The Wireless Constructor

6D MONTHLY

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

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CONTENTS

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 patentee to use the patents before doing so.

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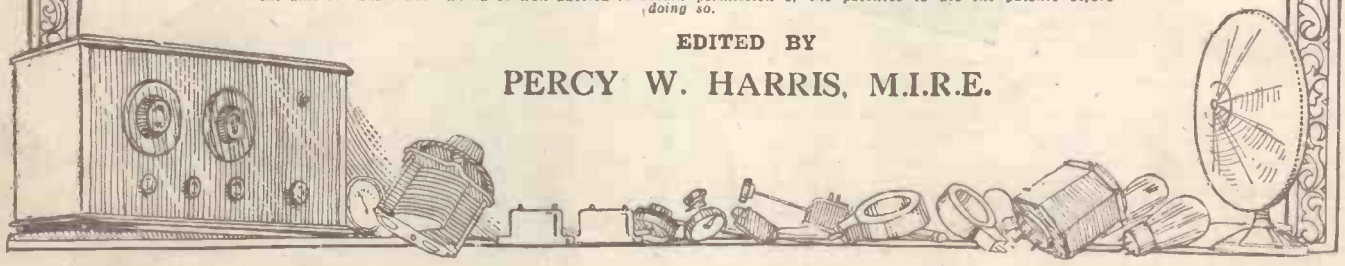

The WIRELESS CONSTRUCTOR

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

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THE EDITOR'S CHAT

In this article Percy W. Harris, M.I.R.E., the Editor of the "Wireless Constructor," discusses the topical question of Portable Sets.

IT is just a year since we published the design of the "Roadside" Four, and in this number, profiting by the experience of twelve months and a very wide use of original designs, we are publishing the New "Roadside" Four, which we feel sure will meet with a widespread welcome. Improved appearance, additional sensitivity, a wave-change scheme by a simple switch, and an excellent quality of reproduction, are but some of the features which will appeal to our readers. As usual, the clearest possible constructional details are given, with a fully adequate collection of photographs and drawings to facilitate the work.

Those Amazing Results

To describe the results obtained with a portable receiver is somewhat difficult in these days, in view of the greatly exaggerated claims put forward by manufacturers of some commercial portables. Shorn of all fanciful description, a portable receiver is simply a compact wireless receiver utilising a small (usually very small!) frame aerial as a pick-up device in place of the usual indoor or outdoor aerial.

Demands of Compactness

The circuits used in portable receivers are but modifications, for compactness and convenience of handling, of those used in ordinary cabinet receivers, and the extremely small space in which it is necessary to pack them prevents us obtaining the fullest efficiency possible with a layout arranged in a more convenient space. The 120 to 150 volts which is becoming more and more usual for the high-tension of normal sets cannot conveniently be utilised in a portable receiver, and the demands of compactness and weight limit the filament voltage to two, thus preventing our using the most highly efficient valves, i.e. the six-volt variety.

Exaggerated Claims

We thus see that a receiver made up in portable form is bound to be less efficient than the same circuit and components used in an ordinary cabinet set with outside aerial and earth. And yet what do we find? Claims for the reception on a loud speaker, using a 12- or 15-in. frame, of sufficient distant stations to reflect very great credit on any receiver with the same number of valves, used on a thoroughly efficient outside aerial. Indeed, a seven-valve superheterodyne operating on a frame at least double the size of that built into the average portable receiver cannot be relied upon to give consistent reception from the list of stations which some portable manufacturers wave before the eyes of intending purchasers.

However, it is surprising what can be done with a portable receiver on a

TELEVISION TESTS IN PROGRESS

Members of the staff of the Baird Television Co. giving one of their test television broadcasts. Attempts were made to prove the possibilities of plays being given by the Baird process on a commercial basis.

The Editor's Chat—*continued*

small frame when critical reaction is used. Loud-speaker reception from the local and alternative stations together with 5 X X and Radio-Paris presents no difficulty whatever, very little reaction being used in most cases to get these results.

Test Results

After dark and *on a good night* some fifteen or twenty other stations *may* be picked up and identified on the loud speaker, but the chances of getting these all on one night are remote, and comparatively few of them can be received at what the average listener would describe as loud-speaker strength—strength sufficient for the enjoyment of the programme by a group of people sitting in an ordinary living-room.

"Business Man's" Four, which is rapidly gaining adherents.

Short-wave enthusiasts will find in this number the description of another short-wave receiver designed by Mr. L. H. Thomas, whose short-wave articles have been regular features of this paper.

"Stedipower" users will be glad to hear that as the result of researches made by one of the manufacturers of electrolytic condensers it has now been found to be quite safe to use the "Stedipower" two-ampere unit, not only to supply the low-tension to the set, but also and simultaneously to supply the six-volt current to a moving-coil loud-speaker field. It will be remembered that when describing this unit we told readers not to use the unit in this way, owing to what was then considered the risk of puncturing the condensers due to the sudden voltage rise in the loud-speaker windings due to the breaking of the field current.

A TANK CONTROLLED BY RADIO

A veteran tank has been lent by the War Office to a film company, who are to use it in some spectacular scenes. Three cars are to be crushed by it. The tank will be controlled by the radio apparatus to be seen on the left.

The station-hunter, however, who is content to pick up a station and identify it at feeble loud-speaker strength, can make quite a good list of stations with this kind of receiver. During the tests of the New "Roadside" Four, a programme from Milan was enjoyed for some ten minutes, strength being quite good for an ordinary living-room, but although the station has been picked up on several occasions since, the strength has not again been equal to that of the particular night.

For the Short Waves

London, 5 G B and 5 X X, Radio-Paris, Eiffel Tower, and a few Germans have, however, been consistently good, as indeed would be expected from a circuit based upon the New

More Picture Transmissions

A short article in this issue explains why this warning is no longer necessary.

We welcome the step taken by the B.B.C. in giving more still-picture transmissions. These are now provided from 2 L O and 5 G B, as well as from 5 X X. Transmissions are also taking place at night, as well as in the daytime, thus being available to the average experimenter. A complete list of the Fultograph picture transmissions, up to the time of going to press, is given in another part of this issue.

May we again thank readers for suggestions for articles which continue to pour in. It is not always possible to acknowledge these personally, but every one is carefully considered and many are adopted. Letters of appreciation of WIRELESS CONSTRUCTOR sets are also much valued, for it is a great help to know that a particular design or set meets with the exact requirements of readers in conditions which they outline.

THE NEW "BUSINESS MAN'S" FOUR

SIR,—I am writing this to congratulate you on the New "Business Man's" Four. I had been using the original "Business Man's" Four for about twelve months, and I was so pleased with it that I had to build this one as soon as I saw it. The results are far beyond my expectations.

I have built it as described by you, with the exception of the reaction condenser which I could not get, so I have used a very small variable condenser. So far, I have logged 56 stations between 215 and 2,000 metres. With the reaction set constant I can tune-in 24 stations which can be listened to.

Perhaps you will be surprised to know that I have picked up eight short-wave stations with this receiver without touching anything but just to change the coil. These stations are: W 8 X K (U.S.A.), 2 unidentified (U.S.A.), W 2 X A F (U.S.A.), W 2 X G (U.S.A.), P C J (Holland), 3 L O (Melbourne), Transtlantic Tel.

I am listening to W 8 X K (U.S.A.) as I am writing this letter. Their strength is R4, with very slight fading. The programme commenced at 8.0 p.m. (G.M.T.).

Items from W 8 X K

Items from 9.10 p.m. are: A talk to English people about Warwick Castle, the Midlands, Stratford-on-Avon, and Shakespeare, with musical interludes. Then followed an advertisement for some patent floor covering. 9.45 p.m.—Afternoon service preceded by an organ solo, "The Lost Chord," by Sullivan, the service still proceeding as I close this letter, 10.10 p.m.

P. BLOOM.

Hertfordshire.

The NEW ROADSIDE FOUR

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

This fine portable receiver embodies the many virtues of the original "Roadside" Four plus screened-grid sensitivity, remarkable quality, and wave-change flexibility by means of a simple switch.

EXACTLY a year ago the WIRELESS CONSTRUCTOR presented to its readers the design for the "Roadside" Four, a portable receiver which at once attained immense popularity and which proved to be a most successful set.

The leading advantages of the "Roadside" Four were great sensitivity and exceptionally good quality. In addition to these advantages, the set, although incorporating high-frequency magnification, had only one-dial tuning. The circuit used was such that almost constant reaction was obtainable over the whole scale, while the well-known WIRELESS CONSTRUCTOR feature of simplicity of construction was once again prominent.

Since the appearance of the "Roadside" Four, numerous portable receivers have been placed on the market, but few have given on four valves a performance comparable with the "Roadside" Four.

Still Better

At the same time, the WIRELESS CONSTRUCTOR laboratory has not stood idle, and has been endeavouring to produce something still better. I am glad to say that the New "Roadside" Four is really a definite advance, for not only are the appearance and performance better than formerly, but we have been able to include, without any sacrifice of efficiency, a dual-range switch, so that both wave-bands can be completely covered.

One of the outstanding features of the new set is its remarkable quality of reproduction. This has been commented upon at once by everyone who has heard it. "I had no idea it was possible to obtain such quality with a portable!" has been the remark of most. "How on earth do you manage to do it?" We can say at once that the reason for its exceptionally good quality is not only the choice of a good circuit and components, but also that we have gone out deliberately to remove low-frequency reaction effects, so frequently present in portable receivers, and which, while raising the low-frequency amplification somewhat, only do so by the introduction of

