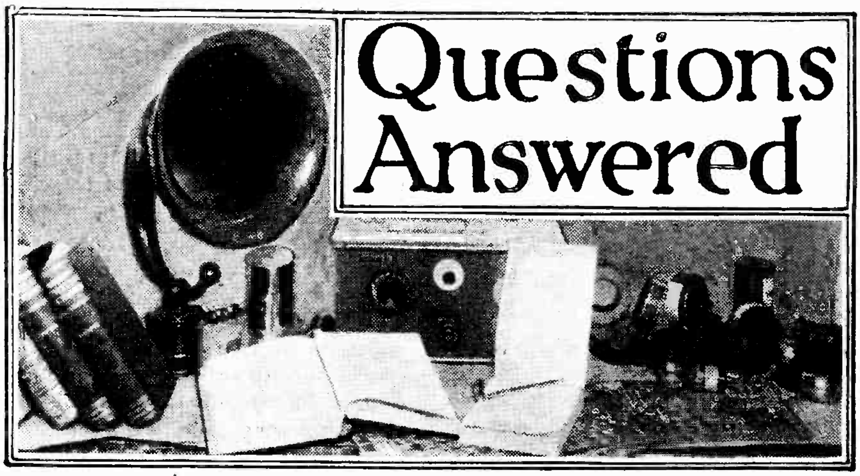
After this operation, refit the diaphragm, making certain it is replaced in the frame the same way round. Then drop the top aluminium ring over the cardboard one, also ascertaining the holes in this to correspond with the ones in the bottom aluminium ring. The cardboard ring should be moved by hand until the coil is exactly in the centre of the annular gap in the pot, when the screws through the aluminium and cardboard rings can be tightened.

The centring device is fitted on the spindle, but before doing so coat the "legs" of the device with gum, fit over spindle, and then tighten up with the brass terminal head provided.



Showing how the diaphragm is formed. The moving coil is fitted when diaphragm has "set," the leads from the former being arranged each side of the join on the latter.

Questions Answered



Suitable Detector Valve

N. C. (Cardiff).—" I have an L.F. transformer, 3–1 ratio, and the primary winding is stated to have an inductance value of approximately 60 henries. The transformer is to be employed in a straightforward Det. and 1 L.F. set. What type of detector valve shall I use ? "

Use a detector valve having an impedance of 15,000-20,000 ohms. With a valve of this type you should obtain good sensitivity and high-quality reproduction, provided you only use a moderate amount of reaction.

H.T. Batteries

G. M. (Berwick).—" I have a five-valve set—2 H.F., Det., and 2 L.F.—which works perfectly from a 120-volt accumulator H.T. supply. When I attempt to use dry batteries, however, the receiver becomes difficult to control, the H.F. stages tending to oscillate, and the L.F. side " motor-boating." Can you tell me why this occurs ? "

The trouble is probably produced by a coupling effect due to the internal resistance of the dry battery H.T. supply. Possibly the current required to operate your five-valve set is a little too great for the particular type of dry battery you are using, with the consequence that the internal resistance rises rapidly. Alternatively the battery may be partly run down. Try one of the " super " batteries with large cells. These are specially designed for such sets as yours.

Neutralising

J. T. (Brixton) wishes to know how to neutralise a single H.F. stage by the " silent-point " method.

This method of neutralisation is very simple provided some means of switching out the H.F. valve filament is included. Tune in the local station and then remove the fixed resistor, or turn out the H.F. valve filament.

Rotate the neutralising condenser until signals become inaudible. This point is sometimes a little critical and the procedure is to rotate the neutralising condenser very slowly. Signals gradually fade away and, the " silent point " having been passed, they return again to full strength as the moving vanes become further in mesh.

After this adjustment the vanes are locked in position, in cases where this is possible, and the H.F. valve filament is switched on again. The set is then ready for use.

Interaction Between Aerials

S. T. C. (Birmingham).—" I am troubled greatly by interference from my neighbour's set. The symptoms are bad fading on the local station and oscillation. This trouble also makes it very difficult for me to tune in distant stations with my receiver, which is a det. and two L.F. stages."

Cases of this kind cannot, as a rule, be cured by one party only, but the co-operation of both parties concerned is desirable. The trouble generally arises from the use of small sets which necessitate the use of a large amount of reaction, and, as a rule, the only certain cure is for both parties to build larger sets, preferably employing neutralised H.F. stages. Sometimes a cure can be effected by making sure that a different earth is used by each receiver, and sometimes the use of a small condenser in series with each earth lead will improve matters.

The only really direct cure is to separate the aerials to as great a distance as possible, and to refrain from using reaction even in such a way as to cause the set *almost* to oscillate.

Aperiodic Aerial Coupling

G. P. (Cardiff) has a receiver employing direct aerial coupling, consisting of a single plug-in coil tuned with a ·0005 variable condenser in parallel. He wishes to know how he may increase selectivity in order to tune in distant stations free from interference.

The use of what is generally termed " Aperiodic Aerial Coupling " is often beneficial in increasing selectivity.

Mount another coil socket by the side of the existing aerial coil, so that the coupling between the new coil and the existing one will be as tight as possible. From one of the terminals on the new socket take a wire to a new terminal on the panel or terminal strip ; this will be the new aerial terminal. Connect the other terminal on this new socket to earth.

The coil sizes used will now be slightly different, and, in general, will be as follow :

In the old aerial socket, which now becomes the *secondary* coil, for the broadcast band a No. 60 or 75 coil. For Daventry, a No. 200 or 250.

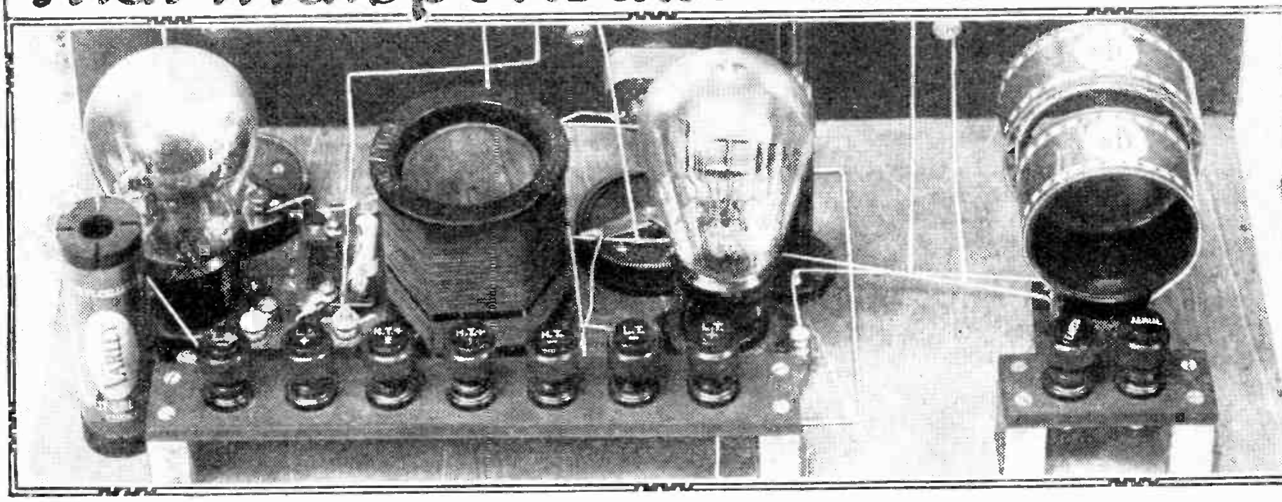
In the new socket, for the broadcast band, a No. 25, 35, or 50 will be needed, and for Daventry a No. 75 or 100.

" Solodyne " Three

D. M. T. (Dublin).—" Will you please tell me where I can find details of the coils for the " Solodyne " Three (3rd version), as described in the April issue of MODERN WIRELESS ? "

Details of these coils will be found in the article describing the " Viking Four, " in the December, 1927, issue.

That Indispensable Inductance



An article concerning all kinds of coils, and the interesting principle upon which they work.

By P. R. BIRD.

THE two most fundamental facts about the workings of any wireless set are capacity and inductance—capacity being concentrated in the condensers, and inductance in the coils; but whereas one occasionally comes across a wireless set which has no condenser in it whatever, one *never* sees a set that has no coil in it.

What Is It?

At first glance it would appear that whilst we can do without capacity in the form of condensers, it is impossible to do without inductance in the form of a coil. What *is* this inductance and why is it so indispensable?

I suppose that most wireless enthusiasts have at some time or other been interested in this question, and it is safe to say that most listeners who have looked up inductance in the text-books or who have tried to form a mental picture of what inductance really is from definitions of the word, have been thoroughly bewildered by the explanations! For to get a good picture of inductance one must employ not figures and facts, but the faculty of imagination. If we turn away from the text-books for a moment, we can, in a flight of fancy, grasp the very essence of the thing.

The Vital Fact

Starting right at the beginning, let us picture first of all a piece of wire in which a current is flowing. Although we have never seen an electric current we have a fair conception of what is happening in that wire. We know, for instance, that if the current is coming from a battery connected to the ends of the wire we can reverse the direction of the current by reversing the battery.

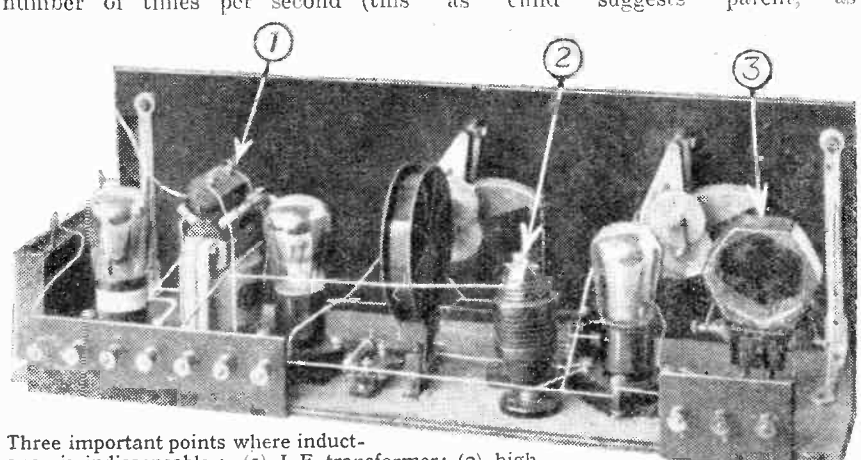
We know that we can increase the amount of the current by increasing the voltage of the battery (or by decreasing the resistance of the wire). We know that if we insert a switch we can break the current by breaking the circuit.

If, instead of connecting a battery across the wire, we connect an alternator across it, we know that we shall get alternating current in it—current which flows first in one direction and dies away, and then reverses and flows again in the other direction, and dies away, repeating this cycle of operations a certain number of times per second (this number being the frequency of the alternating current). But in order to get a grasp on inductance we have to go one step farther than all this.

There is one vital fact of which we must never lose sight—the fact that every electric current of whatever kind has associated with it a magnetic field. This magnetic field lies outside the wire carrying the current, but it is just as important as the current, just as inevitable as the current, and just as varied, versatile, and complex as the current. Between the current flowing in any wire and the magnetic field which appears around that wire there is a complete co-operation.

Current's Counterpart

The relationship between these two is absolutely perfect. As surely as darkness implies light, as inevitably as "child" suggests "parent," as



Three important points where inductance is indispensable: (1) L.F. transformer; (2) high-frequency choke, and (3) tuning coil.

plainly as positive suggests negative, so certainly does the conception of a current imply the accompanying conception of a magnetic field surrounding that current.

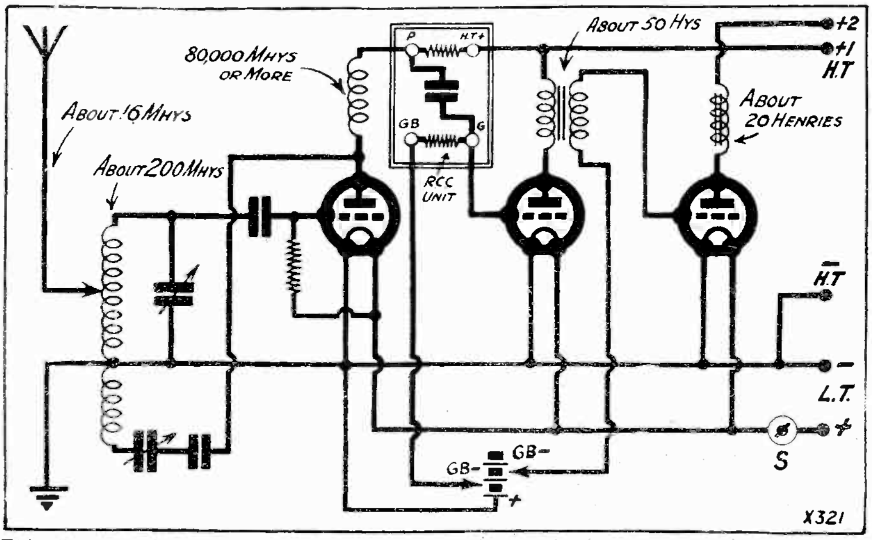
If the current varies, the associated magnetic field varies. When the current starts, the magnetic field starts. When the current attains a maximum, the magnetic field attains a maximum. If the current falls, the magnetic field falls. If the current reverses its direction, the magnetic field reverses its polarity. If the current fluctuates from any cause, at any speed, in any way, that same cause will vary the magnetic field, at a corresponding speed, and to exactly the same degree.

Field Fluctuations

So important is this magnetic counterpart of the current, so perfect is the relationship between the field and the flow, so intensely are these two bound together as it were, that the text-books will completely mislead us if we think of the currents they mention as currents *only*. Alone, electrical currents do not exist. Every current has its magnetic counterpart. Every flow has its fluctuating field, rising when the flow rises, steadying when the flow is steady, collapsing when the flow ceases; and this mysterious magnetic counterpart, this invisible accompanist, lies at the very root and essence of inductance.

Having well and truly grasped the fundamental fact of the matter, the fact that magnetic field is always accompanied by a magnetic field—we can digress a moment to remind ourselves of what we were taught about magnetism. One of the most interesting facts, you will remember, was the fact that if a wire or any other conductor is moved whilst in a magnetic field, an electric current will tend to flow along the wire; and the same holds true if we hold the wire stationary and move the magnetic field itself nearer to or farther from the wire.

Having got so far let us consider a simple coil of wire and the commotion in and around that coil when a current flows in it. Imagine a simple coil, say only two turns of wire, and assume that the current is racing around the first turn on its way to the second turn. Commencing at the moment the current commenced, and reaching outwards as the current races forward, a magnetic field has sprung into being around the first turn of wire. The second turn of wire lies closely by the first turn and right in the path of that moving magnetic field, and consequently the second turn, too, has a current in it.



This diagram of a typical set shows how wide are variations in inductive values. Note the great difference between a long straight wire (aerial) and the shorter length of wire wound to form an aerial coil.

This second current, for reasons which we cannot enter into at the moment, always tends to *oppose* the first current which created it. But, funnily enough, no sooner does that original current cease and die away than the secondary current starts to fall away, and in reversing it actually *assists* that first current, which a moment before it tended to oppose.

Energy Returns to Roost

So, because of the magnetic interleakage between the coils of wire, the current experiences a certain difficulty in getting under way; but once it is fairly under way it cannot be stopped suddenly, for the force which previously opposed it is now assisting it.

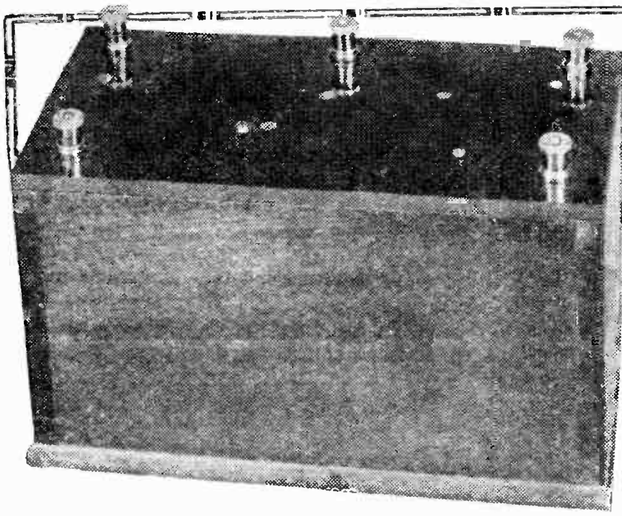
We have all noticed that a motor-car or heavy truck can easily be moved over level ground by one man, when once the initial difficulty of starting it has been overcome. But all the time that it is moving it is saving up that energy that was applied to start it, and it will be just as impossible for one man to stop it suddenly as it was for him to start it. In mechanics this reluctance to budge, and reluctance to stop when once on the way, is called inertia. The electro-magnetic counterpart which we have been discussing—this reluctance of a current to commence flowing through a coil, followed by its reluctance to stop when started—is due to the coil's "inductance."

Multiplying Magnetism

In all the foregoing we have assumed that the magnetic action is taking place in air. It is well known, however, that iron appears to have a multiplying effect of magnetism, so that the magnetic effects of a coil can be greatly increased by providing it with an iron core. Low-frequency transformers, L.F. chokes, and similar highly-inductive windings are always so provided when low-frequency currents are being dealt with. But, generally, the advantage of iron cores cannot be applied to high-frequency inductances because the H.F. currents flow much faster than the corresponding magnetic changes can take place in iron.

The fact that inductance opposes a change in the current flowing can be of great importance in high-frequency work, because if we use sufficient inductance, the rapidly changing current will be so hampered by the magnetic monster confronting it that it will be choked off from any desire to flow that way, and will choose any alternative path that is presented to it. Aptly enough we call such inductances "H.F. chokes."

It is merely for the sake of simplicity that circuit explanations are almost always given in the form of current flow and capacity charges. But the purpose of this article will have been served if it reminds the reader that no current of any kind ever flows except to the accompaniment of a magnetic field, that no condenser ever charges or discharges without a corresponding magnetic commotion, and that every wire inside the set or out of it continually "carries on" to the accompaniment of that indispensable inductance.



A Choke Unit Aerial

While comprising all the elements of an efficient output filter, this unit enables one to employ loud-speaker extension leads as an indoor aerial. Excellent results are possible and there is no danger and no complications to face when installing this economical and convenient system.

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

PRACTICALLY everybody who runs a loud-speaker receiver sooner or later instals loud-speaker extension leads, but the practice is dangerous or, at least, there is a grave probability of trouble occurring unless some efficient H.T. by-pass scheme is arranged. If this is not done it is not only the "sounds" which are led all around the house to the various loud speakers, but also the H.T. current. In a conventional straightforward circuit the loud speaker takes its place in series in the anode circuit of the last valve. In this circuit is directly connected the H.T. battery or H.T. supply.

You will see that in such a case a loud-speaker extension lead is virtually an H.T. positive lead. Remembering that the H.T. negative is invariably taken to earth, the danger of an H.T. battery short-circuit with amateur wiring will be apparent. But it is a very simple matter to confine the H.T. to the set itself by means of a choke condenser by-pass scheme.

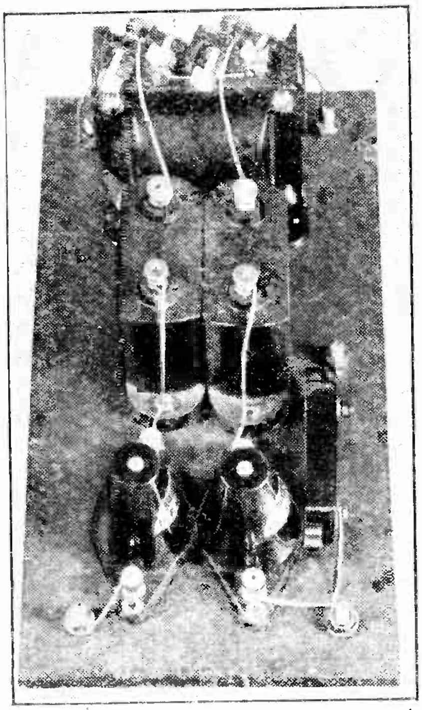
Many Advantages

Across the usual loud-speaker terminals on the set is connected an L.F. choke. Each side of this choke is taken to a fixed condenser and the other terminals of the fixed condensers are joined to the long loud-speaker leads. An incidental advantage is that an L.F. choke of good make will have ample impedance at a low ohmic resistance. The steady H.T. current will, therefore, be carried without saturation trouble, and the loud speaker relieved of the steady current which can cause, into the bargain, demagnetising troubles and so on.

Having installed an efficient by-pass scheme of this nature, the extension-lead wiring can be of the flimsiest character, and it is not essential that very strict precautions should be taken in regard to their insulation, and so forth. Nevertheless, for the sake of permanency it is always as well to carry out the wiring carefully, and with good material.

Dual-Purpose Leads

Now I am going to describe the construction of a loud-speaker by-pass unit which can be connected to any existing receiver. In addition to this article comprising all the elements of a perfectly good by-pass unit, it embodies one or two extra inexpensive components which give it properties of an unusual nature.



The unit comprises only one or two additional components of a simple and inexpensive nature above those which figure in an ordinary loud-speaker filter.

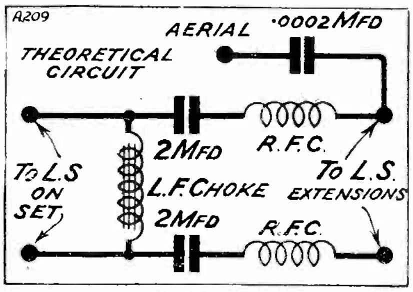
It enables the loud-speaker extension leads to be used in addition as an aerial. There is no reason at all why these long lengths of wire installed in the house should not be employed for such a purpose. They have, indeed, quite good pick-up qualities if employed in the right way.

I originated the idea some two or three years ago, but at that date I only gave a short theoretical explanation of it. This is the first time that the scheme has been brought forward in a practical manner. If you glance at the theoretical circuit of the unit you will see that the idea is a perfectly simple one. There is, first of all, the L.F. choke, which is employed to take the place of the loud speaker in the anode circuit of the last valve of the receiver.

How the Unit Operates

In each lead coming away from this is a large fixed condenser provided for the purpose of isolating the loud-speaker leads in regard to the steady H.T. current. These fixed condensers, however, offer very low resistances to L.F. impulses such as comprise musical sounds, speech, and so on. As a matter of fact, their resistances are so low from this point of view that they can be almost disregarded. But instead of being connected directly to the L.F. extension wires, these fixed condensers are then joined to high-frequency chokes.

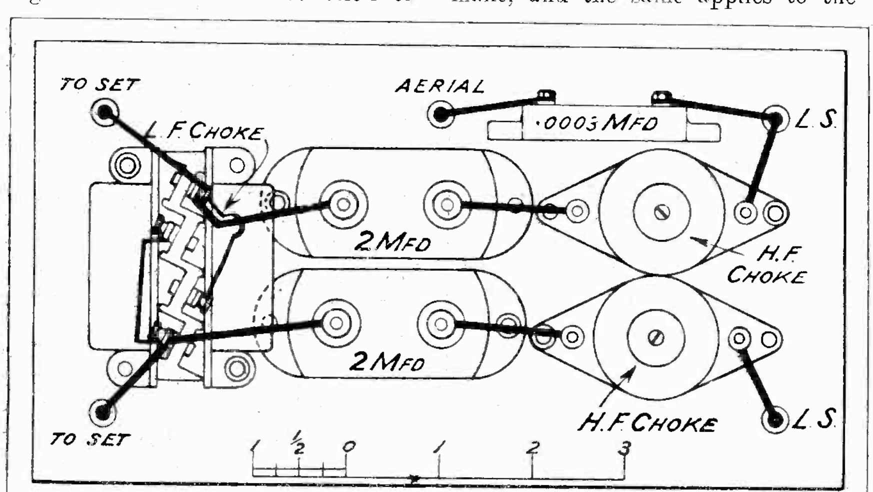
These high-frequency chokes act as complete barriers to high-frequency currents, but these in their turn offer negligible resistances to the low-frequency current proceeding to the loud speaker from the receiver. You will now see that the loud-speaker extension leads get their L.F. impulses through without the slightest trouble, and that the H.F. impulses picked up by the extension leads acting as an aerial can travel only one route, and that is via the aerial terminal on the unit. There is negligible L.F. feed-back owing to the fact that a ·0002-mfd. fixed condenser is placed in series with the aerial. This fixed condenser offers a comparatively high resistance to low-frequency current, although it is an



easy path for H.F. This circuit provides very interesting study, for it shows exactly what H.F., L.F., and ordinary direct current can and cannot do. I want you particularly to note that between the two pairs of terminals on the left- and right-hand side of the unit, only L.F. current can pass. Steady D.C. current and H.F. cannot, for they have barriers raised against them.

An Incidental Advantage

It is not improbable that a fair amount of distortion occurs in some sets owing to H.F. being fed into the L.F. end of the set via the loud-speaker extension leads. It is all very well to include H.F. stoppers and R.F. chokes in the middle of a set if a path is left open for the "pernicious" H.F. at this end of the receiver. It is not improbable, therefore, that another incidental advantage accrues in the introduction of



WIRING DIAGRAM.

these R.F. chokes. Now regarding the efficiency of L.F. extension leads as an aerial, just a few words.

In the first place, you will find them quite selective, especially when employing the unit, owing to the introduction of that series fixed condenser. You can compare their pick-up qualities with an indoor aerial of similar dimensions and arrangements. If the loud-speaker extension leads run along the picture-rails of a lower room, or to an upper room in the house, the pick-up will be quite good, and, in cases, almost equal to that of an outdoor aerial.

Perfectly Safe

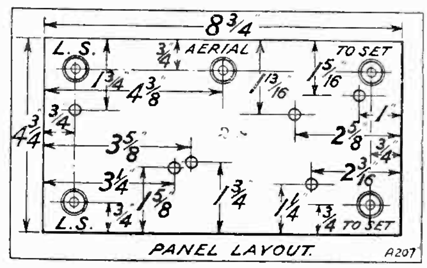
If the loud-speaker extension leads run underneath the floor boards and lower rooms, then the pick-up will be moderately inefficient, but if you use this unit and decided to make double use of your loud-speaker leads then you can run these in such a way that they will answer both purposes equally well. That is, keep the leads high and run them as direct from point to point as possible. Also, keep them away from damp walls and from large metal objects, pipes, and so on. And let me interpolate here that, by the way, the scheme is a perfectly safe one; no damage can be caused either to the set or to its accessories.

The cost of the unit is going to be the cost of any ordinary loud-speaker unit, plus that of two high-frequency chokes and one small fixed condenser. This additional expense will not be anything but a proportion of that of an outdoor aerial system, and only about equal to that of the cost of an ordinary indoor aerial. You will see, therefore, that the scheme has a financial attraction!

The H.F. chokes can be of any good make, and the same applies to the three fixed condensers. The main requirements of the L.F. choke are that it should have ample inductance and should be capable of handling a fair current without saturation. Do not try to use one winding of a low-frequency transformer, because it will not be suitable for the purpose.

The Parts to Use

Regarding the 2-mfd. fixed condensers, these need not be of the large sizes employed in H.T. units. They will not have across them the whole voltage of the H.T., or even a moderate proportion of this. The only other items you will need which I have not so far mentioned are five terminals and a small cabinet. There is no need for you strictly to adhere to the dimensions and layout that I have given. Providing you use satisfactory components and have them correctly wired up there is really little else that matters.



PANEL LAYOUT

Six ⅝-in. or ¾-in. bolts and nuts will be required to hold the components to the panel. Two at diagonal corners of the L.F. choke will hold it quite securely. The two large fixed condensers and the H.F. chokes need have only one each. The small fixed condenser can be held in position by its own leads. If you desire great solidity you can employ screws and nuts for all the holes provided in the components, but in the original model I employed only half a dozen, and found the result quite satisfactory.

Using the Unit

Only a few words will be needed in respect of the wiring. Use a fairly stout gauge of wire for this, Glazite for preference. Providing loops are made in the ends of the leads, soldering is not essential.

There are no difficulties or restrictions regarding the use of the device. It is, however, advisable to keep the leads between the receiver and the unit as short as possible. Place the unit right up against the set, and use two short separate leads for this purpose. Do not use a piece of twisted flex. Also keep that single piece of wire which you will use to connect the aerial terminal of the receiver to the aerial terminal of the unit as short and as straight as possible, and well away from battery leads and the L.F. end of the set.

If you are already using a small fixed condenser in series with the aerial terminal of your set, and this component is embodied in your receiver, you may find that bringing the extra fixed condenser in series in the unit gives you too sharp tuning. In this case, one or other of the condensers can be shorted out of circuit.

Having connected up the unit you can proceed to run your loud-speaker extension wires from it to any and every room in the house. Generally speaking, you will find it better to connect the loud speakers in series.

The Loud Speaker Circuit

You take a wire from the loud-speaker extension terminal on the unit to one terminal of the first loud speaker to be served. From the other terminal of this loud speaker you take a wire round to one of the other loud speakers and from the other terminal of this instrument you run a lead either back to the other terminal on the unit or on to the next loud speaker, and so on.

With the instruments connected in series, if you disconnect one lead from any one loud speaker the whole system becomes inoperative. In order to cause one or more of the speakers to cease operating you will have to short its terminals. That is to say, a simple on-off switch should be connected across the two terminals of the loud speaker. When this switch is closed the loud speaker ceases to work, and when this switch is open it becomes active again.

To cut the loud speaker out of circuit without using a switch you will have to disconnect both of its leads and join them together.

Effect On Tuning

When you are using this combined aerial and loud-speaker extension scheme an ordinary earth connection is still necessary. The earth terminal of the set should be taken to the usual buried metal object or water pipe. Naturally, if you change over from an outdoor aerial or from an ordinary indoor aerial you will find the tuning range slightly altered. You may also find, and I hope you do, that there will be little loss in signal strength from any of your usual stations, and that greater selectivity and more freedom from mush and other sources of interference will occur.

But, as I have already said, much depends upon the disposition of the extension leads. Their length does not matter much, but the higher they go in the house the better the result. You need not worry about increasing their length in order to gain a little bit of extra height. You will not lose strength of signals by so doing. The result in all probability will be a most decided gain.

No Complications

With an efficient by-pass scheme such as this unit provides an extra 20 or 30 ft. of loud-speaker extension wire makes no appreciable difference to the L.F. energy whatever.

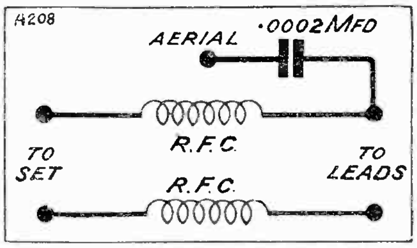


Diagram of a unit for attaching to set already having a choke output in order to make it possible to use the loud-speaker leads as an aerial.

If your set already has a choke-condenser loud-speaker by-pass system, you can still employ the extension leads as an aerial by adding the two H.F. chokes and the fixed condenser. If there is room behind the panel of your receiver you can place them there, though it is probably better to make them up in the form of a small unit and have them outside the set.

I am including a small additional diagram showing exactly how this can be done. There are no complications to fear in putting the scheme into use in this or in any other way. I have tried it with all sorts of sets and the results have been uniformly good. As a matter of fact, in cases I have dispensed with the H.F. chokes, but this is a practice which I do not advise.

IN OTHER LANDS

At the Japanese broadcasting stations the microphones are placed about two or three feet from the ground, owing to the fact that most of the performers are seated upon the floor when broadcasting.

* * *

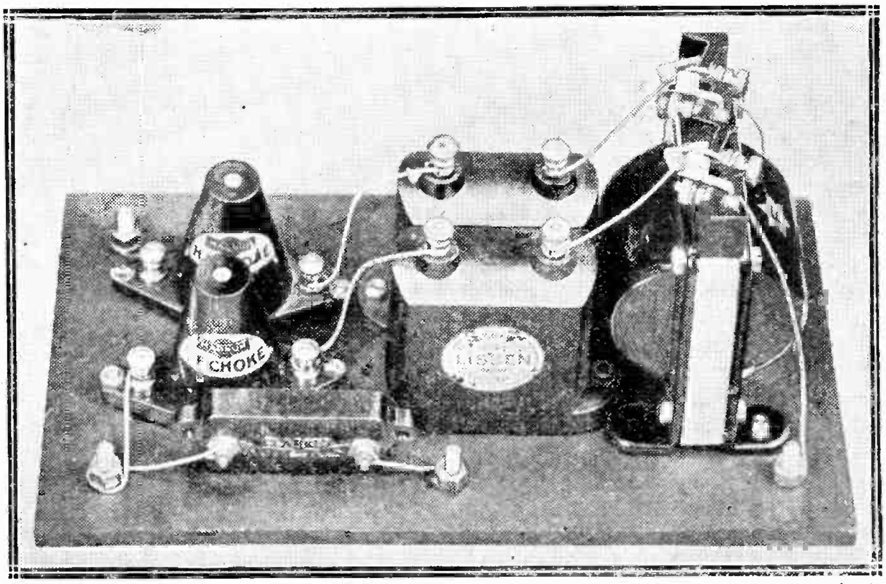
Wireless communication has now been established across Arabia, one of the stations being placed at Mecca.

* * *

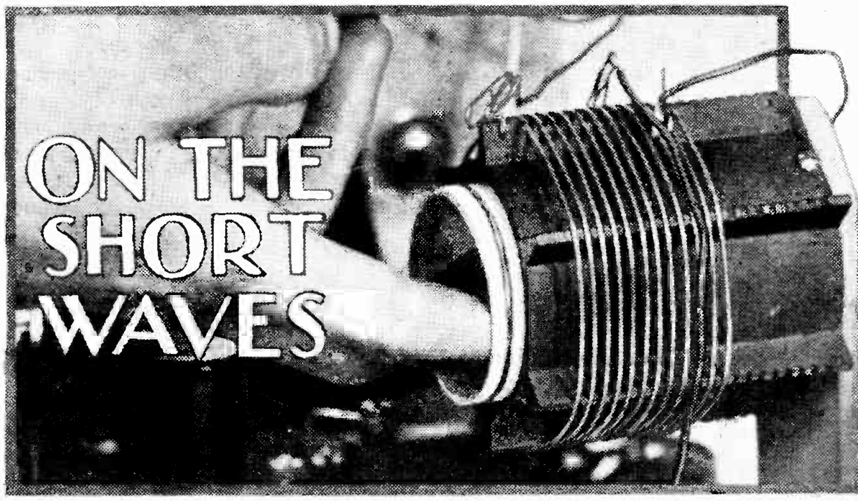
A wireless medical service has been instituted in Belgium and free messages describing symptoms and asking for treatment can be sent by ships needing medical advice through the coastal wireless station at Antwerp (O S A).

* * *

Amongst the great cities of the world, Berlin claims to hold the highest ratio of listeners to population, the figures for that city being 12 per cent, with London next (8 per cent) and then New York (6 per cent).



The layout is such that the connections from the input terminals to the output terminals of the unit adopt practically straight lines through the components concerned. The terminal on the lower right of photo is an input terminal. This is joined to a terminal of the choke, the lead continuing to a terminal of the fixed condenser. This last is joined to one terminal of one H.F. choke, the other terminal of this going to an output terminal. The same series of connections is repeated on the other side of the unit, as you will see by referring to the wiring diagram.



News of interest on short-wave receivers and reception conditions.
By W.L.S.

SUMMER is undoubtedly a time of far greater interest to the short-wave enthusiast than it is to the listener who seldom dives below the ordinary broadcast wave lengths The difference between summer and winter reception for the latter is simply a matter of degree : in summer he generally hears fewer stations and those he does receive are not so strong, and he has to put up with atmospherics

Different Stations

For the short-wave man, however, the advent of the long days simply means that he will receive a different set of stations, and that the old familiars will also be coming through, although at different times. In addition to this, those who listen on 25 metres and below very seldom hear an atmospheric of any description.

The early mornings on the 20-metre band are wonderful at this time of year for those who can read the Morse code. Amateur stations from almost every part of the world romp in at great strength, and our friends in the Antipodes are particularly prominent The American stations right over on the Pacific coast also come in with an amount of vim that they never equal during the winter.

Fewer "X's"

For the short-wave broadcast man the summer is not quite so convenient, for 2 X A D and 2 X A F, in addition to the other short-wave broadcast stations, are not now received particularly well until 11 p.m. and after, whereas four or five months back their "lunch-time programmes" were received over here quite easily.

It is rather peculiar that there should be such vast differences in the characteristics of the 23-metre and 45-metre bands of wave-lengths During a recent thunderstorm I was listening on a short-waver and although the atmospherics were almost overpowering on 45 metres, they were barely loud enough to worry one on the shorter band. I also have some manufactured interference caused by an electric railway a little over a mile away, and this seems barely noticeable on the 23-metre band, while it is very annoying indeed on the longer wave-lengths

Straight "Coils"

Fading also seems at certain times of the year entirely absent on 23 metres and prominent on 45 metres, whereas at other times the reverse is the case.

Incidentally, if the experimenter wishes to do something more original, let him start listening on 10 metres. Quite a few American and Continental stations are now operating down there, and the chief bugbear up to the present seems to be extremely severe fading.

When the amateurs first moved down from 440 metres to 150 metres they thought they had found a wave-length free from fading ; 100 metres was even better, and 45 and 23 metres better still, but now the 10-metre band seems worse than any of them. However, about six years back the writer was solemnly assured by a gentleman who is now a prominent radio engineer that no wave-lengths below 200 metres would ever be of any practical use on account of the fading trouble, so that it is obviously useless to form opinions on the future possibilities of 10 metres as a workable wave-length just yet.

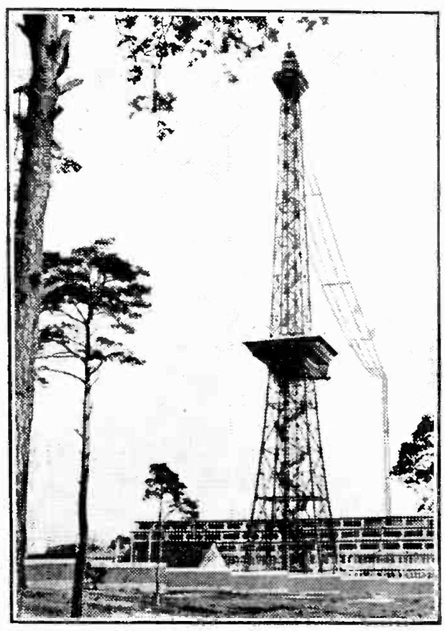
Of course, the trouble in getting down to these ultra-short waves is the inductances. At 10 metres they have been reduced to about one turn, 3 in. in diameter ; at 5 metres, half a turn for each circuit is about sufficient. To dive much lower we shall be using straight lengths of wire as inductances

Rapid Progress

The fascination of short-wave work is, of course, the fact that however one seems to progress, someone is always ahead. When I thought I was very clever and listened on 80 metres, half the stations that were working there seemed to transfer their attentions to 40 metres a day or so after. So a nice 40-metre receiver was installed, and by the time it was working really satisfactorily nearly everyone was down on 32 metres and 20 metres. To keep properly abreast of progress one has to be really "nippy" nowadays !

I am wondering how long it will be before the vagaries of these shorter waves have been sufficiently smoothed out for regular broadcast services to be given in any numbers. I do not think it likely that the present 200-600-metre band will ever be completely dropped, but it is quite on the cards that we shall find, say, 50 per cent of the world's broadcasting stations below 100 metres in a few years' time.

BERLIN'S RADIO TOWER



Over 400 ft. in height, this radio tower not only supports the Berlin station's aerial, but its top platform affords a magnificent bird's-eye view of the capital. The first platform is equipped as a restaurant.

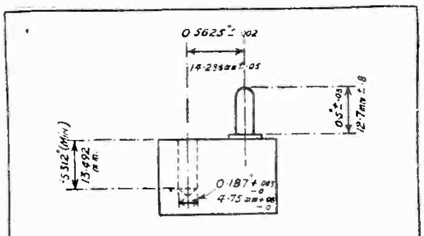
STANDARD COILS

Standardisation in radio is of the utmost importance and could be carried further than it is at present with advantage.

An important article by

J. F. STANLEY, B.Sc., A.C.G.I.

BROADLY speaking, the term "standard," in addition to being a measure of quality or standard of comparison, denotes a common unified practice, method or dimension which it is to the interest of industry and the community to adopt.



DIMENSIONS OF PLUG. FIG. 1.

"Standardisation" may embrace simplification of types and sizes, standardisation of tests, nomenclature, interchangeability of parts, rules for performance and quality of material, to name only a few of the aspects of a very wide subject.

Advantages of Standardisation

There is obviously room for standardisation of wireless apparatus, and no matter which of the aforementioned aspects of the question we consider, we find that advantage to the manufacturer and to the purchaser would result. For instance, take the case of simplification of types and sizes.

How many times have we wanted to change a grid leak, only to find that our only spare will not fit into the clips provided in the receiver?

Again, in the case of cabinets and ebonite panels, how much simpler it would have been if everyone could have agreed, years ago, to use only certain recognised sizes. The cabinet-makers said they could not standardise sizes because it depended on the ideas of the customer regarding the size of the ebonite panel, while the ebonite manufacturer said it was no use making certain sizes only, as the customer would want a special size to fit his particular cabinet.

This problem has recently been remedied to a very large extent by the issue of a British Standard Specification for ebonite panels, in which is included a list of recommended panel sizes which have been agreed upon by the ebonite manufacturers and representatives of purchasers of ebonite panels.