COMPONENTS REQUIRED

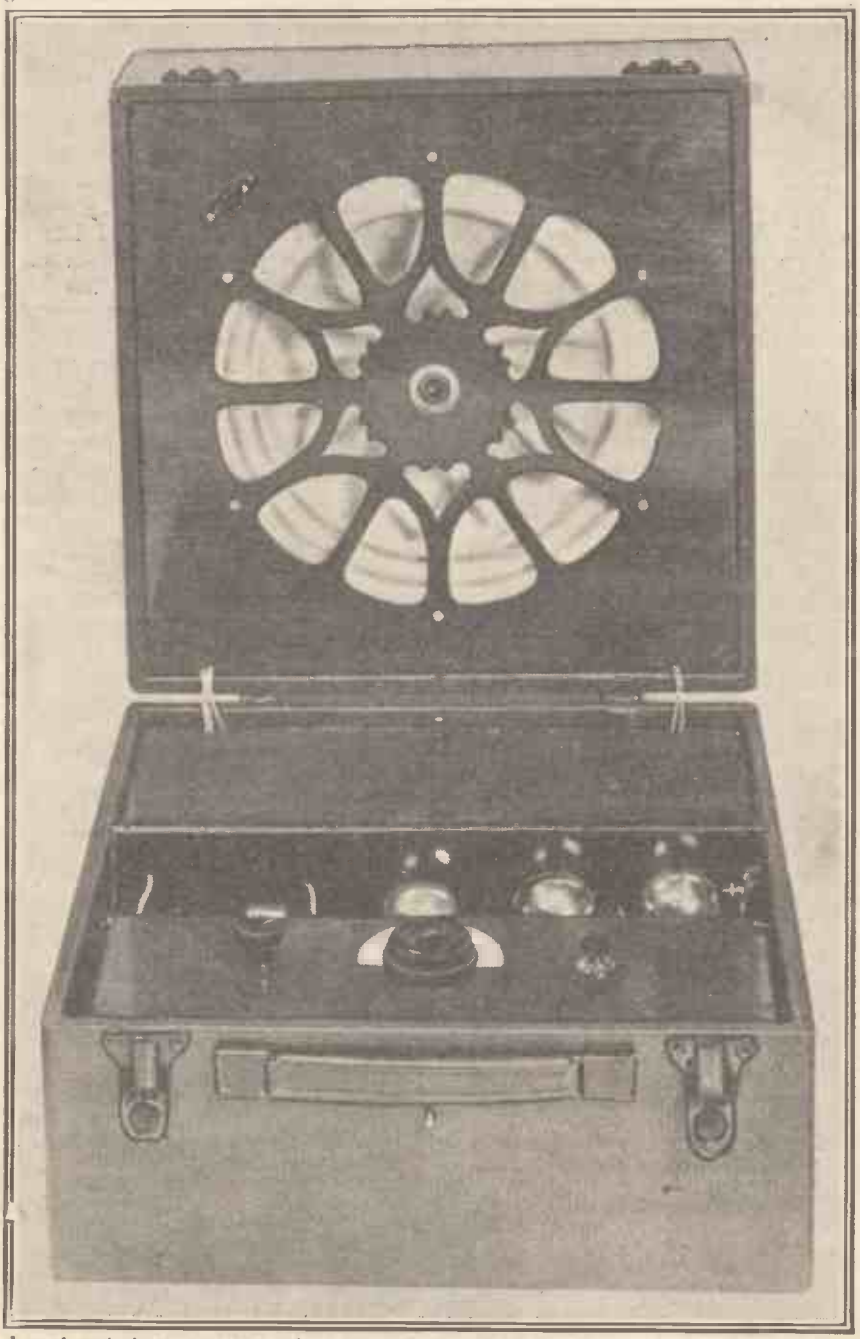
1 Portable cabinet, as drawing, for New "Roadside" Four (Camco).
1 Two-pole change-over switch (Utility new pattern). (Dubilier, Wearite, etc.)
About 60 ft. frame-aerial wire (Goltone). (Lewcos, etc.)
Half a pound No. 24 D.C.C. wire.
A few yards of single silk-covered electric-lighting flex (this can easily be made by untwisting the usual double flex).
5 Wander plugs (three red and two black). (Clix, Lisenin, etc.)
2 Spade terminals (one red and one black). (Clix, Lisenin, etc.)
4 Valve holders (Lotus). (Benjamin, Bowyer-Lowe, Godwinex, Igranic, etc.)
1 ·0005 mfd. variable condenser with vernier knob (Utility Mite). (There is not space for the usual condensers.)
1 On-and-off switch (Lotus). (Benjamin, Duco Lissen, Magnum, etc.)
1 Panel-mounting neutralising condenser (Igranic).
1 H.F. choke (Magnum or R.I.-Varley).
1 Fixed condenser, ·0003 mfd. (T.C.C. flat type). (Dubilier, Lissen, Mullard, Atlas, etc.)
2 Grid-leak holders (Dubilier, either vertical or flat type). (Lissen, Igranic, etc.)
1 Fixed condenser, ·01 or ·015 (Dubilier). (T.C.C., Lissen, Igranic, Mullard, etc.)
1 Fixed condenser, ·0003 mfd. (Lissen). (T.C.C., Lissen, Igranic, Mullard, etc.)
1 Fixed condenser, ·002 (Lissen). (T.C.C., Lissen, Igranic, Mullard, etc.)
1 Fixed condenser, ·001 (Dubilier). (T.C.C., Lissen, Igranic, Mullard, etc.)
1 Anode resistance, 40,000 ohms, with holder (Ferranti, or other good makes if they will fit).
1 Anode resistance, 3,000 ohms, with holder (Ferranti, or other good makes if they will fit).
1 Anode resistance, 20,000 ohms, with holder (Ferranti, or other good makes if they will fit).
1 L.F transformer (Cossor). Not all makes will fit in here.)
1 ½-megohm grid leak (Pye).
1 ½-megohm grid leak (Dubilier or other good make).
1 2-megohm grid leak (Dubilier or other good make).
1 2-mfd. condenser (T.C.C.). (Dubilier, Ferranti, Hydra, etc.)
1 R.C.C. unit (any good make).
2 Panel brackets (Magnum). (NOTE.—The wooden panel is provided with the cabinet.)
1 Loud-speaker mounting unit (Cromwell Engineering Co., Ltd.).
1 Loud-speaker unit for New "Roadside" Four (Cromwell Engineering Co., Ltd.).
1 "Grantona" fabric cone (12 in.) (Cromwell Engineering Co., Ltd.). (NOTE.—Next month alternative speakers will be described.)
1 2-volt screened-grid valve (Ediswan). (Mullard, Cossor, Six-Sixty, Marconi, or Osram.)
2 H.F. valves (Ediswan). (Mullard, Cossor, Six-Sixty, Marconi, or Osram.)
1 Power or super-power output valve (see note in article). (Ediswan, Mullard, Cossor, Six-Sixty, Marconi, or Osram.)
1 99- or 100-volt H.T. battery (Ripault). (Hellesen, Lissen, etc.)
1 2-volt unspillable accumulator for portable set (Ediswan). (Exide type U.S.P., etc.)
1 or 2 9-volt grid-bias batteries (see article).

The New "Roadside" Four—*continued*

considerable distortion. This generally shows itself as an over-accentuation of the high frequencies, giving a hissing background and a nasty "edge" to speech and music with very little low-tone reproduction.

The low-frequency side of the New "Roadside" Four has been worked out to give as far as possible a good uniform reproduction of all tones, without the over-accentuation of any, and instead of forcing the low-frequency amplification to the limit at the expense of quality, the necessary volume has been obtained on the high-frequency side by the use of a screened-grid valve.

The circuit used is based on the New "Business Man's" Four, which has already proved itself to give exceptionally good reproduction. Certain modifications have been introduced to meet the special requirements of a portable. Both L.T. and H.T. consumption are very reasonable, thus obviating frequent replacements of expensive batteries, while the constructional work is exceptionally simple.



A neat and clean appearance is characteristic of the New "Roadside" Four. Note the wave-change switch on the speaker fret.

The Circuit Employed

Fig. 1 shows the circuit, from which it will be seen that at the very first we have something in the nature of a novelty. One of the problems in wave-change design in a portable set relates to the use of two frame aerials, particularly when it is desired to use reaction with them.

If we have two separate and distinct frames, one for the short and one for the long waves, the presence of the adjacent long-wave frame, when working on the short wave, introduces unwanted damping and "dead spots" due to absorption. It is also possible to use a series-parallel arrangement of the windings, so that the two windings are in parallel for the short waves and in series for the long. We could also use, as in some commercial receivers, a loading for the long waves.

Special Wave-Change Scheme

The New "Roadside" Four, however, uses a special scheme which works out very well in practice. Two separate frames are used, and when switched over to the long waves the short-wave frame is disconnected. It is found that the damping effect of the short-wave frame is not marked when working on the long waves. When switched over to the short-wave side the long-wave frame is placed *in parallel* with the short-wave frame, and we thus have a small and large inductance in parallel working together. The total inductance of these two in parallel is only slightly less than of the shorter-wave frame, and the use of the two in parallel completely gets over the usual absorption effect of the long-wave winding. By using a tapping on each frame reaction is easily obtained, only a very small variable condenser being needed for the purpose.

The whole frame on each wave-length is tuned by a ·0005 mfd. variable condenser feeding by to a screened-grid valve. In order to save trouble with battery tappings, and

The New "Roadside" Four—*continued*

also to isolate the high-tension supply from fluctuating currents, series resistances are used in the high-tension leads for reducing the voltage to the screened grid and to the detector valve, while the plate of the screened-grid valve also has a small resistance in series with it.

Transformer-Resistance Coupling

The benefits of this scheme have been previously stated in this journal, and it will be remembered that the "Air Commander" had similar arrangements. The two advantages derived from this scheme are prevention of battery coupling, which normally may easily spoil the low-frequency reproduction, and the uniform discharge of the whole battery. Reaction is obtained as in the New "Business Man's" Four, from the plate of the screened-grid valve, and grid leak and condenser rectification is used with the detector.

One transformer and one resistance low-frequency stage is used, but instead of placing the resistance coupler first, following this by the transformer, as is normally the case, the transformer comes first and the resistance second. The reason for this is that when the transformer is used first it is far easier to prevent high-frequency currents getting into the low-frequency side of the set—always a likely cause of loss of quality in a portable receiver.

Shunting the H.F.

It will be seen that a ·0003-mfd. fixed condenser is shunted from the plate of the detector valve to filament, acting as a by-pass for high-frequency currents.

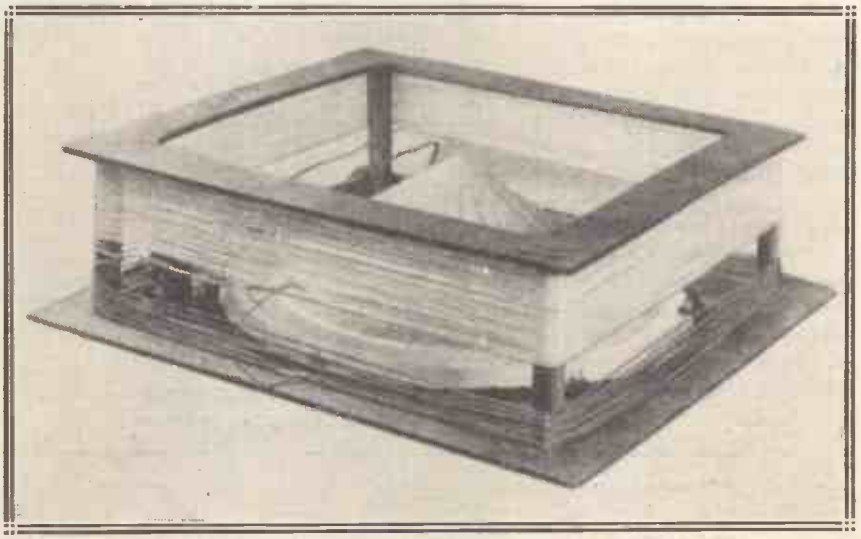
A condenser of this size shunted from plate to filament when resistance coupling is used would result in quite an appreciable loss of magnification, and at the same time the placing of a condenser across the primary of the low-frequency transformer is in accordance with the intentions of the transformer designer.

As previously mentioned, a resistance is placed in the anode circuit of the detector valve, and this is shunted to filament on the transformer side by a 2-mfd. condenser. A quarter-megohm resistance of the grid leak type is placed in the grid circuit of each low-frequency valve, and the plate of the last valve is shunted to filament by a ·001-mfd. fixed condenser.

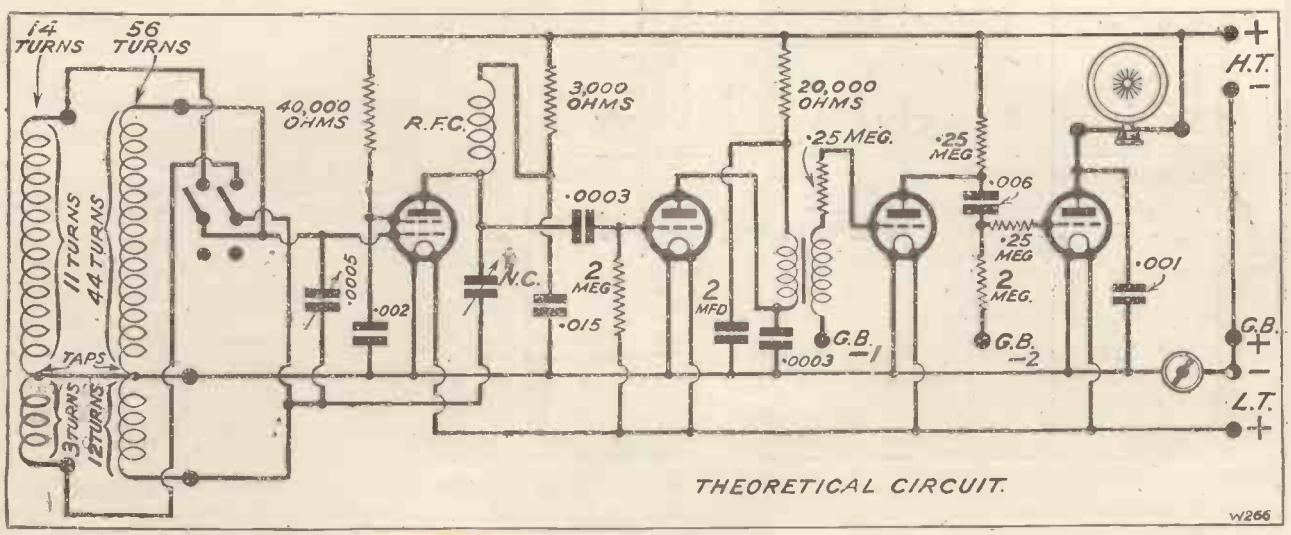
No Feed-Back Possible

Thus every endeavour is made to prevent high-frequency currents getting through and making their appearance in the loud-speaker leads, where they could easily feed back to the frame aerial, which, of course, is wound round the loud speaker. It will be noticed, too, that the secondary terminals of the low-frequency transformer are reversed from their normal connections, this having been found in practice to give slightly better results in this particular circuit arrangement.

So much then for theoretical considerations. Let us examine the



Two separate and distinct frames are used with a novel switching scheme. The speaker comes within the two frames.



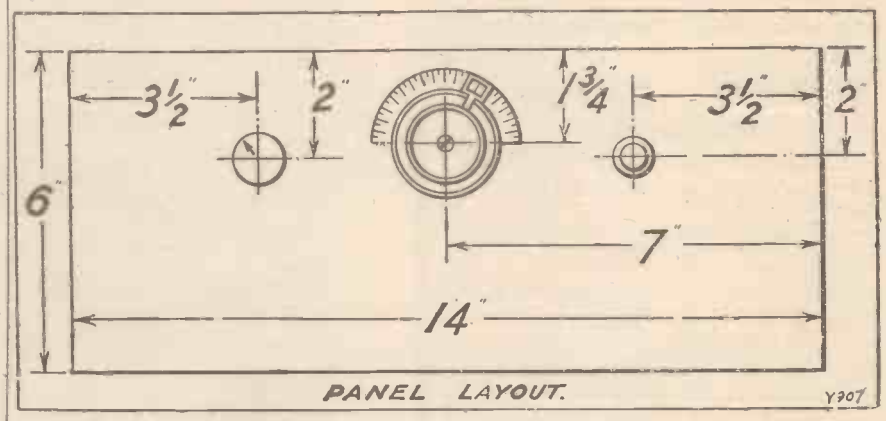
The New "Roadside" Four—*continued*

instrument from the practical side. The cabinet used is of the form which has become conventionalised for portable receivers and is often called the "suitcase" type. When the lid is open it will be seen that the loud speaker is built into it, and a wave-change switch reveals itself in the upper left-hand corner of the lid.

How Set is Arranged

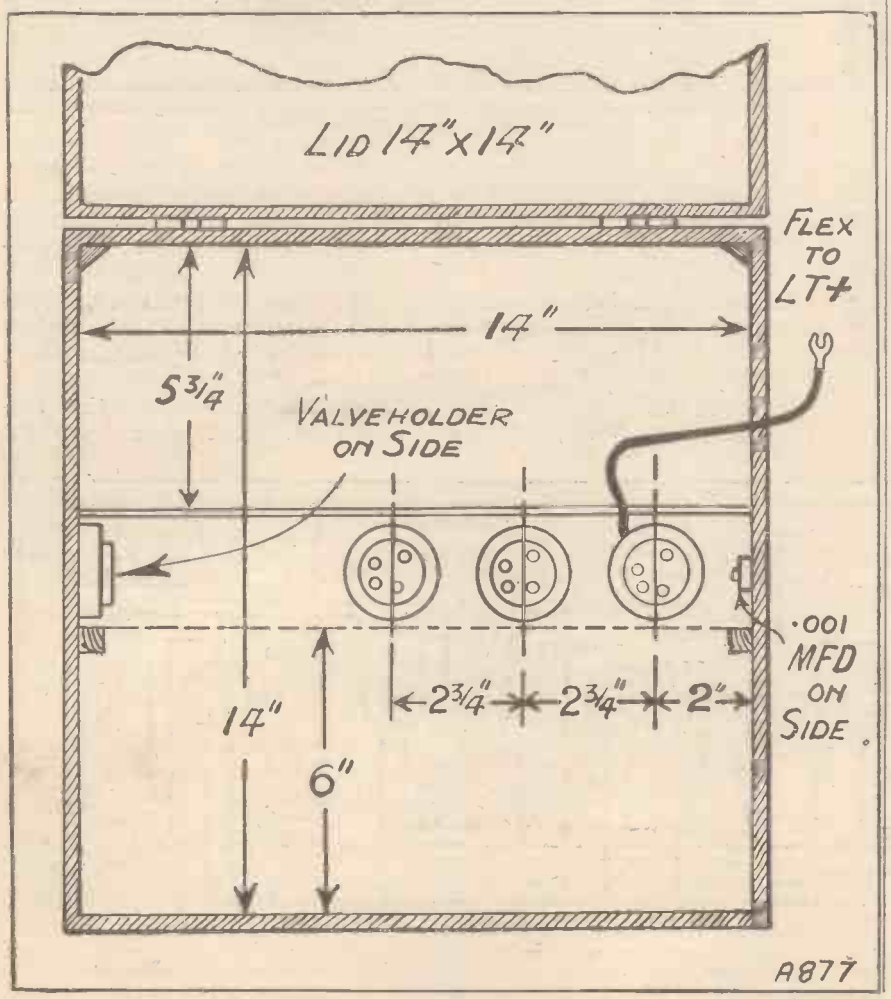
The frame aerial is concealed within the lid and is wound round the special former provided. The whole case, complete with frame, partitions, etc., ready for your own constructional work, can be obtained ready made, but those readers who like to do their own cabinet work will find sufficient particulars in the drawings to build their own cabinet.

The back of the lower half of the cabinet is occupied by the battery compartment—large enough to take a 99-volt high-tension battery, a grid-bias battery and a 2-volt unspillable accumulator. In front of this will be seen the valves, and nearest to the operator the control panel, made of mahogany faced plywood. Thus there is no ebonite panel in this receiver.



The single tuning control, fitted with a vernier dial, is in the centre of the control panel, while a small knob on the left gives the variable reaction. On the right of the tuning dial i placed the on-and-off switch, so tha the whole affair is characterised by great simplicity.

Much thought had to be given tc actual constructional methods to suit WIRELESS CONSTRUCTOR readers, and we are glad to be able to say that something quite new in this way has been evolved. By a combination of rigid and flexible leads the whole set can be built very rapidly and tested before it is finally secured in the cabinet.



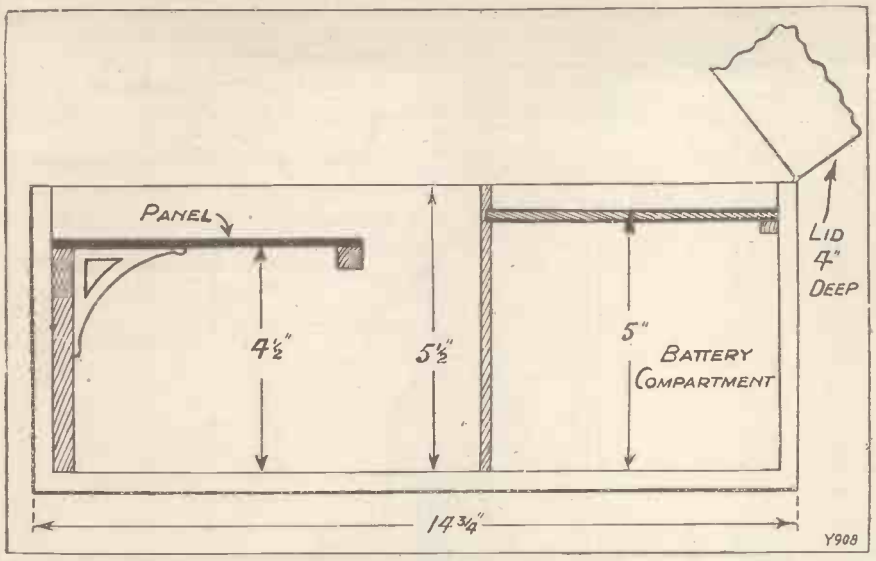
Mounting the Valve Holders

The valve holders are screwed into the case itself, as shown in the illustration on this page. The tuning and reaction condensers, the switch, the radio-frequency choke, the transformer, the resistance-capacity unit, etc., are all mounted on a small baseboard in a general arrangement, which is easily seen in one of the photographs. The valve holders are not on the same baseboard as the rest of the apparatus, and thus flexible leads must be provided for attachment to the valve holders and one or two other parts.

Just how this is done is made perfectly clear from the photographs and diagrams. Briefly described, the constructional work consists of, first of all, winding the two frames and wiring them up to the switch, mounting the loud-speaker unit, placing the loud speaker and frame assembly in the lid of the cabinet, and bringing out flexible leads from it for connection to the receiver proper and batteries.

The next step is to fix the valve holders in place and wire them up, so far as the filament circuit is concerned, after which we proceed to assemble the components on the

The New "Roadside" Four—*continued*



The novel method of fitting the apparatus on baseboard and panel is shown in this diagram, and in the photograph below.

baseboard and control panel. When this last is wired up with its flexible leads we stand it in the box, and the flexible leads which have been attached to it are taken across and screwed underneath the terminals on the valve holders, while the flexible leads from the frames are connected as shown.

The batteries are then placed in the battery compartments, and the battery leads made up with wander plugs and spade terminals.

The set can then be tried out, and when you have assured yourself that all is well, all that is necessary is to lift out the baseboard and control panel with the flexible leads attached, turn it through a right angle and screw it in place to the fillets fitted to the sides of the cabinet. After this all that remains is to fit on the lid of the battery compartment, when you can at once enjoy all the benefits of a good portable receiver.