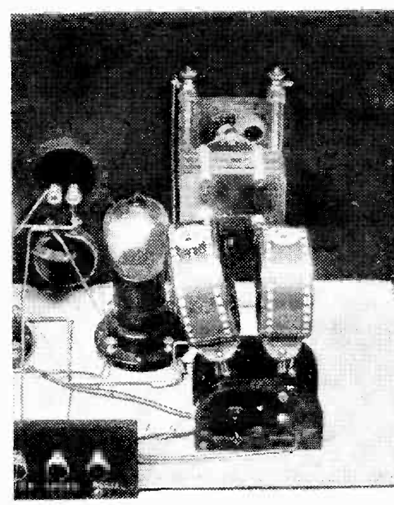
Consider also for a moment the question of standardisation of tests. It would appear to be useful if a standard method of testing telephones and loud speakers could be evolved. Many wireless enthusiasts have been known to describe the efficiency of their pet receiver by declaring that "Sigs. could be heard with the 'phones on the table downstairs." Of course, well-recognised methods of testing the efficiency of telephones are used by the Post Office and in scientific laboratories, but there is still room for a single simple method which could be universally used and by means of which a definite figure of merit could be assigned to telephones and loud speakers in general.

Full of Pitfalls

As regards standardisation of nomenclature, we are still hoping that valve manufacturers will one day adopt a uniform method of designing the various types of valves. How many people could tell you the technical distinction between interference and jamming? The British Standard Glossary of Terms used in Electrical Engineering has been drawn up in order to settle these things, and also to tell us whether we should talk about the "impedance" of a valve or the "A.C. resistance." Verily, nomenclature is full of pitfalls for the unwary, especially when technical matters are freely discussed by non-technical or semi-technical people.

Importance of "Tolerances"

It is hardly necessary to point out the desirability of securing interchangeability of parts by means of standardisation. Fortunately, there is a certain degree of uniformity amongst manufacturers regarding interchangeability, but this has arisen in most cases through one manufacturer copying the dimensions adopted by a competitor rather than by the adoption by all of an agreed standard of dimensions together with an agreed tolerance to allow for unavoidable variations of material and workmanship. The limitation of these tolerances is, of course, just as



A simple and popular form of coil coupling using standard apparatus.

important, in certain cases, as agreement regarding the nominal dimensions.

The advantages of a standard method of testing loud speakers are closely linked with the desirability of having standard rules of performance of wireless receiving sets. To evolve any such standard rules would appear to be a very difficult and complex matter, as the conditions of operation in practice vary so considerably, depending on the size of aerial, geographical position, skill of the operator, etc. Nevertheless, an attempt at such standardisation has been made in America, and the possibilities of the idea should not be ignored, as such standard rules would at least afford some measure of comparison between different receivers under any given set of conditions, although they may not give any guarantee of performance of a particular receiver under other conditions.

We need say very little about the standardisation of the quality of materials, as the advantages to be gained thereby are self-evident. The most important aspect of this is probably the question of the quality of insulating materials, the electrical losses due to poor-quality material still being much greater than many people realise.

Unofficial Standardisation

It was for this reason that the first British Standard Specification for wireless material was for ebonite, which was drawn up at the request of the Radio Society of Great Britain, in view of the poor quality of much of what was sold as ebonite a few years ago. The issue of this specification has undoubtedly improved the quality of the ebonite now generally sold.

As has previously been said, a certain amount of unofficial standardisation has already been achieved by the wireless industry, but the most successful efforts in this direction have obviously been those resulting from the issue of British Standard Specifications by the British Engineering Standards Association, commonly known as the B.E.S.A.

This body sets up committees fully representative of all the interests involved in the particular subjects being dealt with, and in the case of wireless standardisation the committees include in their membership representatives of the radio societies, the radio manufacturers, valve manufacturers, Government departments, National Physical Laboratory, and the Technical Press. Standard specifications have been issued dealing with nomenclature, ebonite, condensers and coils, and it is with special reference to the specification for coils that the rest of this article is concerned. Other standard specifications will, no doubt, be issued before very long.

Important Considerations

Imagine yourself to be a member of a committee the function of which is to draw up details of a standard coil or series of coils. You would immediately be faced with the following questions: Are the coils at present on the market so different in performance and design that it is too late to expect manufacturers to give up their present pattern and adopt a new pattern? Or is the industry so young that we do not really know which is the best type of coil to standardise?

Again, if we do standardise a certain type or types of coil, shall we unduly hinder the progress of design and remove all incentive to produce a better type of coil?

The last of these problems is perhaps the most important; the first question is a matter which depends for its solution on the far-sightedness and manufacturing resources of the producer of the coil, and a study of the psychology of manufacturers as a whole will probably help us to form an opinion as to the ultimate success of the standardisation. The second question is a matter which depends for its solution on the technical ability of the members of our committee, while the third and most vital question involves a point of policy which must receive our very careful consideration.

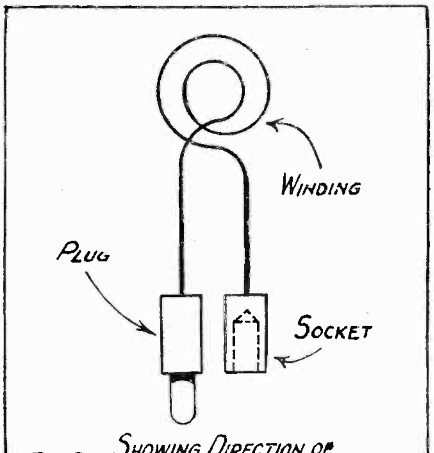


FIG. 2 SHOWING DIRECTION OF WINDING.

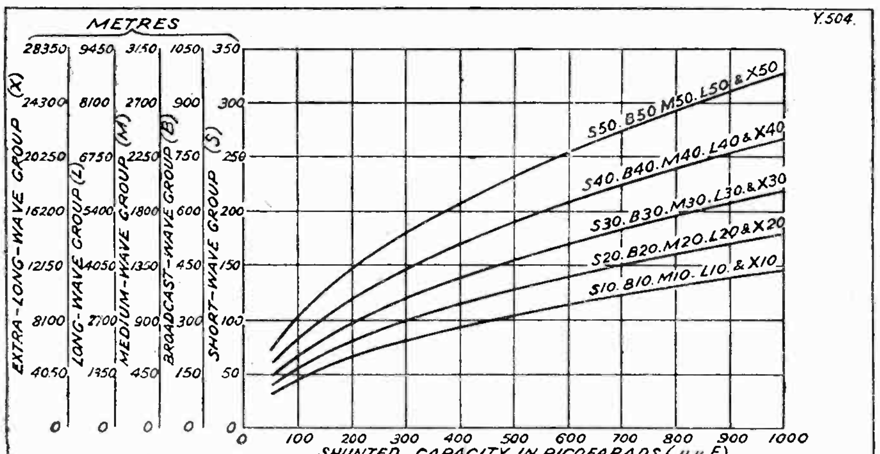


FIG. 3 CURVES SHOWING WAVELENGTHS COVERED BY BRITISH STANDARD PLUG-IN COILS.

Standardisation is intended to assist the industry, but if our efforts are likely to result in stagnation of design we shall not only fail to render this assistance but we shall definitely produce the reverse effect. Either the standard will not be worked to, and the specification will become ineffective, or those manufacturers who do adopt the standard will be put out of business by the keen competition of those who have kept themselves abreast of the latest improvements in design.

"Coils AND Coils"

The committee of which you have constituted yourself a member will probably decide that the design of coils for wireless work is still in a state of flux, and that there appears to be plenty of scope for further experiment before finality in design is reached. There are a large number of types of coil in use: long thin coils, short fat coils, coils on paxolin formers, coils on skeleton formers, coils without any mechanical support at all except the rigidity of the wire itself, solenoidal coils and torroidal coils, slab coils, and honeycomb coils, Heath Robinson coils and Litzendraht coils; in fact, coils *and* coils. Out of all this medley of coils, there is one fairly stereotyped variety which does not seem to change much with the course of time, namely, what is usually known as the plug-in type, so-called because it can be plugged into a socket.

This type of coil appears to have become more or less generally standardised among the various makers by a process of copying dimensions from rival makers, and provided we do not lay down exactly how the coil is to be constructed—thus limiting future design—it would appear that a standard specification which would regularise the dimensions once and for all would be of advantage to manufacturers and purchasers alike.

The Committee Gets Busy

After a thorough investigation of the position, we should probably come to the conclusion that a comprehensive standard specification covering all types of coils would, at the present time, be premature, if not impossible, but that the one type which appears to have become stabilised, namely, the plug-in type, appears to lend itself admirably to standardisation in certain respects.

* * * *

That impressive-looking row of dots indicates that, having decided to draw up a specification for plug-in coils, our committee gets busy, consults representatives of the manufacturers and purchasers, and in due course produces the British Standard Specification No. 289—1927.

The committee having done its work, let us turn our attention to the specification itself.

In order that we may be quite clear as to the type of coil referred to in the specification, a "plug-in coil" is defined as "an inductive winding secured to a plug: the winding may or may not be protected by total or partial enclosure in a case or other covering." Thus it is seen that the details of design and construction are left very largely to the initiative of the manufacturer.

Plug Portion Dimensions

It is further made clear that a plug-in coil is an interchangeable type of coil in which the two ends of the winding are connected to a pin and a socket respectively, the pin and the socket together being part of the "plug portion" of the coil.

The following features of the coils are standardised:

(*a*) The dimensions of the plug portion and the tolerances thereon, in so far as interchangeability is concerned.

(*b*) The method of connecting the winding to the plug portion.

(*c*) A range of "sizes" based on the inductance values.

(*d*) A simple arbitrary system of nomenclature or designations.

With regard to the dimensions of the plug portion, only those which are essential from the point of view of securing good contact in the coil holder are standardised, these being the diameter, spacing and length of the pin and socket. These dimensions and the tolerances, or manufacturing limits, are shown in Fig. 1.

As the design of the pin itself is a matter of a controversial nature (i.e. the pin may be solid, slotted, or "sprung"), the specification confines itself to the requirement that when the pin is inserted into a socket of the diameter shown in Fig. 2, good mechanical and electrical contact is obtained. For this reason the actual diameter of the pin itself is not specified, it being obviously impossible to define the diameter of a "sprung" pin, for instance.

An Erroneous Idea

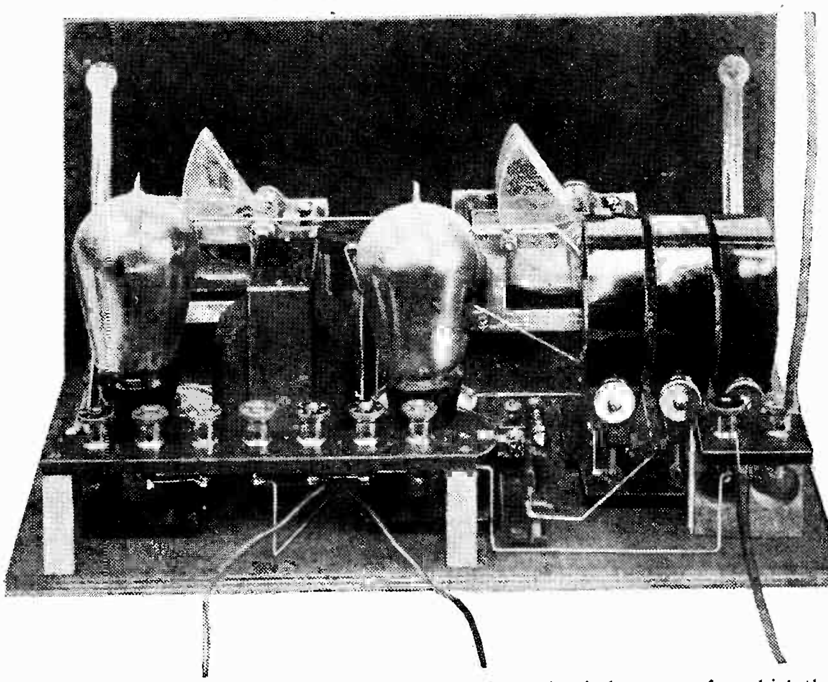
The original design of the pin-and-socket form of plug-mounting was no doubt evolved with a view to making the coil non-reversible, based on the erroneous idea that if the coil were reversed, the direction of its magnetic field would likewise be reversed. The fallacy is apparent immediately we realise that when the coil is reversed the connections of its ends are also reversed, so that the current still flows in the same direction relative to the remainder of the circuit, and the direction of the magnetic field is therefore unchanged. Supposing, however, that the winding were reversed without its terminal connections being changed, or that the terminal connections were interchanged without the winding being moved, then, of course, a reversal of the magnetic field would result.

In a receiver using plug-in coils, it is usually essential that the direction of the field of a coil (i.e. the "coupling") should be unaltered when we change one coil for another. Otherwise, a receiver would have a positive coupling with one coil and a negative coupling with the other coil; if the coils in question were coupled to the aerial coil for reaction purposes, the receiver would be capable of oscillation in the one case and incapable in the other.

Direction of Winding

Hence it is necessary that all coils, of whatever size or make, should have their windings connected to the plugs in the *same* way, so that when once we know the direction of the coupling with one coil, we can rest assured that it will be the same with any other coil. It does not matter whether the inner end or the outer end of the windings is connected to the pin of the plug, so long as the pins of all plugs are connected to the same end of the winding in all coils. For the purpose of obtaining uniformity, the specification has standardised the practice adopted by the majority of the manufacturers, this being as follows:

Looking at the coil in such a manner that the connections are at the bottom and the pin on the left-hand side, the winding shall go in an anti-clockwise direction from pin to socket (see Fig. 2) and



Three standard coils used as aerial, secondary and reaction inductances for which their tight coupling make them specially suitable.

(*a*) in multi-layer coils the inner lead shall be that which is connected to the pin, while

(*b*) in single-layer coils the lead farthest away from the observer shall be that lead which is connected to the pin.

Inductance Values

The most interesting part of the specification, at any rate from the academic point of view, is that which deals with the inductance values of the coils. These values relate to the *true* inductance; that is to say, the apparent increase in inductance owing to self-capacity is allowed for and excluded. The standard series of coils is ingeniously designed to cover, with a minimum number of coils, the whole range of wave-lengths from about 20 metres to 25,000 metres when used in conjunction with a condenser in parallel having a value of 0·001 mfd. or less. The range of coils is divided for convenience into five groups, as follows:

GROUP S.—"Short," intended to cover wave-lengths of 20–175 metres.

GROUP B.—"Broadcasting," intended to cover wave-lengths of 150–750 metres, and therefore including the wave-lengths at present used most generally for broadcasting purposes.

SCHEDULE OF INDUCTANCE VALUES OF BRITISH STANDARD PLUG-IN COILS.

British Standard Designation of Coil.	Standard Inductance (micro-henries).	Approximate wave-length (metres) with shunted capacity (picofarads).				Approximate frequencies (kilocycles) covered by coil with shunted capacity.			
		25 μμF.	125 μμF.	250 μμF.	500 μμF.	25 μμF.	125 μμF.	250 μ F.	500 μμF.
S. 10	**6**	23	52	73	103	13,000	5,770	4.110	2,910
S. 20	**9**	28	62	89	125	10,700	4.840	3,370	2,400
S. 30	**13·4**	34	77	109	154	8,820	3,900	2,750	1,950
S. 40	**20**	42	94	133	189	7.140	3.190	2,260	1,590
S. 50	**30**	52	115	163	231	5,770	2,610	1,840	1,309
		62·5μμF.	250 μμF.	500 μμF.	1000 μμF.	62·5 μμF.	250 μμF.	500 μμF.	1000μμF.
B. 10	**53**	109	218	309	435	2,750	1.380	970	690
B. 20	**80**	133	266	376	532	2.260	1,130	800	560
B. 30	**120**	163	326	461	652	1,840	920	650	460
B. 40	**180**	200	400	566	800	1,500	750	530	380
B. 50	**270**	245	489	692	978	1,230	610	430	310
M. 10	**480**	326	653	927	1,305	920	460	320	230
M. 20	720	399	798	1.130	1,595	750	380	270	190
M. 30	**1,080**	489	978	1,385	1.955	610	310	220	150
M. 40	1,620	600	1,200	1,700	2.400	500	250	180	130
M. 50	**2,430**	734	1,470	2,075	2,935	410	200	150	100
L. 10	**4,320**	980	1,960	2.780	3,915	310	150	110	77
L. 20	6.480	1,200	2,395	3,385	4.790	250	130	89	63
L. 30	**9,720**	1,470	2,935	4,150	5.870	200	100	72	51
L. 40	14,580	1,800	3,600	5,095	7,200	170	84	59	42
L. 50	**21,870**	2,200	4,400	6,230	8,800	140	68	48	34
X. 10	**38,900**	2.940	5,880	8,340	11,750	100	51	36	26
X. 20	58,300	3,590	7,180	10.150	14.360	84	42	30	21
X. 30	**87,500**	4,400	8,800	12,450	17.600	68	34	24	17
X. 40	**131,000**	5,400	10,800	15,280	21.600	56	28	20	14
X. 50	197,000	6,600	13,200	18,680	26,400	46	23	16	11

NOTE.—Those sizes printed in heavy type are primary sizes and will cover all normal requirements. Those sizes printed in light type are included in order to make the range complete, but users are recommended to restrict their requirements to the sizes in heavy type as far as possible.

GROUP M.—"Medium," intended to cover wave-lengths of 700–2,800 metres.

GROUP L.—"Long," intended to cover wave-lengths of 2,500–8,000 metres.

GROUP X.—"Extra-long," intended to cover wave-lengths of 7,000–25,000 metres.

As will be seen from the schedule and the curves in Fig. 3, the actual overlapping of the wave-length range of each group is greater than indicated above, this extra range being obtained by using the condenser at the extreme lower and upper limits of its range.

Thus, Group S, instead of being confined to the band from 20 to 175 metres, which would be covered if used with a condenser having a minimum capacity of 25μμF. and a maximum of something less than 500μμF. (0·0005μF.), would extend up to about 350 metres if used with a condenser of 0·001μF., and would also extend downwards considerably below 20 metres if the condenser were used at its absolute minimum setting.

Wave-Length Ranges

In practice, however, it is not usual to work right at the bottom of the condenser scale, nor is it usual to use a condenser greater than 0·0005μF. on the short wave-lengths, and consequently the limits of 20–175 metres may be taken as the extreme limits for efficient use of the coils in Group S. Incidentally, for those who prefer to think in terms of kilocycles, the corresponding values are also shown in the schedule.

There are five coils in each of the above-mentioned groups, there thus being 25 coils in all. The amount of overlap in wave-length is such, however, that at the higher wave-lengths some of the coils may be dispensed with, and for this reason the 25 coils are divided into primary sizes and secondary sizes, the primary sizes being distinguished in the schedule by being printed in bold type. The secondary sizes are not considered really necessary in practice, but have been included in the schedule to make the range complete, and users are recommended to restrict their requirements to the primary sizes as far as possible.

Designation Numbers

The coils in each group are designated by the numbers 10, 20, 30, 40, and 50, this being more convenient than 1, 2, 3, 4, and 5, as it enables intermediate sizes to be interpolated if required for any particular purpose. Also, if an experimenter had a coil which did not exactly conform to any particular size, he could measure the inductance (or the wave-length with a given condenser-setting) and perhaps find that it was approximately half-way in size between the B.20 and B.30 coils.

For his own convenience he would call this a B.25 coil, so that he could immediately predict the wave-length range of this coil relative to a standard coil by reference to the schedule on this page.

The following extract from the introduction to the specification is quoted in explanation of how the sizes of the coils have been worked out*:

"The inductance values, and therefore the wave-length range of the coils in a group, bear a simple mathematical relation to the values of the corresponding coils in other groups, and a corresponding relation exists between the individual coils in any one grou.p These relations are as follow:

A "Geometrical Progression"

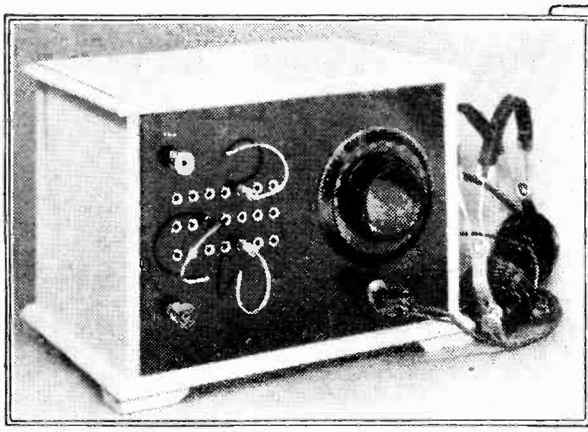
"The inductance values of coils S.10, B.10, M.10, L.10, and X.10, form a series in geometrical progression, the common ratio being 9.

"Similarly, coils S.20, B.20, etc., S.30, B.30, etc., form series in geometrical progression with a common ratio of 9, and so on throughout the whole range.

"The coils in each group also constitute a geometrical series in themselves, with a common ratio of 1·5. Thus the inductance values of coils S.10, S.20, S.30, S.40, and S.50 form

(*Continued on page* 672.)

* Extracted by permission from British Standard Specification No. 289-1927. (B.E.S.A., 28, Victoria Street, London, S.W.1, price 2s. 2d. post free.)



The "HARRIS" CRYSTAL SET

There is a combination of capacity and inductance which, under certain conditions, will tune in a station with greater strength than any other. Here is a receiver which enables one to discover that ideal "L.C." ratio in practically any circumstance.

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

In every practical application of electricity we first aim to obtain definite results, and then, when these are certain, to obtain them with maximum efficiency. Looking back in radio we are bound to smile when we think of the appalling reproduction which at one time satisfied us in regard to quality, while, in the matter

LIST OF COMPONENTS REQUIRED.

- 1 Ebonite panel, 10 in. × 7 in. (Radion, Trelleborg, Becol, Ebonart, etc.).
- 1 Cabinet for same with baseboard, 7 in. (Camco, Caxton, Pickett, etc.).
- 1 ·0005-mfd. variable condenser (Formo, or any good variable condenser will suit).
- 21 Clix "parallel" sockets.
- 2 Terminals for aerial and earth respectively (Eelex).
- 1 Open-circuit jack (Igranic, Lotus).
- 1 Plug for jack (Igranic, Lotus).
- 1 Socket for standard plug-in coil.
- 1 Crystal detector, complete on ebonite base, as shown (Any dealer).
- 1 Pair telephones.
- No. 150 plug-in coil (Any standard make, Lissen, Lewcos, etc.).
- Stiff wire for wiring up, such as Glazite.
- 3 Short lengths of flexible rubber-covered wire.
- 1 Tube, 3 × 3½ in. (Atlas Pirtoid).

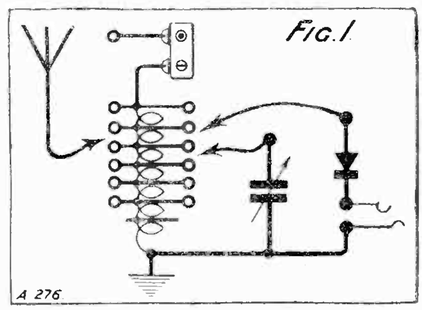
of economy, I have in front of me as I write a seven-valve super-heterodyne receiver using a super-power valve in the output stage which, so far as filament consumption is concerned, uses for the whole seven valves less current than did my first one-valve set!

Increasing Efficiency

Now the humble crystal set, which still serves as the key to broadcasting to many thousands of listeners, can be raised to a point of efficiency not generally realised. It so happens that my daily work includes the testing of all kinds of wireless components, including crystal detectors, and in the process of examining such articles one learns a number of highly interesting facts. Seeing that every wireless laboratory carries out its tests as far as possible with instruments which give quantitative indications rather than approximations and guesses dependent upon the sensitiveness of the ear of the observer, it is possible to obtain definite figures of efficiency, and these I have taken with crystal receivers for some time.

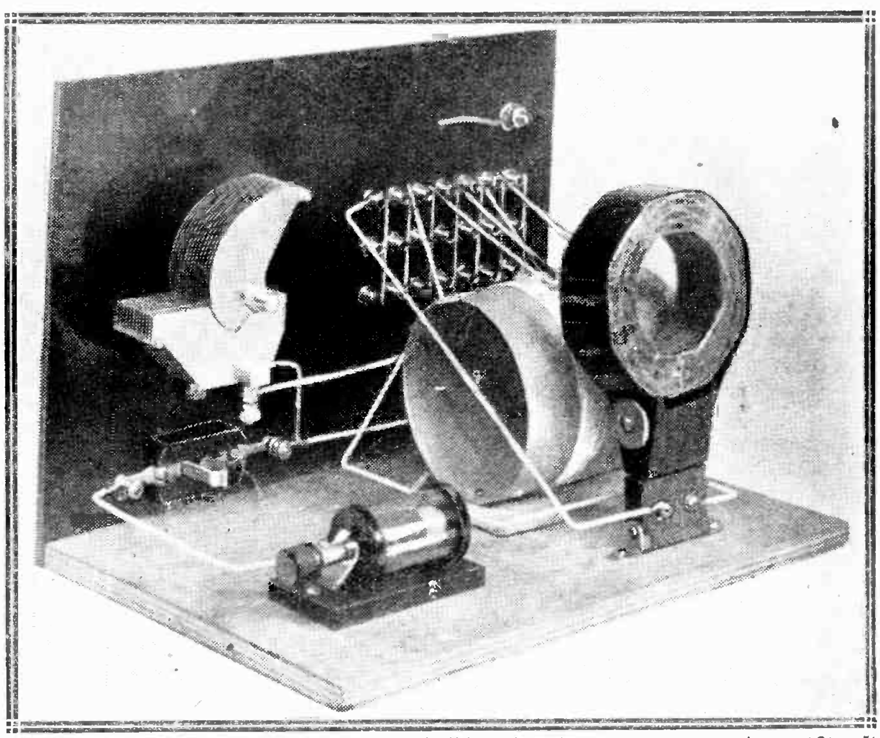
Selectivity Required

Whereas the valve receiver is in the nature of apparatus which uses the incoming signal to "trigger off" local energy from the high-tension supply, the crystal receiver is dependent *entirely* upon the incoming signal, which we must take, convert into unidirectional currents, and pass through our telephone earpieces. The more we can cut out our losses in the receiver itself the louder will be the signals, so that on the one hand the best designed crystal set would give inferior results with a poor crystal detector and, equally, the



best crystal detector is wasted without a properly designed set.

Strength of signal alone is not all that is required in a crystal receiver,



The set is an easy and inexpensive one to build, and makes a neat, attractive outfit. It can be adjusted to tune in both medium and long-wave broadcasters with the maximum possible strength.

we have also to consider selectivity. With the Daventry experimental station 5 G B, crystal-set users in large areas of this country can listen to either their local station or to 5 G B provided their sets are sufficiently selective, whereas before this station opened there was no particular need for crystal sets to be selective (except in coastal districts where Morse interference was bad) as there was only one station to be received. Our ideal crystal receiver therefore should be selective and preferably with variable selectivity, so that on certain occasions there may be no need to sacrifice any strength to obtain the selectivity which is not at the moment required. This means that a variable aerial tapping is needed.

For All Wave-Lengths

The next point to remember is that we want to produce a crystal receiver which will be equally efficient when used for listening to any of the British stations. True, it is possible to design a special set for each wave-length, but we want to provide a design which without structural alterations will suit any station. It is easy to take a coil and tune it with, say, a large variable condenser so that with a minimum of capacity across the coil the set will just tune to the lowest wave-length of the British stations and with the maximum to the longest wave-length, excluding, for the moment, 5 X X; yet if we do this the ratio of capacity to inductance will be unfavourable over a good portion of the scale. It is better therefore to have an arrangement by which both inductance and capacity are variable so as to get the best L-C ratio for a given set of conditions.

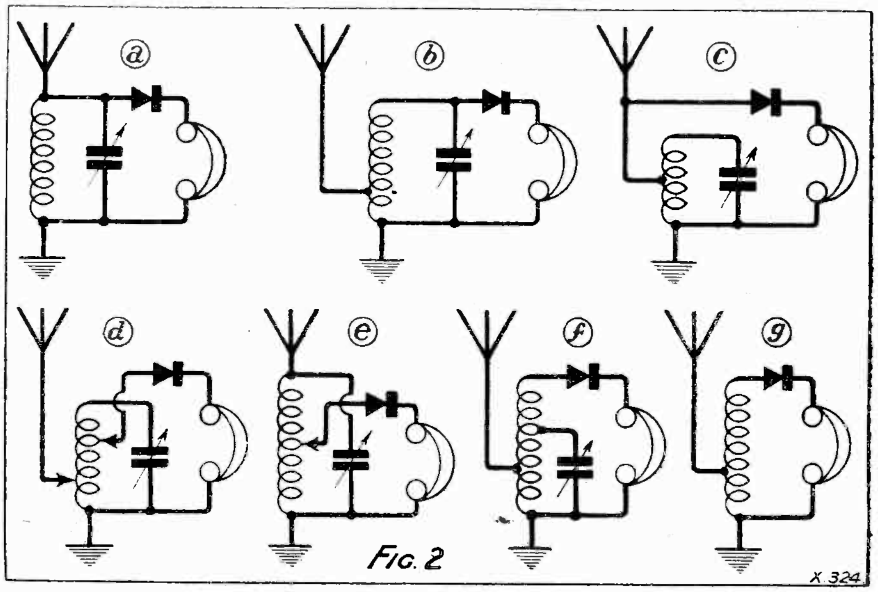
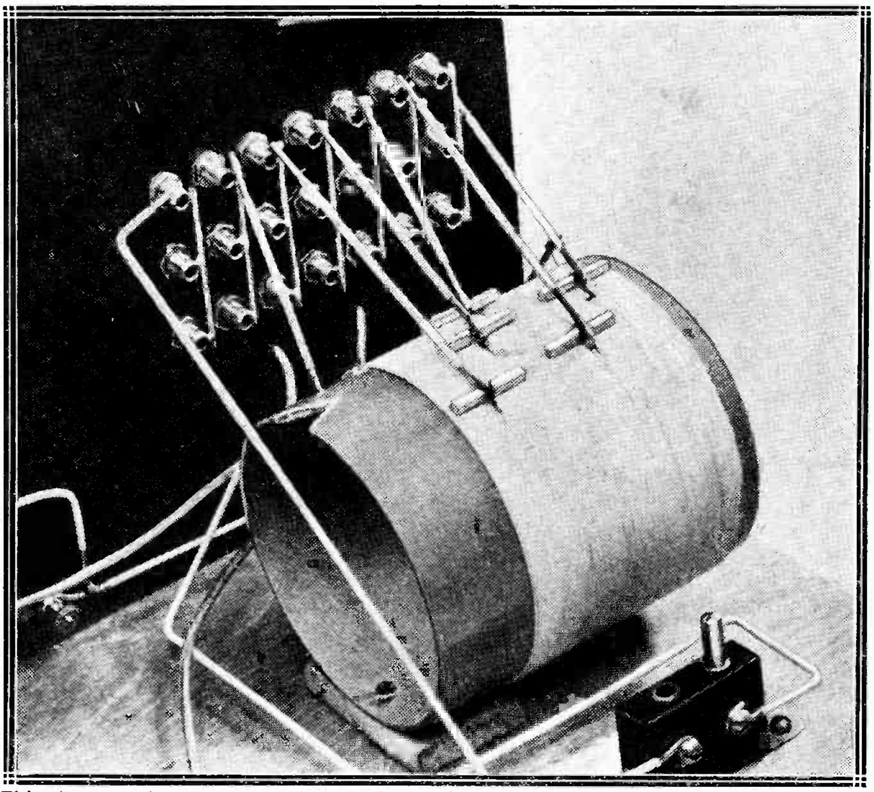


FIG. 2

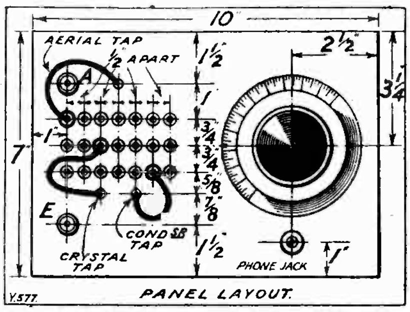
This does not yet end the matter, for we have yet to consider the best way of using our crystal detector. A measurement of the received current passing through the telephone headpieces soon shows that with a given crystal detector the best or loudest signals are *not* generally obtained when the detector is shunted across the whole of the inductance, but when it is shunted across only a portion. The difference between signal strength obtainable when the crystal is shunted across the most favourable proportion of inductance and when it is shunted across the whole of the inductance is very remarkable, and in carrying out experiments for this article I found that with a given crystal detector the current received when the crystal was shunted across approximately a third of the inductance was in the proportion of 140 to 80, or nearly twice as great.


This close-up shows you exactly how the tappings are taken from the coil. In each case a turn of the wire has been gently prised up, a piece of match-stick slipped under it and the lead from the socket securely soldered to the subsequently bared wire.

Greater Signal Strength

Not only do we get better signal strength by shunting our crystal detector across only a portion of the inductance, but we also improve the selectivity, so that our properly designed crystal receiver will be definitely better in signal strength and selectivity than one in which the old method of shunting aerial and crystal across the whole coil is used. Experiments with a number of different crystal detectors show that the optimum ratio of crystal turns to total inductance is not constant, but varies very considerably with different detectors, which, indeed, is to be expected when we know how detectors vary in resistance.

By this time the reader will have fully realised that a tapped coil is necessary in order to get best results, and that taps are required for aerial, crystal and condenser if we are to obtain all we desire. A multiplicity of tappings, however, is not desirable from other points of view, and a series of long leads connected to taps may add considerably to the capacity of the coil and reduce its efficiency. The crystal receiver which I am about to describe has been built for use in my laboratory, and has proved very valuable in a number of investigations. Although it can justifiably be



called a "de luxe" instrument, its cost is remarkably low, and as it contains a few novel constructional features, and as it will enable readers of MODERN WIRELESS to carry out some very interesting experiments, no apology is made for describing it in detail.

An examination of the photographs and drawings will show that the front panel carries aerial and earth terminals, a jack for telephones, a variable condenser and twenty-one sockets in three separate rows of seven. At first glance this suggests that twenty-one taps are taken, but a closer examination shows that on the coil itself there are only five tappings, and that the leads from these are quite short and well spaced. Each socket in the top row is connected to the two sockets immediately beneath it, so that we have seven rows of three sockets in parallel. The extreme right-hand sockets are only used when it is desired to receive 5 X X.

"Permanent" Detector

The crystal detector itself is mounted on the baseboard of the cabinet, access to it being easily obtained by lifting the lid. It is just as well to obtain one of the kinds designed to take the cat-whisker-galena detector, as this will probably be needed among others in the experiments. The small glass barrel and its fittings can be removed in a moment, and one of the permanent types substituted when desired. For general reception work there is no doubt that the permanent type is generally superior to the cat's-whisker type, as it is not easily deranged, and one can carry out all kinds of experiments with varying L-C ratios, crystal taps, aerial taps, etc., without fear of the adjustment being disturbed.

The Tapped Coil

The coil itself is home-wound on a 3-in. former measuring 3½ in. long. No. 24 D.C.C. wire is used, and the procedure for winding the coil is as follows: Pierce three holes on the line of the diameter of the former about a quarter of an inch from one end, and wind on tightly and with turns touching seventy-five turns of No. 24 D.C.C. The choice of this gauge of wire enables us to obtain a coil which has very efficient proportions for the inductance we want. Put in another way, we obtain a coil which contains a very high inductance for the amount of wire used. At the other extreme, if we were to wind a single-layer coil of thick wire on a narrow former, the proportion of length to diameter will be very large and the coil inefficient.

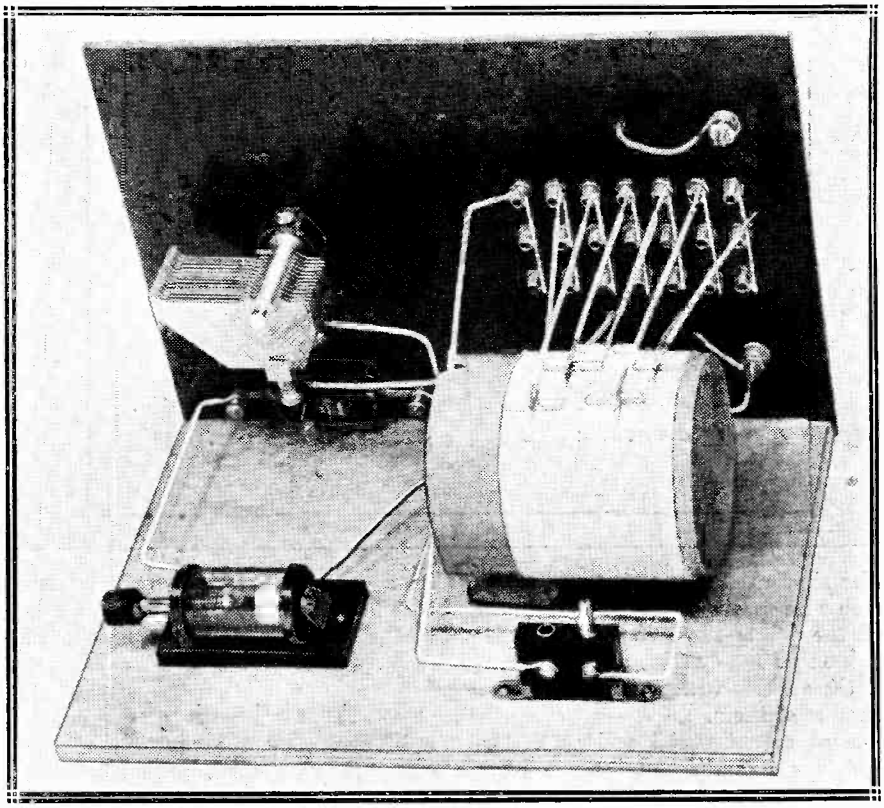
Do not bother about making the tappings as you go along. Wind the coil tightly, and with turns touching, until you reach the number of turns mentioned; pierce three more holes and thread the wire through, pulling it tight. When you have finished winding the coil and have secured the ends, count twelve turns from the beginning, and then, with a sharp-pointed instrument, prise up the twelfth turn, and slip under it a piece of matchstick. You will be surprised at the elasticity of this gauge of copper wire. You will find that it is not at all difficult to prise up the

When Mr. Harris tested this crystal set in his laboratory at Wimbledon, it developed a record current of rectified energy for a receiver of its simple nature.

wire sufficiently to insert the matchstick, which will remain in position without slipping. Now count on another twelve turns and lift the twenty-fourth turn in the same way, repeating the process at the thirty-sixth, forty-eighth and sixtieth turns. It is advisable to "stagger" the tappings as showing in the photographs.

Soldering the Leads

The next step is to take a sharp knife and scrape away the cotton insulation immediately above each matchstick so as to expose the bare copper. A hot soldering iron should



You will note that each tapping from the coil is joined to its own row of three sockets. These sockets can accommodate any one or all of the three plugs provided for aerial, crystal and condenser taps. Dozens of circuits thus become available and the ideal one for your particular local conditions is readily found.

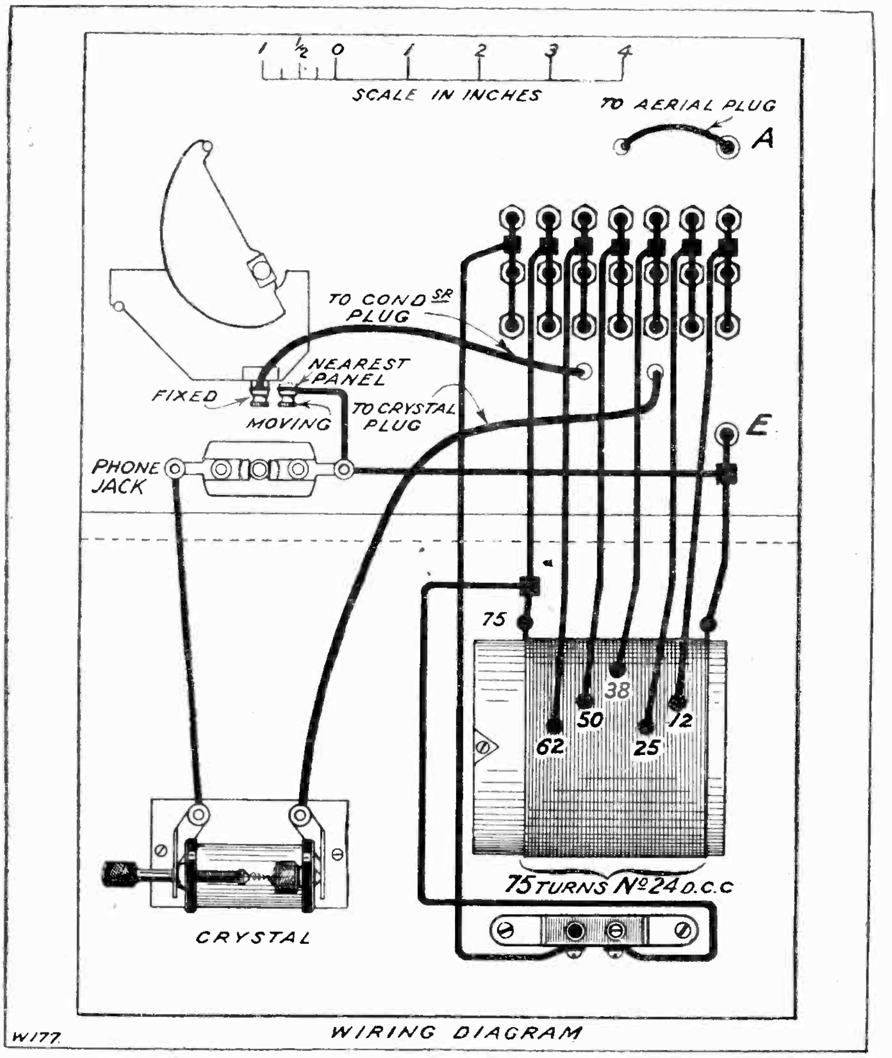
now be obtained, and the tapping points tinned. At the same time cut off the ends of the wire at the beginning and end of the former, leaving about half an inch projection, and tin these two ends ready for further soldering.

Component Assembly

The first step is to drill the panel and to insert the Clix parallel sockets. Before mounting other components on the panel lay it face downwards and carefully tighten all the nuts on the sockets, tin them, and solder in position the seven short lengths of wire shown. Be sure that you solder each wire firmly in position, and *after* all the joints have cooled, carefully tighten all nuts again, as the heating of the sockets will probably loosen a number of them.

Next mount aerial and earth terminals, condenser and jack, and lay the panel aside for the time being.

It will now be necessary to mount the coil on the baseboard. In order to do this take a small piece of thin wood about three-eighths of an inch in thickness, and measuring 2 in. by 1 in., cut a V-shaped slot in one end of your tube, as shown, and drill a hole in the tube immediately beneath this slot. The purpose of the slot is to enable you to insert a screwdriver conveniently. Now drill a hole in the small strip of wood in the correct position (which you will find by experiment), and when this is done place it beneath the tube and pass a ½-in. round-headed wood screw through the tube and the piece of wood into the baseboard, screwing it up tightly. The effect of this will be that the coil will be securely fastened to the baseboard without any of the turns touching the baseboard itself.



WIRING DIAGRAM

Arranging the Coil

In arranging the position of the coil on the baseboard, see that it comes in correct relation to the sockets for the leads, which will have to join the tappings to the sockets. An inspection of the photographs will reveal this quite clearly. It is now quite a simple matter to cut short leads and to solder them between the tappings and the sockets, as shown. Notice particularly that a lead goes from the end sockets right round to the holder for the plug-in coil.

Final Preparations

You will notice that three plain holes are drilled in the panel, two beneath the bottom row of sockets and one immediately above the top row. After you have wired up all the components needing stiff wire to join them, take three flexible rubber-covered leads and fit to them the three plugs. Plug in the first plug into any socket in the top row, and thread its flexible lead through the top hole and soldering it to the aerial terminal. Plug in the second socket into the second row and pass its flexible lead through the bottom left-hand hole (looking at the panel from the front) and from there to one terminal of the crystal detector. Now insert the third plug in any socket in the bottom row, and pass its flexible lead through the bottom right-hand hole, taking it inside the set to the *fixed* plates of the variable condenser.

Selecting Your Circuit

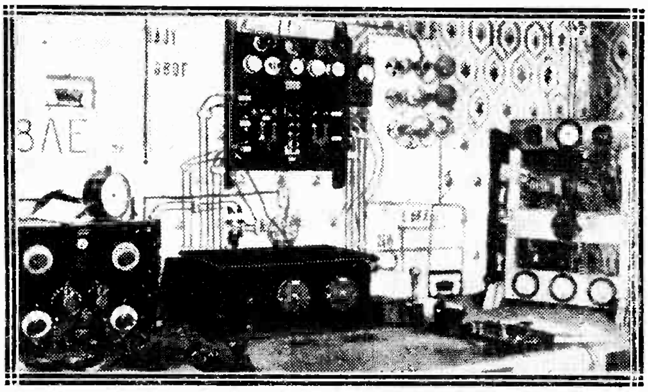
You are now all ready to begin work with the set. The top plug varies the aerial tapping, the second plug the crystal tapping, and the bottom plug the condenser tapping. As a start, try plugging the condenser plug into the third socket from the left, and the aerial plug in the third from the left, with the crystal tapping in the second to the left. Plug in your telephones, and tune with the variable condenser, when your local station should be heard quite well. Notice the amount of condenser you have across the coil, and if it is large, say, 100 or 120 degrees on a 180-degree dial, bring your condenser plug one socket towards the right and retune, whereupon you will find that the station will tune in with less capacity than before. After you have experimented a little with the aerial and condenser taps, try varying the crystal tap and you will probably find that the best signal strength is obtainable either in the first or in the second socket. The diagrams in Fig. 2 show a number of various arrangements which can be tried with this set.

For 5 X X insert a No. 150 coil in the socket at the back, and place *all* plugs in the extreme right-hand sockets.

Radio with Grenfell in Labrador

This exceptionally interesting article was written exclusively for "Modern Wireless" by Mr. F. Dearlove, the man selected to link up Labrador by wireless. How that Titanic task, carried through in the face of difficulties and dangers, constituted a real romance of radio and a triumph for short waves, is thrillingly told below.

THE very name "Labrador" calls to mind a vast tract of snow and ice-covered territory, inhospitable both to man and beast, and while this is only too true in the long winter months from November to May or June, in the summer, short though it be, things are very different and the Newfoundland and Labrador fishermen reap a rich harvest cod-fishing in their schooners from June to October, sailing along its rocky coast where not a tree is seen for hundreds of miles.



The operating table at NE8AE. The short-wave apparatus is to the right and the receiver in the centre. To the left is the set for working on 600 metres.

In the months of March and April thousands of seals are caught on the ice and shipped to St. John's, N.F., for export. Unfortunately, the country is absolutely undeveloped, no roads exist of any kind, and whilst communication is maintained along the coast during the short summer months by a series of small wireless stations comprising induction coils and crystal receivers, these stations are not open in the winter, and the only means of travel or communication even is by dog-team and "komotik," as the sled is called.

Life-Saving Links

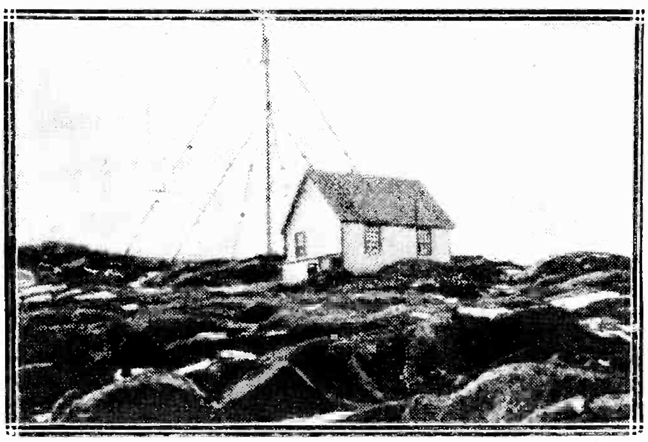
Due to the fishermen's habit of living for the most part on tea and bread and fish alone, in badly ventilated huts, super-heated by wood stoves—when they can get wood—tuberculosis is the great white scourge in this rocky, barren land, and it is a frequent occurrence for a man to set out in search of medical aid, with a team of "huskies" and a komotik on a journey of two or three hundred miles to the nearest doctor or nursing station, with but a slim chance of getting through in safety should an arctic blizzard, invariably followed by a temperature of far below zero, catch him abroad.

The dog trail is dotted with "tilts" or crude huts every thirty or forty miles, but men have died, simply frozen to death, within a few hundred yards of this shelter. Doctor Wilfred T. Grenfell, the man who has done more for Labrador than any other living man, building hospitals and caring for its people when they fall sick of the dreaded T.B., conceived the idea of connecting up his hospitals by short-wave radio, so that the Labrador base at Northwest River, and the main base at St. Anthony, northern Newfoundland, could be in touch with each other and with the office in New York, and thence to England, and it is due to the generosity of an American gentleman and wireless enthusiast, Mr. Eldon McLeod, of Massachusetts, in providing funds and apparatus, that the scheme is now a reality.

The First Station Completed

Doctor Grenfell, or Sir Wilfred Grenfell, as we must now call him, for he was knighted at the dedication of his new hospital in St. Anthony, last July, gave me the task of installing the stations and training operators to work them, and the Marconi Co. very kindly released me from their staff until such time as the task was completed, and accordingly I sailed from England on the 25th May, 1927, for St. Anthony, Newfoundland.

Towards the end of July the first station at St. Anthony was nearing completion, though the transmitting equipment had not yet arrived. I was enabled to carry on, however, with equipment I had brought out with me, and very soon we were "on the air."



Above is shown the "Smoky" wireless station, from which the world first learned the news of Peary's dash to the North Pole. The mast is a one-hundred-and-twenty-footer, on the top of a mountain, the transmitter is a 10-in. spark coil, and the receiver a crystal.

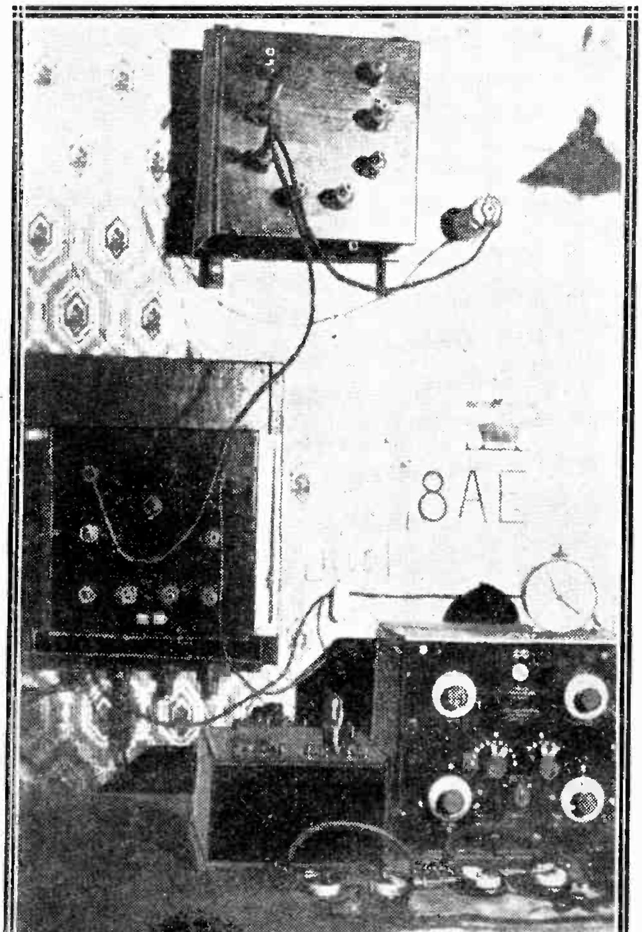
In addition to the short-wave equipment a 500-watt spark transmitter was installed, together with a long-wave receiver, and one for 600-metre work. The call-sign of this set is V O L.

The short-wave set consisted at this time of an "M.L." converter, type "E," running from a 12-volt accumulator, and supplying 500 volts D.C. to the plate of a Mullard S.W.50 valve. The inductances were made from copper ribbon stripped from an old Ford spark coil. The condensers were just plain receiving condensers, whilst the aerial ammeter was a flash-lamp bulb.

Gale Blows Aerial Down

The set was built of well-dried oak, right on the spot, and worked beautifully on 20 and 47 metres; later, 42 and 45 metres were added. The circuit employed was a split Colpitts, and as will be noticed from the circuit the grid-leak and plate supply are at points of relatively little or no difference in high-frequency potential, making for extreme efficiency.

The receiver used on the short waves at St. Anthony is a three-valve Reinartz, of standard construction, the only alteration made being the addition of certain resistances to make the set more stable in operation, as described elsewhere. The receiving aerial is quite large and very high, though a very short one having a fundamental of 30 metres was found to be unsurpassed for short distances.



The long-wave receivers at N E 8 A E. These are used in conjunction with the 600-metre spark transmitter, the inductances for which are shown attached to the wall.

The long aerial has harmonics at 84, 42 and 21 metres, which proved very useful when one day the normal transmitting aerial, a current-fed Hertz, was blown down in a terrific gale which unroofed a couple of houses at the same time. The current-fed Hertz aerial has a fundamental of 21 metres, and for 40-metre transmission the complete Hertz was worked against an extra quarter-wave counterpoise, the Hertz acting as a T.

"Fishing Head," the uncompromising entrance to St. Anthony Harbour.

Almost my first Q S O was my old friend, E G 2 X Y, whom I had visited before leaving England, and who promised to Q R X for us. It was 5 a.m. G.M.T. when we made contact, so he was certainly "on the job."

Stations in Rome, Paris, Germany, Sweden and Austria very quickly followed, but the very greatest thrill of all was one quiet evening when hardly a station was working I sent out a tentative but pessimistic C Q on 20 metres, and the only station heard was S A D A 8 calling me, and saying Q S A R 4. He gave his Q R A as Bernal, Buenos Aires.

I often look at his card now to convince myself we really did work him with so little a power input, less than 20 watts. Since that time many stations have reported hearing N E 8 A E, as we are called, on days when we could not hear a signal because of the aurora borealis putting a blanket on the ether.

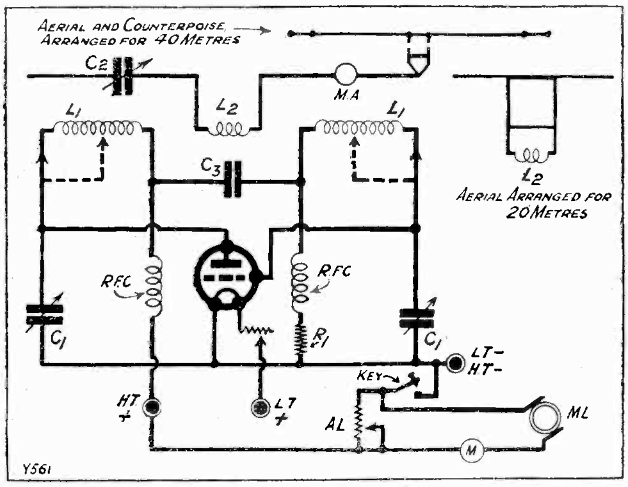
Stations Patrolled By Yacht

Towards the end of August preparations were under way for the second station at Northwest River, Labrador, and great anxiety was being felt by the people there lest winter should arrive before the apparatus which had been furnished by Mr. Eldon MacLeod and John L. Reinartz, the well-known pioneer on the short waves, came to hand. The arrival of the mail boat was awaited with great excitement, and telegrams were arriving from the nearest coastal wireless station on the Labrador from Dr. Paddon, expressing great apprehension as to whether or no he was to have a set before winter.

Dr. Paddon's stations on the Labrador are at Indian Harbour; Gordon, on the south side of the Hamilton Inlet; and at Northwest River, the winter station, one hundred and forty miles from the sea, standing on the shores of a vast inland salt-water lake, wider in parts than the English Channel, called Lake Melville. It is on the way to the famous Grand Falls, in quest of which Hubbard lost his life not long ago, being frozen to death within a few miles of Northwest River.

Dr. Paddon has to patrol his stations in his yacht, the "Yale," simply at the mercy of the wind, during the summer. The boat is only one of fifteen tons, and though it is soon to have an engine, it is without one at present, and November approaches and terrible gales lash

Lake Melville into a fury. The salt spray freezes as it comes aboard and the whole surface of the water is covered with a thick slushy ice called "slob," which precedes the annual freeze-up; his position is serious indeed. But that does not deter him from going out to anyone calling for his assistance.



Above is shown the Colpitts transmitting circuit used at St. Anthony, and finally at N E 8 W G (Labrador). The constants are as follow:

L_1.—7 turns each, spaced $\frac{1}{4}$ in.; No. 14 bare cu.; 3 in. diameter.

L_2.—3 turns, spaced $\frac{1}{4}$ in.; No. 14 bare cu.; $2\frac{1}{2}$ in. diameter.

C_1.—·00025 variable.

C_2.—·0005 variable.

C_3.—·001 fixed.

R_1.—5,000 w., grid leak.

R.F.C.—45 T. No. 28, Lorenz wound.

M.A.—Hot-wire ammeter, ·5 amp.

A.—Antenna Hertz for 20 m., T. for 40 m., each arm 18 ft., down lead 24 ft.

C.—Counterpoise for 40 m., 18 ft.

M.L.—M.L. Converter, E type, machine 12–500 volts.

V.—Mullard S.W.50, later replaced by R.C.A. U.X.210.

A.L.—Artificial load used when key is up, to prevent rise in voltage on M.L. converter (carbon resistance).

Accumulator supply and filament connections omitted for sake of simplicity.

M.—Milliammeter. A.L. is adjusted so that the reading on M. is the same with the key up or down.

Weeks passed by and August gave place to September, and still there was no sign of the apparatus. One boat did arrive, and I spent a good two hours carefully carrying two heavy boxes which looked as if they might contain radio gear down to the station at 4 a.m. one day. On being opened they contained tins of paint, and as one of my American friends remarked, "the joke was on me."

The "Component Boat" Arrives

At last in came the "Kyle"—the same boat, by the way, which later picked up the wing of the "Old Glory" of transatlantic flight fame—bringing with her a 500-watt generator, tubes, condensers, etc. What a collection for the short-wave enthusiast. The like was never seen in the amateur's wildest dream!

It became apparent however, when the pardonable excitement began to cool, that there would not be sufficient power available at Northwest River to supply this generator, so as facilities were better at St. Anthony, a Delco lighting plant was put at my disposal, and I decided to take the M.L. converter to Labrador and build the more powerful station for St. Anthony.

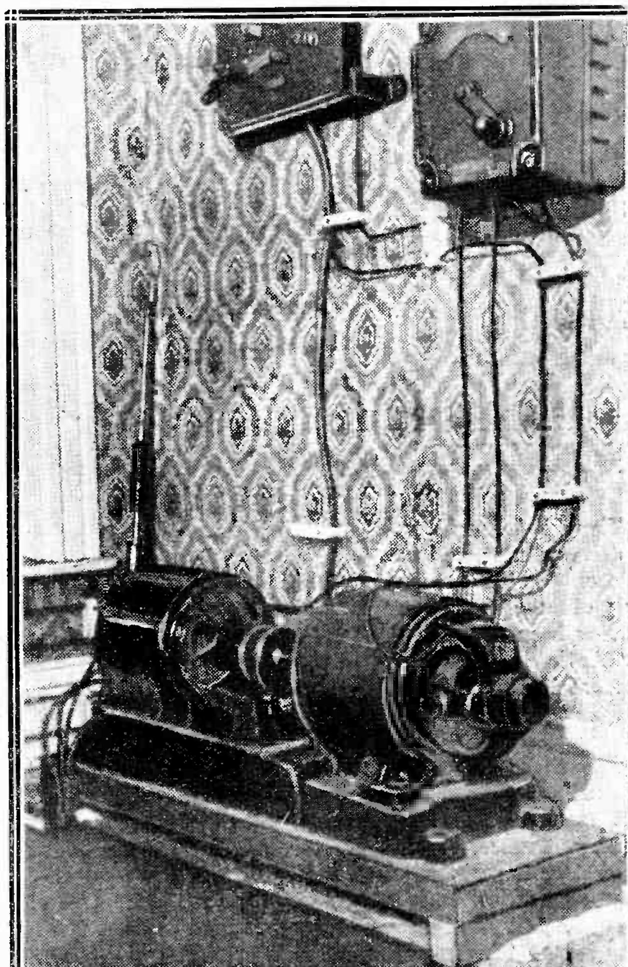
As time was running very short before the Labrador winter set in, the St. Anthony station was hurriedly completed, using the 500-watt generator supplying power to two 50-watt tubes in a Hartley loose-coupled circuit on exactly the same wave-lengths as before.

A Standby Generator

One photograph shows the present layout of the apparatus, the starter for the M.G. being placed conveniently to the right of the operator, on an upright built at the edge of the table. In addition to the M.G. an Evershed hand-generator has enabled N E 8 A E to communicate with England when, due to a failure of the supply, we should otherwise have been unable to carry on.

Taking with me the apparatus which had served so well at St. Anthony station, I set out to install N E 8 W G, as the Northwest River station was to be known "over the air," on the steamer "Meigle," which during the short summer takes supplies north. After a sixteen-day voyage, during which very severe weather was encountered, we arrived at Rigolet, forty miles or so up the Hamilton Inlet, with another ninety miles to go, and apparently the only way to get there was in an open motor boat.

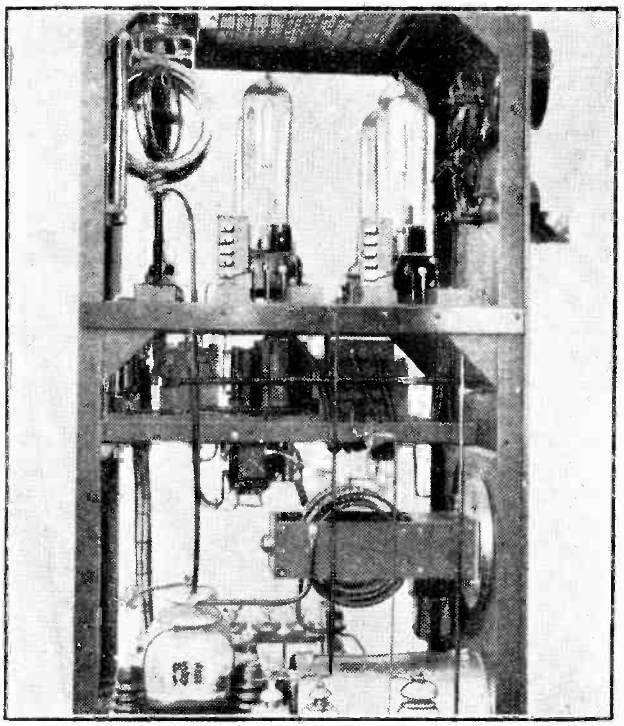
After spending a couple of days here in considering ways and means, a young American doctor also bound



The 2,000-volt, $\frac{1}{2}$-kilowatt "Esco" generator installed at N E 8 A E. The accumulators used to supply this machine have to be charged very frequently—twice a day sometimes!—for the machine takes 30 amperes.

for Northwest River and myself managed, with the permission of the Hudson Bay factor, to get aboard the "Fort Rigolet," a motor schooner, and set off to brave Lake Melville. We were soon at St. John's Island, where we anchored for the night, it not being considered safe to proceed farther in the darkness owing to the sudden storms which are likely to spring up on this dreaded inland sea.

Next morning we were well out of sight of land and, beyond the fact that the rest of the voyage took us four days, during which time we neither had the chance to wash nor sleep, we were fairly comfortable. Minor set-backs, like sudden gales, which necessitated our anchoring behind some island, were of frequent occurrence and seemed to be expected. We did eventually arrive, however, and all deficiencies in the way of sleep, etc., were soon remedied, and the next day I was ready for business.


This interior view of a transmitting "panel" at the Auckland, N.Z., broadcasting station affords an interesting contrast to the simple short-wave apparatus used in Labrador.

There had been a radio broadcast receiver in use the previous winter, and two fifty-foot masts stood in position in front of the hospital, so there was no need to erect any other than those. In about two days, the aerial having been made to the same measurements as that at St. Anthony, the set was in operation exactly as it had been at N E 8 A E.

Remarkable Low-Power Performances

The very first call was made on twenty metres and elicited a reply from New York, and before the week was out stations had been worked in Sweden, Germany, Austria, France, Italy, Belgium, and Porto Rico, whilst several stations in England and Scotland will remember working us also, both in daylight and at night. One of the strongest stations worked in England was 6 Q B*, who reported he was using an M.L. converter also. This shows what can be done with low power, and the very same evening this communication was eclipsed by the fact that F Q O C D L, at Duala, in the Cameroons, French Equatorial Africa, reported our signals a steady R.5!

At St. Anthony an automatic transmitter had been left in operation which, when switched on, would transmit A.B.C. de N E 8 A E. A schedule was arranged beforehand, and the very first evening at N E 8 W G I was delighted to hear these signals at a strength of at least R.8. Q.S.S. was very apparent, however, though it proved we should be able to work fairly consistently, especially as they were heard between R.3 to R.6 for over a week.

We were then Q.S.O., though with difficulty, as Mr. E. MacNeill—or Ted, as we call him—who will work N E 8 A E after my departure, is only just learning the code. He did splendidly, however, in picking us up at all with this handicap.

In Touch With The World

All this time N U 2 H V, operated by Mr. Edward Blodgett, of St. Albans, N.Y., was in touch with both stations, N E 8 A E and N E 8 W G, and handled traffic from me in great style often at the rate of 35 words per minute with no repeats. He used also to send us Press consistently every day, and so we were in touch with everyday affairs. I have to thank this station for keeping his schedules so consistently and contributing in a large measure to the success of the whole venture.

About this time we were puzzled as to where we should obtain an operator for this station at Northwest River, as I was scheduled to return to St. Anthony to operate there during the winter. We suddenly remembered that the coastal stations were closed during the winter, and forthwith approached Mr. J. Watts, the operator at Smoky station, and found that he was willing to go up to Northwest River and operate the station there during the winter. I am informed that Smoky was the first contact with civilisation made by Peary after his dash to the North Pole, and from which station the news of his success reached the outside world.

It was now necessary for us to get hold of Mr. Watts after his station closed for the winter, so five of us left for Smoky, a distance of over a hundred and fifty miles away, in the "Yale," under sail and entirely dependent on the vagaries of the wind. We were only six hours out on the "Bay," as the natives call Lake Melville, when the wind began to rise

"Those Sinister 'Dry Islands'"

Very soon we were being swept fore and aft, and it was all we could do to get our tiny craft to an anchorage behind a small group of islands called "Dry Islands"—very appropriate, but not very reassuring, for we had only one small water-butt aboard. Day followed day, and the weather continued to be atrocious. We could not get away; moreover, we were nearly fifty miles from the nearest fresh-water supply.

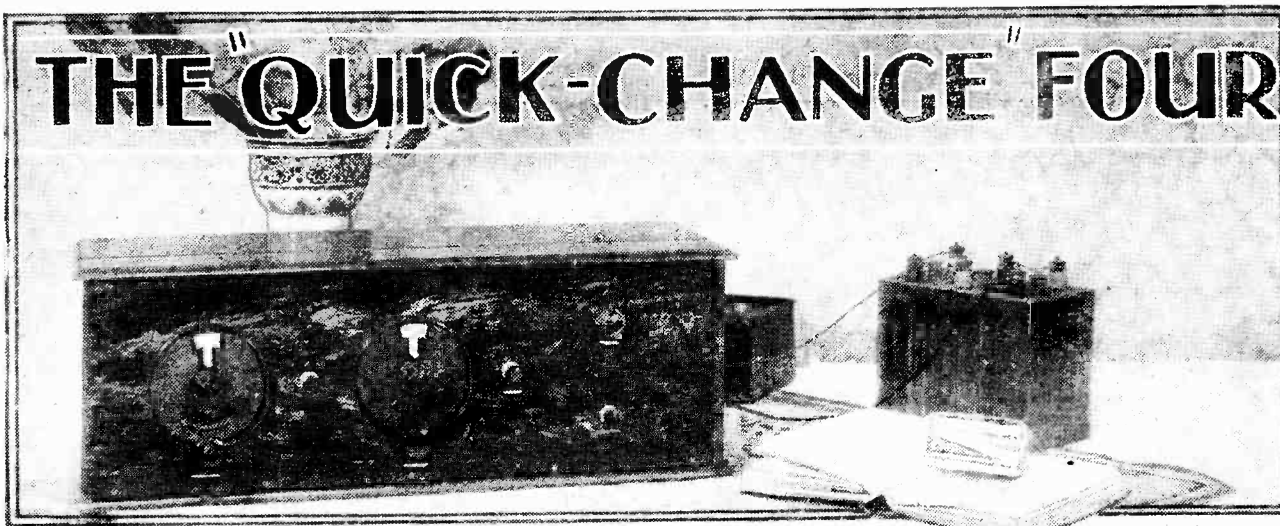
Five days passed slowly by, during which time we were heaved and tossed about like a cork; then, on the morning of the sixth, all was quiet, and at dawn we crept out and, with the wind on the quarter, we put seventy miles between us and those sinister Dry Islands. We replenished our water supply and made all fast for the night, and anchored at St. John's Island, with nearly half of our journey outwards over.

The next morning we hauled up our anchor in the freezing cold, half-blinded by snow, and reached the

(*Continued on page* 680.)

* *It is interesting to note that "6 Q B" is the member of the MODERN WIRELESS Technical Staff who contributes the monthly article "On The Short Waves."*

THE "QUICK-CHANGE" FOUR



The first scientifically designed receiver with an H.F. stage which is efficient on both long and short broadcast wave-length bands and which is provided with simple switching arrangements to enable an instantaneous change in wave-length to be made. It employs the new "M.W." standardised loading coil.

Designed, constructed and described by the "Modern Wireless" Research Dept.

THE idea of having a long-range receiver able to cover all broadcast wave-lengths without the necessity for changing the coils is very attractive. Its achievement, however, has been one of the most difficult problems in radio-set design. A long-range receiver requires an *efficient* stage of high-frequency amplification, and it is chiefly this factor which complicates the design of an all-wave set.

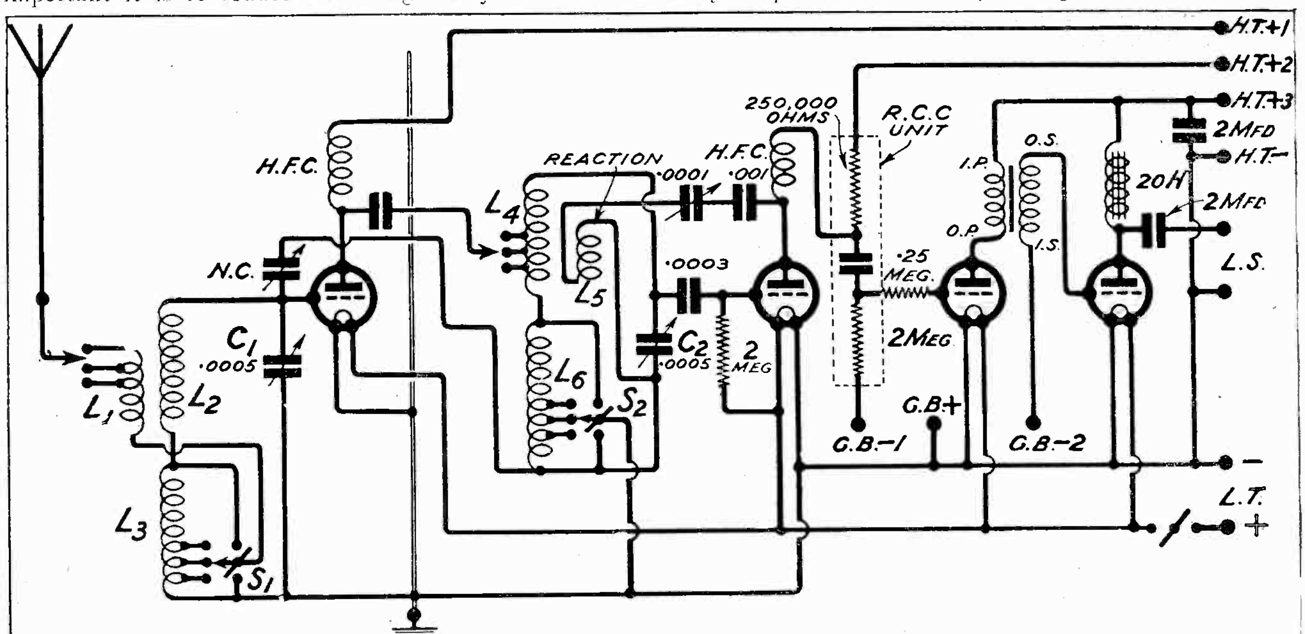
Readers already know how very important it is to reduce all wiring on the H.F. side to an absolute minimum, and also the great danger of hopeless uncontrollability occurring should the slightest interaction take place, or if the circuit is not of a properly "balanced" type.

Early Difficulties

These factors apply to any normal H.F. circuit arrangement intended to cover only a limited wave-band with a single set of coils. Even with such a straightforward design it is only too often necessary to perform some small adjustment upon inserting a second set of coils to cover a different range of wave-lengths.

With these thoughts in mind the difficulties of trying to eliminate the necessity of having to change the coils at once begin to manifest themselves.

The MODERN WIRELESS Research Department has for many months realised the need for such a set, and has been conducting a considerable amount of experimental work with the object of evolving a really sound and simple design.



The theoretical arrangement of the receiver. L_5 and L_6 are "M.W." standardised loading coils, which are brought into circuit when it is desired to change over from short to long waves, by means of a very simple switching device.

The ideal, no doubt, is to employ a single push-pull or throw-over switch which will change over from one wave-band to another with but a "flick of the finger."

In practice, unfortunately, the use of only one switch tends to produce serious troubles resulting from the fact that certain vital leads from each grid circuit are brought exceedingly close together at the switch contacts. Even supposing the actual losses could be reduced to a negligible quantity, there still remains the ever-present danger of instability.

The Circuit Chosen

After exhaustive tests, the MODERN WIRELESS Technical Staff came to the conclusion that although it was possible to construct a receiver on these lines, such a design would not at present be of a type suitable for the home constructor, who often prefers to use alternative components, or who may inadvertently deviate slightly from the published layout.

The circuit finally decided upon was that shown in the theoretical diagram given on the previous page. The arrangement has proved to be highly efficient, with no signs of losses.

Two Switches

Two switches are used, the slight inconvenience of the extra switch being more than counterbalanced by the resulting gain in simplicity and efficiency.

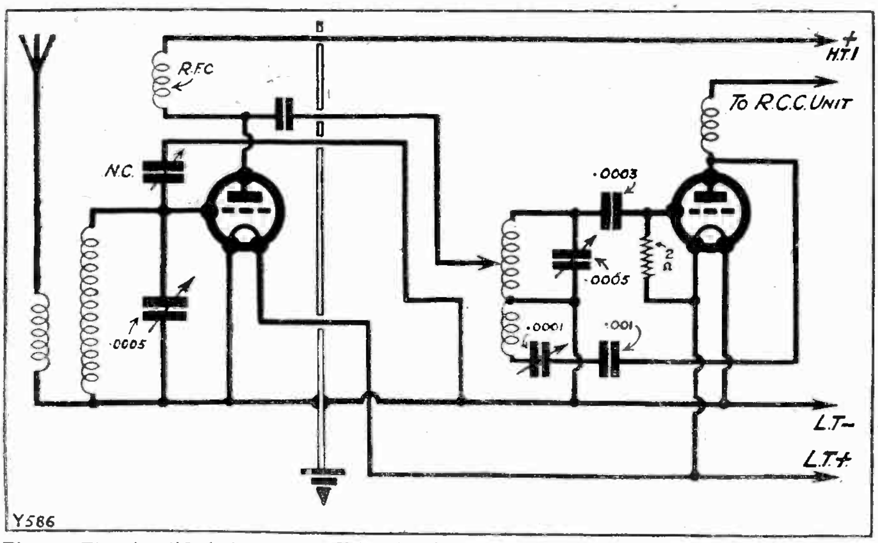


Fig. 1. The simplified short-wave H.F. circuit. A conventional "parallel feed" scheme is employed, the neutralising condenser N.C. having no effect upon the functioning of the circuit.

The complete theoretical circuit looks rather complicated at first glance, but it is really very simple. Fig. 1 shows the short-wave portion only. It will be seen that the arrangement is that of a perfectly straightforward "parallel-feed" circuit, the neutralising condenser (N.C.) having no effect whatever upon the functioning of the short-wave side.

On the long-wave side (Fig. 2), the circuit arrangement becomes an auto-coupled aerial circuit, with a parallel-feed H.F. stage, stabilised with the aid of the neutralising condenser (N.C.). This neutralisation is necessary because when the loading-coil is switched into circuit for the longer waves the feed tap includes a very large proportion of the total winding in circuit, and in consequence there is enough feed-back to produce self-oscillation.

By arranging a filament tap on the loading coil it is possible to include in circuit a sufficient proportion of the turns in the correct phase relationship to enable neutralisation to be carried out. In addition, these turns supplement the existing reaction coil, thereby giving a Hartley reaction effect on the 5 X X band.

The reader will at once say: "But why not employ some form of neutralising on both wave-bands?"

The answer is that neutralised circuits with switching are too complicated. Tests have shown that in ninety-nine cases in a hundred re-neutralisation is desirable when the change-over to another wave-band is made.

H.F. Chokes

The parallel-feed method enables simple shielding to be adopted, which makes for ease of construction. The aerial circuit is conventional, but tappings are provided on the primary winding so that the best ratio of signal strength to selectivity may be obtained on aerials of different types and on different wave-lengths. Similarly the detector grid coil is also provided with tappings, thus making it an easy matter to obtain the correct proportion of the coil to ensure stability with H.F. valves of various types.

The change-over from short to long waves is arranged for by bringing two loading coils into circuit, these

COMPONENTS REQUIRED

- 1 Panel 21 in. × 7 in. (Radion Mahoganite used for original. Any good branded material, Ebonart, Red Seal, Trelleborg, Trolite, etc.).
- Cabinet for above panel, panel brackets and baseboard 12 in. deep (Artcraft, Bond, Camco, Caxton, Maker-import, Pickett, Raymond, etc.).
- 4 Anti-microphonic valve holders, baseboard-mounting type (Benjamin, Bowyer-Lowe, Burndept, Burne-Jones, B.T.H., Igranic, Marconiphone, Pye, Redfern, W.B.).
- 2 Standard "M.W." loading coils (Burne-Jones in original. Any standard make).
- 1 Neutralising condenser, baseboard-mounting type (Any standard make).
- 2 ·0005 variable condensers (Igranic Lokvane in set. Any good make, square law, S.L.F., "log mid-line," etc., according to preference).
- 2 Vernier dials (Igranic in set. Any good make).
- 1 ·0001 miniature type reaction condenser (Bowyer-Lowe, Cyldon, Ormond, Peto-Scott, etc.).
- 3 On-off type switches (One of these is simply the battery switch, and can be any standard make. See text).
- Fixed condensers, capacities ·001, ·0003, ·001 (Clarke, Dubilier, Igranic, Lissen, Mullard, T.C.C., etc.).
- 2 Grid leaks, ·25 and 2 meg., and holders (Dubilier, Igranic, Lissen, Mullard, etc.).
- 2 H.F. chokes (Bowyer-Lowe, Burne-Jones, Collinson, Cosmos, Igranic, Lissen, Ormond, R.I. & Varley, Sovereign, Wearite, etc.).
- 1 R.C.C. unit (Dubilier in set. Any good make, Lissen, Marconiphone, Mullard, etc.).
- 1 L.F. transformer, low ratio (Marconiphone in set. Any good make).
- 1 L.F. output choke, 20 henries ("British General" in set. Any good make, R.I. & Varley, etc.).
- 2 Mansbridge condensers, 2 mfd. each (Dubilier, Ferranti, Lissen, Mullard, T.C.C., etc.).
- 1 Terminal strip with 8 terminals and one with 2 (A good appearance can be obtained with indicating terminals such as Belling & Lee, Eelex, Igranic, etc.).
- Copper screen 12 in. × 6 in., wire, flex, material for coils, etc. (Copper screen can be obtained ready for use from Messrs. E. Paroussi).

coils incidentally being those recently produced by Research Staff under the MODERN WIRELESS standardisation scheme. (See May issue of MODERN WIRELESS.)

In a circuit of this type, or, in fact, in any "parallel-feed" arrangement, it is essential to employ radio chokes of proved efficiency. This applies in particular to the choke in series with the H.T. feed to the H.F. valve, and a poor choke will have a very serious effect upon signal strength on both wave-bands.

The losses will be especially marked on the long waves.

The L.F. side of the set is quite standard, and it is scarcely necessary to make any comments on the various components except in the case of the anode resistance. The value of this resistance should not exceed 250,000 ohms, otherwise it may be difficult to obtain smooth reaction control.

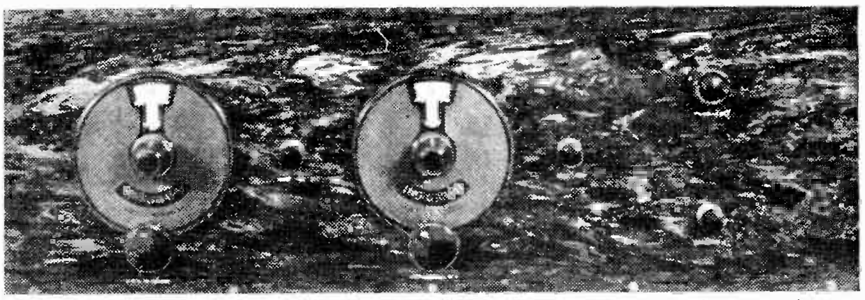
The L.F. transformer can, of course, be of any reputable make, and the ratio should not exceed 4–1 if maximum quality is desired.

So much for the theoretical considerations, and now we shall come to the actual construction and operation of the set.

Simple Construction

To start with, I should like to impress upon the reader that the set really is easy to construct—much easier, in fact, than many of the popular "straight" neutralised receivers which are so common at the present time. This ease of construction is largely due to the use of only one small shield separating the aerial and H.F. circuits.

Take the panel and mark it off *on the back* to the dimensions shown in the drilling diagram. Drill it and screw it to the edge of the baseboard, which incidentally should consist of a stout piece of 5- or 8-ply wood, since it has to support quite a considerable weight.



The two wave change switches are the two little knobs seen here, one between the two tuning dials, and the other to the right of the second tuning dial.

Next mount the various components, taking care to make a secure job of the slow-motion dials, otherwise there will be a tendency for them to rotate with the condenser vanes. Now just a few words about the change-over switches.

These have to perform a very important function, viz., that of changing from one wave-band to the other. When the knobs are pulled out, the loading coils are short-circuited and the receiver is ready to operate on the normal broadcast band of 250–500 metres.