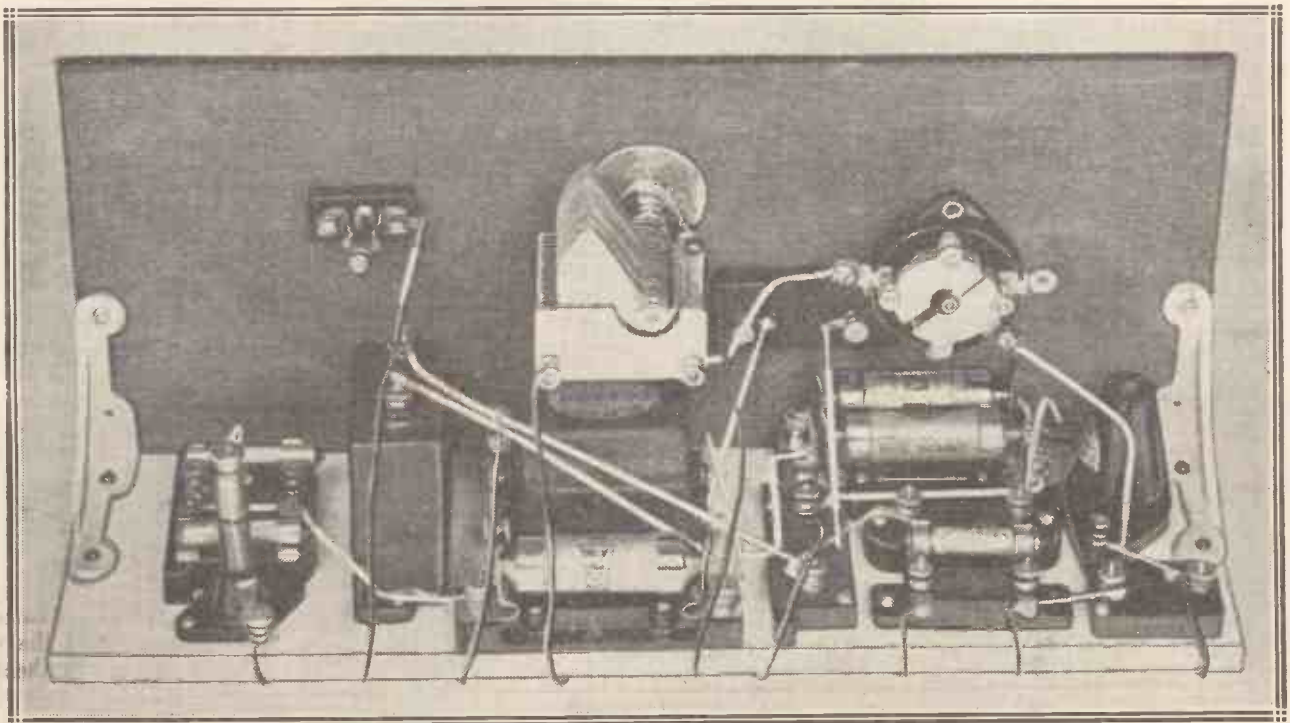
Begin your constructional work by mounting the two-pole change-over switch in the position shown on the loud-speaker fret. Next, mount the loud-speaker unit on the inside of the fret and attach the cone. This work should be carried out very carefully, as it is necessary that the rod attached to the loud-speaker movement should come exactly centrally on the cone. Be careful not to bend this rod. Full particulars for mounting are sent with the unit.

Winding the Frames

Prior to finally attaching the cone, take two flexible leads from the loud-speaker unit, pass them through a small hole in the fabric cone and leave them free for the moment. These need to be about 18 in. to 2 ft. long for preliminary work.

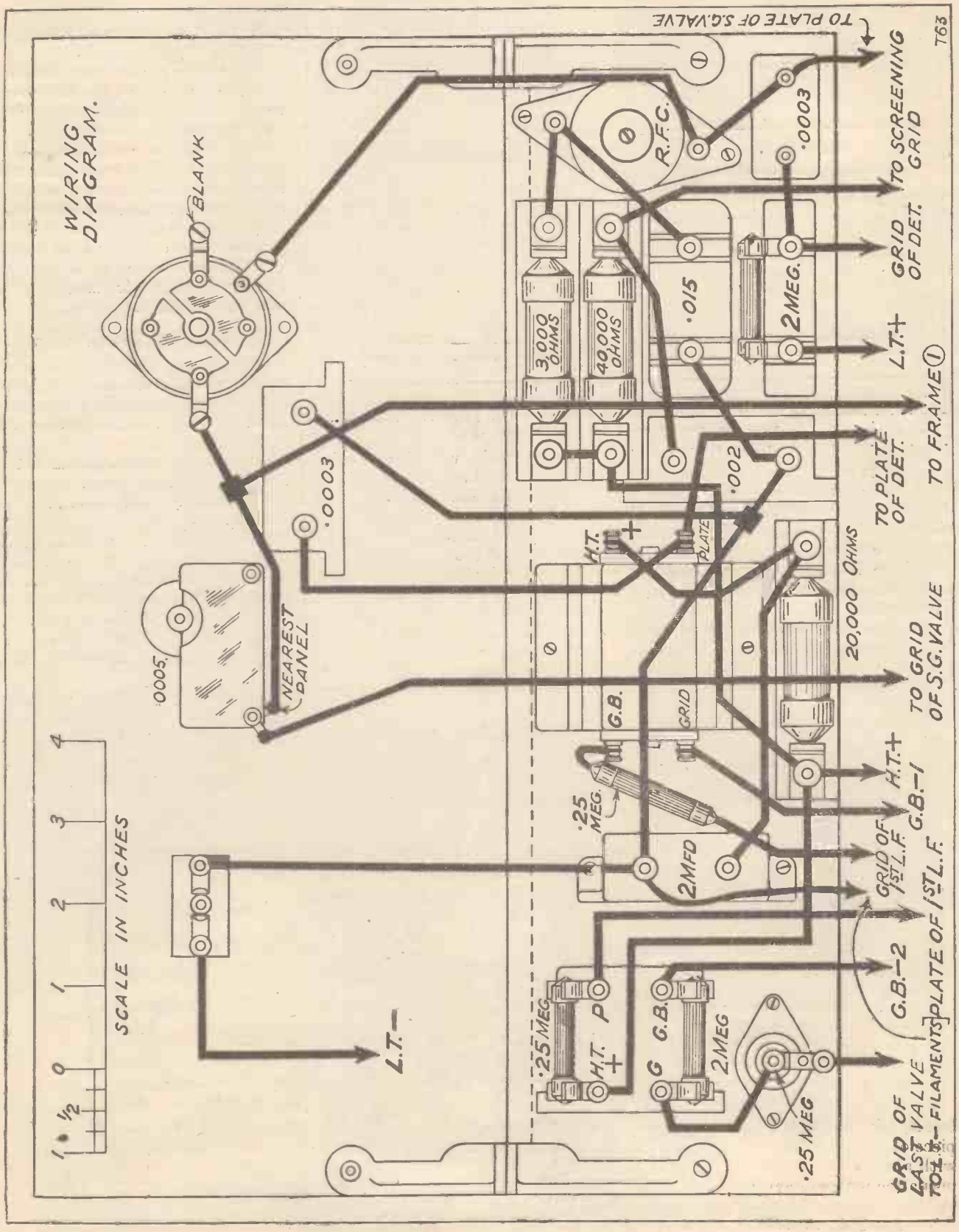
Now wind the two frame aerials as follows :

Take the end of the No. 24 D.C.C. wire and, leaving about six or nine inches for attachment, fix this to the corner of the strut near the switch, but at the back (i.e. at the end away from the loud-speaker fret). Now wind on fifty-six turns with turns

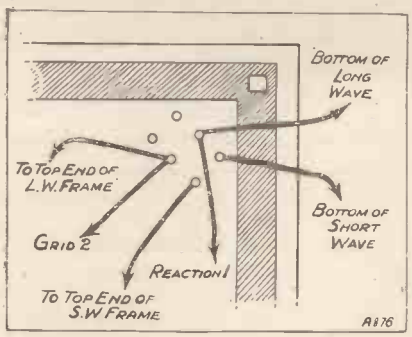


Simplicity of construction, one of the leading features, is attained in several ways, one of which is to assemble most of the parts upon this miniature baseboard.

The New "Roadside" Four—*continued*

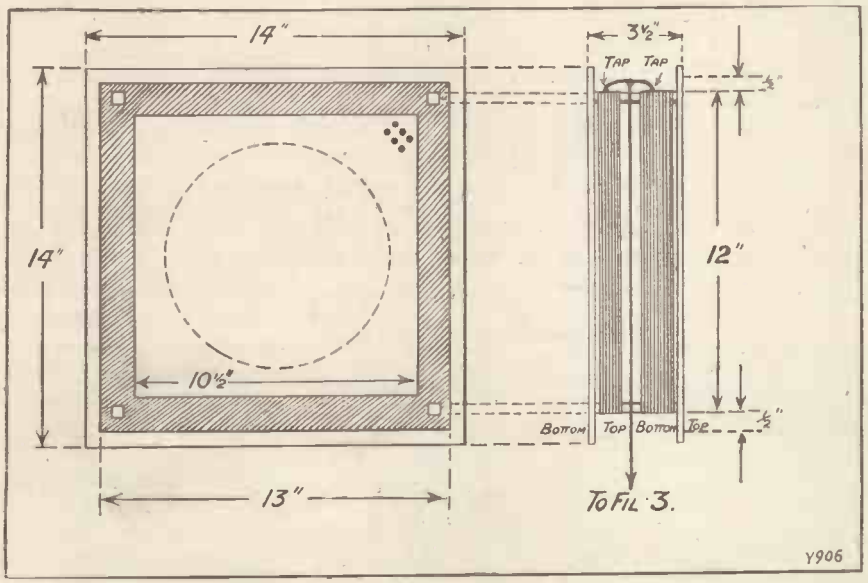


The New "Roadside" Four—*continued*



twelve turns. Lift up the wire, slip a card underneath and bare as before. Solder the flexible lead from the tapping point of the short-wave frame to this tapping point and take another lead from the same point, using for this a piece of single silk-covered flex about 2 ft. long or more.

You can cut the exact length later. Bring the two ends of each frame aerial to the switch exactly as shown, being careful to join them at the



touching, and secure the end to the frame support, leaving again about six inches for connection. A small hole can be drilled through the wooden strut and the wire secured in this way.

Now take the flexible frame-aerial wire and, starting on the same cross-bar right up against the loud-speaker fret, wind fourteen turns in the opposite direction to that of the long-wave frame. This will, of course, make the direction of winding of both frames the same, as you have started winding at the opposite end. As before, leave about six inches at each end for attachment.

The Aerial Completed

Now count three turns from the loud-speaker fret end of the smaller frame, lift up the third turn, slip a piece of cardboard underneath it, and with a sharp knife carefully bare the insulation without damaging the wire. On to this solder a short flexible lead. Now starting on the long-wave frame, from the loud-speaker fret end, count

correct points as shown, and then take two further flexible leads of the single silk-covered flex from the two centre points of the switch. Notice that two switch contacts are left free. This is intended.

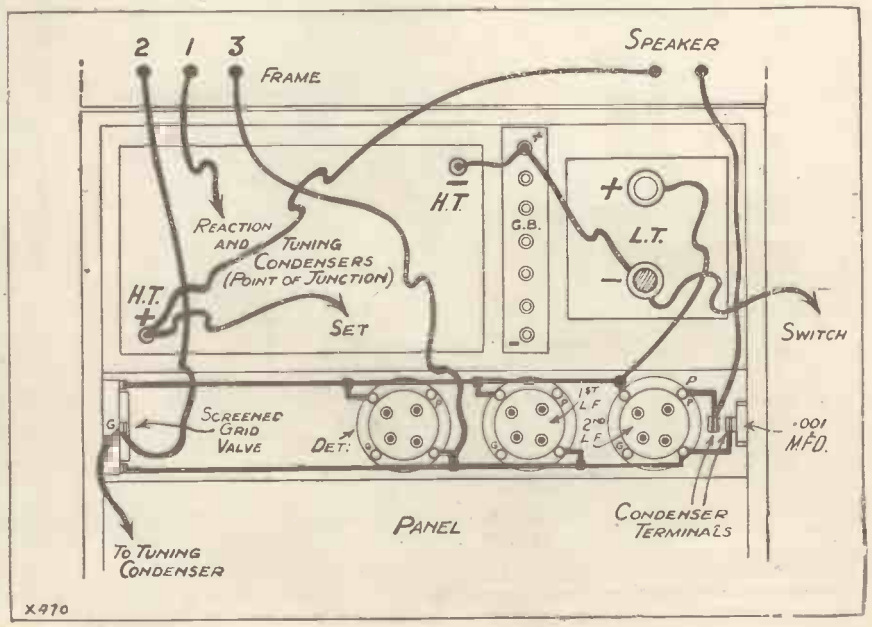
The loud-speaker fret and assembly with the frame aerial can now be pushed into the lid, but not finally fixed.

Now attach the four valve holders, as shown in the drawing and photograph, noting that one is attached to the side of the cabinet. The reason is that this holder must take the screened-grid valve, which is too tall to be mounted vertically. Attach the ·001-mfd. fixed condenser to the other side of the cabinet.

Wiring-up the Valve Holders

Wire up the filament lugs of all four valve holders as shown, and solder a flexible lead to the filament wire which is attached to the valve holders at the back (nearest the loud speaker). This can be slipped underneath the partition and can be finished off with a red spade terminal. One flexible lead which is joined to a centre contact of the double-pole switch (and through this to the outer end of the frame) should now be brought across and attached to the grid terminal of the screened-grid valve.

It is convenient to bore a small hole in the partition to take this wire so that it may come straight to the grid by the shortest path. A lead should also be taken from the negative filament terminal of the last valve to one terminal of the ·001-mfd. fixed



The New "Roadside" Four—*continued*

condenser, the other terminal being connected to the plate terminal of the last valve. A flexible lead is also taken from the plate of the last valve to one speaker lead (the negative lead if it is so marked).

Panel and Baseboard Layout

The other speaker lead is taken to the positive wander plug which fits into the positive of the high-tension battery. This same plug is also connected to a wire which should be taken through a hole in the partition (between the detector and the first L.F. valve), for subsequent attachment to the baseboard assembly.

High-tension positive is thus attached to the loud speaker and to the baseboard assembly. The flexible lead which comes from the tapping point of the two frames is now brought under the partition and attached to the negative filament wire at any one of the negative terminals.

Next mount the two panel brackets on the small baseboard. Now drill the plywood panel and fit the 0005-mfd. variable condenser, as shown. This is about the only variable condenser usable in this design, as the ordinary sizes are much too large.

Mount also the panel-mounting neutralising condenser and the on-and-off switch in the positions shown. When these three parts have been mounted, stand the panel against the baseboard and arrange the other components according to the photographs and wiring diagram. You will notice that I have used one quarter-megohm Pye grid leak with wire ends and one Dubilier grid leak in its mounting, but you can use both leaks of either or any good make if you so desire.

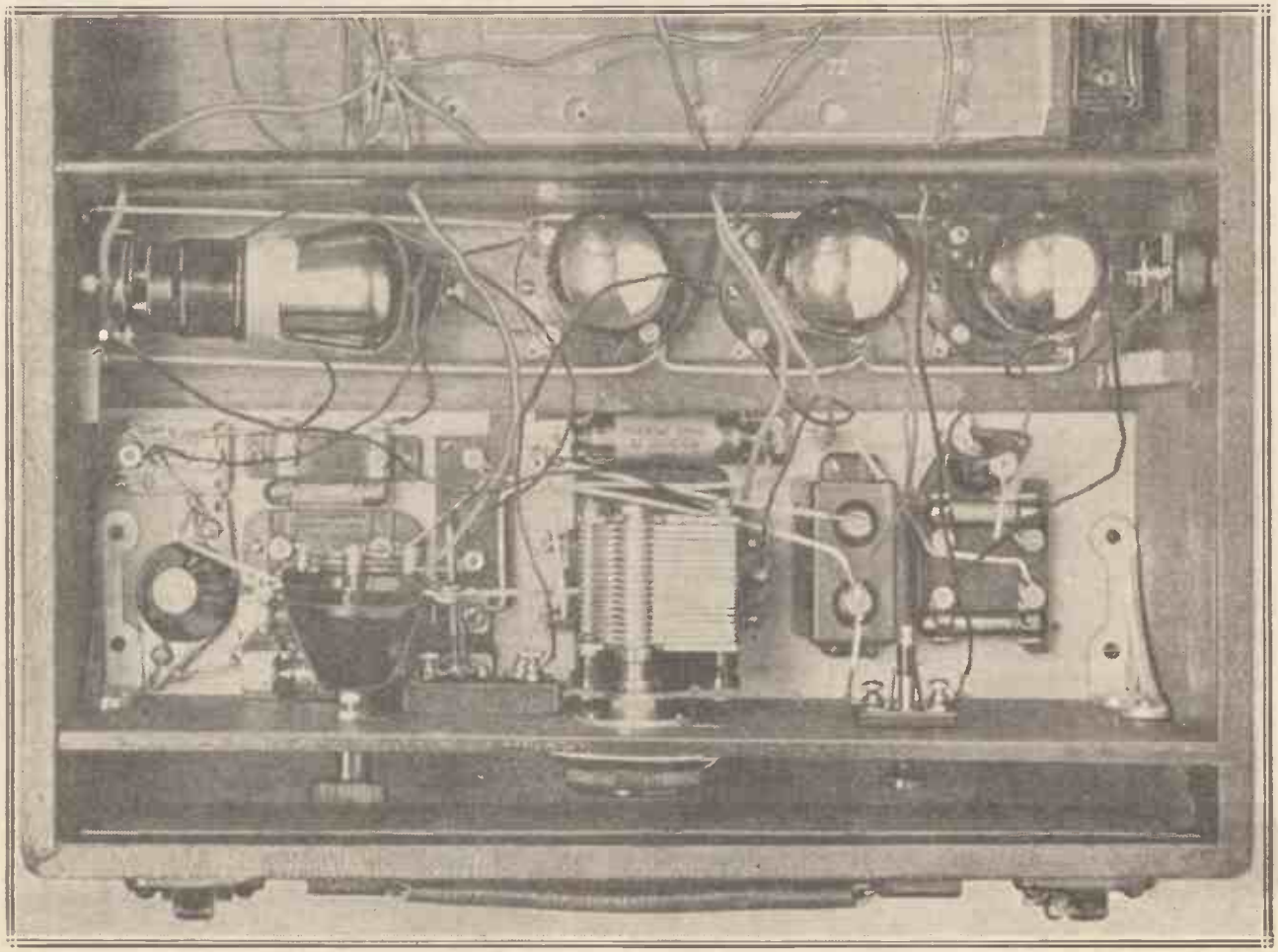
There is plenty of room to use any of the well-known resistance-capacity coupling units, but there is not room for many makes of low-frequency transformer. The Cossor transformer just fits underneath the Utility Mite condenser, and makes for neat assembly.

There are comparatively few radio-frequency chokes which I find work satisfactorily in this particular method of high-frequency choke coupling. This must not be taken to be a reflection on the many chokes which work excellently in normal circuits as H.F. chokes, for example, in Reinartz reaction circuits. The choke is acting as a special anode impedance in this circuit, and many excellent chokes have been tested and found to be wanting.

Good Choke Essential

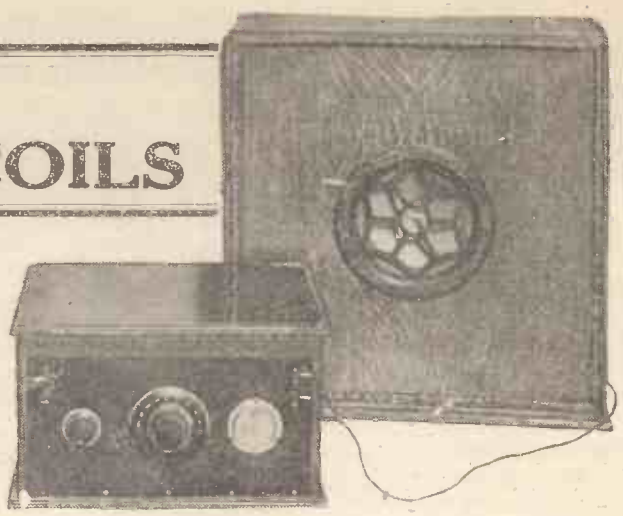
The Magnum and the R.I.-Varley are two which have been found to work very successfully in this set, and the reader is recommended to use one or other of these makes. If an unsuitable choke is used, instability

(*Continued on page* 62.)



The set can be tuned and tried out in the fashion shown before the panel is turned through a right angle and screwed in place.

PUSH-PULL MOVING COILS

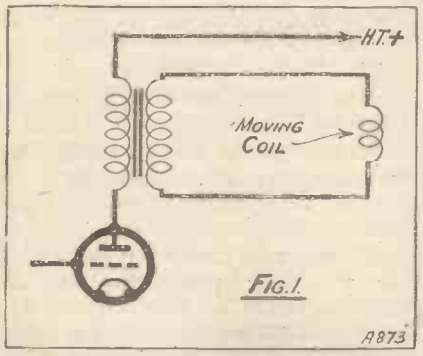


The subject of moving-coil design and impedance was discussed in an article by the same author in last month's "Wireless Constructor." Here is a further article upon the subject, showing how greater efficiency can be obtained.

By L. E. T. BRANCH, B.Sc.

IN the WIRELESS CONSTRUCTOR for April I pointed out the great importance of making the moving coil with a certain gauge of wire and number of turns if the best results are to be obtained. The moving coil is fed usually by means of a transformer, as shown in Fig. 1, or alternatively by a choke and condenser (Fig. 2). Calculations were involved which presumed that the output choke or transformer, as the case may be, was of an exceedingly high order of efficiency.

It is clear that since it is exceedingly difficult to make a transformer which will transform even 90 per cent at all frequencies, and almost difficult to make a choke which will possess a corresponding efficiency, we shall approach very closely to the ideal if we can devise a simple method in which no transformer or choke is



necessary. We shall in this way eliminate all losses due to the transformer or choke, and then all arguments about the transformer not responding to transients, or the condenser in the choke-condenser output doing similar tricks, will be disposed of. There will, of course, also be a considerable saving in cost which should appeal to many.

A Novel Scheme

The method which we are about to describe is to the best of the writer's knowledge put forward for the first time. It consists in using a centre-tapped moving coil, the two ends of which are joined to the plates of two push-pull valves in the output stage, the centre tapping being connected to the positive H.T. The connections are clearly shown in Fig. 3, and they are so simple that not the slightest difficulty should be experienced in following them. Some readers will immediately say that this method is to be deprecated on account of the passage of the high-tension current through the moving coil with its consequent risk of breakdown.

Low Current

This is, however, not so serious as it is often thought, more especially as the valves are working in push-pull. A small calculation will show the position more clearly. Let us suppose that two P.M.254 valves are used in the output stage and are biassed to approximately —28 volts, as they should be for push-pull with a high-tension of 150 volts. The D.C. flowing in each valve and hence through each half of the moving coil is found from the valve curves to be 13 milliamperes approximately.