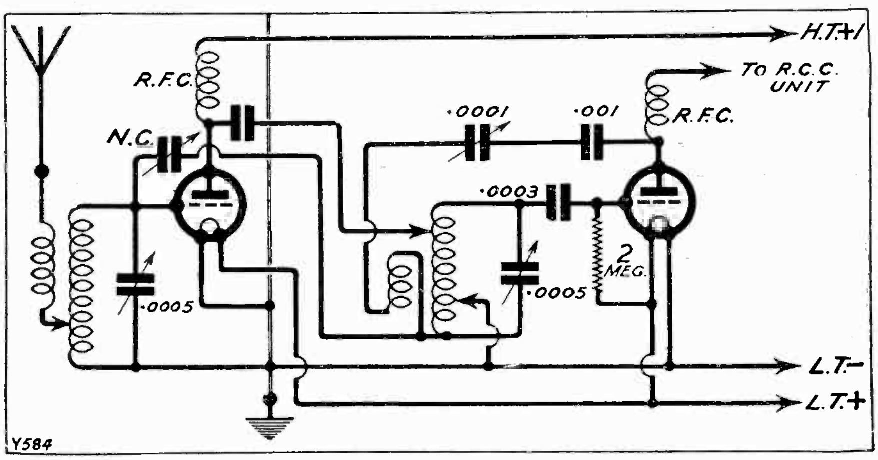
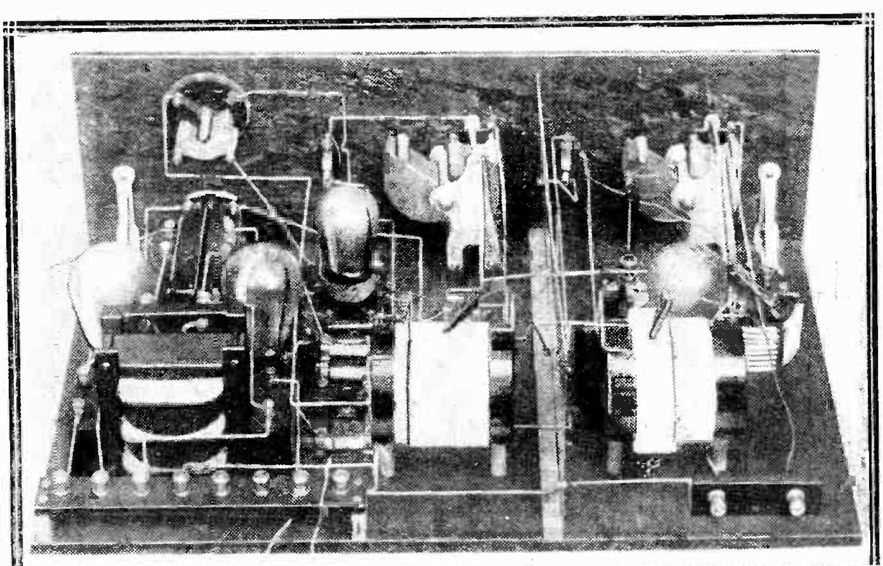


Fig. 2. How the H.F. circuit is arranged for reception on the long waves. The aerial circuit, it will be noted, becomes auto-coupled and the H.F. valve is neutralised.

A Point to Note

If the contact between the spindle and the two tongues of the second switch is imperfect there is a danger of instability arising, since the existing reaction control will be supplemented by the long-wave reaction turns. To obviate this it is a good scheme to solder a piece of flexible wire between the centre contact knob (i.e. the spindle) and the stiff busbar connection which goes to the spindle from L.T. –).

Before mounting the components on the baseboard the two short-wave coils should be wound. The aerial primary and grid windings are wound upon a former 3 in. diameter by $3\frac{1}{2}$ in. long. This former can be made of any good insulating material with low dielectric losses, such as Paxolin, Pirtoid, Radion, etc.



From this back-of-panel photograph it will be seen that the metal screen is supported by a strip of wood which is screwed to the baseboard.

The grid winding consists of 60 turns of No. 24 D.C.C., unspaced. On top of this and at the earth end of the winding is the primary or "aperiodic" aerial coil, consisting of 25 turns of the same gauge wire. Tappings are taken at 10, 15, and 20 turns, and connection is made to these points with the aid of a small spring clip, which is joined to the aerial terminal by means of a short length of flexible wire.

The Coils

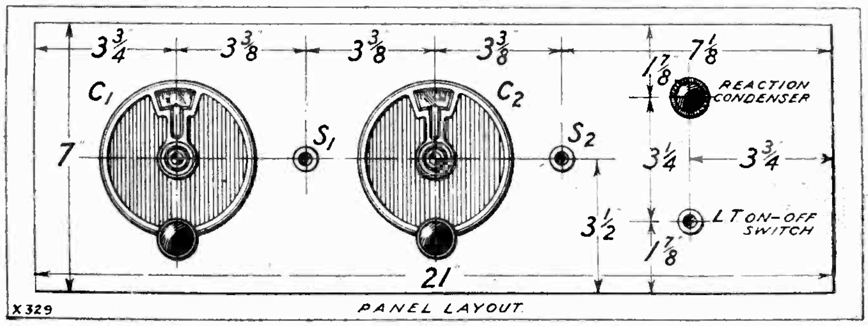
The aerial or primary coil is separated from the grid winding by short lengths of wood, such as those supplied with packets of Glazite.

These strips have a diameter of about ¼ in., and the number actually used is immaterial, since they only serve to separate the two windings. Six is a convenient number.

The H.F. coil is wound upon a similar former, and consists of 60 turns of No. 24 D.C.C., unspaced, with tappings at 10, 15, 20, 25, and 30 turns. The first tapping, viz., the 10-turn tap, is taken at the end of the coil nearest the reaction winding, hence the coil should be commenced from this end. The reaction coil consists of 30 turns of No. 34 D.S.C.

You must be careful in connecting the H.F. coil in circuit. Remember that the end of the coil nearest the reaction winding goes to the loading coil and the other end to the grid condenser.

The first tapping at 10 turns is at the loading coil end of the winding.



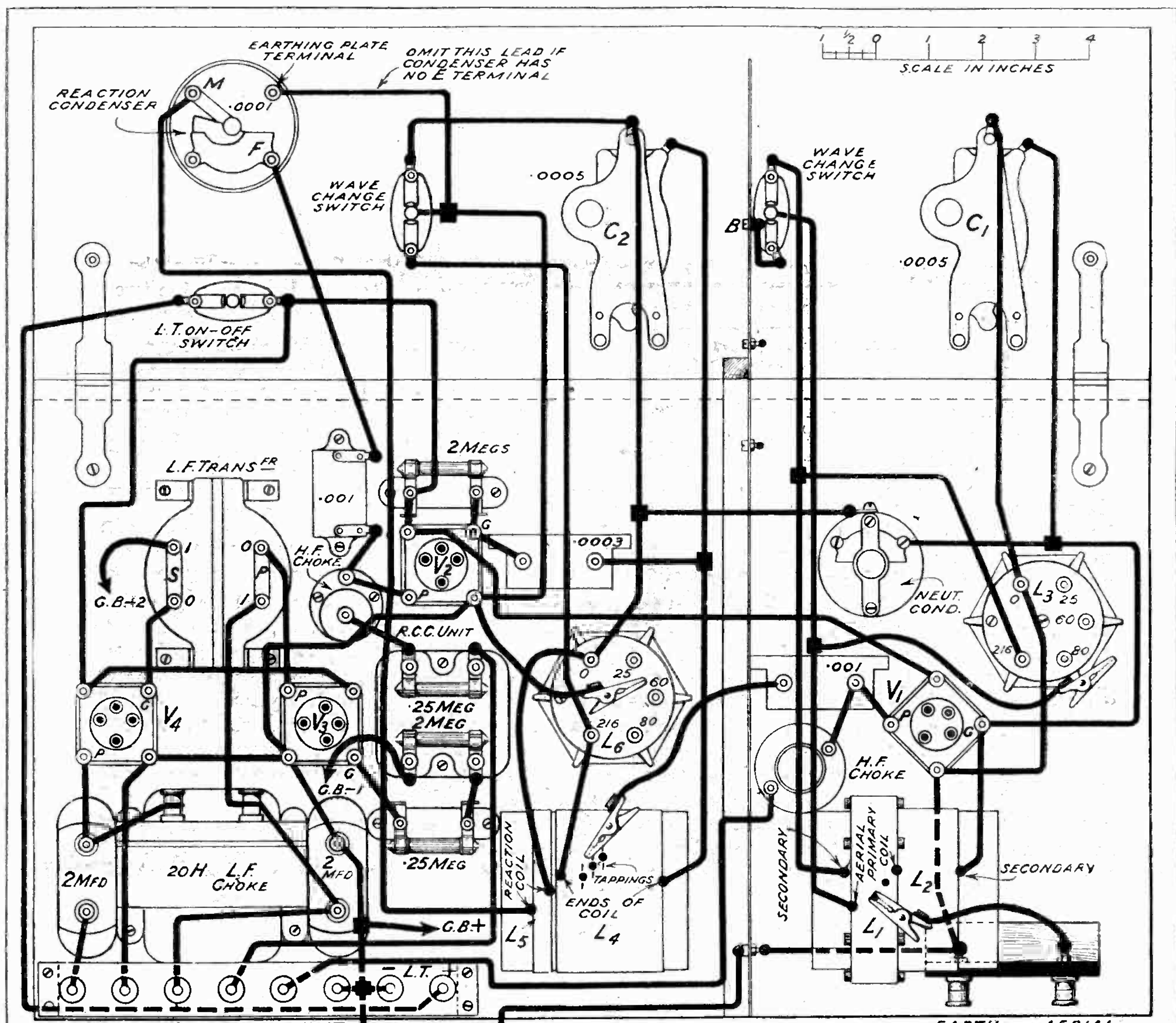
X 329 PANEL LAYOUT

The reaction coil is wound in the same direction as the H.F. coil.

If you arrange your tapping wrongly you will get uncontrollable oscillation.

The method of mounting the coils can be seen from the photographs.

Two 1½-in. lengths of wood are



530 WIRING DIAGRAM.

used for each coil—½-in. diameter curtain rod is suitable, but square-section strips will do equally well.

Now commence the baseboard layout. Screw down the components and mount the copper screen in position. This is attached to a strip of wood, which is secured to the baseboard with three or four wood screws.

Wiring-Up

Wire-up as many of the components as possible, but neglect for the time being those leads which pass through the screen. Then work out the position for these leads with the aid of the wiring diagram and drill the necessary holes for the wires to pass through. These points can be marked in pencil on the metal shield, which can then be removed from the baseboard and drilled. Cut the holes clearly so that the edges will not chafe the insulation covering on the wires.

Use good stiff 16 or 18 gauge wire throughout, preferably No. 16 for the longer leads. The form of insulation covering employed is immaterial so long as it is of good quality. Systoflex tubing is very convenient.

The terminal strips used, as will be seen, are of the horizontal type and will suit any cabinet. In future, however, it is probable that all cabinets will be standardised and that a 2-in. slot will be cut right along the back to take the ordinary vertical type of strip.

The type of terminal strip employed is immaterial, either serving equally well.

It will also be noticed that a very large power choke of low D.C. resistance is incorporated in the set. A big choke is desirable in cases where it is intended that a "super-power" valve is to be used, or where a heavy anode current is flowing, such as might be the case on high H.T. voltages supplied by a mains unit. For ordinary small-power valves, or for super-power valves operating on a moderate voltage, a smaller choke could be employed.

The operation of the receiver is quite straightforward once the preliminary adjustments have been carried out.

Connect up the aerial and earth and insert valves of the following types:

H.F. socket: A valve of the "H.F." type, impedance 30,000 ohms or thereabouts, amplification factor about 20.

Detector: A similar valve or alternatively one of the R.C. type.

First L.F.: A valve having an impedance of 12–20,000 ohms, such as one of the L.F. or "H.F." type (not power).

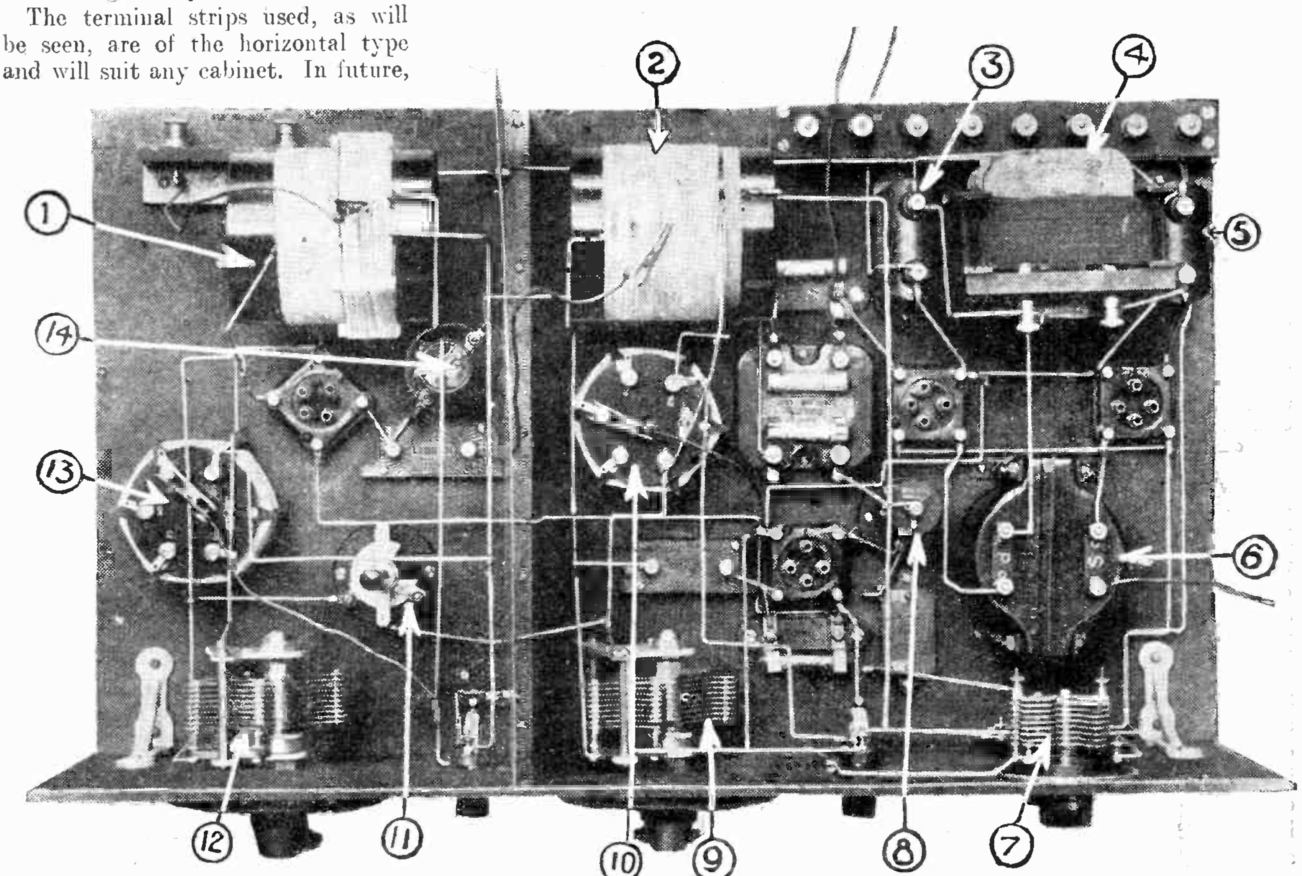
Second L.F.: A valve having an impedance of 6–8,000 ohms if signals of moderate strength are being handled, or one of 3–4,000 ohms for large volume.

In the preliminary tests apply H.T. voltages as follows: H.T.+1, 60 volts; H.T.+2, 60–100 volts; H.T.+3, 120 volts. The grid bias on the first L.F. valve should be about 3 volts, and upon the last valve 9 or 18 volts, according to the type of valve used.

Working the Set

The grid bias, in any case, must be adjusted to suit the requirements of the particular valves employed, and the necessary details will be found on the valve-maker's carton or pamphlet supplied.

Place the two wave-change switches in a position in which the loading coils are short-circuited, and connect the aerial spring clip on, say, the middle tapping on the aerial winding.



Here is a complete plan view of the receiver: (1) and (2) are the aerial and H.F. coils; (3) and (5) the 2-mfd. H.T. shunting and output condensers; (4) is the filter choke, and (6) the L.F. transformer, which should be of the low-ratio type; (7) is the reaction condenser, and (8) and (14) the two H.F. chokes; the condenser marked (9) tunes the H.F. circuit, while (12) is the aerial grid circuit tuning control; (10) and (13) are the loading coils for the long waves.

Join the spring clip for the H.F. "feed" tap (viz., the H.F. coil) on the 10-turn tapping. Keep the reaction condenser at its minimum and adjust the two tuning controls until you hear your local station. Then adjust the aerial tap for maximum results. You will soon find the position which gives you the best signal strength combined with selectivity. Try various positions for the spring clip on the H.F. coil. Choose the tapping which gives you good stability over the whole wave-band.

Final Adjustments

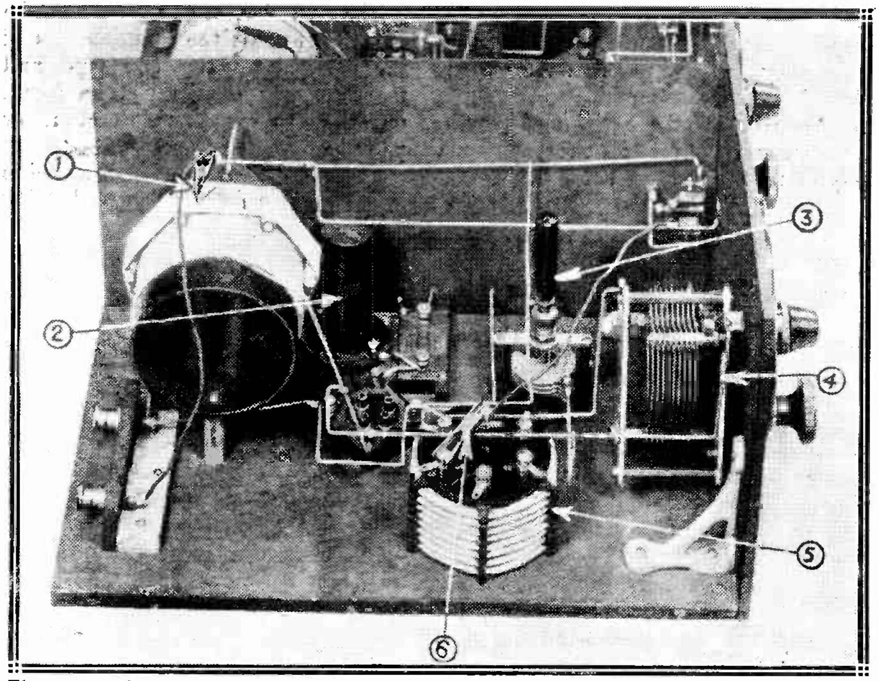
Then adjust the reaction condenser and vary the H.T. voltage on the H.F. and detector valves for the maximum results.

the loading coils, but you must remember that a high tapping point on the H.F loading coil will increase the reaction effect and may make the *detector* valve oscillate very freely, thus giving the impression that the H.F. valve is oscillating.

For maximum selectivity on the long-waves try taking the feed tap (the spring clip joined to the ·001 fixed condenser) to the 80, and the filament tap to the 60 tappings on the loading coil.

Remember that selectivity on the long waves is also controlled by the adjustment of the spring clip on the aerial loading coil, whereas the clip on the H.F. loading coil controls the reaction effect and neutralisation.

In the type of wave-change switch required one contact is joined to two others in the "on" position," and is separated in the "off" position." In the "off" position these latter two contacts must also be separated from each other. Suitable types are the Lissen and Lotus "on and off" switches, to mention two examples. If you examine the wiring diagram and the photos carefully you will have little difficulty here.



The connections to the aerial circuit can be clearly seen in this photograph. (1) Is the tapping clip for the "aperiodic" aerial winding; (2) is the H.F. choke in the plate circuit of the first valve; (3) is the neutralising condenser; (4) is the aerial circuit tuning condenser; (5) the aerial loading coil, and (6) the aerial tapping clip for long waves.

Now place both the switches in the position for long-wave reception, i.e. with the tongues insulated from the centre knob. Connect the spring clip on the aerial loading coil to the 60 or 80 tapping, and that on the H.F. loading coil to the 80 tapping.

With the reaction control at its minimum tune in 5 X X. It is probable that the H.F. valve will oscillate, so rotate the "neutralising" condenser very slowly until oscillation ceases. Then try to tune in other stations on the long waves and adjust the "neutralising" condenser slightly so that the set is perfectly stable even at the lower end of the tuning scale. You can, if you wish, try various tappings on

There is no need to touch the clips on the short-wave coils when operating the set on the long waves.

Test Report

These stations were received on a loud speaker, using a poor aerial approximately 100 ft. in length, and having an average height of only 15 ft.

Nürnberg	Rome
Muenster	Langenberg
Munich	5 G B
Toulouse	Brussels
Dublin	Vienna
San Sebastian	Hilversum
Hamburg	Berlin
Ecole Superieure	Motala
Bournemouth	5 X X
Milan	Radio-Paris

POINT-TO-POINT CONNECTIONS.

Join moving vanes of C_1 to terminal O on L3, to one filament contact of V_1, to earth terminal and to screen.

Join L.T. – terminal to H.T. – terminal, to screen, to one side of first 2 mfd. condenser, to one filament contact of V_3, V_4, and V_2. Join remaining filament contacts of V_1, V_2, V_3, and V_4 together, and to one side of L.T. on-off switch.

Join G. of V_1 to one side of neutralising condenser, to fixed vanes of C_1 and to top of secondary winding L_2.

Join bottom of secondary L_2 to top contact of first wave-change switch, and to terminal on L_3 marked 216. Join middle contact of first wave-change switch to bottom of primary coil L_1, and to a flex lead terminating in a clip for L_3.

Join bottom contact of first wave-change switch to terminal on screen marked B.

Connect plate of V_1 to one side of ·001 fixed condenser, and to one side of first H.F. choke.

Join remaining side of first H.F. choke to H.T.+1 terminal.

Join a flex lead terminating in a tapping clip for tappings on L_4 to remaining side of ·001 fixed condenser.

Join remaining side of neutralising condenser to terminal marked O on L_6, to moving vanes of C_2, to top contact on second wave-change switch, and to the side of reaction coil L_5 nearest to L_4.

Join fixed vanes of C_2 to one side of ·0003 fixed condenser and to top end of L_4.

Join remaining end of L_4 to terminal marked 216 on L_6, and to bottom contact on second wave-change switch.

Join middle contact of second wave-change switch to earthing plate terminal on reaction condenser and to filament contact on V_2 which goes to L.T.–.

Join remaining side of ·0003 fixed condenser to G of V_2 and to one side of 2 meg. leak.

Join remaining side of 2 meg. leak to filament contact on V_2 which goes to filament switch.

Join P. of V_2 to one side of second H.F. choke and to one side of second ·001 fixed condenser.

Join remaining side of second ·001 fixed condenser to fixed vanes of reaction condenser.

Join remaining side of second H.F. choke to terminal on R.C.C. unit marked A.

Join terminal marked H.T. on R.C.C. unit to H.T.+2.

Join terminal on R.C.C. unit marked G to one side of ·25-meg. leak.

Join remaining side of ·25-meg. leak to G of V_3.

Take a flex lead from terminal on R.C.C. unit marked – G.B. to G.B.–1.

Join P. of V_3 to O.P. of L.F. transformer.

Join I.P. of L.F. transformer to one side of L.F. choke, to remaining side of first 2 mfd. condenser and to H.T.+3.

Join O.S. of L.F. transformer to G. of V_4. Take a flex lead from I.S. to G.B.–2.

Join P. of V_4 to one side of second 2 mfd. condenser and to remaining terminal on L.F. choke.

Join remaining side of second 2 mfd. condenser to one L.S. terminal.

Join remaining L.S. terminal to filament contact on V_4 which goes to L.T.–.

Join remaining side of L.T. on-off switch to L.T.+ terminal.

Take a flex lead from the filament contact of V_2 which goes to L.T.– to a tapping clip for L_6.

Join a flex lead terminating in a tapping clip for L_1 to the aerial terminal.

Join remaining side of reaction condenser (moving vanes) to remaining side of reaction coil.

Take a flex lead from L.T.– to G.B.+.

RADIO and the GRAMOPHONE

A section for the Music Lover.
Conducted by KEITH D. ROGERS.

MANY readers have written and asked me for a circuit of a receiver which will operate equally well as a radio or gramophone record reproducer, and I do not think I can do better by way of a reply than to give a circuit which I have often used.

It is true that it errs rather on the side of luxury from the point of view of the number of valves, because on very many records one may have to tone the reproduction by a large amount by means of the volume control. But the set has a large factor of safety and can be relied upon to give good results not only on the local broadcasting but on several D.X. stations and also on any gramophone records worthy of that name.

Those Bass Notes

Because the circuit is rather on the elaborate side readers must not imagine that it is necessary to have an elaborate set in order to get *good* reproduction from a gramophone record. But if you want the *best*, both from radio and the gramophone, then you must go a little bit farther than the average three- or four-valve set, and build something more on the style of the one indicated in these pages.

Such a circuit is quite suitable for use with the moving-coil type of loud speaker, and the bass reproduction is exceedingly good because the set has been designed give good amplification at frequencies well below twenty-five cycles per second.

Of course, one cannot get a loud speaker that will operate anywhere near that depth of tone, but if you have the deep bass delivered from your set then it will give your speaker the best chance it can possibly have of reproducing those notes in a full and round fashion.

With the rapid development taking place in the design of L.F. amplifiers and loud speakers, and also in the production of gramophone records, it is natural that these two sections of the radio and gramophone industries should be combined for the benefit of the music-loving public.

The electrical "pick-up" has enabled this combination to take place, with the result that anyone with a reasonably efficient valve set can, for a very small outlay, enjoy all the benefits that radio and the gramophone have to offer.

In this section of MODERN WIRELESS each month will be discussed both technical and other data of interest to the set owner who is also interested in gramophones, whether from a technical or purely utilitarian point of view.

In addition to articles on the operating side of amplifier and pick-up combinations, and various hints and tips of value to the constructor and set owner, a brief survey and critique of the latest gramophone records is included, making the section of vital interest to all music-lovers.

As we are discussing gramophone reproduction we are more concerned with the low-frequency side of the receiver than with the high-frequency-detector section, although in discussing the circuit it will be necessary to refer to the first two valves, even though we may be more concerned with the last four. It will be noticed that two valves are used in parallel in the last stage, while when the pick-up is in use we have four L.F. stages. That is, as you will imagine, a luxury.

Factor of Safety

There are very few records that really need four low-frequency stages, even though they may be resistance-coupled, but the valves and resistances used in this set are chosen so that small amplification per stage is obtained, and the whole idea of the receiver has been to provide the set with as large a factor of safety as possible, both from the point of view of amplification and from that of being able to carry large volume.

High-mu valves and high-magnification L.F. stages have been avoided altogether, and the result of this set is that of a receiver having about $1\frac{1}{2}$ valves less than the maximum possible if high-magnification stages were used, but the quality is far and away beyond that possible were very high-magnification stages to be employed.

The output choke is marked as having twenty henries inductance, but in actual practice I use two chokes of that value, or approximately so, connected in parallel. This is done to cut down the D.C. resistance so that the H.T. voltage drop across the choke is made as low as possible.

The Coupling Condensers

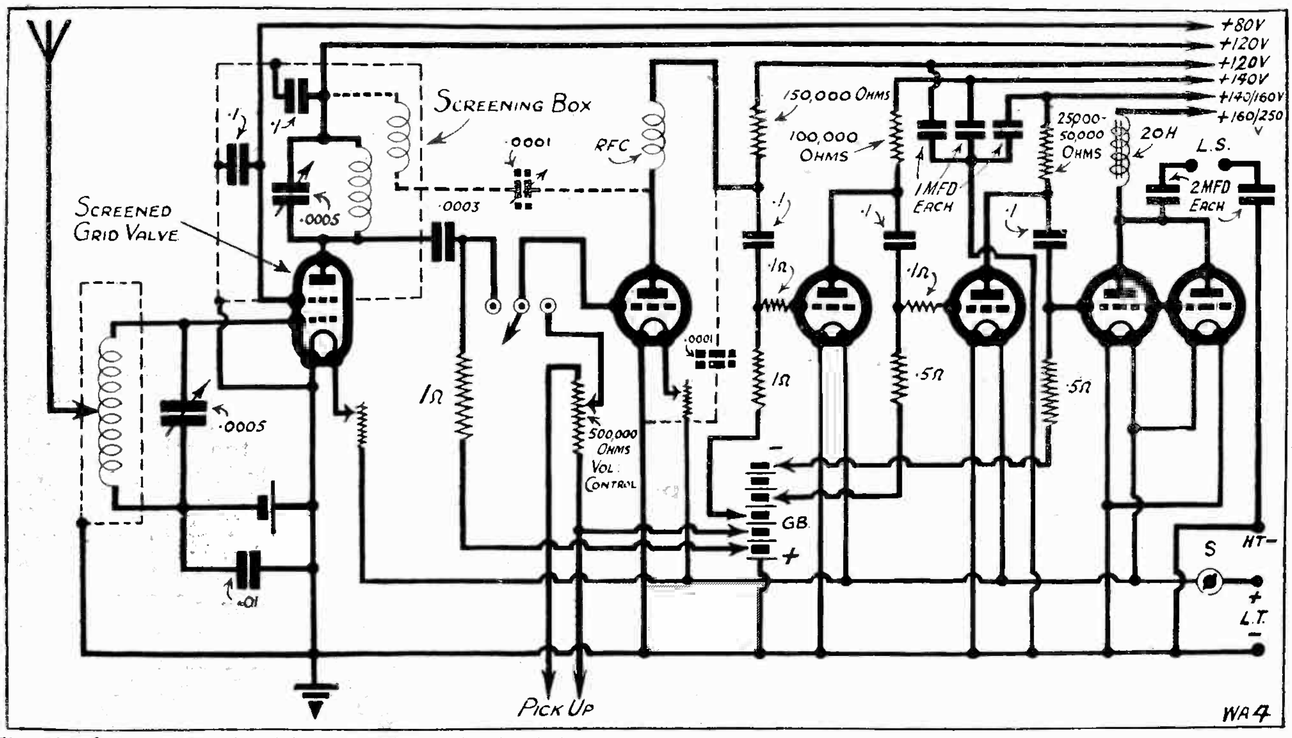
The ·1 coupling condensers in the L.F. stages are used so as to provide plenty of bass amplification, and the anode resistances and the grid leaks are chosen to suit those factors. It will be noticed that each plate circuit, or, rather, I should say each H.T. circuit, on the L.F. side, is by-passed by a 1-mfd. condenser, and this is to ensure that trouble due to L.F. feedback and anode coupling shall be eliminated.

In practice those by-pass condensers are connected close up to the resistances and taken to the nearest filament points. They are not placed by the H.T. terminals or near the H.T. battery, which, by the way, consists of accumulators in this case, but they are placed as close to the resistances as possible so as to provide a direct path for the L.F. impulses.

Incidentally, this receiver allows rapid tests to be made between broadcast reception and gramophone reproduction, for by just moving a single-pole double-throw switch in the grid circuit of the detector valve one is enabled to switch over from gramophone to radio and vice versa without any other alteration.

The rheostat in the filament circuit of the H.F. valve enables that to be turned out when gramophone reproduction is to be enjoyed, and, as a matter of fact, a double-pole double-switch could have been arranged instead of single-pole switch in order to automatically cut out the filament of that valve. It was, however, decided to use a filament resistance in the circuit of the high-frequency valve, to act as a volume control on radio, and it was therefore decided that it would be simpler to employ this for turning out the H.F. valve when the gramophone was to be employed rather than complicate matters by using a double-pole switch.

The aerial circuit is of the ordinary tapped variety and is not particularly selective, as the receiver is used mainly for the local, 5 G B, and one or two of the more powerful stations. A screened valve is employed and gives ample H.F. amplification, so that on the local, 5 G B, 5 X X, and those other few stations, reaction is not really necessary.



Though of an apparently elaborate nature this circuit is not an expensive one to build, while, if desired, the H.F. stage can be omitted and grid-leak rectification employed on the detector valve.

Stopping H.F.

Provision for reaction, however, is made, and is shown by the connections in the dotted line from the plate of the detector, through the variable ·0001-mfd. condenser to the reaction coil coupled to the anode coil. Actually, when used for the local station or 5 G B, as the set usually is, this reaction condenser is disconnected so that no feedback through that coil occurs. Another ·0001 dotted condenser between the H.F. choke and the filament of the detector valve is used as a precautionary measure in case any H.F. gets through that choke.

The same may be said of the ·1-meg. leaks used as H.F. stoppers in the grid circuits of the first two L.F. valves.

Bias Batteries

These stoppers, of course, have no significance when the gramophone is employed, as practically pure L.F. is supplied to the set from the pick-up, but when radio is being received, especially on the long waves, a certain amount of H.F. is likely to pass through into the L.F. side and this will cause no end of trouble, especially as the set is resistance-coupled.

Screening is employed for both H.F. circuits—that is, the aerial coil and the anode circuit—while volume control can be obtained either by the variable resistance in the filament circuit of the H.F. valve or else by detuning. The first valve has its own grid-bias battery, while the detector grid bias is supplied by the same battery when the set is used as a radio receiver. When used, however, as a pick-up amplifier, the grid bias, which is connected to the pick-up, is taken to the main grid-bias battery, as will be seen in the diagram.

More sensitivity could be obtained on radio reproduction if the grid leak of the detector valve were 2 megohms, but with the 1 megohm I found quality is better, although the selectivity is slightly less.

However, one does not expect great selectivity when using a screened-grid valve, and it will be observed that the detector is worked as an anode-bend rectifier, the grid leak being taken to grid-bias negative. As a matter of fact, this is one of the main objects in using a screened-grid valve—to provide a good input for the detector valve.

"Boominess"

It might be remarked here that, as this set is designed to give good amplification of the very low frequencies, and it is inclined to make reproduction sound rather "boomy" if used on a loud speaker which has plenty of bass colouration, I have noticed that on some cone types of loud speakers which are rather inclined to manufacture their own bass, so to speak, the reproduction is certainly on the boomy side, but this can be removed by increasing the resistance of the grid leaks on the L.F. side, and lowering the values of the coupling condensers to something to the order of ·006 mfd.

Slightly higher anode resistances can also be employed here, but these should not be raised too much or a rather serious cutting-off of the higher frequencies may occur.

With regard to the valves used in this set, at the present moment I am using the ordinary 6-volt screened-grid valve, followed by a P.M.5X. detector, an S.S.610P. as the first L.F., followed by a D.E.5A., and then two L.L.525's in parallel. Actually in this last stage two P.M.256 valves in parallel, or a couple of D.E.5A.'s, work quite well, while those who have plenty of H.T. voltage and plenty of filament current might care to try a couple of L.S.5A.'s or D.F.A.7's. In this latter case, however, they will require anything from 250 volts upwards for H.T.

Other Types

These particular valves mentioned, however, must not be taken as being the only ones which work properly in the set. Any valves of good type and the correct impedances will work equally well. For instance, the D.E.L.610, which has a lower impedance and lower magnification factor than the P.M.5X., works very well in the detector position, while the D.E P.610, 7,000 ohms, and a magnification of 7, works quite well in the first L F. stage. Those mentioned are only typical valves and it should be remembered that no attempt is made to specify any particular make.

Two- or Six-Volters

The approximate H.T. voltages are marked on the diagram, while the filament voltage, of course, is fixed by the valve. I have tried 2-volt valves and, while excellent results were obtained, I cannot get quite the same volume and even roundness from them as I find can be obtained from the 6-volt type.

One is more inclined to overload, especially in the last stage, because 2-volt super-power valves have not yet reached the same efficiency as the 6-volt valve. They will, however, give excellent results for medium volume.

If this receiver is to be used with a loud speaker which has a low-resistance winding, then one must, of course, use a suitable output transformer connected to the loud speaker; but, in any case, I prefer to employ the filter circuit shown in the diagram, whether a loud-speaker transformer is used or not. This filter circuit has no appreciable bearing upon the results obtained on any type of loud speaker, so that the set is, one might say, isolated as a set or amplifier from the loud speaker, so that any kind is quite suitable for use with it.

PICK-UPS TESTED

The number of pick-ups on the market are steadily increasing, and it is becoming more and more difficult to differentiate between them. One which, however, is well worthy of the attention of all gramophone-radio enthusiasts is that marketed by the Loewe Radio Co., Ltd., of Tottenham.

Exceptionally small, this little pick-up is exceedingly well-designed and reproduces the whole range of the musical frequencies dealt with by the best of records in a manner that one might expect to get only from an instrument of several times the price. This latter is of the modest order of 18s. 6d.

Another Model

The G.E.C. have improved their pick-up, one of the earliest on the British market, and have made it lighter—an action that is to be highly commended. The pick-up, as is shown by the photograph, is well-made, and is adaptable for any type of tone-arm. On test it gives very satisfactory results and can be obtained with or without a volume control and plug adaptor.

GRAMOPHONICS

It is better to control volume at the input of your receiver or amplifier than at the last stage.

* * *

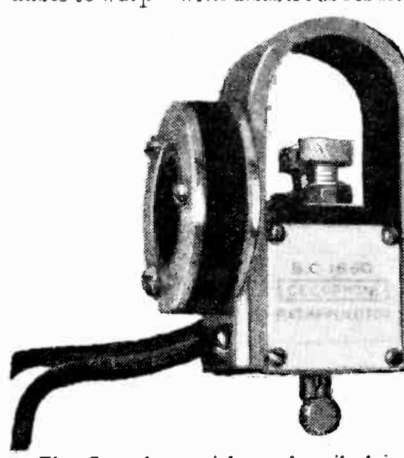
Blasting or less noticeable distortion is not always caused by the pick-up or a fault in recording, it may be due to overloading in one or other stages of the amplifier, or even due to the loud speaker.

* * *

A gramophone, in common with all mechanical devices, needs careful attention and the motor should be oiled occasionally with the special oil sold for that purpose.

* * *

Records should be kept in cool places and kept level or vertical; if stored in a warm place and allowed to rest in a slanting position they are liable to warp—with disastrous results.

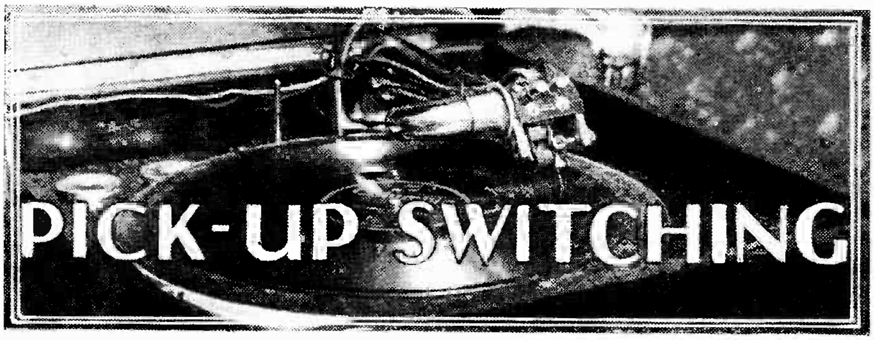


The Gecophone pick-up described in this page.

Don't forget that a fall in H.T. or L.T. voltage may completely upset the quality of your reproduction, especially if resistance - capacity coupling is employed.

* * *

Keep an eye on the grid battery as well as on the L.T. and H.T. supply if you want to ensure good results—and invest in a plate-circuit milliammeter, it is an excellent aid to distortionless amplification.



Easy methods of changing over from Radio to Gramophone.

By G. T. KELSEY.

THE jack and plug method of switching, with which most people are familiar to some extent, is one that lends itself very

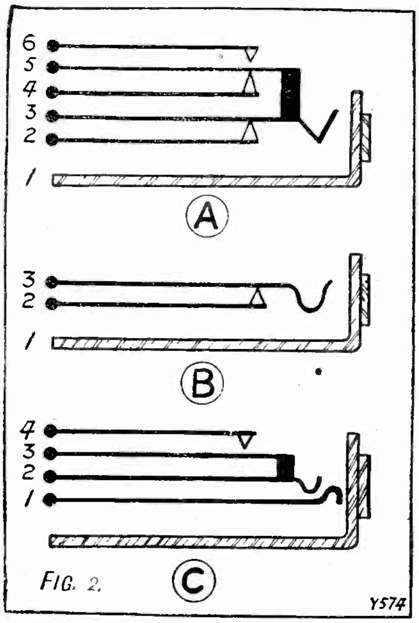


FIG. 2.

admirably to use in conjunction with a gramophone pick-up.

Taking a perfectly straightforward circuit arrangement such as that shown in Fig. 1, which, it will be seen, consists of a neutralised H.F. stage, detector and two resistance-coupled L.F. stages, supposing it is desired to use the pick-up across the grid and filament of the second valve. How can this be done with a jack?

Filament-Grid Switching

First, it is desirable to break the grid lead at the point marked B, and, second, it is necessary to make provision for the H.F. filament to be broken. Both of these functions can be done by the use of a five-spring automatic jack, a side view of which is shown in Fig. 2A, and the following connections are necessary.

The sheath of the jack (contact 1) should be joined direct to the L.T.—, or, if it is desired to bias the valve, to G.B.—. The grid circuit of the detector valve should be broken at the point marked B, and contact 3 requires to be joined to the grid of the valve, whereas the other lead caused by the break (that going to the condenser and leak) is joined to contact 2.