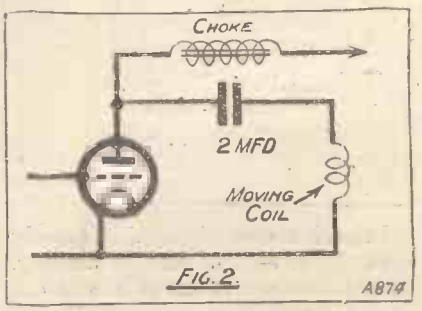
When No D.C. Flows

When signals reach the grid of the valves the currents in each half of the coil will vary at most from zero to 26 milliamperes. As the valves are working in push-pull the current in one half of the coil will be rising when the current in the other half is falling. Now, if an ordinary choke-capacity filter circuit were being used there would admittedly be no D.C. flowing through the coil, but during reception, that is, when signals are being received, there will be currents flowing in the coil, and with, for example, two valves in parallel the current will reach up to as much as 32 milliamperes.

High Peak Values

In other words, except when no signals are being received the currents in the moving coil will not be very different in the two cases, hence the chance of breakdown is very much the same. Moreover, it should be remembered that for public address work and very high-power reproduction it is not unusual to put as much as 50 to 100 milliamperes peak current into the moving coil.

The centre-tapped coil method was first worked out by the author a year or so ago, but it was not then such a practical proposition as it is now because of the very fine wire (No. 47 or 48 S.W.G.) needed for the coil. The reason why such fine wire had to be used was that in making the calculations for determining the number of turns and gauge of the wire required it has to be remembered that the two push-pull valves are working in series and their combined impedance is double that of



one of them. Hence two P.M.254 valves gave a combined impedance of 7,000 ohms, and this necessitated a coil of about 1,700 turns of No. 47 or 48 S.W.G. (assuming the coil is of 2-in. diameter).

Push-Pull Moving Coils—*continued*

With the advent of the new Marconi Osram P.625A valve, which has an impedance of only 1,600 ohms, we can place two of these in series and only obtain a total impedance of 3,200 ohms. The coil required in such a case will be similar to that required for a single P.M.254 valve, namely 1,000 turns of No. 46 S.W.G. on a 2-in. former, except that our coil for push-pull must have an extra lead at the centre-tapping.

With the special method of Fig. 3, using two P.625A valves and a centre-tapped coil, the results are rather improved as regards volume by increasing the number of turns for a 2-in. coil to 1,200, giving 600 on each half, and with such a coil we can be quite confident that we are getting the last ounce of volume and general efficiency that it is possible to get out of that end of the set.

The Resistance Value

The coil is wound just as easily and simply as the ordinary "high resistance" coil which is customarily used, and no special precautions are necessary, the only point of difference being, in fact, that we require a centre tapping, and there will, therefore, be three leads from the set to the loud speaker, although even this can be avoided in the case where both the set and the pot magnet are fed from the D.C. mains.

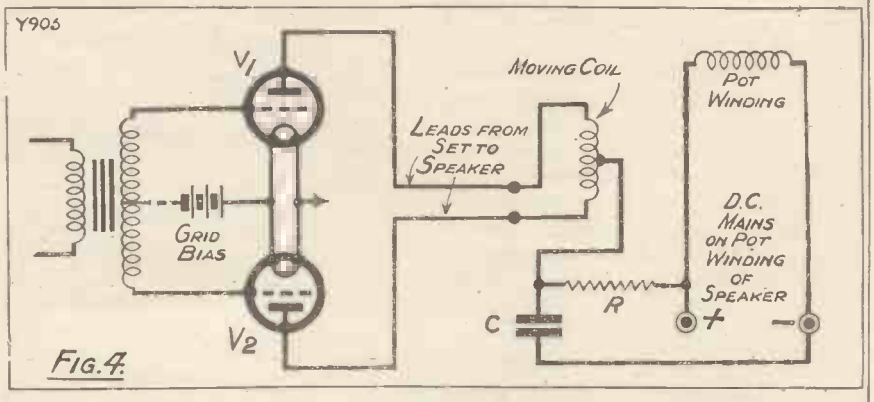


FIG. 4.

In such a case, the H.T.+ already goes to one each of the pot winding, so that the centre-tap of the M coil can be connected to this H.T.+ through a suitable resistance (with by-pass condenser C) if necessary, as shown in Fig. 4.

The pot winding is connected to the D.C. mains by two wires. Beside it is the moving-coil winding, the centre tapping of which is fed from the positive main via the resistance R. The condenser C should have a capacity of 4 mfd. or more.

The value of the resistance R will, of course, depend entirely upon the H.T. voltage and current which it is desired to feed to the power valves V_1 and V_2. For example, if they are P.625A valves with 30 to 35 volts grid bias, the resistance R will need to be 100 ohms for every 5 volts drop required. The resistance of each half of the coil is 600 ohms, which will give 15 volts drop.

For A.C. Mains

Since the maximum permissible voltage for P.625A valves is 180 volts, we see that for D.C. mains of 200 volts, R is 100 ohms; while for 220 volts, R should be 500; or for 230 volts, R should be 700 ohms; or for 240 volts, R should be 900 ohms.

Even if D.C. mains are not being used, there can be little objection to the use of three leads for the loud speaker instead of the usual two. Three wires twisted together are obviously no more unsightly or inconvenient than two. In any case, the gain to be obtained by the push-pull arrangement in which all losses due to the output chokes or transformers are eliminated is worth it, and the results are, therefore, better than when using the best choke or transformer obtainable.

TRADE JOTTINGS

A brief review of recent issues of trade catalogues and literature.

Now that Spring is here, tra-la-la, the evenings are growing longer, the buds will be bursting, and all the "birds" will be buying new hats, etc. Moreover, the radio young man's fancy will lightly turn to thoughts of portable sets, and, knowing this, the G.E.C. people designed an accumulator specially suitable for portable receivers. The result is that the new Geco U-type unspillable accumulator, which is retailing at 25s., can be said to solve at least one problem of portability.

It is a two-volt accumulator with

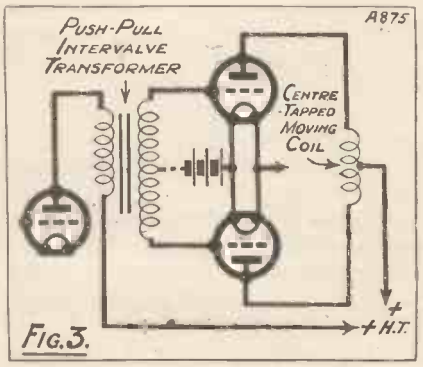


FIG. 3.

an actual capacity of 20 amp. hrs. The great feature of this new Geco accumulator is the solid electrolyte. Ham-handed Henry himself could not spill it, for instead of the usual acid solution, which in the ordinary up-ended accumulator simply asks for trouble, there is a solid acid jelly surrounding the plates.

Lewcos Coils

The London Electric Wire Co. & Smiths Ltd. (you and I call it "Lewcos") have sent me one of their new catalogues to which I should like to put you wise. Nowadays, of course, everybody knows of the Lewcos coils, but it is certainly not everybody who knows the best types for particular purposes, nor the various circuits in which any particular type of coil can be used. Everyone ought to have a copy of this catalogue, for it is full of useful information and practical details of the kind which make all the difference to efficiency.

The Lewcos people, too, have been "matey" enough to prepare a very valuable section dealing with wires, resistances, and resistance tables, etc., from which all sorts of valuable information can be obtained. Every constructor should have a wire table, and these are excellent, containing much information as to size of wire (a thing all constructors want to know at some time or another), its resistance, its carrying capacity, etc.

P. R. B.

EXPERIMENTING WITH THE THIRTY-ONE NEW CIRCUITS

BY THE EDITOR.

IN last month's issue we had a talk about high-frequency units. This month we shall deal with Circuits 18 to 21 in the booklet, "Thirty-One More Tested Circuits," these being of various practical types of mains units, or "eliminators" as they are sometimes called.

An H.T. A.C. Unit

Circuit No. 18 shows a high-tension A.C. unit for the Raytheon or filamentless type of rectifier. This type of rectifier is much more popular in the United States than here, although the Majestic high-tension unit sold by the Benjamin Electric Co., Ltd., until recently, utilised this type of rectifier very successfully. In England the majority of high-tension mains units use either valve rectifiers of the filament and plate type (some being single- and others double-wave rectifiers) or else the copper oxide dry rectifiers with which the name Westinghouse is intimately connected.

In Circuit No. 18 it will be seen that a transformer is connected to the mains, the secondary being centre-tapped. The two ends of the secondary are taken to two special electrodes in the valve; the third electrode, joined to high-tension positive output through the filter, being a special form of plate. The internal structure of these gas-filled filamentless rectifiers is rather peculiar, and the working of these valves is based on the fact that it is more easy for a stream of electrons in ionised gas to pass from a point to a plate than from a plate to a point.

The Raytheon Rectifier

If you examine the Raytheon type of rectifier you will see two small clay-like cylinders side by side and very close to one another, while fastened to the top of these two cylinders is a flat metal plate completely covered at the top by a dome-shaped cap. The two cylinders are of a special insulating material and serve to support and protect the two-point electrodes which are held a short distance away from the plate.

The interior of the valve is filled with a special gas, and when the points become positive current will flow across the intervening space between the point electrode and the plate. When the points are at negative potential no current flows, so that the valve can be used as a rectifier and, indeed, will carry a good deal of current depending on the size of the valve. Raytheon rectifiers have been designed to carry no less than 350 milliamperes, and we have one of these in the WIRELESS CONSTRUCTOR laboratory.

It is a peculiarity of these valves that the voltage on the electrodes has to reach a certain figure before the current flows. The output, therefore, is not of the "half sine wave form" as with the copper oxide type of rectifier. In practice it has been found advisable for smooth operation to shunt two condensers,

Here is a further chat on the practical applications of the circuits shown in the book given away with the December, 1928, issue of the "Wireless Constructor."

C_1 and C_2, across the transformer, as shown, the value of these being ·1 mfd. These fixed condensers are unnecessary with the filament type of valve, but should never be omitted in the filamentless type.

The filter, consisting of the three condensers C_3, C_4 and C_5, the two chokes L_1 and L_2, and the voltage controlling output consisting of the resistances R_1 and R_2 and R_3, and the condensers C_6 and C_7, can be used in any form of rectifier, and indeed are a good practical combination. It is interesting to compare the voltage output device of Circuit 18 with that of Circuit 19 and Circuit 20, and a few notes regarding these will be given later.

It is impossible to build a really good high-tension mains unit cheaply, for low cost can only be obtained by reducing the quality of condensers and chokes. The condensers C_3, C_4 and C_5, the values of which are given under Circuit 18, should in no circumstances be the ordinary small Mansbridge type of condenser generally sold for shunting across high-tension batteries.

Special Condensers Advisable

These small condensers, although having sufficient capacity for the filter, are not built to stand the high voltages of a mains unit, and will invariably break down sooner or later, when by short-circuiting they may ruin the whole unit. Special high-voltage condensers for mains eliminators are sold by all the leading makers and, although they cost more than the smaller types, are a good investment.

The chokes L_1 and L_2 should be of as low direct-current resistance as possible, for the whole output current flows through these chokes, and any resistance here is bound to cause a voltage drop. Ferranti, Radio-Instruments, Pye, Climax, and other makers sell chokes of high inductance and low ohmic resistance suitable for this purpose. Most cheap chokes have both high resistance and low inductance, bringing about unnecessary voltage drop and inadequate smoothing. It is false economy to buy cheap chokes for eliminators.