Next comes the filament switching, and the two leads caused by breaking the circuit at A should be taken to contacts 4 and 5.

It will not be difficult to see exactly what happens with this arrangement. The insertion of the plug, to which, of course, the pick-up is connected, will place this latter across the desired points and will also break the circuit at points A and B.

An Alternative Position

Provision can also be made for using the pick-up across the first L.F. stage thereby cutting both the H.F. and detector valves out of circuit.

For this purpose, a similar jack—namely, the five-spring automatic—can be employed. In the case of the L.F. valve, the grid circuit can be broken at either points D or G, and preferably the latter, since the grid-bias arrangements for this valve are not then altered by the insertion of the plug. As the grid is already biased, the sheath of the jack (contact 1) in this case should be connected direct to L.T—.

Contacts 2 and 3 will be joined to one side of the H.F. choke (and anode resistance) and grid condenser respectively. With regard to the filament switching, there are in this case two valves to be extinguished, and filament circuits should be broken at the points marked A and H.

The side of the break at A which goes to the rheostat requires to be connected to the same side of the break at H, and also to contact 4. Contact 5 can then be joined direct to L.T.+.

The Output Circuit

The insertion of a plug into a jack of the single open filament type joined in the anode circuit of the last valve can perform the dual function of joining up the loud speaker and switching on the L.T.

Referring to C in Fig. 2, which shows the type of jack required for this purpose, contacts 1 and 2 should be joined to the plate of the last valve and H.T.+ respectively, while the two leads caused by breaking the filament circuit at F are joined to contacts 3 and 4.

A pair of 'phones can, if desired, be placed in the anode circuit of the third valve by means of a plug and a single closed jack such as is shown at B in Fig. 2. In this case 1 and 2 are joined together and to the anode resistance, while 3 goes to H.T.+.

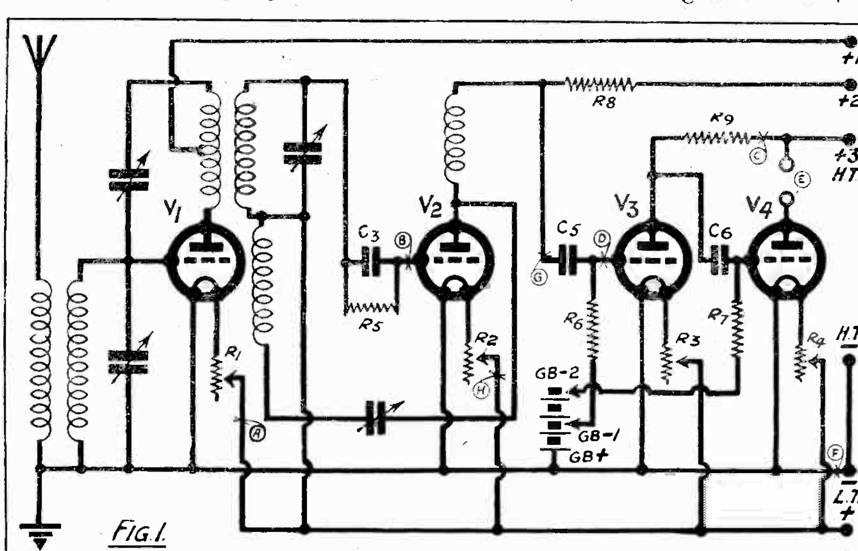


FIG. 1.

RECENT RECORD RELEASES

Orchestral and Band

Brunswick. **Dolly's Dancing** and **Estudiantina.** The Paul Godwin Orchestra. (12 in. 4s. 6d. 60004.)

An excellent record, full of good quality and tone that are expressed very well by pick-up reproduction.

Londonderry Air and **Drink to Me Only With Thine Eyes.** Solloway and his Orchestra. (10 in. 3s. 159.)

Once more we have that Irish favourite played with a depth of feeling and clarity that make this record one that should be bought by all music lovers. The reverse side is also well played, but is not, in our opinion, as good as the "Londonderry Air."

Broadcast. **Martial Moments** (Pts. 1 and 2). The Band of H.M. Life Guards. (1s. 3d. 244.)

A lively record that should be very popular among military band enthusiasts.

Pathé Actuelle. **Carmen** (Entracte Act 4) and **Peer Gynt** (Morning). The Pathé Symphony Orchestra. (12 in. 15255.)

Well played and very enjoyable except for a peculiar harshness that we have noticed on several of the "Actuelle" recordings. This harshness is not present on the Pathé Perfect records, and seems peculiar to the former types.

Instrumental

Brunswick. **Baltimore** and **Brandy and Soda.** Piano Solos by Fred Elizalde. (10 in. 3s. 161.)

Two excellent pieces of recording played by that master of syncopated pianoforte work. His harmonies are works of art.

Broadcast. **Sometimes I'm Happy** and **Possibly.** Piano Duet. (1s. 3d. 232.)

Two lively pieces of syncopated piano-playing.

Minuet (Organ Solo from "Berenice"—Handel) and **Chimes and Hymn Tunes** (Bells of St. Martin's). (1s. 3d. 225.)

A novelty record the first side of which is an organ solo on the St. Martin's in the Field Organ.

Listening and **The Islander** (Bell Solos by Billie Whitlock). (1s. 3d. 246.)

Another very interesting novelty record.

Parlophone. **Dainty Miss** and **Polly** (Piano Solos). Raie da Costa. (10 in. 3s. R3534.)

An exhilarating jazz piano record that is a marvel of mastery and technique. All radio-gramophone and gramophone enthusiasts should hear this record.

Roses of Picardy and **Girl of My Dreams** (Organ Solos). Sigmund Krumgold. (10 in. 3s. R3538.)

Two excellent pieces of cinema organ recording, the latter piece having a vocal interlude which provides a pleasing novelty.

Zonophone. **Janette** and **Can't You Hear Me Say I Love You?** (Organ Solos). Charles W. Saxby, F.R.C.O. (10 in. 2s. 6d. 5094.)

A superb piece of recording that deserves better subjects. The former piece is rather monotonous, though the latter is worth hearing. There is nothing the matter with the recording or playing, and the effects are good.

Vocal

Broadcast. **Macushla** and **Because** (Tenor Solos). By Victor Karne. (1s. 3d. 243.)

Two exceedingly well sung and recorded examples of two famous and popular songs. We should like more from the same vocalist.

Angels Ever Bright and Fair and **Come, Holy Ghost, our Souls Inspire.** Sung by Kenneth Purves (Boy Soloist). (1s. 3d. 224.)

Very well sung and well recorded.

Old Barty and **Learnin'** (Bass Solos). By Harry Dearth. (1s. 3d. 234.)

Two more popular items sung by one of the most popular of British bassos. Every word is clear-cut, and the good diction is a feature many others would do well to copy.

Pathé Actuelle. **Did You Mean It?** and **Is She my Girl Friend?** By Jay C. Flippen. (10 in. 11541.)

Two further items from an American jazz vocalist. We are not struck with these from an entertainment point of view. The latter is undoubtedly the better of the two. "Did You Mean It?" being horribly rendered and, in our opinion, utterly spoiled by the way it is "sung."

Who-oo, You-oo, That's Who and **Are You Happy?** Annette Hanshaw. (10 in. 11540.)

Another light musical record by a well-known artiste.

Pathé Popular. **I Heard You Sing** (Solloway) and **The Hours I Spent With You** (Baritone Solos). By Gilbert Austin. (10 in. 1s. 6d. P367.)

Two average songs that are neither striking nor particularly attractive.

Henry's Made a Lady Out of Lizzie and **I Scream, You Scream.** By Jack Kaufman. (10 in. 1s. 6d. P366.)

Two excellent comedy songs. The former has a peculiarly topical appeal and should be heard by all.

Zonophone. **Vocal Gems from "Patience"** (Pts. 1 and 2). The Zonophone Light Opera Co. (12 in. 4s. A336.)

A perfect record, wonderfully sung and doing full justice to that peculiarly beautiful music associated with all Gilbert and Sullivan operas. An excellent record for pick-up purposes.

Abide With Me and **The Lost Chord** (Contralto Solos). Esther Coleman. (12 in. 4s. A337.)

Well sung and well recorded. Perhaps Miss Coleman is a little harsh on some of the higher notes, but the whole forms a delightful record.

Constantinople and **She's Gone Crazy** (Comedy Songs). Clarkson Rose. (10 in. 2s. 6d. 5091.)

Excellent recordings and amusing items. The former is going to be extremely popular. Clarkson Rose is a little harsh, and could be further from the microphone with advantage.

(Continued on page 678.)

Lamp "Aerials"

An interesting system for testing out a broadcasting station, so as to make sure everything is in proper working order before starting a session, is in use at W E A F and W J Z. About half an hour before the broadcasting period the transmitters are placed on test on a dummy aerial consisting of large banks of electric lamps lighted by the radio-frequency energy and providing the equivalent of the actual radiation system. Frequency measurements are then made throughout the entire transmitter, ensuring that the apparatus is functioning correctly.

When a broadcast programme is ready to "go on the air," a signal is received at the transmitter from the studio. Immediately the carrier-wave is fed into the aerial and this effect is in turn signalled back to the studio. In the case of W E A F this signal is automatic, since the carrier-wave energises a coil which operates a relay in the control room, illuminating a green light on the announcer's control box in the studio.

"Grid-Glow"

It is no longer necessary to press a button to start a 170,000 horse power electric plant. Radio does this by a wave of the hand! This was demonstrated recently when the Chairman of the United States Steel Corporation set in motion the power station at Homestead (Penn.) by a motion of his hand over a "grid-glow" relay tube in New York. The hand-capacity effect set off a telegraphic relay which transmitted an impulse to a short-wave set in Newark. Its wave, 42·95 metres, actuated a receiver at Pittsburg, the relay of which in turn closed a switch at the power station and started a 6,000-kilowatt generator.

A New System

A very elaborate broadcast system is planned by the Italian Government, and it is proposed, presumably in order to avoid any possible difficulties with the listening licences, to place a small radio tax on all householders, whether they have radio sets at present or not.

A Radio Delusion

Another familiar radio delusion has been exploded. For years it has been imagined that the coating of oxide and other corrosion products which forms on wires of copper or brass when they are exposed to the air has a considerable effect in increasing the resistance of such tarnished wire to high-frequency electric currents. According to the theory of the "skin effect," it has been assumed that the electric current would tend to the outside layers of the metal in such wires.

All this is a plausible theory. The only detail the matter with it is that it turns out to be untrue, as has been proved by the best test in the world—someone has tried it!

Not Measurable

W. M. Roberds, of the University of Kansas, has found that at 10,000 kilocycles (30 metres), at 8,600 kilocycles, and at 15,000 kilocycles there was not sufficient variation in the resistance between a bright copper wire and the same wire after it had acquired a heavy coating of oxide to be recorded with certainty. "If the acquisition of oxide by copper wire causes any change in high-frequency resistance," says W. M. Roberds, "it is very small." The foregoing is taken from "Popular Radio," U.S.A., and a full account will be found in the "Physical Review" (Minneapolis), volume 29, pages 165 to 173, under the heading of "The Resistance of Copper Wires at Very High Frequencies."

Short-Wave High-Power

A French military radio engineer, Mons. Descarsins, has developed a circuit into which he can put as much as 20 kilowatts at a wave-length of 45 metres. His transmissions have been heard throughout various parts of Europe and the East, as well as in South America. Mons. Descarsins uses valves of the Holweck demountable type, which he has found greatly facilitate his work owing to the fact that they can be readily taken apart, repaired and reassembled.

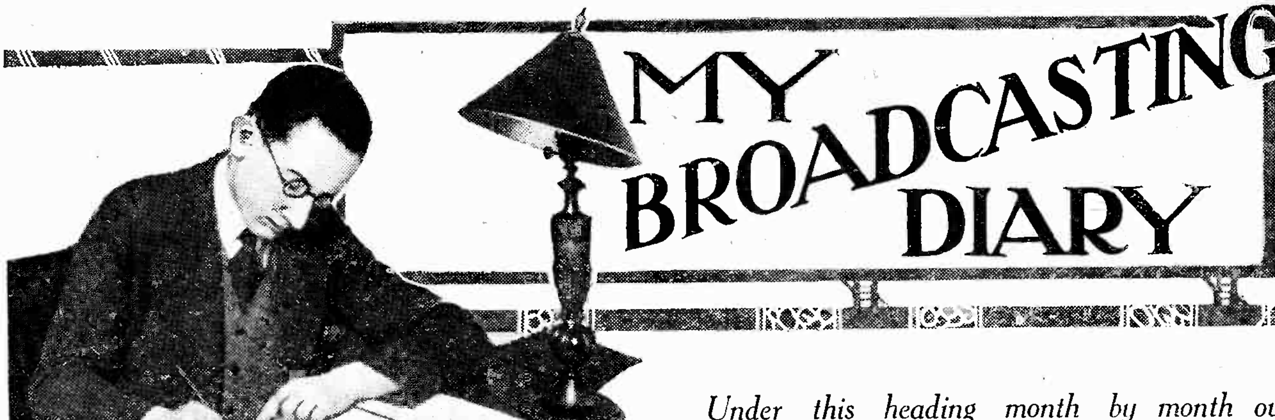
W E A F

Station W E A F, at Bellmore, Long Island, which is now on the air, is of the finest of modern broadcast apparatus and cost over £150,000. The

(*Continued on page* 679.)

YOUNG BRAVE BRAVES RADIO

Speaking at Buffalo, N.Y., in the Seneca tongue, throwing in a war-whoop or two for effect, this Indian brave delivered the first-recorded radio lecture to the red man.



MY BROADCASTING DIARY

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

An O.B. From Bethlehem?

A PROMINENT American weekly journal is promoting a proposal to do a special Christmas "Outside Broadcast" from the actual Manger in Bethlehem. The spokesmen of this message are to be Dr. Cadman and Mr. J. B. Kennedy, two well-known American preachers. The National Broadcasting Company of the United States has agreed to participate.

The plan is to carry the signals over landline to Cairo, relay thence by Marconi beam to England, radiate through the B.B.C. system, and relay again across the Atlantic by Marconi beam. This seemed all very nice until the B.B.C. was invited to accept its part in the enterprise. Then a snag was encountered.

The B.B.C. will have nothing to do with it, and its attitude is undoubtedly right. British listeners do not want their broadcasting system turned to such stunts. To "exploit" the Manger at Bethlehem for the circulation of a weekly journal is against the British idea of good taste. It is not known whether the scheme will be undertaken independently of the B.B.C. Savoy Hill will say nothing at all about it; but the American Press are making up for this reticence!

The Communists and Political Broadcasting

British Communists applied to the B.B.C. for the same facilities as Conservatives, Labour, and Liberals under the "controversial broadcast" scheme. They were told that they could not expect to rank with the main parties owing to their numerical inferiority. It was added, however, that their views might not be excluded from discussions or symposiums. This seems to be an admirable solution of an admittedly difficult situation.

Quite apart from considerations of political doctrine, there are not enough members of the Communist Party to entitle them to the same broadcast opportunities as are given to Conservatives, Liberals, and Labour. Nevertheless, now and then they will be given a chance to put their views.

Summer Broadcasting

There is some contraction of broadcasting hours this summer. For instance, the afternoon programmes of 2 L O, 5 X X, and 5 G B will not start until 4 o'clock except on Thursday, when the time will be at 3, in order to include the service from the Abbey. Saturday and Sunday afternoon programmes will remain as at present, that is, they will start up at 3.30.

As for changes in programme material, apparently the big symphony concerts have been "washed-out" for the summer. There is to be dance music regularly from 5 G B on Tuesdays, Thursdays, and Saturdays at 10.15 p.m. Curiously enough, there are no changes in the evening talks arrangements.

This, I believe, is the first year in which the B.B.C. has been bold enough to attempt to carry its full talks programme straight through the summer. Most people would doubt the advisability of such a plan, but Savoy Hill is more convinced than ever of the growing popularity of the talks, irrespective of weather conditions.

The Carnegie Trust Affair

The B.B.C. sailed close to the wind in its arrangements with the Carnegie Trust for the subsidising of the performance of some of the prize new works being pushed by that body. Savoy Hill has been to some pains to explain that the sole object of the effort is to encourage British composers who might not otherwise get a chance of recognition.

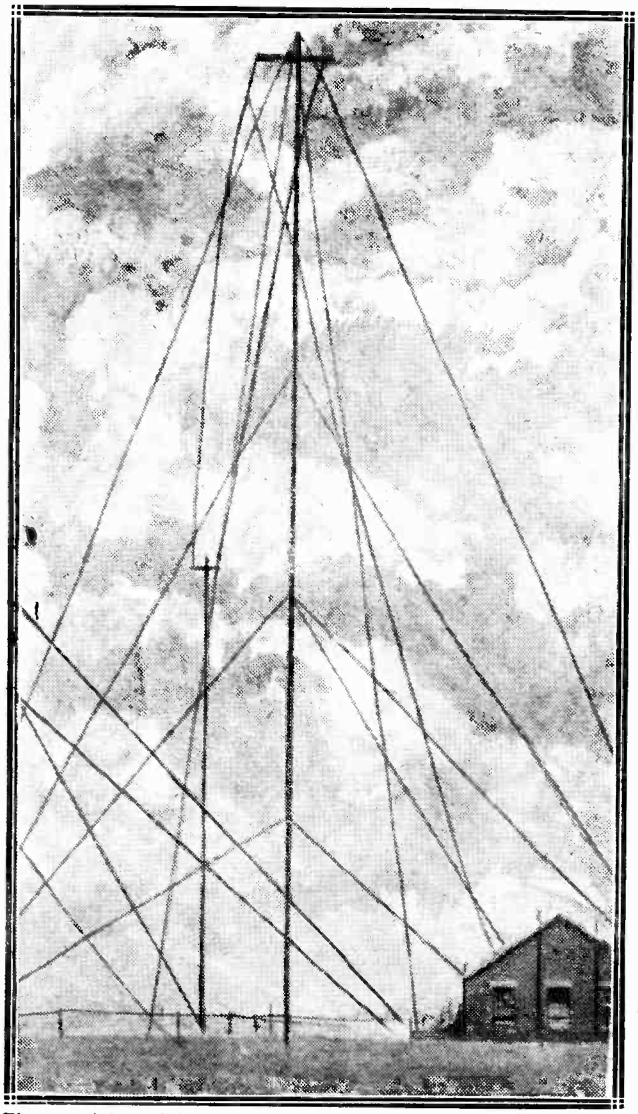
It is added that the performance of these new works requires a great deal more rehearsal than is possible or that can be afforded for the normal broadcast programme.

THE FIRST OF THE REGIONALS

This photograph of the 2-kw. mobile transmitter was taken a few miles north of London, where the B.B.C. is busy choosing a site and carrying out tests in connection with the new London station—the first of the twin-wave broadcasters.

It has been represented in quarters unfriendly to broadcasting that this arrangement is virtually a breach of the condition of the licence which debars the B.B.C. from the right to take money for broadcasting. Then there is the further suggestion that such an arrangement involves the inclusion in programmes of items which would not be selected by the programme builders in the ordinary way.

This means that the B.B.C. is lending itself to the propagation of the uplift ideas of the Carnegie United Kingdom Trust. The objections are mostly far-fetched but there is a trace of rationality in them. Uplift is always a temptation for Savoy Hill!



The special aerials erected at Daventry by the B.B.C. for Daventry Junior "—5 G B.

Discontent at the B.B.C.

The coincidence of two separate but similar "public indiscretions" by B.B.C. station directors calls attention to an alleged change in the working conditions of that organisation. The suggestion is that the only effort made by the new Board of Governors has been to cut down salaries and stop increases. It is impossible to confirm or disprove the allegation; but a strong impression persists that the Governors are much meaner to their staff than were the Company Directors.

One station director is quoted as saying that it took the Governors three months to decide to knock £5 a year off his already meagre reward. It is to be hoped that the Chairman of the B.B.C. will take an early public opportunity to reassure listeners that there is no solid foundation for these disquieting rumours. No one grudges the Governors their generous allowances from licence revenue; but they are expected to be at least as generous to those who actually do the work.

The Regional Scheme

Now that "single wave-length" working has been accepted by the B.B.C. engineers as a practicable and efficient device, the prospects of the Regional Scheme are distinctly brighter. True, the Post Office have not yet given permission to the B.B.C. to go ahead with the four stations apart from London, but I understand that the conditions of the permission for the new high-power London station contain a clue to a formula which may make possible the simultaneous construction of the other stations.

The Post Office have made it clear in connection with their sanction of the London station that it is to be worked at first as a one-wave station, and that the introduction of the second-wave service is to be gradual and experimental. A similar formula might be applied in the case of the other stations of the scheme. If this is so, and there is some reason for believing that it is, then the Pennines, the West Country, and Scotland may have their own high-power transmitters fairly soon after the London one is complete, perhaps all of them about the end of next year.

The Danger of the Dead Level

I have been disturbed lately by the unanimity of the opinion of several discerning listeners who complain that the B.B.C. is suffering from a dead level of mechanical efficiency. This is appropriate in the engineering end of the business; but it leads to bad results in the programme end.

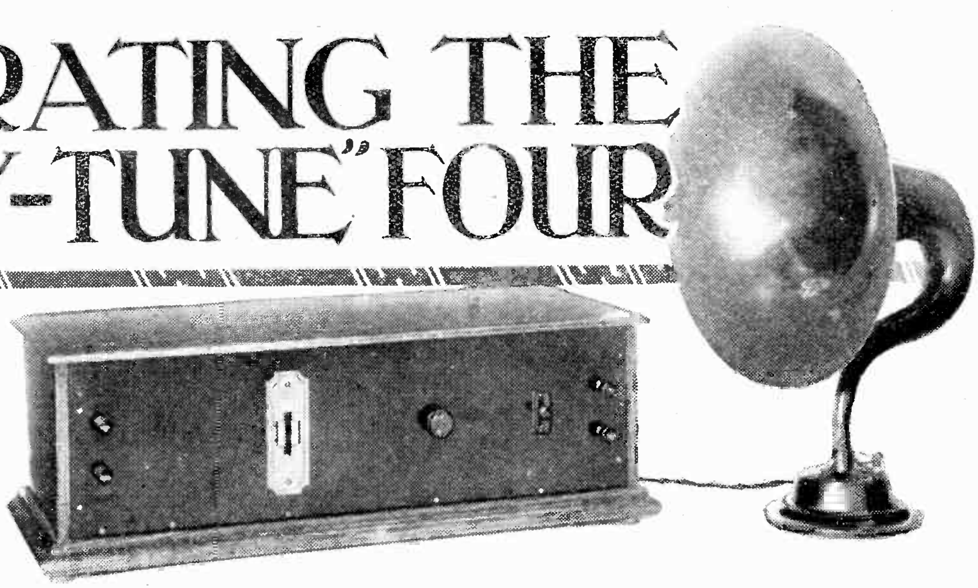
There is no longer an occasional "stunt," such as formerly distinguished programmes and stimulated licence revenue. One suggestion is that the programme staff is stale. Colour is lent to this view by the fact that the B.B.C. complains it has tried all possible stunts and peaks, and that there are none left now.

This, of course, is nonsense. The alert, imaginative programme builder is never at a loss for novelty or originality. Is it that there should be drastic changes in personnel? Last year one of the B.B.C. Governors declared at a semi-public dinner that the new board had agreed on periodical changes in the executive and artistic staff, and that they thought two years was quite long enough for the ordinary broadcasting official to exhaust his usefulness.

This policy would be distressing to a good many officials; but it might be modified by some switching about. For instance, it is well known that Captain Eckersley would be quite willing to take over the programmes from his brother. Captain Eckersley is as strong an adherent and practiser of "peaks" as his brother is of the average standard of efficiency. Incidentally, Mr. R. H. Eckersley is an engineer of recognised competence. Why not change them about?

A change of position would be refreshing to the official and possibly provide him with stimulating food for thought. And it would add to the strength of the staff as an entity if it were elastically constituted.

OPERATING THE "EASY-TUNE" FOUR



In this article are given details of the coils for both long and short waves, together with further data concerning this remarkable receiver.

By
C. P. ALLINSON, A.M.I.R.E.

In the last issue of MODERN WIRELESS I described the construction of a four-valve receiver which I called the "Easy-Tune" Four, on account of its extraordinary ease of handling.

I propose here to deal with the question of the construction of the coils for both the long and short waves, and also give some information as to the correct adjustment of the receiver in order to obtain the maximum efficiency on all wave-lengths.

With regard to the coils, we will take the short broadcast waves first. The aerial coupler, which consists of two coils, L_1 and L_2, is wound on a featherweight former, the primary being wound on an interchangeable former which fits within the secondary so that the degree of coupling can be adjusted according to the aerial and earth system in use, and also to vary the selectivity in cases where this is an important point.

The Grid Coil

The grid winding L_2 consists of 55 turns of 28 D.S.C. copper wire, spaced one diameter, a tap being taken at 14 turns from the bottom end. Where the constructor has no means for space winding I suggest that he uses 22 D.C.C. wire and winds the turns side by side. This will give a coil differing very little in its characteristics from the one recommended.

The sketch in Fig. 1 shows the method of connecting the coil. If we commence at the bottom of the former the beginning of the winding is connected to pin No. 2. We wind on 14 turns and then take a tap which is connected to pin No. 3. The remainder of the winding is then put on the former and the end of the winding taken to pin No. 1.

The primary winding, which is wound on an interchangeable former, is connected so that if the winding begins at that end of the former which is nearest to the pins—that is, the bottom of the former—the beginning of the winding is connected to pin No. 4 and the end of the winding—that is, the top—to pin No. 5.

Increasing Selectivity

Where the question of selectivity is not an important one I would suggest two formers in order to obtain the maximum efficiency, namely, 10 turns for the lower half of the broadcast

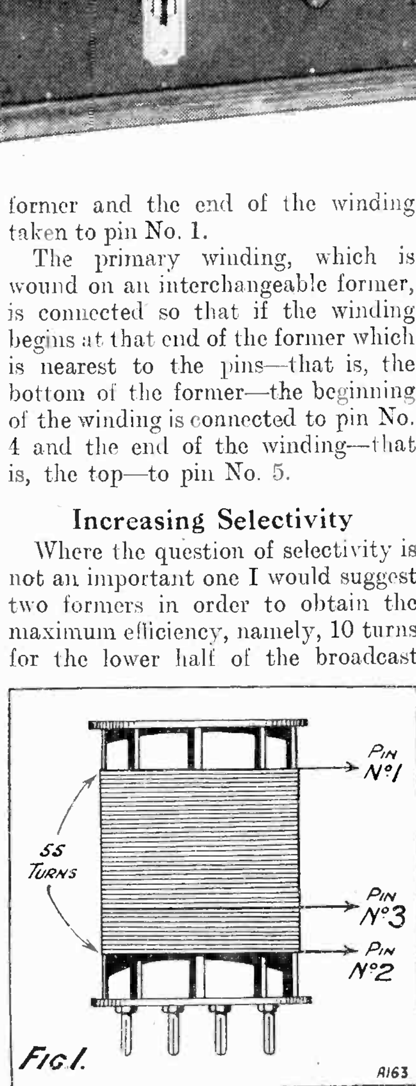


FIG. 1.

wave-band and 20 turns for the upper half. In cases, however, where a very great degree of selectivity is required, the primary winding can be reduced to about 5 turns, though this will, of course, result in a drop in signal strength on distant stations.

The windings L_3 and L_4 are wound on another featherweight former. The primary winding will, of course, depend to a certain extent on the H.F. valve that is to be used. In view of the fact, however, that I have definitely recommended the use of an ordinary H.F. valve having an impedance in the neighbourhood of 20,000 to 30,000 ohms, the correct number of turns will be 15 for the short broadcast wave-band.

Here, again, where greater selectivity is desired, the number of turns may be cut down. If 8 turns are used, it will be found that a greatly increased degree of selectivity is obtained with only a very slight loss in signal strength.

The winding L_4 consists of one-half only of the whole inductance which is in the grid circuit of the detector valve and 35 turns should be wound on in this position. The beginning of the winding, as before, is taken to pin No. 2 and the end to pin No. 1. The same gauge of wire and spacing are employed as in the aerial coupler.

The Reaction Winding

We now come to the question of the coils L_5 and L_6, that is, the other half of the grid coil and reaction winding respectively.

These are wound on a 3-in. paxolin former on a 4-pin base, as shown in Fig. 2. On examining this mount it will be found that the distance between two pins, as shown at A in the figure, is greater than that between the other pins, namely, B and C.

The winding L_5 is connected between pins No. 1 and 2 and consists of 35 turns of 22 D.S.C. wound side by side, or else the same number of turns of 28 gauge D.S.C. spaced one diameter. The beginning of the winding is connected to pin No. 1, and the end of the winding to pin No. 2. A space of ¼ in. is then left, and the reaction winding put on, the beginning going to pin No. 3, and the end, if a fixed winding is used, going to pin No. 4.

I have found it, however, a slight advantage to take a number of tappings on this winding and connect

"A curious point with this circuit is that the H.T. voltage on the detector valve has practically no influence on the reaction control."

a spring clip at the end of a piece of flex to pin No. 4, so that the correct size of the reaction coil may be found to suit all requirements. The largest number of turns required will be 35 turns and tappings may be taken at 20 and 25 and 30 turns from the beginning.

We will now turn to the question of the coils for the long-wave band. The aerial coupler for the long waves can be obtained from Messrs. Collinson Precision Screw Co., but should you wish to construct it yourself you will need a slotted former in order to accommodate the number of turns required. Fig. 3 shows the necessary dimensions and gives the number of turns of wire required in each slot.

Long-Wave Aerial-Coupler

With regard to the long-wave aerial coupler, it should be noted that the beginning of the winding, that is, that at the bottom of the former, is connected to pin No. 4, and the end of the winding to pin No. 5, the beginning of the secondary winding L_2 is connected to pin No. 1, three-quarters of the winding being put in position, and a tap taken to pin No. 3, and the end of the winding taken to pin No. 2.

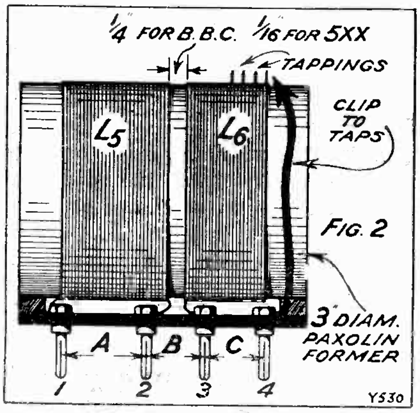


FIG. 2

For the two windings L_3 and L_4 a featherweight former is again used. The primary winding should consist of 25 turns on an interchangeable former, that is, the former should be wound full, while the secondary winding consists of 125 turns of gauge 32 D.S.C. wound on side by side, the beginning being connected to pin No. 2 and the end to pin No. 1.

It may be thought that the primary is decidedly on the small side, but if you desire to obtain absolute stability under all circumstances on the long-wave side, complete freedom from parasitics or other forms of oscillations, and absolute interchangeability between long and short-wave coils without having to re-set the neutralising condenser, then the number of turns given above is correct.

Interchangeable Primary

Greater amplification may be obtained by increasing the number of primary turns to 37, but it will then be found that it is necessary to readjust the neutralising condenser when changing over from the short to the long waves, while if the primary is increased still further instability may result which can be uncontrollable in some cases.

The circuit used in the "Easy-Tune" Four is somewhat more liable to give instability on the long waves, owing to the division of the detector coil into two portions, than a straightforward circuit, and this has therefore enabled me more easily to determine the cause of instability on the long waves when using any form of split-secondary circuit.

A further advantage is obtained by the use of an interchangeable primary winding for the long-wave coupling, in that it enables selectivity again to be controlled, especially in cases where severe interference from Daventry is experienced on Radio Paris.

Obtaining Maximum Efficiency

The coils L_5 and L_6 consist of 125 turns for L_5 of 32 D.S.C., L_6 consisting of 35 turns of the same gauge wire, spaced $\frac{1}{16}$ in. away from the grid portion of the coil.

It is necessary for the reaction winding to be quite small for the long waves, and this is no doubt due to the increased efficiency of the detector valve as an H.F. amplifier on the longer waves, so that a larger H.F. component is present in the plate circuit. A smaller reaction winding is therefore required.

We now come to the question of obtaining the maximum efficiency from the receiver. One point that should be emphasised without further delay is that the greatest signal strength is obtained from the detector portion of the circuit when the variable resistance across one half of the grid coil is as high a value as possible consistent with a satisfactory degree of reaction being present.

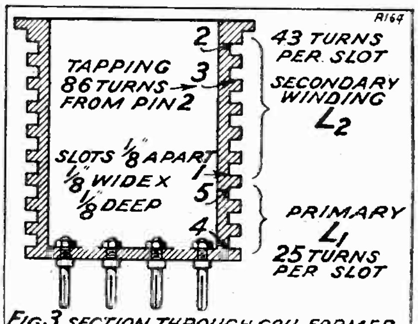


FIG. 3. SECTION THROUGH COIL FORMER.

The first thing to do is to see that the H.F. valve is correctly stabilised, and the procedure for carrying this out has been described last month. In view of the fact, however, that the particular circuit I have employed is one that gives a slight amount of under-neutralisation at the higher wave-lengths, it will sometimes be found an advantage slightly to increase the value of the neutralising condenser above that required to give neutralisation at, say, 250 metres. This will give a somewhat more constant-reaction demand with the circuit used in this receiver.

Tuning Adjustments

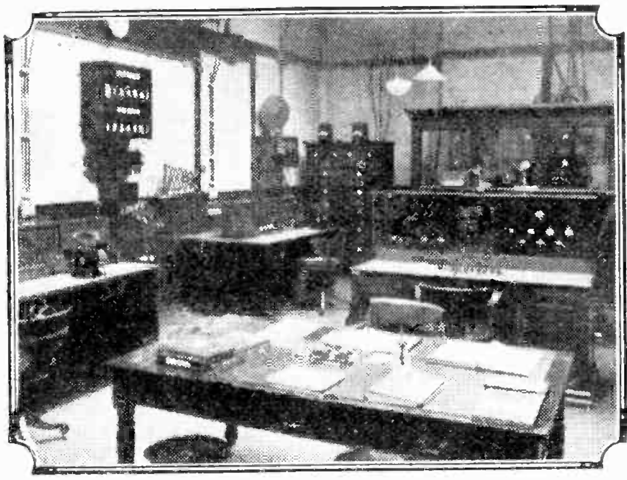
Having correctly adjusted the neutralising condenser, increase the value of the resistance R until the detector just oscillates when the two tuned circuits are brought into step.

This, incidentally, provides a simple test of determining whether the two circuits come into tune at the same reading on the dial, and, should they not do so, then it is a simple matter to adjust one of the windings until they come into tune at exactly the same reading. It should be noted that whichever dial reading gives the lowest reading belongs to the condenser tuning the inductance which has too many turns on it.

"Over 45 stations on the lower broadcast band have been received at loud-speaker strength on the Easy-Tune Four."

Should it be found that the resistance has to be decreased to a fairly low value before the detector stops oscillating, then the number of turns on the reaction winding L_6 should be reduced. This test should, of course, be carried out on one of the longer

(Continued on page 673.)



HOW YOUR BROADCAST is PROVIDED

Great Britain was the first country to place broadcasting in the hands of a single authority. How our radio programme services have developed is told below.

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

OWING to the fact that broadcasting was an entirely new art not more than five or six years ago, the engineer called upon to design and lay out a series of broadcast stations so as to give the best possible service throughout the country was evidently faced with a formidable task, and one in which there was little or no previous experience to guide him.

Birth of Broadcasting

This was the difficult and onerous position in which Captain P. P. Eckersley found himself upon the inauguration of the B.B.C., and in a paper recently contributed to the Institution of Electrical Engineers he describes in considerable detail how he went to work to solve the many problems of broadcasting and how, during the succeeding years, experience has shown the way to various important improvements. Captain Eckersley's paper is a compendium of information relating to general broadcast engineering and should serve as a valuable guide in other countries where a broadcast system is being introduced or may be introduced in the future.

The British Broadcasting Company started with a contract with the Postmaster-General for the erection of eight stations of 1-kilowatt power.

Relays Required

It soon became clear, however, that the stations of this power, situated as they were in the hearts of large cities, did little more than serve adequately areas between a radius of 20 to 30 miles around them. Outside such areas the weakness of the signal strength (compared with extraneous disturbances) made listening more of a technical hobby than an artistic pleasure.

The eight main stations brought approximately 50 per cent of the population of the British Isles within areas where the programme was not interfered with by extraneous disturbances. In order to increase the effectiveness and scope of the service, it was evident that more stations had to be erected or else the power of the existing ones had to be increased.

Valuable Additions

After careful consideration it was decided to erect 11 stations, having a power of 100 watts (this has since been increased to 200 watts), in many towns and cities not included within the service area of a main station.

The erection of this series of "relay" stations has many times been criticised, but it should be pointed out that the stations were of very great value in building up the service, and it has been shown that an annual revenue varying from £5 to £10 was received to the expenditure of every £1 of capital outlay upon the relay stations.

The relay stations involved only small capital risk, whereas a high-power scheme, had it failed, would have ruined the Company. High-power stations are wasteful, giving too great a signal strength nearby and too weak a signal at a distance. Add to this the fact that the relay stations created great local enthusiasm, and it will be possible to appreciate their great value to a growing service.

Use of Landlines

The programmes for relay stations have mostly been provided from London *via* landlines, since it has been found unwise to dilute

A corner of the control room at the Leeds-Bradford relay station. The future of such stations is still undecided, and is dependent upon the success or otherwise of the Regional Scheme.

programme revenue beyond a certain point. The addition of "relay" to "main" stations brought 70 per cent of the population within reach of uninterrupted service. It is, however, uneconomical to fill the whole area of the country with relay stations, as they are only effective in densely populated parts, and there is a limit, which was apparent even in the early days, to the number of available "channels." It may be said that the main and relay stations were effective in bringing the British *urban* population within reach of a proper service, and it remained to fill in the gaps and serve those lonelier country districts where broadcast has perhaps an even more real function to perform than in the towns.

First High-Power Station

This was the reason why the B.B.C. sought, and received, Government permission to erect, first experimentally at Chelmsford and afterwards permanently at Daventry, a relatively high-power station using a much longer wave-length than had been formerly employed for broadcasting. The Daventry equipment comprised at the time of its installation the world's first high-power long-wave broadcast station, and it has since fully justified its existence. With the advent of the Daventry station the total percentage of the population living within the service area of a station was brought up to 85 per cent.

The use of so-called "long waves" for broadcasting has also been criticised, but it is economical in certain important respects and, thanks to the less rapid attenuation with long waves, the service area for a given power is greater. The "fading characteristics" are better, and service without fading up to 300 miles is common, in addition to which interference by spark transmitting apparatus and from other causes is much less.

It is estimated that 50 per cent of listeners rely upon the long-wave Daventry station and that no other station is listened to in 90 per cent of the rural areas of the country.

"Service Area"

Recently what is known as the "Regional Scheme" has been started, experimentally at first, by introducing a second high-power medium-wave station at Daventry, giving programmes contrasted with those of the older long-wave station.

It is rather interesting to notice that the term "service area" has been defined in a special way by the engineers of the B.B.C., and the definitions have been accepted by the Technical Committee of the Union Internationale de Radiophonie. The "service area" is defined in four categories as follows:

Four Divisions

1. The "Wipe-out" area, in which a service from the local station can be absolutely guaranteed whatever the sources of extraneous interference; a listener within such area will, however, require a receiver of very special design if he is to hear relatively distant or weak stations.

2. The "A" service area. A listener within such area can be guaranteed service, even if he lives near to the usual sources of electrical interference, such as trains, electro-medical apparatus, electric signs and so on, and he will have a good chance of distant listening with properly designed receiving apparatus.

3. The "B" service area in which a listener can be guaranteed crystal reception with a good outdoor aerial, but in which he will be at the mercy of severe types of interference which occur in perhaps 5 per cent of cases normally met with.

100-Mile Radius

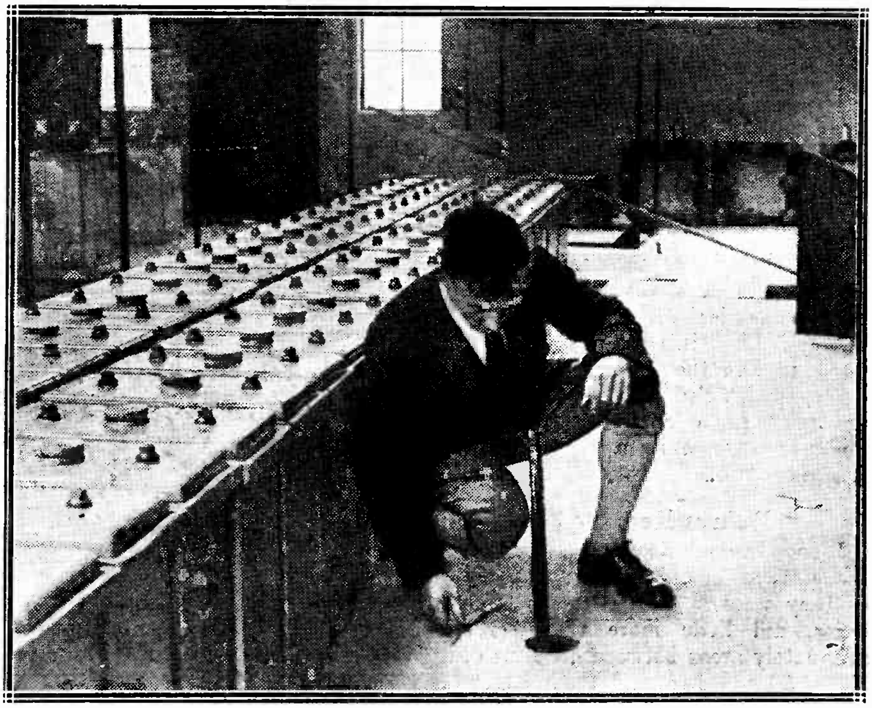
4. The "C" service area, which will be subject to interference from spark sets, electric trains, atmospherics and so on, but which in time should be assured of an 80 per cent service, because it is hoped that in due course some of the interference mentioned in the above categories will be eliminated at the source.

As fading may set in outside a radius of 80 to 100 miles the obvious ideal is to make the "B" service area have a radius of 100 miles.

Various factors, such as wave-length, type of ground covered, transmitting aerial and mast design, and so on, have their influence upon the question of "service areas" so that it is always difficult to give an exact prediction as to what type of service may be expected at any particular point. As an average of observations taken from the London and Daventry medium-wave stations, however, using frequencies between 800 and 600 kilocycles, it is possible to give some rough idea as to the extent of A, B, and C service areas for different powers.

Question of Wave-Length

The question of available wave-lengths is also an important one for the broadcast engineer. In some recent tests undertaken by night in winter-time, it was found that two 1-kilowatt stations, 500 miles apart, their carrier-waves separated by 1,000 cycles, produced an audible beat *outside* a radius of 2 miles from either station. Other tests showed that stations separated by about 100 cycles in fundamental frequency, and separated geographically by 1,500



One of the numerous earth leads which run under the building at Daventry. 5 X X is probably the most popular of all our stations, and has earned a world-wide reputation for excellence of transmission and reliable service.

miles, produced audible beats at 10 miles from either station.

Added to these specific tests there is the accumulated evidence of private listeners who have from time to time complained of interference inside the "B" service area, due to the heterodyne produced between the station to which they are listening and some other station. These effects are chiefly noticeable at night and, of course, programmes are listened to by a maximum number of persons at night.

The Heterodyne Problem

In order to obtain a solution of the problem of the heterodyne interference we cannot seriously rely upon any principle other than adequate separation of fundamental frequencies between stations which are within 3,000 miles of one another. Various suggestions have been made from time to time to overcome this type of interference, but taking into consideration the rapid growth of small-power stations in many parts of the Continent, the desire of many countries to have a service at small capital cost, the expense involved in extremely high-power stations and the growing need for alternative programmes, it is obvious that even a 10-kilocycle separation of fundamental frequencies is really insufficient, whilst anything less than that degree of suppression is in practice impossible.

The separation of 10 kilocycles makes room for 101 stations within a frequency span of 1,500 and 500 kilocycles.

Realising so long ago as 1924 that if stations were to go on being erected at a rapid rate, if the frequency span allocated were not further extended, or if some international agreement were not arrived at, broadcast development would suffer a severe check, the B.B.C. offered invitations to representatives of other countries to meet in London for a discussion of this important question. This resulted in the formation of the Union Internationale de Radiophonie, with headquarters in Geneva. The organisation is framed to allow discussions between different nations on all matters relative to broadcasting in its international aspect.

The wave-length problem which confronted the Technical Committee of the Union was easy to state, although very difficult to solve: There was room for roughly 100 stations; there existed more than 150 stations; more stations were being built; what, then, was to be done about interference?

The Geneva Plan

On the suggestion of Captain Eckersley (who is a member of the Technical Committee) a compromise was arranged. Of the 100 available wave-lengths, 84 were to be allotted, according to an agreed formula, for the exclusive use of the more important European stations, while the remaining 16 were to be shared by the surplus stations. The "Plan de Geneve," as it is called, was based upon these principles and was put into practice on November 14th, 1926. Under this plan, Britain has nine exclusive wave-lengths. Counting Daventry long-wave station there are ten channels in all available for British broadcast.

Now we come to a question which is of very particular interest to the broadcast listener, namely, the question of alternative programmes. It is true to say that the provision of alternative programmes more than doubles the value of a broadcast service. An alternative programme has two advantages: First, it tends to satisfy a larger number of persons because there will always be an alternative choice, and, secondly, each programme is able to achieve artistic unity and need not consider compromise.

> ". . . Many receiving sets are in use which, to all intents and purposes, do not 'tune' at all. This is particularly found in 'wipe-out' areas."

For such a service to be practical, it is obvious that the two transmission strengths should be equal. If, for instance, a listener lives within the "C" service area of one programme, he should also live within the "C" service area of the alternative programme.

British listening has so far been conducted upon a technique in which the average listener has been content to listen to one programme. In consequence, many receiving sets are in use which, to all intents and purposes, do not "tune" at all. This is particularly found in "wipe out" and "A" service areas, where the listener has taken the greatest liberties, but, thanks to the overwhelmingly loud signals, has to some extent been satisfied.

Any scheme of broadcasting must rely to some extent upon the possibility of linking any studio or microphone point to a distant transmitting station. This is most conveniently done by the use of telephone lines.

It has been found by experience that it is quite practical to rely upon the use of such a form of connection. No serious loss of quality in the transmission need be feared if proper precautions are taken.

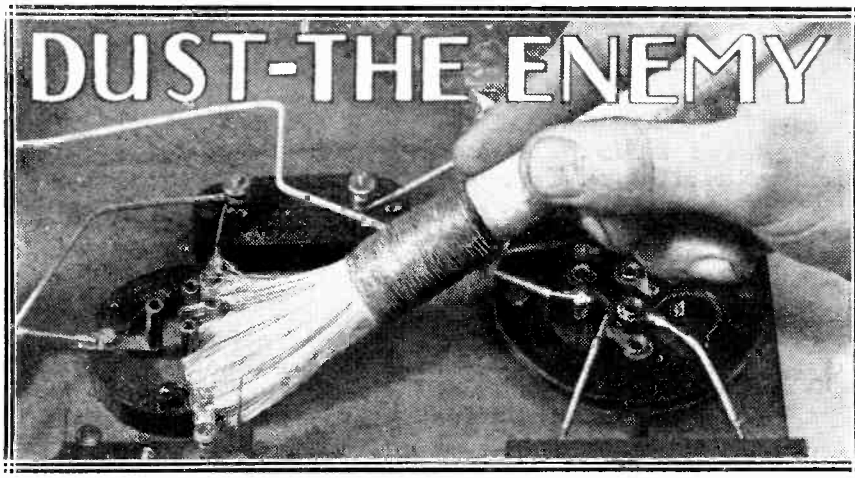
Inter-Linking

It is interesting to consider how it may be possible to link national systems (already linked by landline between themselves) so that a world system of broadcasting may be established. No engineer would think of using anything but landlines for this purpose, but the landline method of connection has its limitations; it cannot be used, for example, where it has to pass under considerable sea areas. The success of the London to New York radio-telephone service has brought up the question as to whether a similar system might not be used for linking up different national broadcast systems.

An ideal scheme might seem to base itself upon the erection of a giant central station radiating from one point as many programmes as there

(*Continued on page* 674)

When the London station 2 L O was moved from the Strand to Oxford Street many alterations were made, and the transmitter was brought right up-to-date. This photograph shows part of the main transmitter, situated just beneath the aerial on the roof of Selfridges.



Peculiar and apparently untraceable crackling noises, fading, poor signals, and many other "faults" can often be attributed to the evil effects of dust. The remedy is obvious, keep your sets and batteries clean by the means indicated in this article.

By H. J. BARTON CHAPPLE.

An accumulation of dust on a wireless receiver will sooner or later bring trouble in its train. With the older types of sets, which were constructed so that they had a fairly large horizontal panel, serving to accommodate a large proportion of the components exposed to the air, the effects of dust were more marked, but even with the present-day designs favouring a vertical panel carrying the fewest of controls, the components in this case being mounted on a horizontal baseboard and all housed in a cabinet, the problem is still one that requires careful attention.

Although apparently totally enclosed, particles of dust have a knack of getting inside the cabinet, and it behoves the possessors of sets periodically to overhaul their receivers and remove all traces of dust from the interiors as well as from the front panel. It is fairly well-known how the spaces between the fixed and moving vanes of variable condensers are favourite "parking places" for dust particles, and unpleasant crackling noises can frequently be traced to this source.

Cleaning "Variables"

Probably the best plan to adopt in these cases is carefully to insert a feather or pipe cleaner between the vanes and remove any offending particles, but there are other spots which serve as "danger zones" as far as dust is concerned. Bad leakage effects on what was previously good insulating material can be caused by any undue dirt accumulating between terminals or contacts, and receiver performances have, in many cases, been wholly upset as the result of this.

When a set is first constructed, particular attention should be paid to ensure that the soldering flux is used sparingly, and, after joints are made, superfluous material must be wiped away so that the work is quite clean, otherwise this material will soon collect dust and cause deleterious effects by reducing insulation resistance to very low values.

Necessary Equipment

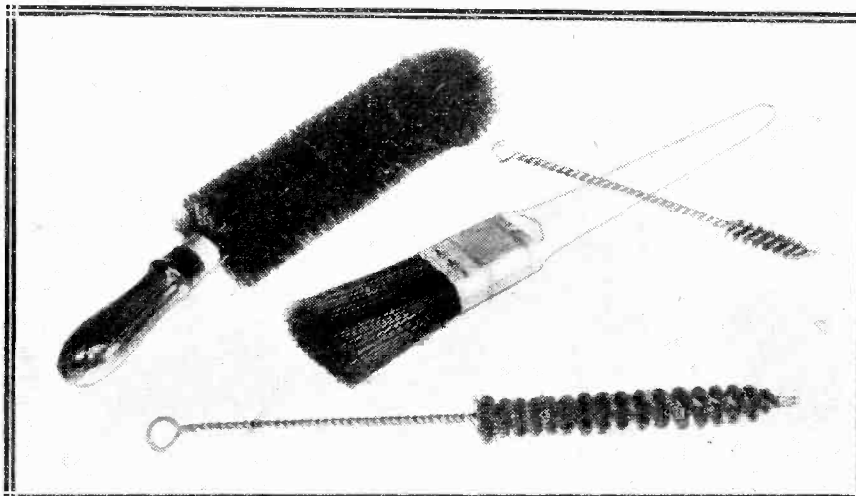
It does not take long to do the "spring cleaning" provided one has the necessary simple equipment, and the accompanying illustration shows the four brushes which I always keep by me for work of this character, and the combination proves equal to any occasion. There is a large and small stiff spiral brush, each of which is useful after soldering operations, and they are capable of getting into all sorts of odd corners to remove offending material. The small one can be inserted into valve holder, coil holder and dry battery sockets, and twisted round to clear dirt, the stiff bristles ensuring that the work is properly carried out.

Other Items

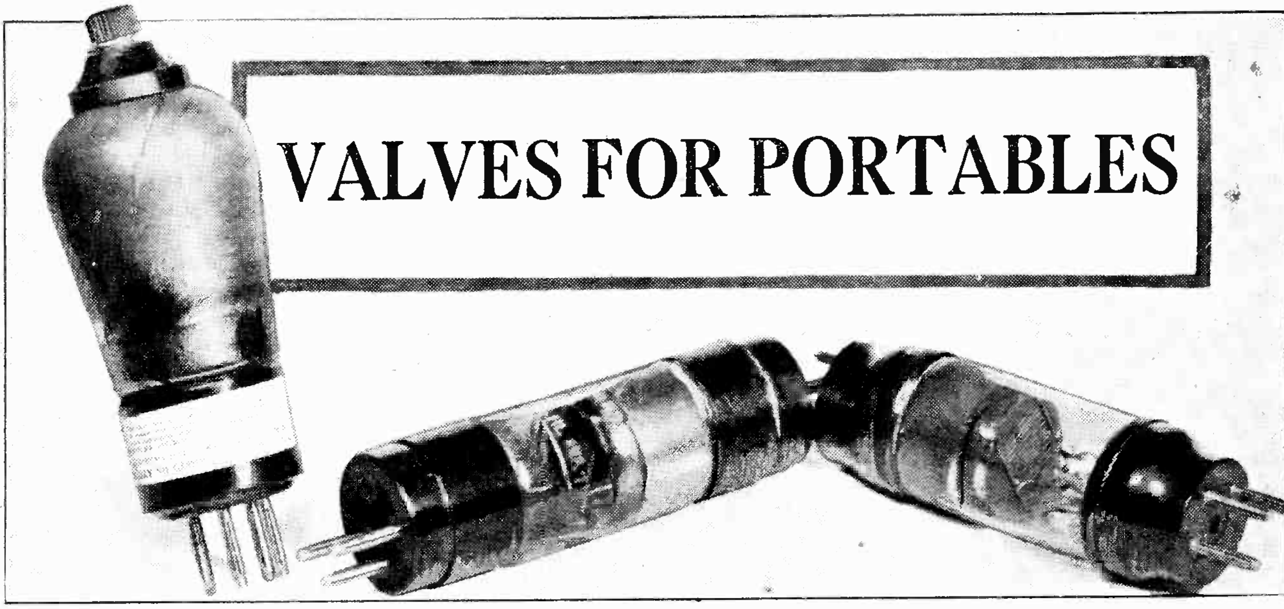
A camel-hair paintbrush, such as the one shown with a long white handle, is very useful for cleaning up panels, tops of accumulators (after being rubbed with a rag), dry batteries, the loud-speaker horn and the baseboard generally, and is capable of getting into very out-of-the-way places, but the favourite one is undoubtedly the wireless brush, also depicted in the photograph. The hair is particularly soft, and is held in a close wire spiral passing through the centre. This is bent round at the top, and although normally the brush diameter is 1½ in. it will close up to a very narrow thickness, and this proves a most effective dust remover in all circumstances.

If one's set has been standing idle for some time in a spare room, the dust is liable to be so thick in parts as to necessitate the use of the "blower" attached to the "domestic" vacuum cleaner, but a periodic clean-up of any wireless set, whether in use constantly or not, is really essential, for as far as wireless is concerned it can be said quite truthfully that "cleanliness is next to good reception," and a little time spent in that direction is duly rewarded by improved results.

KEEP YOUR SET CLEAN



The four types of brushes used by the author. The largest one is a special soft "wireless" brush, the next in size is an ordinary soft paintbrush, while the two spiral cleaners are useful for dealing with valve sockets, coil sockets, and similar awkward items.



VALVES FOR PORTABLES

The sensitivity of a portable receiver is largely dependent upon the valves employed, as is explained in this article.

By KEITH D. ROGERS.

In choosing a circuit for a portable receiver there are two main things which have to be considered. One is the question of weight and bulk, and the other is the question of reception and receptive powers. The former will, of course, have to be answered with special regard as to the uses to which the set will be placed.

The Question of Weight

For instance, if you want the receiver for use at picnics and out-of-door recreation, and have no means of carrying it other than in your own hands, so to speak, then the weight certainly must be cut down. It is no good having a multi-valve set with a heavy, stout case and loud speaker and plenty of H.T., and all the luxuries which might go with such a set, unless you have some means of transporting it.

I know of several sets on the market which are really fine jobs from the radio point of view, but when looked upon from the point of view of portability are quite outside the pale, which, of course, is because they are designed not to be used for portability from the point of view of one being able to carry them about from place to place out of doors, but so that they can be used in any room in the house without having to be disconnected. In other words, they are *transportable* self-contained receivers.

Quality and Sensitivity

When one has decided upon the matter of bulk and weight, one has to decide upon what type of reception is to be obtained. For instance, one may have 'phone or loud-speaker reception, and in the latter one may have reception of good quality, or of just mediocre quality, while together with the point concerning reception goes the question concerning sensitivity or range of reception.

If a loud speaker is desired, several valves will have to be used, and you will have carefully to consider the types of valves you would employ. Whatever kind of reception, whether 'phone or loud-speaker, is desired, one will naturally employ valves which will give the maximum signal strength under the circumstances, and while in a telephone receiver one cannot go very far wrong from the point of view of quality, when one is dealing with a set which is to be used to work a loud speaker, the quality will largely depend upon the circuit and especially upon the valves used in that circuit.

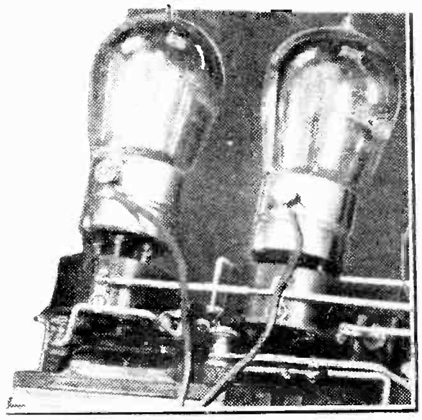
The H.T. Problem

So in a portable set, as in others, the question of sensitivity and quality have to be considered together, one against the other, and a compromise made which will best suit the needs of the owner of the set.

It stands to reason that in a portable receiver one does not want to carry about any more H.T. than is absolutely necessary, and in order not to need a tremendous amount of H.T. one has to keep down the number of valves, and possibly the number of stations to be received, and to watch very carefully the consumption of anode current for the whole set—which means a careful watch on the anode current of the last valve.

A Typical Example

Let us take a typical form of receiver; employing four valves, an ordinary H.F. stage, followed by a detector working on the grid-leak principle, and then followed by a resistance and a transformer or another resistance-coupled amplifier.



Four-electrode valves make ideal valves for small portable sets, and enable good results to be obtained with very small anode voltages.

Now it is obvious that in an H.F. stage one can use either an ordinary H.F. valve or a screened-grid valve, while whereas the latter may be very efficient in its operation, it requires far more screening and careful design

(Continued on page 674.)

American Views On Home Television

Some trenchant transatlantic comments concerning the "Simple Televisor" and the present position of Television in general.

THE fact that television sets and parts have appeared on the English market seems to have caused a good deal of interest in American amateur radio circles, and in the June issue of "Radio News," the London correspondent of that paper has a "message," which he cabled over at the request of his editor.

In the course of this message he says:

"The 'Televisor' described is a *very crude piece of work*; it serves as both transmitter and receiver; to *avoid synchronising*, the *two* discs sit on the *same* spindle.*

Many Difficulties

"In practical construction, this 'Televisor' model appears *to offer many difficulties to the fan*; he is asked to invest also in a four- or five-stage audio amplifier to boost up the received impulse so that the impulses can flash a neon lamp! The 'B' voltage required for this purpose is given as *four to six hundred volts*; as the power tube specified is a most expensive transmitting tube.

"*I am afraid that the Baird system is hopeless*, after all. It cannot give sufficient detail and, if you glance through recent copies of English radio magazines, you will find quite unbiased opinions of leading physicists which point to only one conclusion—something radically different and novel is wanted *if television is to be a sister science to radio*."

A Matter of Perspective

The "Radio News" editorial comment continues as follows:

"From the contents of this letter, it might seem as though someone had been trying to foist on the public something which operates—yes, indeed!—BUT HOW? Of course, a store with such a high reputation as Selfridge's enjoy cannot afford to sponsor anything that smacks of crookedness; but it is true that the managers of the store are not scientists or engineers, but only enterprising merchants.

"These business men might be shown a screen on which appeared a silhouette of a man's face, and be told that "here is Television.' If they had never seen anything better, with what could they make a comparison? Therefore, the store's advertising carried only the impressions of laymen desirous of being first in a great and profitable field; not that of trained radio men who have seen the most successful demonstrations in television, and can judge of the comparative merits of the performance.

Only a Toy

"Such advertising, therefore, is bound to cause a reaction in readers' sentiments, and scepticism, to even an undeserved extent. The backers of a promising invention who have but limited capital, and wish to retain control by financing the device through popular sales of stock, face the problem of attracting investors through striking and skilfully-arranged publicity. In so doing, there is a great danger that exaggerated or over-optimistic propaganda, even though it is permitted but passively by the promoters, will cast doubt on their proposition in the minds of the well-informed, and for only a short time appeal to the credulity or inexperience of the public and the unwary experimenter.

"Readers of 'Radio News' are again assured that, whenever there is a really-worth-while development in television available to the constructor and to the public, this magazine will be the first in giving them full details. Until the laboratory apparatus, which has made possible the remarkable demonstrations we have in previous issues described, is released for public sale, the amateur can make nothing in his workshop except interesting toys—such as that which might be built up out of the components offered by Messrs. Selfridge.

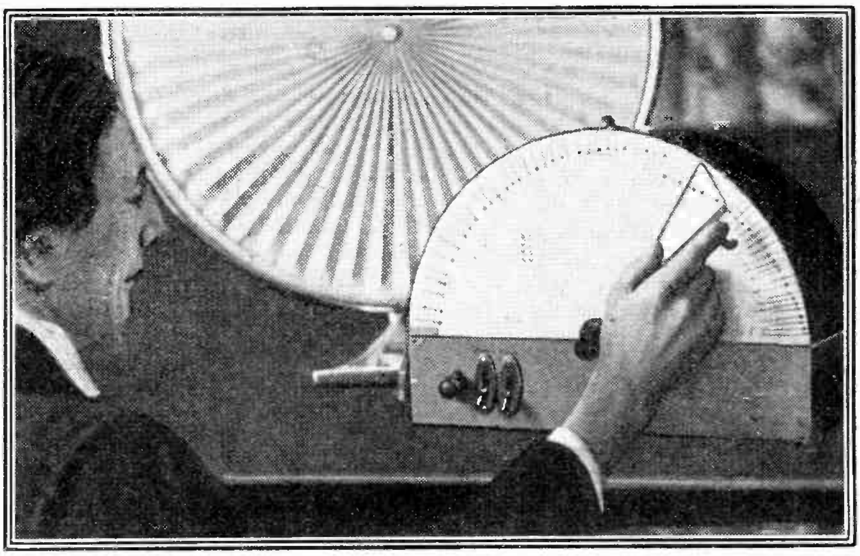
Television Not Yet Here

"As related in the April issue of 'Radio News' (on page 1163), we have talked with engineers of the General Electric Company and of the Bell Telephone Laboratories, and they put the time for the amateur to come into the field at five years hence. They are, of course, conservative gentlemen, and the time may be only three years from now, or less—but, anyhow, it is *not* now"

The above extracts from the "Radio News" need no comment; but readers who have perhaps considered the MODERN WIRELESS television policy rather pessimistic will no doubt realise that, even in America, our policy is supported and substantiated.

**Editorial Note:—The "Radio News" correspondent makes a slip at this point. The machine actually incorporates two discs mounted on separate spindles and driven by separate motors, both discs being required for transmission. One of these same discs is also used to re-build the received image.*

ANOTHER ELECTRICAL MUSIC MAKER



Rene Bertrand, a French electrical engineer, with the device he has invented for producing musical sounds electrically. He claims that his "instrument" is easier to play and has more possibilities of range and power than other devices of the kind, such as the Theremin apparatus which has recently been heard in most of the large cities of the world.

New Mullard L.F. Transformer—A Celestion Loud Speaker—A Short-wave H.F. Choke—The "Time-Saver"—The New "Lotus" Plugs and Jacks and Jack Switches, etc., etc.

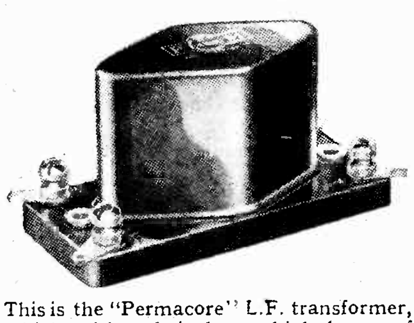
New Mullard L.F. Transformer

HAD it been our practice to judge by appearances, we should have put aside the sample Mullard Permacore L.F. transformer, which recently arrived, as being an inefficient component. It has the size and weight of the smallest of the so-called cheap transformers, but we must say right away that its performance is that of a high-grade product.

Its compactness and lightness has been achieved by the incorporation of a new design. Incidentally, the silver wire used for the primary winding in order to provide a high conductivity also has the advantage that it stoutly resists deterioration.

Nickel is used in the secondary winding, and the core is of a special iron known as "Permacore." In this way the component obtains an efficiency out of all proportion to its dimensions.

There is an unusually high degree of transference of energy, and the primary will handle large D.C. currents without saturation. Its curve is very straight from 200 cycles upwards, and the falling off below that figure still gives a large percentage of amplification down to 50 cycles. Messrs. Mullards say that the windings of their transformer have been so selected that no resonance peak occurs at about 8,000 to 10,000 cycles, as in most other makes.



This is the "Permacore" L.F. transformer, which, although it has a high degree of efficiency, is remarkably small.

> Manufacturers and traders are invited to submit for test purposes radio sets, components and accessories to the "Modern Wireless" Test Room at Tallis House. Under the personal supervision of the Technical Editor all tests and examinations are carried out with the strictest of impartiality.
>
> Readers can accept the Test Room reports published monthly under the above heading as reliable guides as to the merits and demerits of the various modern productions of the radio industry.

It is, in fact, a very excellent transformer, and can take its place in the highest grade of this kind of component, with the added advantage that it is ideal for portable receivers owing to its small size.

Price Reductions

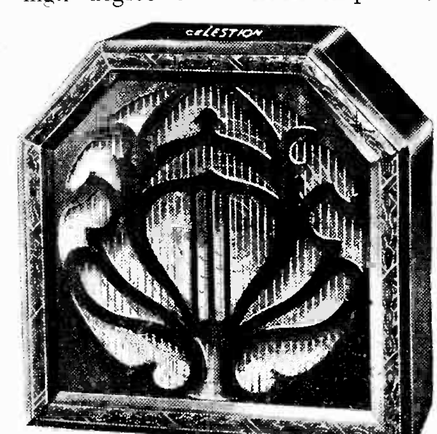
Messrs. Ripaults, Ltd., inform us that their well-known lateral-action condensers have recently been greatly improved. Furthermore, they have found it possible to reduce the prices, either the ·0005 mfd. or ·00025 mfd. now being available at 10s. 6d. each, without dial. The price of the slow-motion dial is 4s. 6d.

A "Celestion" Loud Speaker

Good loud speakers are of comparative excellence—there are good loud speakers which we cannot enthuse about because we have heard much better ones. We wish we could adopt some sort of scheme of classification such as percentage figures, but, unfortunately, there are considerations such as that of price which make this impracticable.

For instance, not all of our readers would be able to afford £7 5s. for an oak version, or £7 10s. for a mahogany version, of the model C.12 "Celestion" loud speaker, but we do not think that anyone could quarrel with such a purchase. It is one of the very best instruments we have heard. In our opinion this C.12 runs the expensive moving-coil variety very close. It has practically no colour and its projection is crisp and clear. It provides ample bass, and speech is almost uncannily natural.

It is of the cabinet cone type, and its dimensions are 14 in. by 14 in. by 6 in. We thoroughly endorse the makers' claims that its outstanding features are "its sensitivity, its ability to handle great power, and its even response." Its construction is tastefully and beautifully carried out. The woodwork displays a high degree of craftsmanship and,



The "Celestion" C.12. A high-class loud speaker.

altogether, the speaker has a most handsome appearance. We consider it an excellent proposition and very good value for money.

The Stewart-Warner Reproducer

Amateurs looking for a variation in the usual design of loud speakers should be interested in the Stewart-Warner Reproducer due to the Stewart Engineering Co., Ltd., of Long Acre, London, W.C. It is a heavy instrument, finished in antique bronze, and it bears graceful figure mouldings in a sort of Grecian style. It is a totally enclosed model, and has no adjustments. Although it is sensitive it will also carry fair inputs. It has not the projection of the open cone type, but the reproduction is clear. It is moderately good on speech, and has a fair bass. Its price, complete with a length of silk flex, is £6 15s.

Trix R.C.C. Unit

Messrs. Eric J. Lever (Trix), Ltd., of Clerkenwell Green, London, E.C.1, have produced two R.C.C. units. They are known as the A and B types respectively. The former is for use immediately following a detector stage, or after a medium-impedance valve. The B type is for use after high-impedance special resistance-coupling valves, and employs high values of anode resistance and grid leak. The units are compactly built into moulded bakelite cases with nickel-plated terminals. They retail at 5s. 6d. each. On test we found them quite satisfactory and the resistances embodied were found to carry the moderate currents handled recordable variations.

A Short-Wave H.F. Choke

An H.F. choke as normally used in a receiver employed for the reception of the ordinary broadcast stations does not need to be ultra efficient, but on the short waves the reaction choke becomes of paramount importance. As a matter of fact, practically any det.-L.F. or det.-2 L.F. receiver will successfully bring in the short-wave stations providing it has a moderately efficient capacity reaction control and providing the necessary coils are used and the H.F. choke replaced.

Constructors will no doubt note with interest that Messrs. Burne-Jones & Co., Ltd., have produced a version of their very well-known H.F. choke, which is suitable for sets tuning from below 10 metres up to 100 metres. The choke retains its familiar tapered cylindrical form and its exceptional compactness. One was included in a special short-wave receiver built by the "M.W." Research Department and found to be completely satisfactory. Constructors need have no hesitation in embodying this component in their next short-waver. It retails at 7s. 6d.

The "Time-Saver"

Something quite new in the way of radio station logs has recently been placed on the market by Messrs. Adsigns, of 265, Strand, W.C.2. The neat little article can be screwed to the lid or to the front of a set without detracting from its appearance. In principle it is similar to a small roller blind. By pulling a nickel ring at the bottom some 10 in. or so of white linen can be pulled out.

This has printed on it all the well-known broadcast stations together with wave-length details, and so on. Three columns are provided for the insertion of dial readings. When the ring is released the log springs back into the case. The "Time-Saver" should, in our opinion, achieve popularity both on account of its novelty and its genuine usefulness. It appears to be quite reasonably priced at 2s. 6d.

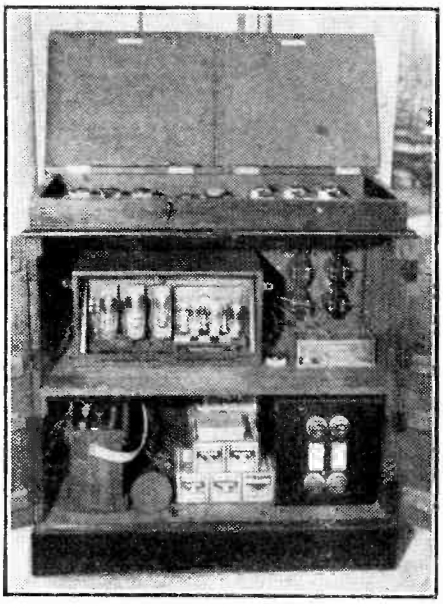
New Lotus Components

There is no neater and, in many cases, no more efficient method of switching than by the use of jacks and plugs or jack switches. But, hitherto, many constructors have been debarred from using them owing to the fact that they necessitated soldering. It will be, therefore, good news to many of our readers when they learn that Messrs. Garnett, Whiteley & Co., Ltd., of Liverpool, have placed a most comprehensive range of jacks and jack switches on the market, all of which are provided with terminals instead of with the more usual and irritatingly closely placed soldering tags.

The "Lotus" jack switches will be of exceptional interest to radio set builders. They are push-pull switches which are just as easy to mount on a panel as the familiar and simple on-off filament switch. Indeed, this comprehensive Lotus range includes a battery switch at 1s. 6d.

Only one hole has to be drilled in the panel to mount even the double-throw double-pole jack switch, and the six terminals on it are widely spaced and most accessible. Nevertheless the switch is compact and neat in appearance. Similarly to all other "Lotus" components, it is well made and nicely finished. The action is positive and the contacts firm and good. The price of this D.T.D.P. jack switch is 4s. The other jack switches are similar in design and similarly attractively priced.

There are five jacks available, ranging from the single-circuit type at 2s. to a double filament-control jack at 3s. The Lotus jack plug costs 2s. Messrs. Garnett, Whiteley & Co., Ltd., are to be congratulated on their new productions which will undoubtedly open a new field of interest to many constructors.



A section of the Marconiphone Public Address gear with which the historically famous York Minster has been equipped. This amplifier can, if necessary, operate seven loud speakers, including one placed outside the building for the benefit of "overflow" visitors.

An Amplion Extension

Owing to rapidly increasing business, Messrs. Graham Amplion, Ltd., and its subsidiary company, Messrs. Alfred Graham, Ltd., have found it necessary to acquire new and extensive premises comprising 165,000 sq. ft. floor space at Slough, Bucks.

A Useful Book

Messrs. Longmans, Green & Co., Ltd., recently sent us a copy of "Intermediate Electricity and Magnetism," by R. A. Houstoun, M.A., D.Sc., It is a book the serious amateur should have on his bookshelf in order that he can from time to time refresh himself in what are the basic elements of his hobby. A chapter on electrical oscillations and waves is included. There are well-drawn and informative illustrations in practically every page.

The TRANSFORMER that NEVER BREAKS DOWN

Nearly two years ago every one of Lissen's expensive transformers was withdrawn in favour of the present Lissen transformer. For not only does this one amplify fully every note, every tone, every harmonic, every overtone, but it never breaks down.

Many tens of thousands of these Lissen transformers have been sent out. They are being used in all kinds of circuits in all parts of the world, including India. India has a notoriously bad climate for transformers. There is a humidity in the atmosphere which has played havoc with expensive transformers of all makes and countries of origin, but the Lissen transformer has withstood the Indian climate without the slightest trouble. It has earned there, as it has at home, a reputation for never breaking down. You can use it in every circuit, no matter what other transformer may be specified. It will suit every valve, and it will give you full satisfaction all the time.

You can test it for 7 days!

We challenge comparison of it against the most expensive transformers or chokes you can buy on money-back terms. You can return it to any dealer within 7 days of purchase and he will willingly refund your money if you fail to prefer the Lissen to any other transformer you have tested against it, no matter how expensive those transformers may be.

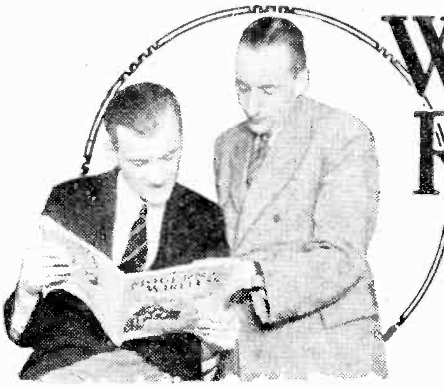
PRICE 8/6 Guaranteed for 12 months

Turns ratio 3 to 1; resistance ratio 4 to 1.

Use the Lissen transformer instead of any other transformer that may be specified in any published circuit.

LISSEN LIMITED,
20-24, FRIARS LANE, RICHMOND, SURREY

(Managing Director: Thomas N. Cole.)



WHAT READERS THINK

The Plain Detector—5 S W in Chile—Regarding 5 G B, etc.

The Plain Detector

Sir,—I am glad to see that Modern Wireless has of late been devoting more space to plain detector sets (some [and why not all ?] for short-wave work). Given a fairly good aerial (my own is 60 ft. long and 40 ft. high), it seems that a good detector will bring in any signal which rises sufficiently above the general level of X's, mush and muddle to be of *any* use on *any* set. It's a pity H.F. stages don't refuse to amplify this background, but, alas, they seem to delight in exalting it, and the noisiest set I know is the 8-valve super-het.

If a detector set is made to work well down to 15 metres, will get good, clear signals from 3 L O (Melbourne), and very loud signals from 2 X A D, it will work well enough on the ordinary broadcasting bands, and there is no difficulty in designing a quick change-over by shifting coils. Such a set, with two good L.F. stages, is very satisfactory for any sort of loud-speaker work.

Our "local" station here is Daventry, 250 miles distant, and we are quite 200 miles farther from the majority of European stations than London is, but the station-getting powers of such a simple 3-valve set here compares quite favourably with your published reports of, say, the 5-valve "Solodyne." The selectivity is, of course, lower, which doesn't matter here. The quality is equally good.

My own 5-valve "Solodyne" has been a "quarry for parts" for some time, and the general tendency here is to alter H.F. sets to plain detectors, in spite of our very unfavourable position.

Cardiff, only 100 miles away, is usually inaudible on anything. Plymouth Relay (45 miles) is very strong, but heterodyned six deep. Bournemouth, at 170 miles, is moderate strength, but usually useless from interference. Of the two Daventrys, 5 X X is strong and reliable in daylight, but fades a good deal after dark, while 5 G B is weak in daylight and varies from very strong indeed to very weak at night. Spanish stations are easier here than in the S.E. area, and often at great strength. French, Italian, Polish and German stations are nearly as easy here as in Suffolk, while practically everything N. or N.E. of us is very badly screened.

Yours faithfully,

F. C. James.

St. Mawes,
Cornwall.

5 S W in Chile

Sir,—Your March number contains a comment to the effect that reports of the reception of 5 S W, the new short-wave station of the B.B.C., will be welcomed.

On February 21st of this year I completed a two-valve receiver on the lines of the two articles in your 1927 Christmas Number. Within five minutes of testing out I was listening to music from London, very clear in the 'phones, but subject to considerable fading.

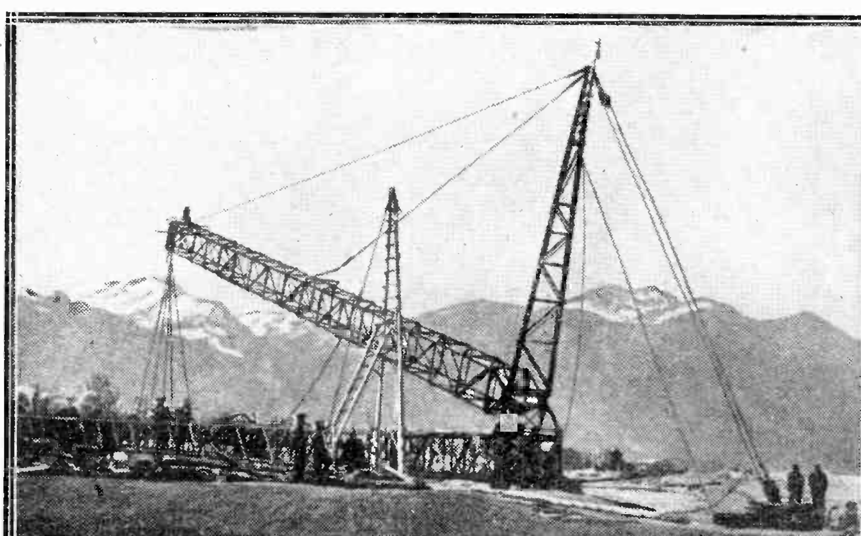
Since that date I have added another valve and made various changes, and my set now consists of detector, one transformer-coupled L.F. and one choke-coupled L.F., with series-controlled reaction, and careful by-passing of all stray H.F. currents.

5 S W is now on the loud speaker at fair strength every night from 10 p.m. to midnight, and is much enjoyed. Unfortunately 8 p.m. here is midnight at home, and at the end of this month the introduction of Summer Time both here and in England will increase the time difference to six hours. As there is no transmission as yet during the week-end we shall not be able to hear much of the Old Country during our winter.

We are anxiously looking forward to hearing some definite news as to the promised extension of the times of transmission, and if you could see your way to publish an authoritative statement you would be doing a great service to a large number of Britishers abroad.

Stations K D K A, W G Y, and 2 X A F are well received here later in the evening, but credit must be undoubtedly given to our own home station for the manner in which it comes through the ether. The latter is "one low-frequency valve" better than the Americans, and can be regularly depended upon, whereas the U.S. stations vary in strength from night to night.

The broadcasting in this country and the Argentine on ordinary wavelengths is poor in the extreme, and the atmospherics around 200-500 metres have to be heard to be believed. Components are costly and difficult to obtain, but short-wave transmissions are opening up the possibilities of good reception here little by little.



Workmen erecting one of the giant masts at the new station at Teheran.

No 6 YOUR COPY IS NOW READY FREE!

THIS special enlarged number of "Radio for the Million" is waiting for you . . . send the coupon to-day. In it there are over 20,000 words of intense interest to every radio owner and a special message to those contemplating the possession of a first radio receiver embodying every modern refinement.

America on the Master Three
The tens of thousands of owners of this amazing three valve receiver are given in this new issue the magic key to the reception of American, Continental and Australian stations on the fascinating short waves. Many letters from owners of Mullard P.M. Sets are published describing remarkable trans-world results.

The Mikado P.M.
—a wonderful two valve version of the Master Three, giving pleasing, powerful and certain results in return for a minimum outlay of time and money. Anyone can construct the Mikado P.M. regardless of experience or skill. Complete instructions and simplified Blue Print are supplied free with every copy of this issue. Make sure of your copy.

The Editor, "RADIO FOR THE MILLION," Dept. 6,
63, Lincoln's Inn Fields, London W.C.2.
Please send me FREE No. 6 "Radio for the Million"
complete with Blue Print for the MIKADO P.M.

NAME ....

ADDRESS ....

....

M.W.

Mullard
MASTER · RADIO

I manage to get your valuable paper month by month, and it is much appreciated.

Yours faithfully,
G. R. JOHNSON.

Casilla 1874,
Valparaiso,
Chile, S. America.

Regarding 5 G B

SIR,—I was very surprised indeed to read the selfish and insulting letter from Mr. C. P. Brown in your March issue.

I am afraid that in his anger he has let himself go a little too far.

In his remarks about 5 G B, he says that it was made directional because Birmingham "screamed," as he calls it, when their local station was closed down. I should think that one of the most important of the provincial cities has a right to complain when its local station is replaced by one at some distance, which, as Mr. Brown himself admits, cannot be received at all well in Birmingham, while almost every other large city still has its "local."

In these circumstances it was up to the B.B.C. to give Birmingham the very best service possible from 5 G B. Mr. Brown speaks as though 5 G B

Loud speakers are now being used extensively at railway termini for announcing platform arrangements. This illustration shows the "announcer" at Liverpool Street.

was quite efficient, but was made directional deliberately. I thought it was well known that, owing to screening from the 5 X X masts, reception was poor in one direction. Would it have been fair to make that direction that in which Birmingham lay, when London already had its local station, and Birmingham had nothing at all ?