Controlling Output Voltages

There are several ways of controlling voltage on the output of a mains unit, and it is usual to arrange the highest tapping to give the full voltage of the mains unit. Thus H.T. positive 3 should give the maximum. H.T. positive 2 has, in Circuit 18, a series resistance R_3 which should be of the continuously variable type and must also be able to carry the maximum current which will ever be taken from H.T. positive 2

The voltage on H.T. positive is thus continuously variable. H.T. positive 1 is also variable within

(*Continued on page* 58.)

MORE WORK FOR THE HAND-DRILL

Some alternative uses for one of the most necessary of all the tools used in set construction.

From a Correspondent.

THE ordinary hand-drill can be used for many more purposes than the mere making of holes in ebonite or metal. My own, in fact, I have used on occasions as coil-winder, as an aid to running loose wire quickly on to a reel, as a miniature lathe, as a lightning screwdriver and as a tool for the rapid threading of holes drilled in ebonite.

For Winding Coils

The drill is exceedingly handy for the rapid winding of solenoid coils if you set about the work in the following way.

Myself, I nearly always use 3-in. ribbed formers for the purpose, and I have a round piece of hard wood which fits tightly into these. In the exact centre of this plug is fixed a short length of ¼-in. studding which can be gripped firmly in the jaws of the drill chuck.

When winding is to take place, the horizontal hand-grip of the drill is removed and the stud to which it is attached is firmly held in the jaws of the vice. The drill itself is thus fixed parallel with the ground. The coil former is gripped in the way already described, the end of the wire is anchored to the former in the usual way, and the reel is placed in a holder provided with a brake which can be adjusted to give the right tension.

My own drill is geared exactly four to one; each rotation of the crank thus puts four turns on to the former. If one moves the crank not too quickly the wire runs on quite evenly and a 60-turn coil can be made with almost incredible rapidity.

Rapid Screwdriving

Chokes can be wound in a similar way on formers divided into compartments. Since a great many turns are required, one has not been long at work before one blesses the four-to-one gearing. Most of us waste a great deal of wire when taking coils or chokes to pieces, simply because it is too much trouble in the ordinary way to run it on to a reel. If a small plug of wood or ebonite rod is made which is a tight fit for the hole through an empty reel, the reel can be mounted in the chuck of the drill and the wire run off almost in the proverbial no time.

For turning-up small pieces of work, the drill—provided, of course, that its chuck runs pretty true—makes an admirable miniature lathe. Fix it horizontally in the vice in the way previously described and mount the work to be turned in the jaws of its chuck.

A friend must be pressed into service to provide the motive power. Cutting can be done either with a small lathe tool, a rest of some kind being rigged up with a block of wood, or with a suitable file.

For rapid screwdriving it is an excellent tip to make a screwdriver attachment to fit one's hand-drill. This can be done from a short length of ¼-in. steel rod. One end is filed up or ground into the proper shape for a blade and is subsequently tempered by heating and dipping in oil. Box spanners can also be made in the home workshop to fit the hand-drill.

Take a piece of brass or mild steel tube whose internal diameter is such that it will just fit tightly over a nut of the size required. Put a short piece of studding into the nut and insert it into the end of the tube. Now hammer the outside of the tube near the end, shaping it to fit snugly on to the faces of the nut.

Cut off a short piece of metal rod that is a tight fit for the other end of the tube, push it in for ½ in. or so, drill a hole right through and fix with a pin. Cut the protruding end of the pin off fairly close and rivet it over.

A Tapping Tip

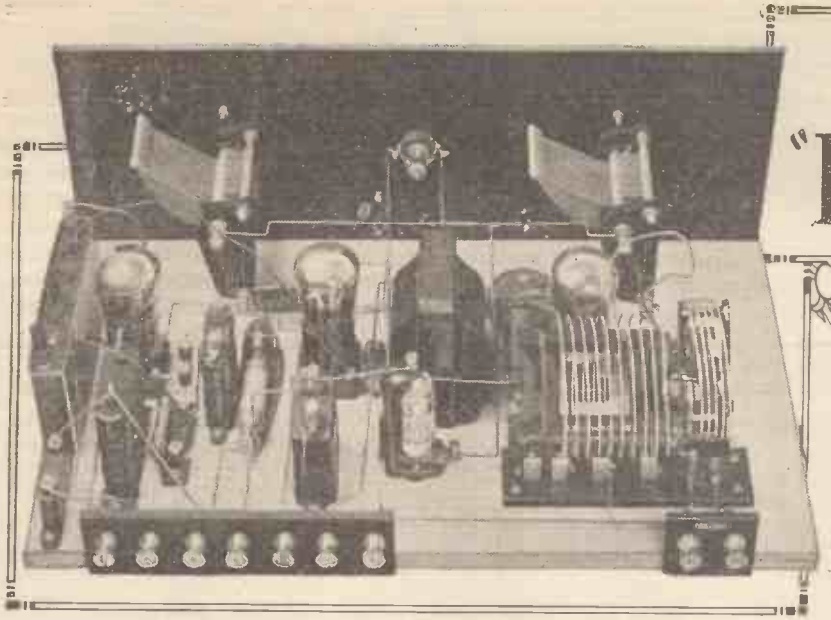
If you have a considerable number of holes to tap in a piece of ebonite, don't bother about the ordinary tap holder. Drill all holes, first of all, to the proper size, then mount the tap in the chuck of the hand-drill. Don't try to drive the tap through "in one." Taking care to see that you are going straight, give it one turn or a little more, then turn backwards to allow the tap to clear itself of dust.

Now go forwards again for a few turns, turn back to clear once more, and then drive straight through. With the hand-drill one can easily tap three or four 4 B.A. holes in a minute in ¼-in. ebonite.

Many constructors use the hand-drill for holes up to ¼ in., but employ the brace for bigger ones since the average small chuck will not take a drill shank of greater diameter than ¼ in. Nowadays $\frac{5}{16}$-in. and ⅜-in. drills are obtainable with ¼-in. shanks from most good tool shops, so that the small hand-drill can be used for making holes of the largest size ordinarily needed in wireless work.

RADIO IN RUSSIA

The first prize in a recent home-constructors' radio competition in one of the leading towns in Russia was won by a peasant woman, who is here seen receiving the award.



THE "DIGGER"

A specially designed three-valve short-wave receiver capable of bringing in the Australian broadcast stations with remarkable ease. By means of interchangeable coils it is also eminently suitable for ordinary broadcast reception.

By L. H. THOMAS.
(6QB.)

THE percentage of readers of the WIRELESS CONSTRUCTOR who possess more than one receiver is, I suppose, not high, and this in itself accounts for the continued popularity of the "general-purpose" type of set, which can be put to a multitude of uses and behaves with reasonably high efficiency in each class.

For some time I have been using a set very similar to the "Digger" for myself at home; primarily as a short-waver, but with provision for receiving broadcast when necessary, both simply as a matter of interest, and also because of a series of tests that I have been carrying out in connection with a detailed comparison of the fluctuation in receiving conditions on the long and short waves.

Equal to the Best

I decided to make up this set in a more finished form with a few minor alterations suggested by experience, and the final product appears herewith.

I can say definitely at the outset that the "Digger" takes equal place with the best short-waver that has ever been on my bench for my own use. It was made up in the first instance exactly as if short-wave work were to be its only occupation, and the provision for broadcast reception was allowed to look after itself. This, in a way, confirms my doctrine, about which readers are probably tired of hearing by now, that if a set can be made to work well on the ultra-short waves it will, when converted, make a broadcast receiver of more than average efficiency.

Thanks largely to the short-wave coils used, the conversion in this case consists of nothing more troublesome than changing coils.

The circuit employed is quite "straight," but a few modifications have been introduced which will not be found in every short-waver. We have the usual leaky-grid detector with loosely-coupled aerial circuit, magnetic reaction "throttle-controlled," transformer coupling to the first note-magnifier, with an anti-motor-boating device in the H.T. lead to the detector. The last valve is resistance-coupled, on account chiefly of the excessively loud signals produced by two transformer-coupled stages on short waves.

The first unconventional feature is provided by the means of "artificially reducing" the capacity of the tuning condenser. Anyone with any short-wave experience will know that it is quite hopeless to attempt to tune-in a signal below about 60 metres with a ·0005 condenser. I myself rarely use anything larger than ·0001 or ·00015 for short-wave work, and the range covered by a small condenser such as this with the average coil is tremendous. It is of interest to note that the band from 20 to 24 metres can be covered with a four-turn coil and a condenser with a capacity of ·00002!

The Tuning Condenser

The usual method adopted in a "general purpose" receiver is the provision of a fixed condenser in series with the variable, which will have the effect of reducing the effective capacity of the latter to a reasonable figure for short-wave work, and can be shorted out by a switch when the set is being used for broadcast.

This has the disadvantage that the curve of the variable condenser is distorted, the fixed condenser having

COMPONENTS REQUIRED

- Ebonite panel, 18 in. × 7 in. × ¼ in. (Becol). (Ebonart, Resiston, etc.)
- Baseboard 18 in. × 10 in. deep, and cabinet if required.
- 2 ·0005 variable condensers (Ormond S.L.F.). (Cyldon, Lotus, Lissen, Polar, etc.)
- 2 Slow-motion dials (Ormond D.I.D.). (Indigraph, Utility, etc.)
- 3 Non-microphonic valve-holders (Whiteline). (Benjamin, Lotus, Godwinex, Redfern, Magnum, etc.)
- 1 L.F. transformer, 3½ : 1 (Lissen). (R.I.-Varley, Ferranti, Igranic, Philips, Mullard, Brown, Cossor, etc.)
- 2 2-mfd. Mansbridge condensers (Ferranti, Dubilier). (T.C.C., Hydra, Polymet, Lissen, etc.)
- 1 ·1-mfd. mica condenser (Dubilier). (T.C.C.)
- 2 ·0005, 1 ·0001 fixed condensers (Igranic, Dubilier, T.C.C.). (Mullard, Atlas, Lissen, etc.)
- 1 20,000-ohm wire-wound resistance (R.I.-Varley). (Ferranti, Lissen.)
- 1 100,000-ohm resistance. (R.I.-Varley). (Ferranti, Lissen.)
- 1 2- or 3-megohm and 1 2-megohm grid leaks (Dubilier), (Lissen, Igranic, etc.)
- 1 H.F. choke (Met-Vick). (R.I.-Varley, Magnum, Polar, Igranic, Colvern, Lissen, etc.)
- 1 Base-mounting rheostat.
- 1 On-off switch.
- 1 Set short-wave coils and broadcast adaptor (Marconiphone)—or materials for home-made coils.
- 1 Two-terminal and 1 seven-terminal strip.

Wire, Glazite, wood-screws, etc., etc.

The "Digger"—*continued*

but a very small effect when the variable is near zero. I have, therefore, favoured the method used in this set, and have, in fact, standardised it for my own purposes, as I find it infinitely more convenient and efficient than the other.

When listening on short waves one arranges the variable to tune a small portion of the coil only (by means of a small spring clip on the bare wire of the coil), and when switching over to broadcast the whole coil is tuned. In this case, for broadcast work the spring clip is simply attached to the lead from the grid condenser to the end of the coil, while for short waves it is generally clipped on to the coil at a point about one quarter of the distance up from the filament end.