With regard to his remarks about the new transmitter being fifty miles from London, if this is to be the case, and it is to serve both the South and the Midlands, I see no reason why those in the South should not have to reach out as far as the thousands who live in the Midlands. It is the fairest way—in fact, the only fair way.

As a matter of fact, I believe the first Regional station is to be about ten miles north of London ; if that is not near enough for Mr. Brown, for a 30-kw. transmitter, I should like to know what he does want. Incidentally, the lot of the distant listener, with this high-power station right on top of him, will not be very enviable.

At any rate, when the scheme is completed, Mr. Brown will have the satisfaction of knowing that Midland listeners will have to reach out about 100 miles for their programmes, if one may go by the scheme outlined in the B.B.C. Handbook. It appears from this that while the Regional stations will be outside all the other principal cities, we shall be totally ignored.

As a matter of fact, although the position is pretty hoepless here with regard to crystal sets, and not too good with valves, H.F. valves are certainly unnecessary to receive 5 G B efficiently, and I see no reason why conditions should be different with a similar station the same distance from London.

The fact is, I am afraid, that Londoners have got a very inflated idea of their own importance, and want absolutely perfect service at the expense of everyone else. Why, when there are only five stations available, should one be devoted almost entirely to London, leaving only four to serve the rest of Great Britain ?

Yours faithfully,
BARRY J. DAVIS.

Birmingham.

An Earth-Plate Tip

SIR,—I enclose sketch of a little tip re earth plates, which may be helpful to some of your readers. The sketch explains itself.

By this means one can be certain that nothing has gone wrong underground, as the soldered connection is always visible.

Yours faithfully,
A. E. BARROW.

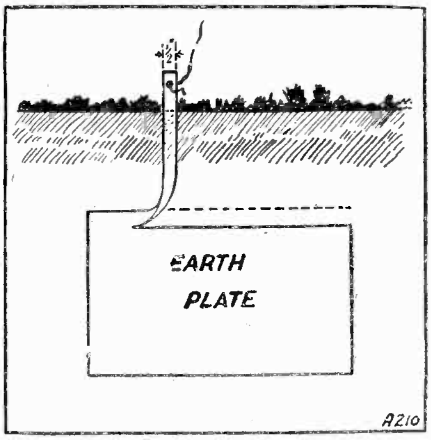
Bexley, Kent.

"My Broadcasting Diary"

SIR,—In the article "My Broadcasting Diary," in a recent number of your always very interesting paper, MODERN WIRELESS, there is the sentence : "The only point that concerns the public is that the programme service should be the best available, and that every possible penny should be devoted to the programmes."

With this, every listener will wholeheartedly agree.

During the past twelve months there has been a great improvement in the programmes, and much of the



The earth-plate modification referred to in Mr. Barrow's letter on this page.

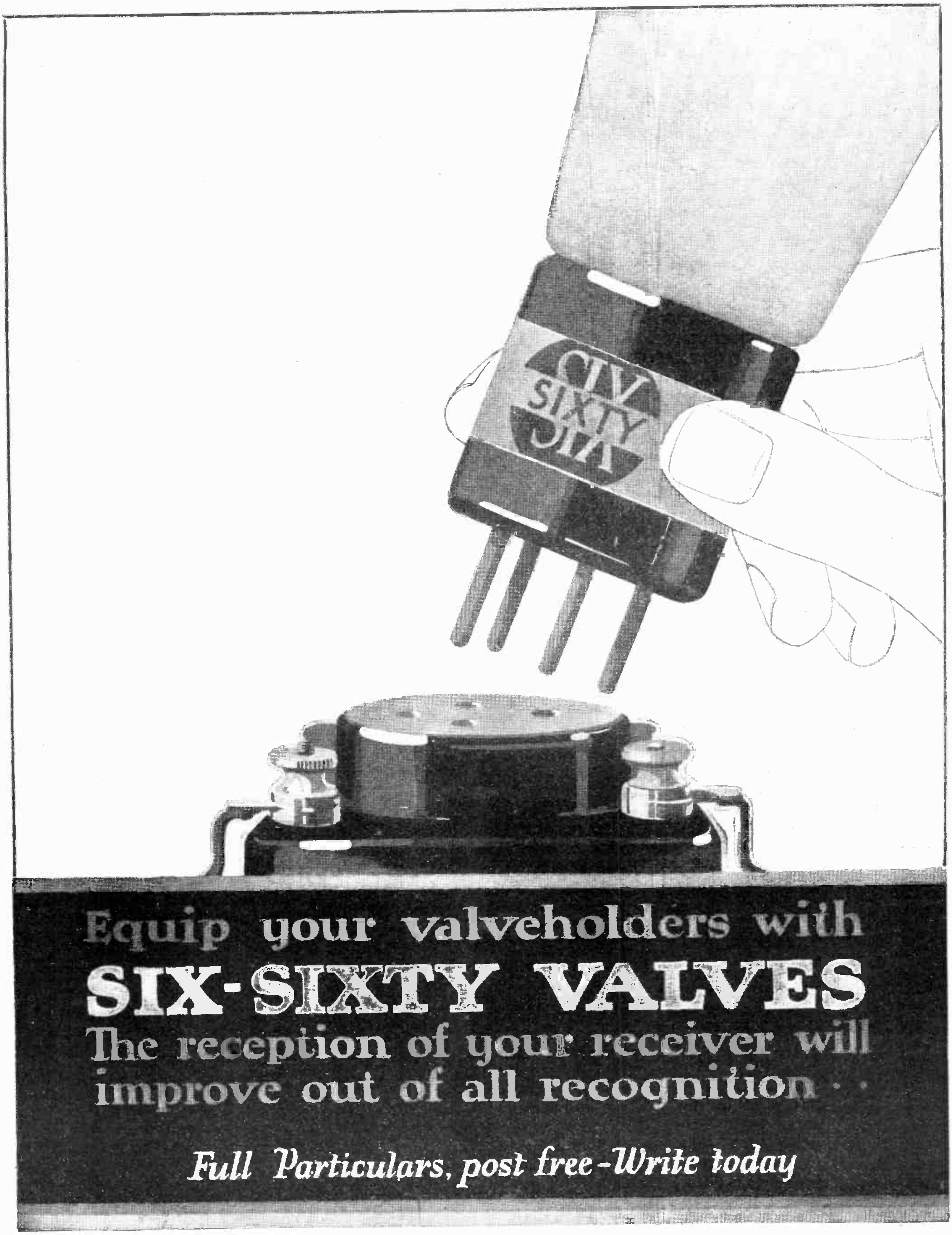
present grumbling is unjustified. Still, there is much room left for improvement. But I much doubt if outside grumbling from listeners is going to effect much more without inside help at Savoy Hill. It seems to me that what is really needed is someone in authority *there* who is really keenly interested in the question—as a whole, and not just keen on one or two of the many types of programme which must be broadcast to suit different tastes. At present, as of course you know, there is no individual, or Board, as supreme or central moving force in connection with this very important branch of the work. The members of the Corporation will have nothing to do with it—and a very good thing, too!

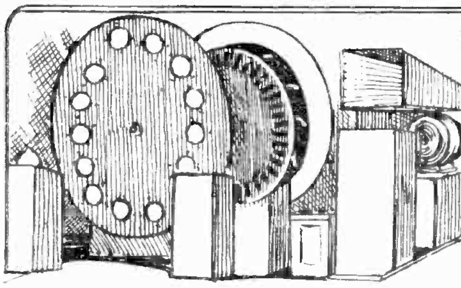
But surely there is one official who not only *might*, but who *ought* to make it the chief part of his work—the Director-General.

Rumour is again afloat that Sir John Reith is retiring from that post. This may or may not be actually a fact, but its persistence seems to indicate that he is at least thinking of retiring.

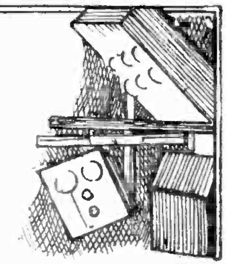
Cannot something be done to secure someone as his successor who is known

(Continued on page 677.)


Equip your valveholders with
SIX-SIXTY VALVES
The reception of your receiver will
improve out of all recognition . .
Full Particulars, post free - Write today



TELEVISION NOTES OF THE MONTH



THIS month television has forsaken startling technical progress for business development. When the whisper that Baird Television Development Company, Ltd., had sold American rights "for a large sum" reached the Stock Exchange, one pound shares which not long ago were fourteen shillings leapt in a few days to £2 17s., and one shilling shares rose to twenty-one shillings. I know a man who sold his shares and pocketed £125 profit.

More Boom

Sir Charles Higham has been enlisted in the booming forces of television. Going aboard the Leviathan on his way to visit New York and Chicago he was full of his new subject. If present plans fructified, said he, the Leviathan would be the first liner to be fitted with a floating television receiving station. The American rights, he carefully explained, had been sold to groups of radio dealers, "instead of leaving it to big companies."

The Other "T."

"I am going from tea to television." said Sir Charles. Sir Charles Higham, as you should know, is the publicity expert who went to America on behalf of tea producers and started the 4 o'clock tea habit over there.

Looking Ahead

One idea behind the amalgamation of the Radio Corporation of America (who joined forces with the G.E.C. for the recent television broadcast to homes) and the powerful Victor Talking Machine Company is that all gramophones sold will be fitted so that they can be used to turn a television disc.

News From Bélin

M. Edouard Bélin, the famous French television experimenter, has been seriously ill. He is well again now, he tells me, and back at his work. He has not yet reached the limit of achievement with his oscillating mirrors at the transmitter and M. Holweck's specially designed cathode-ray oscillograph at the receiver. Each month he makes an increase in the number of units into which he can split his object, and each month M. Holweck is able to report an increase in the sensitivity of his screen or a reduction in the potential necessary between the filament and the grid. For 30 years M. Bélin has been experimenting in television.

Patents First

A man who has a television idea and not the £10,000 needed to try it out, asked me the other day to offer the idea for him to a large electrical firm. The company are interested, but there can be no negotiations until the inventor has received patents. "We have seen so much trouble with inventors alleging that their ideas have been stolen," said the head of the company to me, "that now we will not look at any proposition unless the inventor has himself fully covered by patents." In television, when one move forward has been made, it is surprisingly easy for several unconnected investigators to take the next step simultaneously.

Ideas "Stolen"

Baird says the American Telephone and Telegraph Company have come out with several bright ideas he had years before. Jenkins, too, says that some of his rights were stolen for the famous Washington-New York demonstration by the A.T. & T.

The telephone company turn round and accuse Jenkins of infringing their patents in demonstrations he has given before members of the Government. A case in the courts is threatened, but it is the opinion in America that both sides will wait to see who is the first to make money out of sets containing the supposedly stolen ideas, and then the other side will act!

Charlatans!

Rivalry is a mild word for the feeling between some television investigators. Two I know call each other charlatans. But I have been able to carry greetings between others over thousands of miles, and several have helped each other along in their early days with the loan of light-sensitive cells and similar pieces of apparatus.

This photograph shows some of the apparatus used in Mr. Baird's London laboratory.

IN PASSING

MY radio career, as the attentive reader of these pages may have remarked, has been a series of bumps and depressions; but of all the phenomena of that kind with which it has enriched my *ego* commend me to that one which is now to be described—like a circle, for instance, round a point. I am the point.

A point, like a Scotch trader's discount, has no parts and no magnitude. I feel like a point. You could hide me behind an undergrown electron. My size in hats has diminished so greatly that I have not as much superiority complex as a window-cleaner's apprentice viewing the Woolworth Building in New York. I wish I were the Invisible Man. Or a snail with a nice shell, double-convoluted. Or a millionaire—when all of me to be seen would be four secretaries and my wife's diamonds.

Walk Warily

Let me say now, because I shall be incapable of moderate expression by the time I have finished, that (1) a lot of knowledge is a dangerous thing—especially knowledge of radio; (2) a good deed may be a bad egg; (3) don't judge by appearances—a man is often a bigger fool than he looks

"I have not as much superiority complex as a window-cleaner's apprentice viewing the Woolworth Building in New York."

(4) don't forget the smile on the whale's face when he said of Jonah, "Lo! he was a stranger, and I took him in."

If I had not been ass enough to go and re-imbibe all the radio theory I had forgotten during twenty years' grappling with the facts, plus a lot more invented by college professors who never get nearer to the fundamental wickedness of radio than x—y=c (and a lot more alphabet to the same effect) I should not now have found myself wishing my name were Johnson, or Smiggins, and that I lived in Tierra del Fuego.

There is no authenticated instance on record of a man who tried to teach his grandmother how to put a safety-pin in a baby's plus-fours and lived it down. Plato tells the tragedy of young Epimondas, who asked Socrates whether Xantippe married him or whether he married Xantippe. Old Soc. cleared his throat and asked, by way of an answer, whether his (Epimondas') mother bore a fool for a son or whether a fool claimed her for a mother.

He then spoke for a day and a night on the answer, holding Epimondas, as the Ancient Mariner held the Wedding Guest, "with his glittering eye." And when old Soc. had done with him, Epimondas crawled off on all-fours and entered the olive-oil trade forthwith. I believe I must be descended from Epimondas, despite the fact that olive oil and I have nothing in common.

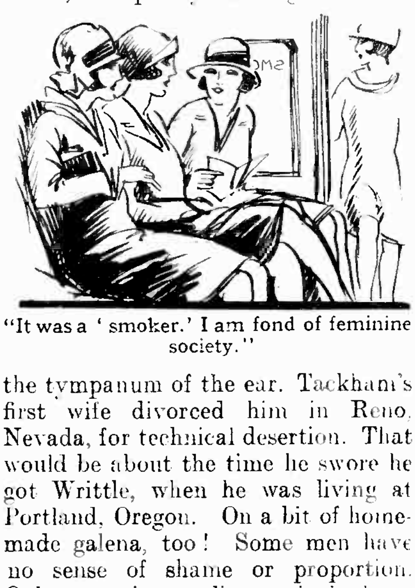
Times Have Changed

Oh, I forgot! (No. 5). Beware the inquiring stranger with whiskers. He is bound to be a deceiver. Say unto him "Baa!" and let him go. If he has those half-and-half spectacles, one half for reading and one half for looking innocent, drop him as you would a live coal. For a live coal from off the altar cannot bite as keenly as he. In fact, if you are wise, you will either strangle him or change carriages.

The root of the matter is that I failed to realise the passing of the years. It becomes increasingly difficult to realise that as they mount over one's head, and I expect that when I am a great-grandfather I shall continue to describe Mafeking night as though it occurred only the week before. It seems only yesterday, that time, when to be a wireless man was to be wellnigh as good as a wizard. Respectable householders looked at me as they would look at Dr. Nikola or Svengali, and warned their children "not to go too near." Why, I remember that when I demonstrated a wireless spark transmitter to an Indian prince in 1910 he was plainly in doubt as to whether he should clap me in prison or fall down and pray to the spark. And now skinny school-kids in England talk to Australia by radio. The bloom is off the peach.

A Week-end "Holiday"

I was snugly ensconced in the 4.39 "down" from Victoria *en route* to Puggleburv, where I was to spend the week-end watching Tackham—vulgarly called Tack-hammer—try to pick up 3 L O (Melbourne) on half a valve, no aerial, three volts on the anode, and plenty of imagination on



"It was a 'smoker.' I am fond of feminine society."

the tympanum of the ear. Tackham's first wife divorced him in Reno, Nevada, for technical desertion. That would be about the time he swore he got Writtle, when he was living at Portland, Oregon. On a bit of home-made galena, too! Some men have no sense of shame or proportion. Only an artist can lie convincingly.

It was a "smoker." I am fond of feminine society.

Just as the guard piped all hands aboard, some cretinous porter stuffed the bloke and his baggy umbrella in, followed him up with an unspeakably disreputable suit-case, rooked him for a "bob," slammed the door as only an N.U.R. Communist can, and shouted "Ri'way! Goin' on, there!"—a shibboleth which, I gather, is sacred to those attendant on trains. Then, I presume, the fellow went home to Lambeth, devoured liver-and-bacon and beer, and took his wife to the "movies" to see "Blood and Passion," featuring Helma de la Ghetto, *née* Bates.

The intruder turned his back and whiskers on me, and began to stow his suit-case, umbrella, hat, muffler, three paper-covered packages, two books and a rug on the luggage-rack, puffing meanwhile like the Blue Train at rest. This job being done, he flopped on to the seat, ran his fingers comb-wise through his chin crop and sized me up with a pair of eyes which, seen from my side through his spectacles, might have belonged to a bull. I took Modern Wireless from my pocket and got behind it.

After the lapse of half an hour I crept from my hiding-place and lit my pipe, laying the magazine open and cover upwards on the seat. The old boy focussed his lenses upon the picture.

I Commence to Explain

"Hem," he clucked, "I observe that you are a devotee of wireless. My son amuses himself with one of those—hem—broadcasting receivers, I believe they are called, and derives the most extraordinary effects."

That word "effects" should have warned me. I see it now, alas!

To cut a tedious conversation short, I may as well confess that bit by bit I led him to believe that I am absolutely the B.B.C.'s text-book on radio science. I now regret that I hinted that to the lay mind, his included, the theory of radio is still as incomprehensible as is the Egyptian "Book of the Dead" to a Solomon Islander.

"Well, well, well, well," he said, with the suspicion of a chuckle, as he

"His eyes positively glistened with joy."

settled himself down like a chicken about to caress its favourite egg, or like a fellow who is about to hear the Will of his rich auntie. "Tell me something of these wonders."

So I began by sketching lightly the electro-magnetic theory of light. It was all wrong, but I could see by his eyes that he thought it was top-hole. By the way, he was awfully considerate; when I got into the stickiest part of the theory he coughed and blew his nose like blazes—he could see I was passing through a crisis and he showed sympathy!

The Lecture Continued

He was tickled to death and invited me to his house. As I could not dine at two places at the same time, I agreed to beg off from Tackham's and spend Sunday evening with him, so that I could explain amperes and dielectrics at length.

Thus, behold me knocking at the Lindens — old Whiskers' place — at 6.45 p.m. on the Sunday. Quite a passable *ménage*. Quiet *and* respectful servants, bath, and clothes laid out ready. Grub? Well, the old boy knew the difference between eating and the mere mangling of garbage. There was a wife, I believe, but she was almost as respectful as the house-maid. Very sad! Probably a third cousin.

After dinner he and I toddled off to a room at the top of the house, where he produced coffee, brandy, and cheroots, and bade me continue the lecture on radio.

I took an immense amount of trouble over him because, as I told him, he was a clean slate for me to write upon; because he was not puffed up and arrogant with the awful superiority of the half-instructed, and because I could see that he tried hard to understand what must be a very difficult subject. Yes. I told him all that. Every word of it.

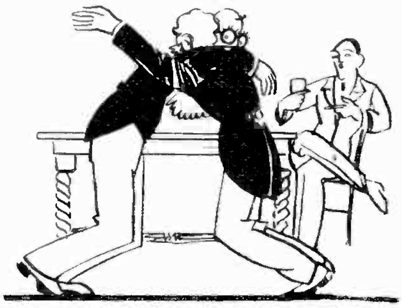
Another "Pupil"

He asked me to repeat my visit on the following Sunday, an invitation I accepted, and told me his name was Octavius Gundlestuck.

When I arrived the second time I found that the party had been augmented by another comical old daddy. Name of Chalps. Old G. half apologised for foisting Chalps on me, but said that he did so much wish to share his pleasure with his oldest friend. And they nodded and winked at each other like a blessed pair of idiots.

Side by side they sat, all ears, spectacles and beards, as I held forth on the subject of radio for beginners. I pointed out all the pitfalls and snags which beset the path of the unscientific learner. I waxed almost inspired as I taught them about oscillations, high-frequency, and how the little electrons nip up and down. I was very profound on "skin effect," and playful about wireless waves. I sketched a sine curve on old Chalp's shirt-front and he pointed it out to Gundlestuck with the pride of a V.C., and then wept, whilst old G. coughed and choked from pure jealousy.

We had a great old time. I was at the top of my form and took the opportunity of inveighing against the pretensions of college professors who, I said, "obtruded their absurd, academic conceptions into a realm of



"They clung together and cried like children."

knowledge opened up, explored and made fruitful by the blood and sweat of the practical pioneers." Hot stuff, eh?

At this they both dissolved into general ruin; they clung together and cried like children—and filled my liqueur glass again and again.

I Meet Disaster

"This young man," said Chalps, "is a veritable tonic. I am enormously indebted to you, my dear Gundlestuck, for bringing him to my notice. I am rejuvenated and shall not now require my usual summer vacation."

I had arranged to sleep at Tackham's, and when I got to his place I gave him a résumé of the whole triumphant business.

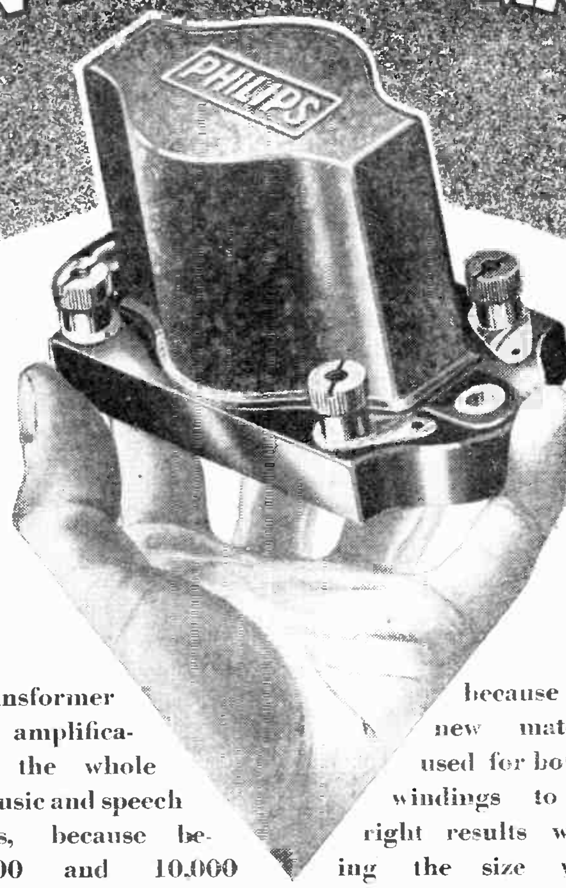
"Gundlestuck? Chalps?" he exclaimed in a tone of mixed joy, horror, and incredulity. "Oh, my dear, poor lunatic fellow, do you know who they *are*?"

"Oh, a couple of decayed City directors, or export agents," I replied lightly.

"May Heaven help you!" he said. "It's a put-up job. Gundlestuck is a Senior Wrangler, a Nobel prize-winner in Physics, Head of the Research Department of the National Physical Laboratory, owner of innumerable patents in radio, and Consulting Radio Engineer to at least six Governments. As for Chalps, he is the mathematical and physical genius 'behind the throne' of the new cable-wireless merger. Go home and pray."

Beware of whiskers, pride, and old brandy, my brothers. I've had some.

THE NEW PHILIPS TRANSFORMER

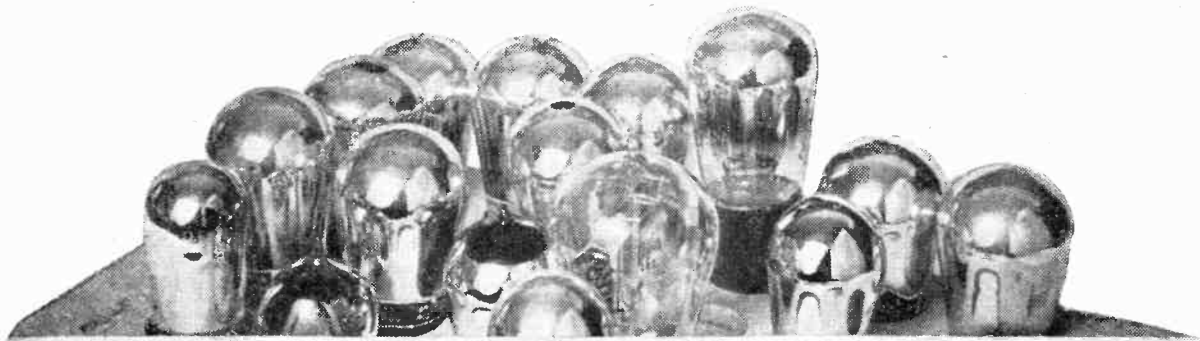


Philips Transformer gives even amplification over the whole range of music and speech frequencies, because between 200 and 10,000 cycles amplification is absolutely constant and at even as low as 50 cycles it is well over half of the maximum. Intermediate and high frequency oscillations are not amplified, because beyond 10,000 cycles amplification rapidly diminishes to zero. The size is convenient and compact because special new materials are used for both core and windings to give the right results while keeping the size within the smallest limits. Consequently Philips Transformer ensures very rich tone and faithful reproduction, prevents distortion and maintains purity, takes little space on the mounting board and is easily fitted, even to existing sets. The ratio is 3—1. Dimensions: Base $3\frac{5}{8}'' \times 1\frac{3}{4}''$. Height 2".

25/-

PHILIPS
for Radio

Advert. Philips Lamps Ltd. Radio Dept., Philips House, 145 Charing Cross Road, London W.C.2. R.3



VAMPIRE VALVES

The results of some interesting tests make the author ask, "Are low-loss valves needed?"

By C. P. ALLINSON, A.M.I.R.E.

I have, during the past month, been carrying out a number of H.F. measurements of different descriptions.

During these experiments I had occasion to remove the valve from the holder and much to my amazement the H.F. voltage across the tuned circuit went up by an extremely large percentage.

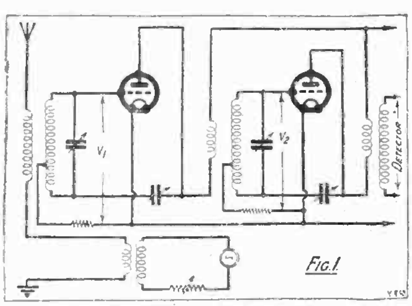


Fig. 1

The receiver that I was investigating at the time used the circuit which is shown in skeleton form in Fig. 1 on the H.F. side.

I have been carrying out some further investigations with this circuit, and the result is a receiver incorporating two stages of H.F. which has given me every satisfaction in operation.

The H.F. Voltage

I was carrying out measurements on the experimental set, in which two stages of H.F. were employed, by coupling a local oscillator into the aerial so as to inject a signal of adjustable strength.

Readings of the H.F. voltage between grid and filament at V_1 and V_2 were being taken, and it was while some adjustments were being made that one of the H.F. valves was removed and the increase in voltage noted.

The actual voltage being measured was that shown at V_2, which is, of course, the most lightly damped grid circuit in the receiver. It is evident that in the case of the first H.F. valve considerable damping is introduced into the grid circuit owing to the aerial, while in the case of the detector circuit, of course, we have the rectifier damping, which can be of quite a considerable order.

Marked Increase

The actual H.F. voltage between grid and filament at V_2 was 7 volts. This was with the H.F. valve in position, but with the filament turned out.

On removing the valve, however, the voltage went up to 9·5 volts, representing an increase of 36 per cent.

I was so staggered by this marked increase in signal strength that I determined to investigate my whole stock of valves with a view to determining the losses introduced by the various makes and types into a tuned circuit.

For this purpose special apparatus was got together and assembled with great care as to the layout and screening, etc., so that no external errors should be introduced, or where these were unavoidable that they should be compensated for in all cases, and therefore not introduce any actual errors as to the results obtained.

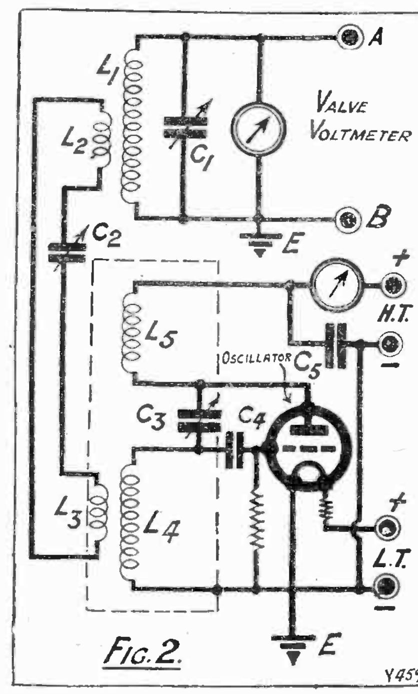
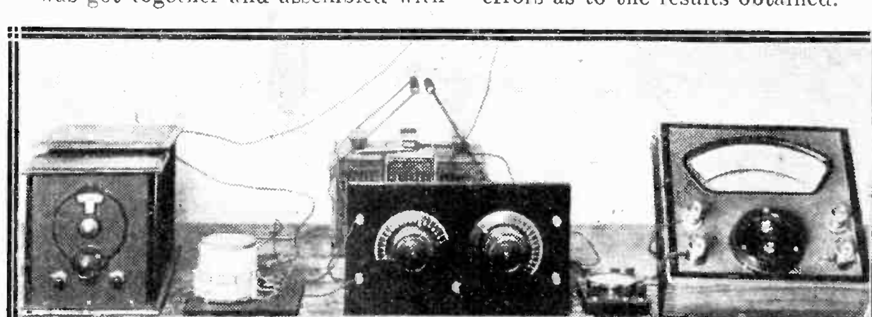


Fig. 2



Apparatus used in the "Modern Wireless" research laboratory to determine the degree of efficiency of a tuning coil or unit, or an H.F. transformer.

THE WINNER

In

DARK BLUE CONTAINERS

60 VOLTS **7/-**
66 VOLTS **7/6**
99 VOLTS **11/6**
9 VOLTS GB **1/3**

On

COST & SERVICE

these Batteries provide

THE FINEST H.T. VALUE OBTAINABLE

EVER READY Regd

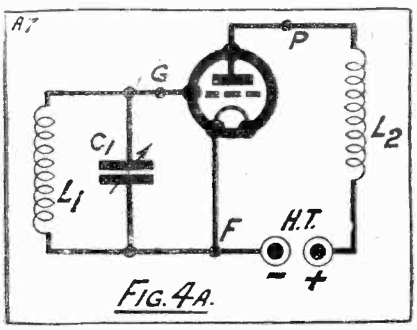
BRITAIN'S BEST BATTERIES

Their pure tone makes listening worth while

Great care had to be taken, of course, to see that all the components used were really low-loss components, since otherwise small additional losses which might be introduced by the valve or other component which I might be testing would be swamped owing to a very high initial resistance being present in the measuring circuit.

The Testing Outfit

Fig. 2 shows the theoretical circuit of the completed arrangement. A low-loss coil L_1, having an inductance of approximately 200 microhenries and an H.F. resistance of 5 ohms, tuned by a low-loss variable condenser C_1, is coupled to an oscillator by a link circuit having a variable condenser C_2 in series with it. By means of this condenser an easy adjustment is obtained of the amount of energy transferred from the oscillator to the tuned circuit.



Across the tuned circuit a valve voltmeter is connected as shown, while the components to be tested are connected across the terminals A and B.

A milliammeter is also included in the plate circuit of the oscillator valve in order that change in current might be read. Actually this meter was backed off so that a small change in current could be noted with ease.

	Type	H.F. Volts No Load	G—F					P—F				
			1	2	3	4	5	1	2	3	4	5
2-volt valves	A	2·3	2·05	2·07	—	—	—	1·96	2·18	—	—	—
	B	2·3	—	—	2·05	2·1	1·85	—	—	2·05	2·12	1·8
	C	2·3	1·6	—	2·12	—	1·95	1·55	—	—	2·15	1·6
	D	2·3	—	—	2·02	—	2·0	—	—	2·03	—	2·05
	E	2·3	—	—	—	—	—	—	—	—	—	—
4-volt valves	A	2·3	2·1	* 1·9	—	—	—	2·05	* 1·85	—	—	—
	B	2·3	2·04	—	—	—	2·0	2·0	—	—	—	2·1
	C	2·3	—	* 2·05	—	—	—	—	* 2·03	—	—	—
	D	2·3	—	2·1	—	—	—	—	2·12	—	—	—
	E	2·3	2·1	—	—	—	1·8	2·15	—	—	—	1·75
6-volt valves	A	2·3	2·1	2·05	—	—	—	2·2	2·12	—	—	—
	B	2·3	2·15	* 2·1	* 2·1	2·1	2·1	2·1	* 2·15	* 2·15	2·15	2·15
	C	2·3	—	* 2·15	This is	a scree	ned-grid	valve.	—	—	—	—
	D	2·3	—	2·15	* 1·9	—	—	—	2·2	* 1·95	—	—
	E	2·3	1·95	—	—	2·15	2·05	1·9	—	—	2·15	2·05

Fig. 3. The results obtained by the author, tabulated in a manner which make them convenient for reference.

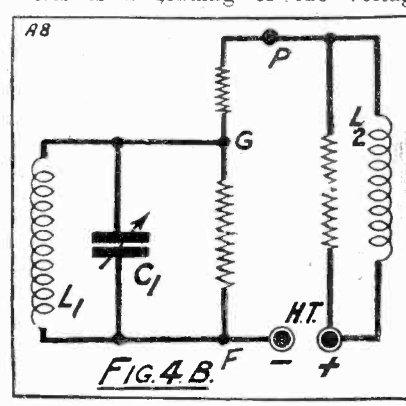
The chief purpose of this experiment was, of course, to get a comparative idea of the losses introduced into the circuit by the valves owing to dielectric leakage and the like. Two sets of measurements were taken, one between grid and filament and one between plate and filament.

Interesting Results

In order that the results may be clearly examined by every one I have tabulated them in a comprehensive manner in Fig. 3. In the first column we have the type of valve, 2-, 4-, or 6-volt, while types A, B, C, D, and E represent the following types of valves.

A. High-mu high-impedance valve.
B. Medium-mu medium-impedance valve of the H.F. type.
C. A general-purpose valve.
D. A small-power valve.
E. A super-power valve.

The next column marked H.F. volts is a reading of the voltage



across the tuned circuit L_1 C_1 when unloaded. It will be seen from this that this value was checked up constantly so as to avoid any errors arising owing to variations in output from the oscillator.

Column 1, which is subdivided into five columns, is the H.F. voltage obtained when the grid and filament of the valve were connected across the tuned circuit; 1, 2, 3, 4, and 5 represent five different well-known makes of valves.

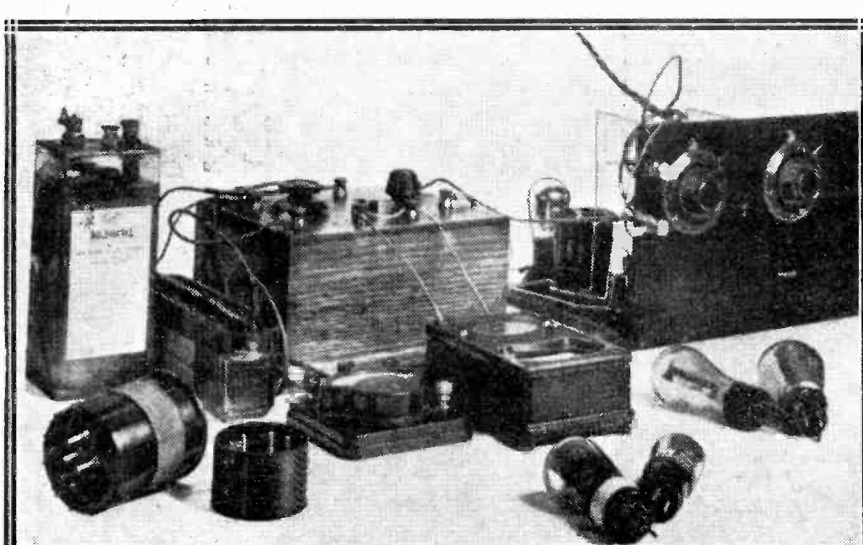
Comparative Tests

Column 2 represents the reading obtained when the plate and filament of the valve were connected, the same figures applying to the same make of valve.

I would like to state here that I have not used any but the valves which have the best reputation, and these give the results which are tabulated in this figure.

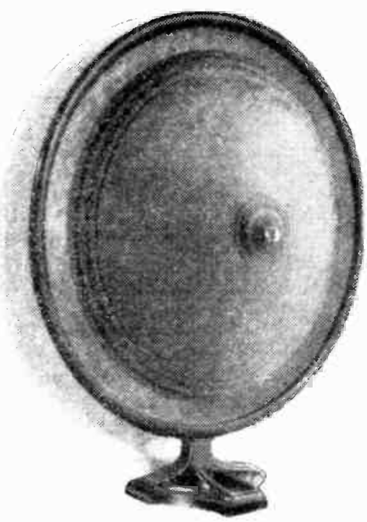
Farther on I give some comparisons between the best of the British valves and some odd Continental valves which I had by me, and the

(Continued on page 678.)



This is some of the apparatus used by Mr. Allinson in order to gain the interesting data on "losses" embodied in the accompanying article.

'Ideal' speaker reproduction for 37/6



The popular 'Ideal 44' Cone Speaker at a reduced price

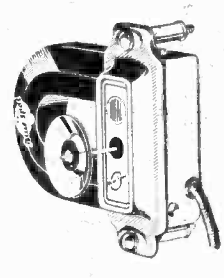
Right from its introduction the popularity of the 'Ideal' Cone Speaker has been indicated by continually climbing sales. This increasing demand has enabled us to revise production costs and we are now able to offer our 44 model at a reduced price.

Everyone who has heard the 'Ideal 44' is eloquent of the purity of its reproduction, its range of interpretation, its exceptional quality at either extreme of the scale.

You would not believe that such a speaker was obtainable at such a price, yet you can prove it to your satisfaction in your own home to-day—your dealer is selling the 'Ideal' Cone Speaker at the new reduced price, 37/6.

This price reduction applies also to the 'Ideal' Loud Speaker Kit, from which you can build up the 'Ideal 44' in your own home.

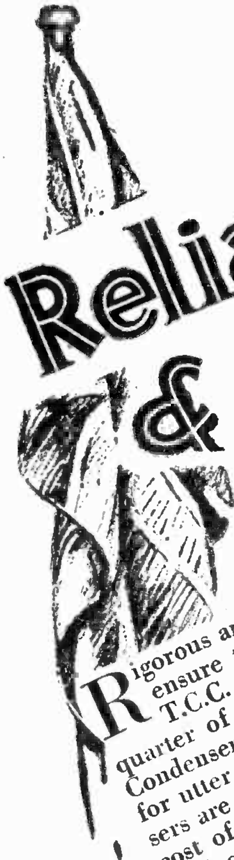
For the home construction, the 'Ideal' Four-Pole Balanced Armature supplied as a separate unit exactly as embodied in the 'Ideal 44.' Supplied complete with two padded washers on threaded spindle, 25/-



The IDEAL 44 CONE SPEAKER

F. A. HUGHES & CO., Ltd., (Dept. W3), 204/6, Gt. Portland St., LONDON, W.1.

and they're labelled **BLUE SPOT**



Reliable & British

Rigorous and individual factory tests ensure the unfailing reliability of T.C.C. Condensers. For nearly a quarter of a century these All-British Condensers have enjoyed a reputation for utter dependability. Fixed condensers are one of the smallest items in the cost of your receiver. Is it worth while to jeopardise the success of your set by buying cheap, inefficient condensers in order to save a few pence on its total cost? T.C.C. Condensers may cost a trifle more than others, but they are guaranteed as reliable as the Union Jack.

Specified for the COSSOR "MELODY MAKER"

T.C.C.

To Telegraph Condenser Co., Ltd., Wales Farm Rd., N. Acton, London, W.3.

I enclose 1d. stamp. Please send a copy of "How to build your High Tension Eliminator for A.C. or D.C." to:

Name............................ Address............................

M.W. June

CA 2785

RADIO NOTES AND NEWS OF THE MONTH

A feature in which our Contributor brings to your notice some of the more interesting and important Radio news items.

Conducted by "G.B."

Radio Drama

HERR FEUCHTWANGER, the famous German playwright, recently wrote an article in which he gave it as his view that radio drama was a failure, and Mr. George Bernard Shaw seems to agree with him. Drama, according to Mr. Shaw, really depends as much upon visual acting as upon words, and is therefore beyond the reach of both microphone and cinematograph. We are coming more and more to recognise that invisible drama can only be presented by the human voice. Everything depends upon the tone and quality of the voice and of individuality. The microphone magnifies and also suppresses. The difficulty is to get distinct variety in tone in the expression without exaggeration, and to get it home it is personal quality of voice that unquestionably counts, for the invisible "actor" cannot become theatrical.

Indian Broadcasting

According to Mr. Eric Dunstan, the General Manager of the Indian Broadcasting Company, a vast new field for British industry is lying fallow in India. Mr. Dunstan, who is visiting England on business, said recently: "There lies in India a great country with a population of over three hundred million, where a service of broadcasting is the only thing which can fill a vital need in the lives of the inhabitants. If we only reached half per cent of them we should be able to sell one and a half million wireless sets."

Another Ban Lifted

The ban imposed on the broadcasting of the service at the Cenotaph on Armistice Day is to be lifted this year. When the subject was raised last year the Home Secretary said that, while he declined to remove the ban, he would be happy to consider the question as sympathetically as possible in light of such indications of popular feeling as might be available. As a result, repeated applications by the B.B.C. for permission to broadcast the Cenotaph ceremony have been refused hitherto by the Cabinet, but the Home Secretary has now reversed his decision, and it would be interesting to note what evidence has been available recently to make him change his policy in this direction.

The Third "Eck"

According to "London Calling," a third member of the Eckersley family is to join the B.B.C. This is Stephen, well known for his scientific research work with the Marconi Company. The other two Eckersleys at the B.B.C. are, of course, well known. There is Peter, the chief engineer, and his elder brother Roger, responsible for programmes. A trio of Eckersleys at Savoy Hill should prove a strong combination.

Not "Blithering Idiots"

Captain Eckersley, at a recent lecture before the Manchester Radio

(*Continued on page 668.*)

RADIO NOTES AND NEWS OF THE MONTH

—*continued from page 666*

Society was rather badly heckled, and more than one speaker openly charged the chief engineer with insincerity when he gave answers to the questions in connection with the attitude of the B.B.C. to the satisfaction of reception from 5 G B in Manchester. Captain Eckersley said he was at a loss to understand the attitude of his audience. "Why do you always assume," he retorted, "that we are blithering idiots and you are the wisest people on earth?"

He was asked why the quality of reception in Manchester was poorer than that in London, and he replied that the Manchester engineers had been working on the matter, and that a marked improvement might be expected shortly.

Twin Manchester Station

Interviewed after his lecture, Captain Eckersley said that he liked Manchester and Manchester people, but as for being terrified of the criticisms in Manchester, he wasn't a bit.

"My audience, I am sure," he said, "did not represent the average listener. While knowing something about wireless, you know, they were, after all, amateurs. I fail to understand this sort of criticism. It is incredible. What is 5 G B to do with Manchester? 5 G B was only intended as an experiment. It was not part of the Regional Scheme, though it will be crystallised into such. I hope to get a twin wave-length station close to Manchester to do for Manchester what 5 G B is doing for the Midlands. As for the complaints of bad quality, I may say that for every letter of unfavourable criticism the station receives here we get eight appreciative ones."

Amusing Anecdote

Mr. E. R. Appleton, the director of 5 W A, told some entertaining stories about wireless at the Third Annual Dinner and Dance of the Barry Island Radio Club. The best story was, perhaps, the one about the Scotsman who wrote to the studio stating that he was deaf in one ear, and asking if he could have a 50 per cent rebate on his licence.

One man wrote to the station saying that he had a brother in Australia, and asked Mr. Appleton, or his engineers, whether they could suggest a wave-length by which he could experiment so as to get in direct communication with him. A group of people, regarding whom suspicions were aroused by their persistent oscillating, wrote to the station emphatically denying the innuendo, and adding that they had a private earth.

And, finally, a lady wrote to Mr. Appleton the following: "Enclosed is a copy of my aerial. Can I get Cardiff?"

First Controversial Broadcast

The first broadcast item under the new B.B.C. scheme which permits the discussion of controversial subjects was decidedly interesting, and it was a good stroke in inviting Sir Ernest Benn and Mr. James Maxton, M.P. (two very old antagonists), to debate the question of the problem of poverty. We hope that more broadcast debates like this will figure in the programmes.

Loud-Speaker Ban

The York Watch Committee are asking the City Council to adopt a by-law forbidding the use of a loud speaker "in such a manner as to cause annoyance to, or disturbance of, residents or passengers."

(*Continued on page 670.*)

RADIO NOTES AND NEWS OF THE MONTH

—continued from page 668

But if the York Watch Committee are going to gain their day on this point, it is only logical to assume that the same ban must apply to gramophones, street organs, and little girls and boys practising on the piano.

Lecture "Turned Down"

The Anti-Vivisection Society recently asked the B.B.C. for permission to broadcast a lecture on the movement in its relation to public health. The B.B.C. came to the conclusion that the subject was unsuitable for broadcast discussion.

The "Anti-Vivisection Journal," commenting on the B.B.C.'s refusal, says: "Why is one aspect, and one of vast importance on the subject of public health, to be ruled out? Even before the Prime Minister's declaration of the admissibility of controversial matter for broadcasting purposes, those who voiced the orthodox medical views have been permitted to make reference to medical theories that are bound up with animal experimentation. Apparently the admission of controversial matter is to have no meaning so far as concerns those matters in which we are interested."

America on L.S.

One of the principal charms of wireless is its unexpectedness. Whether one is a skilled transmitter or merely a simple listener one is certain, sooner or later, to encounter the unusual. Mr. G. F. Waley, of Ealing, has just done so, as is explained in the letter printed below. There can be no doubt about this being a fine achievement, with which the skill of the operator has no doubt had much to do.

Mr. Waley in his letter says:

"I should like to inform you that on Friday night, April 13th, utilising a two-valve 'Gecophone' set purchased in January, 1927, I was successful in picking up Schenectady, America, which came through at loud-speaker strength, at about 11.45 p.m. Greenwich time, for over three-quarters of an hour with practically no distortions of any kind. The voices were perfectly audible and understandable through the loud speaker, even at a considerable distance away. I should add that since the set was purchased none of the vital parts has been either renewed or in any way repaired, this including the valves.

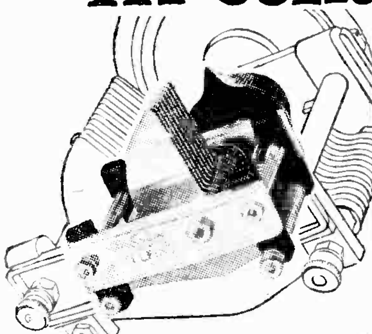
"Yours very truly,
"G. F. WALEY."

Ealing, W.13.

PCJJ

Until further notice P C J J, the Dutch short-wave station, will transmit as follows: Tuesdays and Thursdays, 16.00—20.00 G.M.T.; Fridays, 23.00—2.00 G.M.T.; Saturdays, 15.00—18.00 G.M.T.

Something new in Condensers



PRICES:
Supplied with pointer knob and drilling template.
·00015 mfd. **6/-**
List No. 312.
Also supplied in three other sizes.

	List No.	
·0001 mfd.	311..	5/9
·0002 mfd.	313..	6/3
·00025 mfd.	314..	6/6

Illustration shows the "Elfin" compared with the Bowyer-Lowe 'Popular," itself a compact instrument.

Bowyer-Lowe TESTED RADIO APPARATUS

"ELFIN"

The smallest and lightest condenser model made—the ·00015 mfd. weighs only 2¼ ozs., and with fully extended vanes occupies only 2¾" × 1¾" × 2" behind panel.

A precision instrument of quality, a miniature logarithmic condenser. Specially designed for reaction control or for tuning-in sets where space is at a premium.

Ask for Bowyer-Lowe catalogues of Components and Receivers.

BOWYER-LOWE Co., Ltd., Spring Road, Letchworth, Herts.

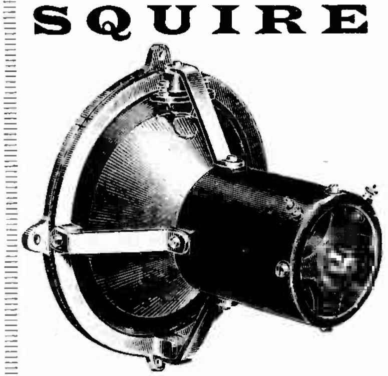
SQUIRE

COIL-DRIVEN LOUD SPEAKER

Parts for Easy and Accurate Assembly.

Improved Model "D," Set of Parts for Mains, **£4 : 18 : 6**

DE LUXE MODEL "E," Set of Parts for Mains, Consumes **60** Milliamps. **6 6** extra.
For Accumulator, Consumes ½ amp.



'Phone: *Clissold* 0334.

F. SQUIRE,
24, Leswin Road, Stoke Newington, London, N.16

IT IS IT!

THE LATEST

4 and 6 Pinless Contact Foolproof Becol Formers. Complete, ready for winding.

NO PINS—NO WRONG CONTACTS.
Can be fixed in the dark.

FORMER 6/-. **BASE 4/6.**
Inland Postage and Packing, 9d. extra.

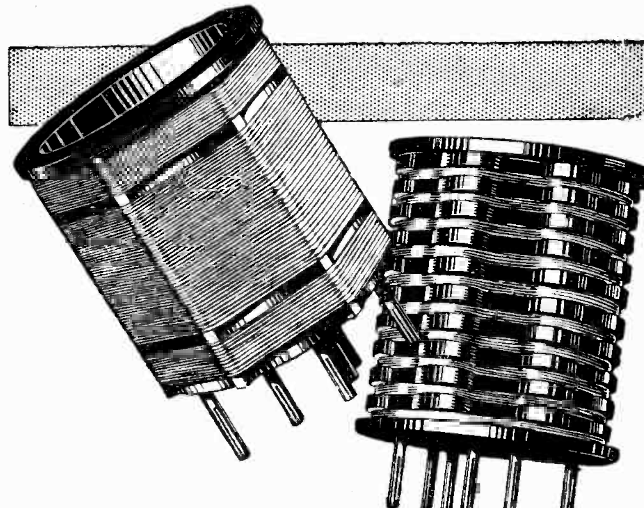
Inside formers for above
1¾" × 1½" × 2¼" **6d.** each.
Packing and postage, 3d. extra.

As described and illustrated in "Modern Wireless," January, 1928, issue.

Write for Handbook on Circuits and Windings, fully illustrated—Price 6d. post free.

Sole Makers:

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



Mullard **The Master Three**

ULTRA-SHORT WAVE COILS ARE NOW AVAILABLE FOR THIS RECEIVER

Prices:—

Two Short Wave Coils: Space-wound—20 to 45 metres, and 45 to 90 metres. **7/6 Each.**

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

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

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

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 highest degree is easily obtained with Colvern Coils.

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 on each of the three wavebands.

VOLUME is similarly dependent 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.

COLVERN
ACCURATE SPACE WOUND COILS

Colvern Ltd., Mawney's Road, Romford.

A THREE-VALVE PORTABLE

—*continued from page* 604

If the set refuses to oscillate, check the connections to the reaction winding. Better still, change over the leads, as this is easier than puzzling out the various direction of windings and connections. Also, make sure that the valve is suitable for the Filadyne detector, although any general-purpose valve should give results.

Final Assembly

If the set works satisfactorily, as it should do if there has been no fault in construction, you can place it finally in position in the case, in which it should fit snugly, but not too tightly. The middle rail carrying the doors, when screwed in position, will retain the skeleton rigidly in place without any fear of it shifting. This middle rail is easily removed, so that the set can be taken out again without much trouble.

Having connected up the loud speaker (+ terminals to H.T. +), you can try the set in its completed form, and it should work as well as it did on its trial run. This time, however, you can walk about the room with the loud speaker working at full volume!

There is no consumption of current, either L.T. or H.T., when the switch is in the "off" position. If you require to use the 'phones, remove the pieces of wire shorting the terminals B and C, and connect the 'phone tags to A and C.

The valves required are: For the first L.F. stage an ordinary L.F. amplifier of magnification factor 20 and impedance 20,000 to 30,000 ohms, and, for the second stage, a small power valve of magnification factor 5 to 7 and impedance 40,000 to 80,000 ohms.

You should have no difficulty in selecting from the multitude of valves available two having approximately these characteristics. Of course, with three-electrode valves the two inner grid leads are omitted, and if 2-volt valves are used, working from a 2-volt accumulator, the common resistor will have a value of $1\frac{1}{2}$ ohms.

STANDARD COILS

—*continued from page* 620.

a series in geometrical progression, as do also the values of the coils B.10, B.20, B.30, B.40, and B.50, and similarly for the remaining groups.

"These ratios of 1·5 between coils in a group, and 9 between corresponding coils in successive groups, have been used in calculating the values shown in the schedule. The values there given, however, have been rounded off for the sake of convenience. Should it be desired to calculate the values to a greater degree of accuracy than as shown in the schedule, such calculation should be based on the exact values of the coils in Group B as shown below, this group having been taken as the basis for all calculation.

Winding Self-Capacities

"The figures for other groups are obtained by successively multiplying or dividing the inductance values by 9 and the wave-length values by 3.

"It should be noted that the *wave-length* values shown in the schedule and in Fig. 4 are given for the information of the user, and are not intended to form part of the specification. The values of the shunted capacity comprise the self-capacity of the winding and its mounting, the capacity of the condenser connected in parallel with the coil, and any inherent capacity in the circuit in which the coil and condenser are included."

In case the term "picofarad" is new to any reader, it should be explained that this is the term generally recognised by scientific bodies as denoting a micro-microfarad.

A Simple Principle

It will be noted that the standard designations of the coils are not based on the number of turns of wire in the winding. The number-of-turns system of nomenclature is excellent so long as *all* coils having the same number of turns have approximately the same inductance, but unfortunately owing to differences in design this is not the case, and, as a matter of fact, in some instances the number of the coil does not correspond even to the number of turns; a No. 50 of one make being called a No. 50 coil merely because it is more or less equivalent in wave-length range to a 50-turn coil of another make.

When once the simple principle underlying this system is understood it is claimed that the standard designations will prove to be more useful and comprehensible than the number-of-terms system or any other system having a physical relation to the properties of the coils.

THOSE CLASSICAL BROADCASTS

—continued from page 606

Take the great B Minor Sonata by Liszt; in this work Liszt gave a musical representation of the good and evil in himself—good and evil at war with each other; and the tranquil ending suggests that the old Abbé Liszt at least came out of the fight fairly at peace with himself! One wonders, after reading his life story, whether he did!

Chopin's music is, of course, so poetical and so full of melody that few listeners who have even the slightest "taste" for music can say that Chopin is dull or highbrow in the condemnatory sense. But Bach is difficult to appreciate unless one is prepared to concentrate, although not so difficult to appreciate as some of the ultra modern composers who, like Bela Bartok, seem to delight in a cacophony of sound that apparently means nothing and sounds like a thousand tom-cats having a Froth-Blowers' Reunion.

Appreciating Technique

As for chamber music, I will say nothing. One must forbear to suggest how the average listener can learn to enjoy chamber music, because it is really a matter of individual taste.

But even chamber music which is not "tuneful" can be enjoyed if you can learn to appreciate the technique which goes to the planning and composition of some of, say, Mozart's chamber music. Chess probably means nothing to a man who only plays golf—but a man who plays Bridge could easily learn to appreciate chess.

The analogy may seem obscure, but it is there all the same!

OPERATING THE "EASY-TUNE" FOUR

—continued from page 644

wave-lengths (about 480 metres), and the adjustment should be made so that the receiver can just nicely be made to oscillate with about three-quarters of a turn to spare on the variable high-resistance.

Having made this adjustment it will be found that when the dials are adjusted to tune the circuits in the neighbourhood of 280 metres, that the receiver will probably oscillate a little The variable resistance should now be decreased somewhat in value until the set is just stable, and after this it will be found a perfectly simple matter to tune in any station within reach of the receiver either on the upper or lower wave-lengths.

For the best possible results as regards long-distance work you will, of course, probably like to use the variable resistance as a regular reaction control, and in view of the characteristics of the circuit this will be found to be delightfully smooth and constant.

A Curious Point

A curious point which will be found with this circuit is that the H.T. voltage on the detector valve has practically no influence whatever on the reaction control. I carried out an experiment with this receiver in which I put 120 volts on the detector and then reduced it to nothing at all, or, rather, to 6 volts to be exact, by taking the high-tension positive lead to the positive terminal on the low-tension battery.

It was found, however, that the detector went into oscillation at almost exactly the same setting on the variable resistance which controls it, while the use of a different valve, from a very high-mu valve down to a power valve, hardly affected the oscillation control either.

The only point which does affect it is the use of different voltage valves. Thus a 2-volt valve and a 4-volt valve will have a different reaction demand from each other and also from a 6-volt valve.

On the Long Waves

The number of turns I have given for the reaction winding, therefore, is the maximum number of turns which will be required, and with the particular voltage valves which you may be using you may find it an advantage to cut it down a trifle.

For the long waves the operation will be found exactly the same as on the short, and the only difference that may be noticed when the long-wave coils are plugged in instead of the short-wave is that the setting of the reaction resistance has to be altered a trifle. By following the details given as to the coils, however, there will be no need to readjust the neutralising condenser. If, however, you wish to experiment with the long-wave coils, then it should be remembered that readjustments of various descriptions may be necessary when changing over from one type of coil to another.

HOW YOUR BROADCAST IS PROVIDED

—continued from page 647

are available channels. Thus, if there are ten available channels, one wave-length might be allotted permanently to the lighter type of entertainment, another to news, another to symphony music, another to modern music, another to opera, and so on. From a programme service point of view such an arrangement might be considered ideal, but technically it is unsound. Firstly, the power of the station would have to be of hundreds of kilowatts, and even then the "service area" might not extend more than 100 miles owing to fading. There would be an enormous "wipe-out" zone in which the use of highly selective sets would be necessary if any other foreign station were required to be listened to. Dense centres of population are apt to be found 300 and 400 miles apart, and it is almost essential to give an "A" service area over large towns and cities owing to the prevalence of electrical disturbances of all sorts in such localities and because "A" service areas have previously existed there.

Always an Alternative

On a single-programme service there must be as many centres of distribution as there are available channels. The provision of alternative programmes makes it necessary to divide the number of wave-lengths available by two in order to obtain the number of centres of distribution.

The above reasoning underlies the proposed so-called "Regional Scheme" for broadcasting in Britain, in which existing stations will be done away with and replaced by high-power twin-wave-length stations outside cities previously possessing single transmitters. The scheme assures to every listener an alternative programme, gives to the selective valve-set user a choice of as many programmes as may be occurring simultaneously—although some will fade and be interrupted—and makes the field strength over the country as uniform as possible.

It is important in choosing sites for these stations to take account of the dislocation that will inevitably occur. Scientifically it would be right to site the station so that the "wipe-out" area fell upon sparsely-populated, and the "A" service area upon densely-populated, parts. The majority of stations existing to-day produce a "wipe-out" area over large cities. A reduction in field strength under the new scheme may be right scientifically while wrong psychologically.

Two Receiving Problems

It is better, therefore, to arrange for the least possible reduction in actual signal strength in any area, and, even if this results in interference between two programmes, this is better than that the ordinary listener should hear nothing. There are two receiving problems to face when changing the distribution system to the dual-programme type, viz., sensitivity and selectivity. It is important that the general level of signal strength on change-over be as high as possible. The listener will soon equip himself with the necessary wave-trap.

VALVES FOR PORTABLES

—continued from page 649

of the set than the ordinary H.F. valve, which may or may not be neutralised.

As in a portable receiver both space and weight are considerations, I would not advise you to use screened-grid valves which need careful and heavy metal screening, and incidentally would need more H.T. on their anodes than the normal H.F. valves. So in a portable set which is to employ an H.F. stage we would usually decide upon an ordinary H.F. valve, which, of course, can either be resistance- or transformer-coupled and neutralised.

High-Mag. Detector

In this case a valve having a moderately high-magnification factor should be employed, so that as much magnification as possible can be obtained from this H.F. stage.

The detector valve, if resistance-coupled to the next, as it often will be in order to keep down the weight, may use anode-bend or grid-leak rectification, the latter giving a little more sensitivity, but in any case a fairly high-mag. valve should be employed. It is assumed, of course, that the portable receiver owner is not aiming at the quality of reception that can be obtained by a very up-to-date receiver which may contain any number of valves, and have high anode voltages. One

(Continued on page 675.)

VALVES FOR PORTABLES

—continued from page 674

cannot expect in the space at one's disposal, and with the small loud speaker that one must use, to be able to obtain the quality from a portable receiver that it is possible to get from a well-designed household broadcast set.

So a certain amount of quality is bound to be sacrificed, and one must make up as far as possible on the sensitivity side by using fairly high-magnification valves. For instance, in the detector stage in an ordinary broadcast set one might use a valve of 13,000 to 20,000 ohms, but in the case of the portable set, especially if it is resistance-coupled, one can do very well by having a valve with a magnification factor of 35.

The L.F. Stages

This may cut off a little of the high notes, but that will not be noticed in a portable set like it would in a really up-to-date indoor receiver, while it will certainly give a far greater magnification, and a high-mag. valve is worthy of its position in this stage.

Coming to the first L.F. stage, we find that here resistance-coupling or transformer can be employed. Here a little more care is necessary, and grid bias must, of course, be employed, but a valve with a magnification factor of 20–35 can be used in this stage if resistance-coupling is employed, for with the majority of portable receivers there is no fear of badly overloading at this stage, especially if a frame aerial is employed as the pick-up.

If this stage is transformer-coupled, a transformer having a fairly high-impedance primary should be employed and a valve of about 12,000 ohms to 20,000 ohms impedance can be used. This will enable a reasonable magnification to be obtained, and will enable the owner of the set to get as much range out of the receiver as he can.

The Last Valve

The last valve is always a problem when one is designing a portable set, for here one has to watch the question of overloading even more carefully than one has to in an ordinary broadcast receiver, because the H.T. voltage is limited, in fact, I may say, it is very limited indeed, because if

(*Continued on page 676.*)

VALVES FOR PORTABLES

—continued from page 675

one uses a super-power valve in the last stage of a portable set, this valve will probably take anything from 15 milliamps upwards, so that one would have to use more bulky H.T. batteries in order to last for any reasonable length of time.

Now, the best thing, as a rule, to do in a portable set is either to use an ordinary power valve having an impedance of somewhere about 5,000 ohms and grid bias it very carefully, putting as much H.T. on it as is possible, or to use the super-power with average batteries and not expect them to last too long.

Don't Expect Too Much

The quality will not be quite the same in the former case as that obtainable from more carefully chosen apparatus, but it can be reasonably good, and as the signal strength from a portable set is never expected to be that obtained from the larger broadcast receiver of a more bulky type, the power valve will usually handle quite sufficient for ordinary use.

After all, a portable set should not be expected to give enough volume to fill a dance hall or anything of that description, and you should find that an ordinary power valve suitably biased in the last stage will operate the loud speaker usually incorporated in such a set with every satisfaction.

It is largely a matter of choice, of course, whether one has range or quality in such a set, but it should be remembered that ultra good quality should not be expected from any portable set, because the loud speaker and the whole design of the set rather militates against *super* quality being obtained.

The True "Portable"

When talking about a "portable" receiver, I mean that type of set that can be carried about with ease. I am not referring to a receiver that is *transportable*, and can with difficulty be carried from room to room, and which is normally used as an ordinary broadcast set. This article is devoted solely to the question of the outdoor portable, so that I do not want the reader to get the idea that all portable sets, or, rather, all sets that are called portables, must necessarily give mediocre quality.

There are "portable" sets on the market that give excellent quality. I merely wish to point out that in the majority of designs of home-made sets a certain amount of quality has to be sacrificed in order that sensitivity of a fairly high degree can be obtained.

Care Must Be Taken

This is inclined rather to militate against the quality—not seriously, perhaps, but it is bound to suffer slightly. So in designing your portable set, and in choosing the valves for it, you will have to choose between sensitivity and quality, or a mixture of the two. If you go all out for sensitivity and do not worry about quality, then use fairly high-magnification valves as far as possible. If you want quality and not much sensitivity—that is, you do not want to use the set far from a broadcasting station—then use valves with fairly low-magnification factor, grid bias carefully, use plenty of H.T. and design your circuit accordingly.

But if you want a mixture, then you should follow the lines that I have laid out. Use valves of fairly high impedance, but do not go too high, especially in the last stages, and always employ as much H.T. as is practicable. Do not forget the grid bias, and remember that in the majority of sets resistance-coupling is almost as sensitive as transformer with a good valve, and it is much cheaper from the point of view of H.T. consumption, and is usually lighter.

So that an H.F. stage and grid-leak detector, followed by two resistance, or one resistance and one transformer, if the transformer is not bulky, forms an ideal four-valve portable receiver, provided the design and choice of valves and components are given due consideration and careful thought.

WHAT READERS THINK

—continued from page 656

to be really keen on "this Programme Business?" An outsider would not do—it requires someone who thoroughly understands studio and microphone work and requirements, in a practical way, from practical experience, therefore it ought to be some one already on the Staff at Savoy Hill, and it is probable there is no one so capable of managing this important work as Mr. Rex Palmer. He has been on the Staff from the beginning, and has worked not only behind the scenes, but also *at the microphone*—a very important point—and that as an announcer in charge of various programmes, and also as a professional vocalist.

The Suggestion

That he is very deeply interested in the programmes I know, for a few months ago I visited Savoy Hill several times in the course of three weeks for the purpose of being present in the various studios for transmissions of every class of programme—except Military Band—and, at his request, I then met Mr. Palmer, and we had several conversations on broadcasting in general and programmes and transmissions in particular, and I found him very keen indeed. I have no idea if he would care for the post of Director-General; I am considering the question from the listeners' point of view only.

Can you not make a move in the matter in your papers, which are so popular and read by such large numbers of listeners? There is no doubt that Mr. Palmer's appointment would be very popular—particularly if pressure were brought to bear on the "powers that be" to make him ex-officio Head of the General Programme Department.

"A Highly-Trained Musician"

If any move be made in the matter I beg that my name may be kept out of it altogether, please. If you wish to publish this letter in part, or the whole, do so by all means, but without my name.

I am a highly-trained musician with a large concert experience, and, on my mother's side, a member of an old well-known theatrical family. I received most of my singing training from the late Alberto Randegger and Manuel Garcia—from which you will gather that I am no longer young.

Yours faithfully, ——

VAMPIRE VALVES

—continued from page 664

figures obtained prove somewhat interesting to compare.

To return to the table, it will be found that of the valves tested, which are more or less a representative stock, four give a drop in signal strength in the neighbourhood of 25 per cent, four give a drop of 20 per cent, and the balance give a drop of 15 per cent to 8 per cent. The majority of readings show a drop in the neighbourhood of 8 per cent.

Why Figures Vary

These readings, however, only refer to the losses occasioned by connecting one pair of electrodes across the tuned circuit; the two main divisions representing the losses between grid and filament and plate and filament. Readings were taken between grid and plate, and these were found to be of the same order as those occasioned by the connection of the other two pairs of electrodes.

Now, in actual practice, neglecting the H.T. battery, the circuits associated with any one valve are approximately as shown in Fig. 4 at A. If we redraw this as at B, showing grid-filament, grid-plate and plate-filament elements as resistances, it will be seen that we have not got one set of losses only across the tuned circuit. This accounts for the fact that in the practical circuit on which I first took measurements the losses obtained were greater than any of those shown in the table.

It will be noted in the table of the readings which I took that certain items have been marked with a cross. In view of the fact that I had not got 2-, 4-, and 6-volt valves of all makes I have not been able to use the same make for the tests in each column. The valves marked with a cross, therefore, do not belong to the type indicated by the column heading.

Foreign Valves

Three different types of valves of continental make were also tested, but these gave quite reasonable figures and were in no way as bad as one might have expected from their appearance and price. One of the worst valves indeed that I measured was an old bright-emitter, and this was not as bad as the reading given by valve C, type No. 1, in the 2-volt class.

As a matter of interest, I took some readings with a valve in a holder connected across a 6-pin base with a 6-pin coil former plugged in position. The valve holder I used was an anti-microphonic one of a popular type, the other components also being of standard make. The readings obtained were as follow:

1. Signal voltage, 2·9. 2. With an average valve inserted in valve holder connected across the tuned circuit, 2·1. 3. With valve, holder, 6-pin coil base and 6-pin coil, 1·9.

Effect of "Lighted" Filament

I also tried the effect of lighting the filament of the valve, and as soon as this was done the H.F. voltage dropped to 0·95. On H.T. being applied to the valve, however, the value actually used being 60 volts, the signal voltage rose to 1·45, and on applying grid bias the voltage rose again.

RECENT RECORD RELEASES

—continued from page 639

Dance Records

Brunswick. ***The Sunrise*** (F.T.) and ***The Man I Love*** (F.T.). Ben Bernie and his Hotel Roosevelt Orchestra. (10 in. 3s. 3735.)

Two very good pieces, played well and excellently recorded. They are both very tuneful.

Broadcast. ***Can't You Hear Me Say I Love You?*** (W.) and ***Music and Moonlight*** (F.T.). (1s. 3d. 239.)

Worryin' (W.) and ***The Trail of the Tamarind Tree*** (F.T.). Harry Bidgood and his Broadcasters. (1s. 3d. 238.)

Sunshine (F.T.) and ***Singapore Sorrows*** (Slow F.T.). Ciro's Club Dance Band. (1s. 3d. 236.)

What'll You Do? (F.T.) and ***Let a Smile Be Your Umbrella*** (F.T.). Riverside Dance Band. (1s. 3d. 241.)

All such good records that it is difficult to differentiate between them.

Pathé Perfect. ***There Must Be Somebody Else*** (F.T.) and ***Dream Kisses*** (F.T.). Meyer's Dance Orchestra. (10 in. 1s. 6d. P358.)

An excellent record. The latter item is particularly tuneful.

Parlophone. ***Enchantment*** (Tango Blues) and ***Jalousie*** (Tango Blues). The Pavilion Lescaut Tango Orchestra. (10 in. 3s. R3529.)

Two of the prettiest and best-played tangos we have heard for a long time. Lovers of this kind of music should certainly get this record. Superbly played and equally well recorded.

RADIO ABROAD

—*continued from page* 640

power output is 50 kilowatts, which, according to Dr. Alfred Goldsmith, the chief broadcast engineer, can be depended upon to give a reliable service within a radius of 100 miles under all conditions.

The 250-ft. aerial is supported upon two lattice steel towers 300 ft. in height. The towers will be illuminated by flood-lights at night, to serve as a guide for aviators, and also as a warning in case the aeroplanes might strike the masts or the wires.

The power supplied to the installation is sufficient to light 10,000 homes. The current for the filaments of the big transmitting tubes would operate 200,000 of the low-consumption receiving valves, or about 50,000 average receivers. The energy used in the plate supply of the transmitter would provide sufficient H.T. supply for about half a million ordinary receiving valves.

Trouble in Sweden

A curious and rather amusing problem is troubling wireless enthusiasts in Sweden, owing to the prevalence of large apartment houses and to the fact that on the roofs of many of these houses there is a tangled mass of aerials, whilst the hot-water installation of the building is made use of as a common earth return. It is not difficult to imagine the readiness with which "diplomatic relations" may break down between two otherwise perfectly friendly neighbours in the event of their respective aerials crossing, or even being suspected of interfering!

A house in Gothenburg has adopted a very simple contrivance for getting out of the difficulty by which everyone shares alike. A small iron ring is supported at the centre of the available roof space a few feet above the roof, and from this the various aerial wires radiate more or less at regular angular intervals. The net result by the time about fifty aerials are erected is a kind of gigantic spider's web; but, at any rate, there can be no actual crossing of aerials, and no individual can allege that anyone else is receiving preferential treatment. Every tenant is required to pay a fee of 15 kroner (about 16s. 3d.) for his aerial.

In Stockholm, in some of the hospitals, a system is now being adopted similar to that in use in some of the hospitals in this country.

RADIO WITH GRENFELL IN LABRADOR

—*continued from page 628*

end of Lake Melville where it joins a very narrow waterway and so reaches the sea twenty miles farther on. Here a 10-knot current is running, and it behoved us to be very careful.

There was a very strong, blustery wind blowing, and at times our lee rail was entirely under the water as we simply flew down that narrow waterway. Then just ahead we saw the water was lashed to fury as a squall was coming from a half-hidden cove.

After a short consultation we decided to reef our sails, and made in under the land to do so. Our lucky star was not in the ascendant, however, for before we could do a thing the squall was upon us, and we were driven ignominiously ashore.

A kedge anchor was immediately thrown over, and there we lay quite quietly, apparently none the worse, though very hard and fast. Fortunately the tide was rising, and a few hours later, when the weather had moderated, we hauled on the kedge and, to our satisfaction, floated easily, none the worse for our stranding.

Two days later, after but one more incident worthy of note, we arrived at Indian Harbour in a very severe snowstorm. The incident should not have happened, but, remembering how very nearly we had run out of water, we replenished at a creek not far from the scene of our stranding. We were over two hours out when, sitting down to lunch, we found milk, tea, soup, and everything as salt as if made with brine.

The Smoky Island Station

There was nothing for it but to go in again for water, as we might very easily have encountered bad weather which would hold us up for days. We made inshore and anchored off the mouth of a fair-sized stream.

Over went the dinghy, and we rowed very carefully in a very big swell over immense rocks just showing under the surface. A little farther along we saw the water tumbling over a fall composed of huge boulders, and with great difficulty we manœuvred the tiny craft as near as possible in order to ensure the water being fresh this time.

It was so cold the barrel was covered with ice by the time it was full, but for all that it tasted better than the finest wine on earth. We returned to the yacht, and the rest of the outward trip was without particular incident.

It was a bitterly cold morning in the first days of November when we anchored at Indian Harbour, three miles from Smoky radio station, with a sense of great relief, donned our sealskin boots, and started off across the land, covered feet deep in snow, towards the wireless station. The photograph shows the barren spot it occupies but cannot convey the bleakness of the place, standing as it does at the top of a small mountain lashed by the fierce winter winds and blizzards.

We found Mr. Watts dismantling his apparatus, and news of the outside world was received next day as the last mail steamer left the Labrador coast for many long months.

We listened in silence to the news of many disasters to vessels less fortunate than ourselves, for we still had to brave the terrible Hamilton Inlet and Lake Melville on our return trip. One hundred and fifty miles does not seem far when one thinks of a fast railway express, but with an Arctic blizzard and contrary winds we might have been ten thousand miles away.

Communication With England

I am writing this at Indian Harbour at anchor. It has been snowing all day, and we are comforted by the thought of raising that anchor with twenty-five fathoms of chain by hand, partly covered by ice as it is, to be hacked away at dawn to-morrow when, if weather conditions permit, we will venture out on our return trip.

On arrival at Northwest River, Mr. Watts will be initiated into the mysteries of short-wave apparatus, as compared with the "rock-crusher" variety, and then endeavour to return by some means or other to St. Anthony, Newfoundland. Should the "Bay" freeze up —as is more than likely—it will be necessary to do the journey by dog-team and komotik, a very pleasant prospect indeed.

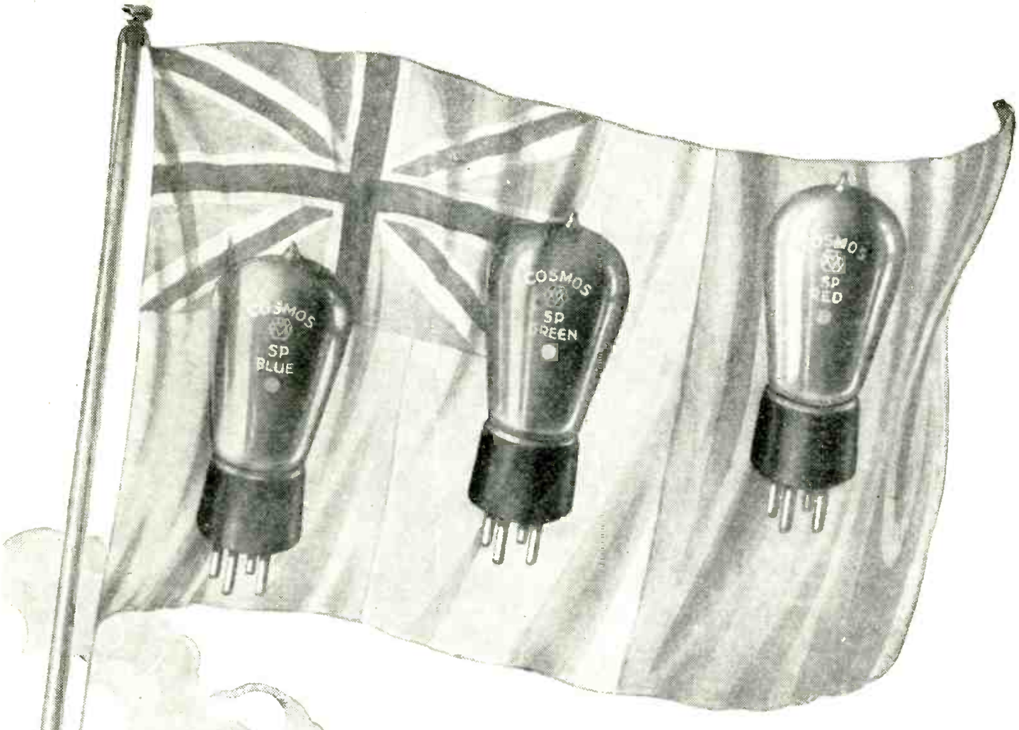
As it may interest some, I give a list of the British stations worked from Northwest River since its opening some three weeks ago: E G 2 A O, 2 D N, 2 N H, 5 B Y, 5 M A, 5 M L, 6 I Y, 6 W L, 6 N X.

6 W L tells me that his transmitter consists of a B.T.H. B.5 valve supplied with H.T. by dry cells! His signals were R.5 at times. Another tribute to low-power work. In addition to the above EG stations, over sixty NU stations were worked, as well as Holmgren Radio in Malmo, Sweden, and many stations in different parts of Europe.

Both N E 8 A E and N E 8 W G will be operating in the 20- and 40-metre bands this Arctic winter, and every station communicated with will receive a Q.S.L. card, though, owing to the length of time it takes by dog-team for the mails to be carried to the outside, cards may not be received for many months.

INDEX TO ADVERTISERS

All communications concerning advertising in "Modern Wireless" must be made to John H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. Telephone: City 7261.



BRITISH TRI-COLOUR VALVES

THE 'STANDARD' OF COMPARISON

"Cosmos" Valves have also set the standard for the six-volt user, as well as for those who prefer to use two volts.

The S.P.50/B Blue Spot for H.F., Resistance Coupling, and possibly Detector stages. This valve has an amplification factor of 35 and an impedance of 50,000 ohms.
This valve is particularly suitable for use with the Cosmos Resistance Coupling Unit.

Price **10/6**

The S.P.50/R Red Spot is acknowledged to be the super-power valve. Used in the last stage it has an amplification factor of 6·5 and an impedance of 4,500 ohms

The S.P.50/R is the ideal valve for operating a cone-type loud-speaker.

Price **12/6**

No other valves in the same class give such astonishingly good results, because no other valves can have the advantage of being built on the SHORT PATH principle. Every Wireless paper and Technical correspondent recommend them, but no one more so than present users.

Ask your dealer for Booklet 4117/3, which also gives details of the S.P. 2-volt valves and the remarkable 'Cosmos" A.C. Mains Valves. A line to the makers will bring it to you free by return post.

MET-VICK

VALVES, SETS & COMPONENTS

METRO-VICK SUPPLIES LTD., 155, CHARING CROSS ROAD, LONDON, W.C.2. RV/87

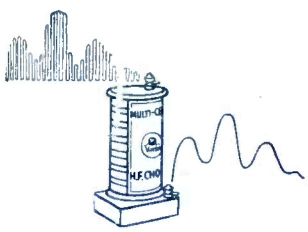
SPECIALISTS IN LOW FREQUENCY AMPLIFICATION

YOU—one of thousands—are satisfied *only* with real QUALITY in wireless reproduction. In the past, tens of thousands were content with very poor reception provided they could tune in a few stations at audible loud-speaker strength. But the time is coming when the public as a whole will insist on really good reproduction, and, what's more, many already know they can get it by using R.I. & Varley components. We have made a special study of all forms of L.F. Intervalve Coupling, because we realise the necessity for QUALITY if radio is to be really worth while.

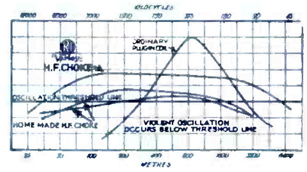
The famous Bi-duplex winding, developed and perfected after years of research, has been incorporated in our Resistance Capacity Couplers, and has resulted in a degree of real tonal purity undreamt of hitherto. The National Physical Laboratory Curves of our R.C. Couplers and Straight Line Transformer show that a wonderful degree of amplification has been attained, together with remarkable uniformity at all audible frequencies. That explains why you can hear the deepest bass notes and yet lose none of the high frequencies when using the R.I. & Varley Transformers or R.C. Couplers.

In this connection it must be remembered that no matter how good an L.F. Transformer or R.C. Coupler may be, distortion is bound to result if the H.F. Choke fails to choke back the H.F. currents efficiently.

Here again our Bi-duplex winding has enabled us to produce a component which for negligible self-capacity, minimum external field, extremely small dielectric hysteresis, and maximum choking efficiency over a very wide range, has no equal on the market to-day.



This diagrammatic sketch illustrates the effective way in which the R.I. & Varley Bi-duplex wire-wound H.F. Choke (9/6) deals with H.F. currents.



Comparative curves showing relative choking efficiencies. It will be seen that the R.I. & Varley H.F. Choke—distributed capacity 25 microfarads—chokes efficiently over a range of from 30–4,000 metres (10,000 to 75 kilocycles).

General Purpose Transformer
15/-

"Popular Wireless" writes—"It must have been very skilfully designed for it gave results far superior to those its price would lead one to anticipate. We must admit it falls very little short of transformers in the one pound class."

Bi-duplex Wire-wound Resistance Capacity Coupler.

Type A .... 20/-.
Type B .... 22/6.

Straight Line Super Transformer
25/-

THE MARK OF RI AND Varley LTD BETTER RADIO

Kingsway House, 103, Kingsway, London, W.C.2. *Telephone: Holborn 5303.*

Printed and published by the Amalgamated Press, Ltd., Fleetway House, Farringdon St., London, E.C.4, on the 1st of each month. Address for advertisements only: John H. Lile, Ltd., 4, Ludgate Circus, E.C.4. Telephone: City 7261. Registered for transmission by Canadian Magazine Post. Subscription rates: Inland and Abroad, 17/- per annum; 8/6 for six months. Sole Agents—Australasia: Gordon & Gotch (Australasia), Ltd.; South Africa: Central News Agency Ltd.; Canada: Imperial News Co. (Canada), Ltd.—June, 1928. D/R