Naturally, one can vary this point in accordance with the band that one wishes to cover with one sweep of the condenser. I often use the clip very nearly at the bottom of the coil, so that the tuning effect of the variable condenser is reduced to the smallest fraction of that which it would normally have.

Reducing Noises

More will be said about this in connection with the operation of the receiver.

A fixed condenser has been connected in series with the reaction condenser, but in this case the object is not to reduce the capacity, but rather to reduce the noise caused by dust accumulating on the plates of the latter, which would otherwise have the H.T. voltage across it. All these little unwelcome noises, unless quelled at the start, will combine to make the difference between a successful and an unsuccessful short-waver.

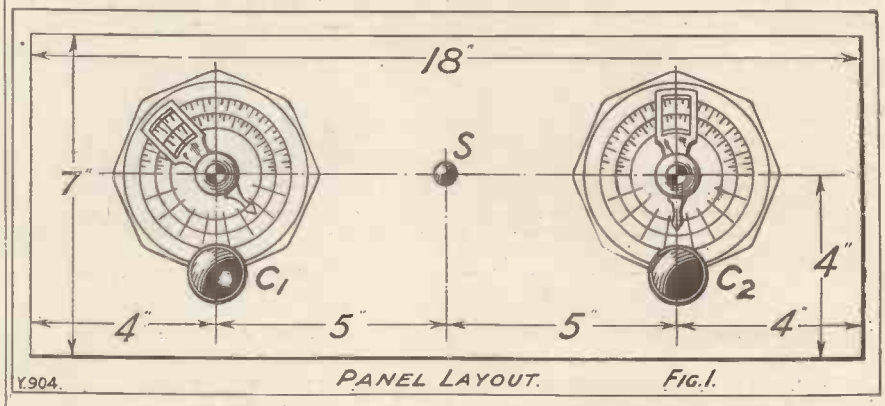
The "throttle control" method of reaction adjustment is, I am convinced, the most satisfactory for short-wave work. The setting of the reaction condenser has only the slightest effect upon the tuning control, thus giving freedom from the awful "interlocking control" effect that one strikes on some receivers.

Another distinct advantage is that one can still use series feed for the H.T. With parallel feed in use there is bound to be a slight loss of efficiency unless one uses a perfect H.F. choke (which, we all know, does not exist). With series feed there is normally no need to use a choke at all with this "throttle control" method, the self-capacity of the primary of the transformer usually being low enough to prevent the set from oscillating when the reaction condenser is set at zero.

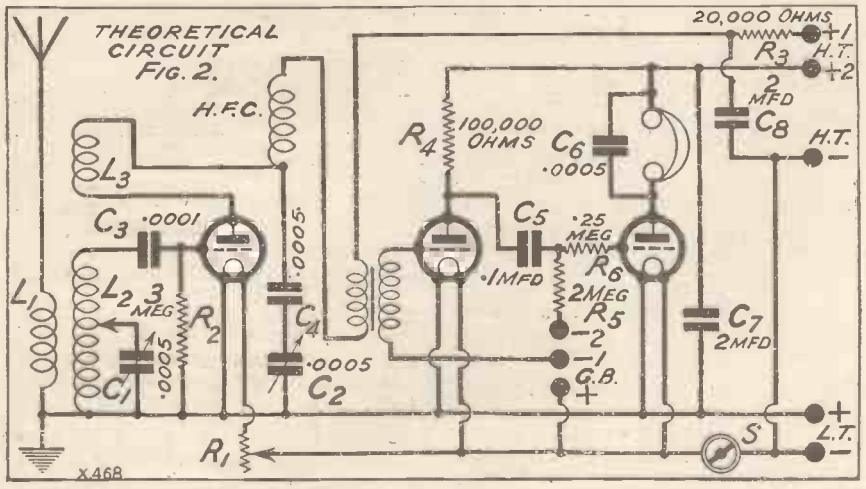
In this particular case the transformer used has a "built-in" fixed condenser across the primary, so that a choke is necessary, but it need not be a short-wave choke, or one of particularly high efficiency.

It will be seen also that this method allows one to earth both the sets of moving vanes of the variable condensers, thus eliminating hand-capacity effects to a large extent, and also doing away with that most undesirable effect that one sometimes strikes of a coupling effect between the grid and anode circuits when the hands approach the two variable condensers simultaneously.

In the case of this particular set it was not even necessary to earth the metal shields of the slow-motion dials. Doubtless, however, many readers not so fortunately placed as myself with regard to an earth will prefer to do so.



PANEL LAYOUT. FIG. 1.



Stops "Threshold Howl"

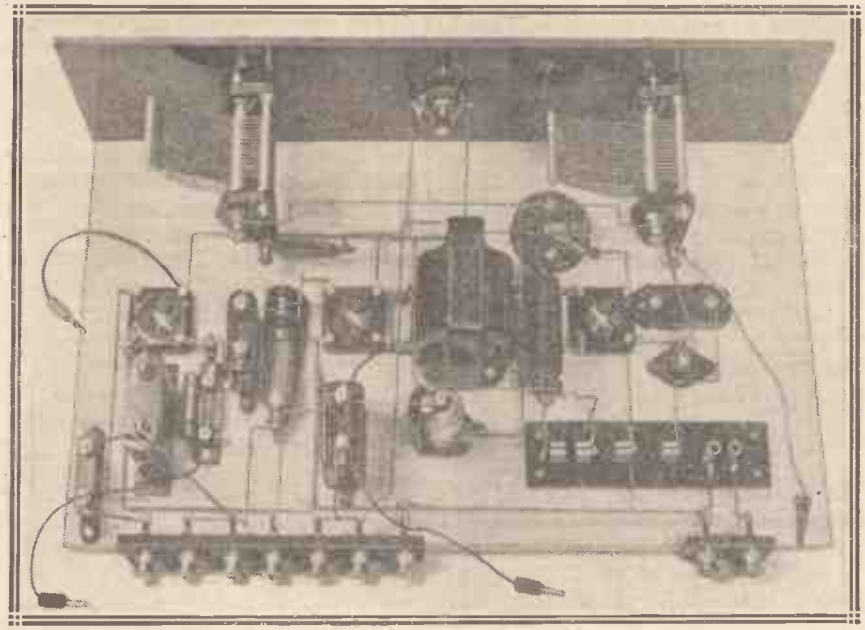
It will be noted that the size of panel and baseboard is not unduly large; adequate spacing of components has been achieved without the "great open spaces" effect that one sometimes sees in short-wavers. The original layout should be adhered to as closely as reasonably possible, although the use of different makes of components will naturally make slight deviations necessary.

The one component that should *not* be taken liberties with is, in my opinion, the "anti-motor-boating" device. This consists of a 20,000-ohm wire-wound resistance in series with the H.T. feed to the detector, with a 2-mfd. condenser across the "set" end of it and earth.

This combination of values seems practically ideal, and its function in this set is not so much to stop motor-boating as to stop "threshold howl."

The "Digger"—*continued*

What the connection between the two maladies is I really cannot say, but there certainly appears to be a very definite relation between them.



The layout is symmetrical and easy to duplicate, while the wiring is extremely simple.

With this particular set there appeared to be a tendency towards "threshold howl," *without* this precaution, with any form of H.T. supply except accumulators. The other 2-mfd. condenser connected right across the H.T. and L.T., and also the ·0005 fixed condenser across the output terminals, also had a beneficial effect when the set was operated with some very ancient dry batteries, with which most of the tests were purposely carried out.

No H.T. Coupling Effects

Using H.T. accumulators, and with the components all wired up in the final form, exactly as shown in the diagrams and photographs, a resistance of about 400 ohms inserted in the negative H.T. lead appeared to have no noticeable effect upon the performance of the set, so that it may apparently be assumed that it will behave itself under all average conditions.

The wiring having been completed, suitable valves should be inserted in the various sockets, the batteries connected, also the aerial and earth, and there should be very few minutes between this operation and the logging of stations both on short and long waves.

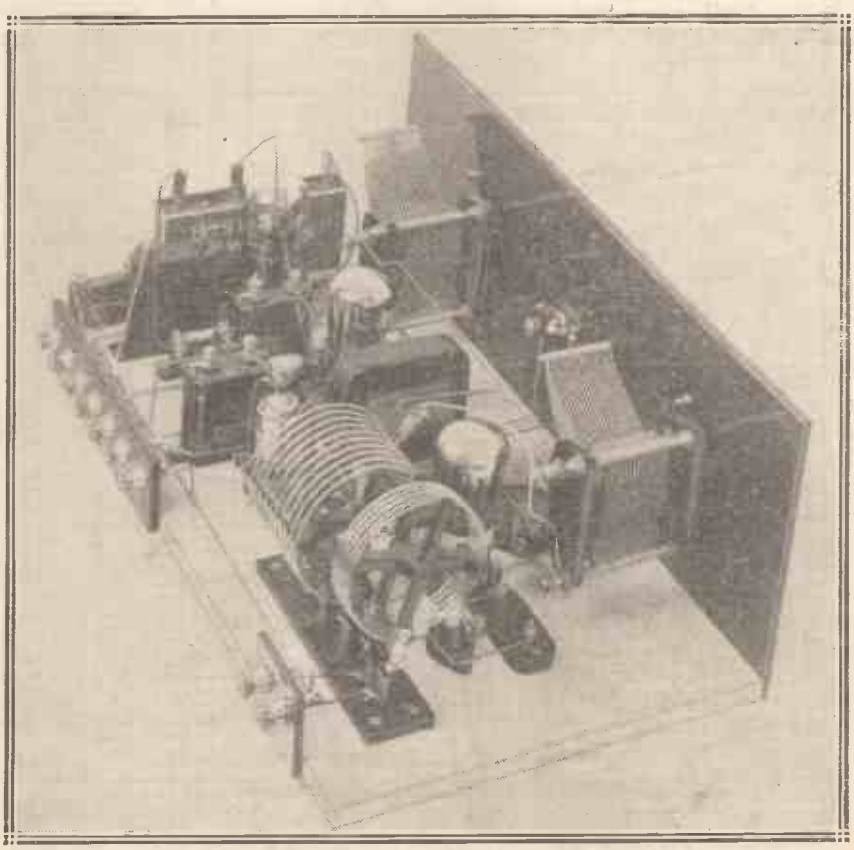
I used a valve of the medium "mu" class as detector (impedance about 7,000 ohms), but advantage may be taken of valves with considerably higher impedance and amplification factor than these. For the first note-magnifier an R.C. type valve should be utilised, and for the output a good power or super-power valve. The set has been operated with upwards of a dozen valves, all changed round several times, and does not appear to be critical in its likes and dislikes.

About 65-70 volts is suitable for the detector; the last two valves, which have a common positive terminal, taking anything up to 120 or so.

Preliminary Tests

Of the short-wave coils supplied (see also list of home-made coils) the 9-turn covers a wave-length range of roughly 30-60 metres, and it is on this that stations are most likely to be heard on the first test. Insert this, therefore, together with the aerial coupling coil, and place the condenser clip about half-way up the 9-turn coil.

From about 70-120 degrees on the scale amateur signals of all kinds will probably be heard, and just below this, during the afternoon, two or three strong telephony stations may generally be found. One of them is Kootwijk, the Dutch end of a



A three-quarter view of the "Digger" with S.W. coils and valves in position.

The "Digger"—*continued*

telephone service between Holland and the Dutch East Indies. Various powerful German telephony stations are also to be heard.

American Broadcasting

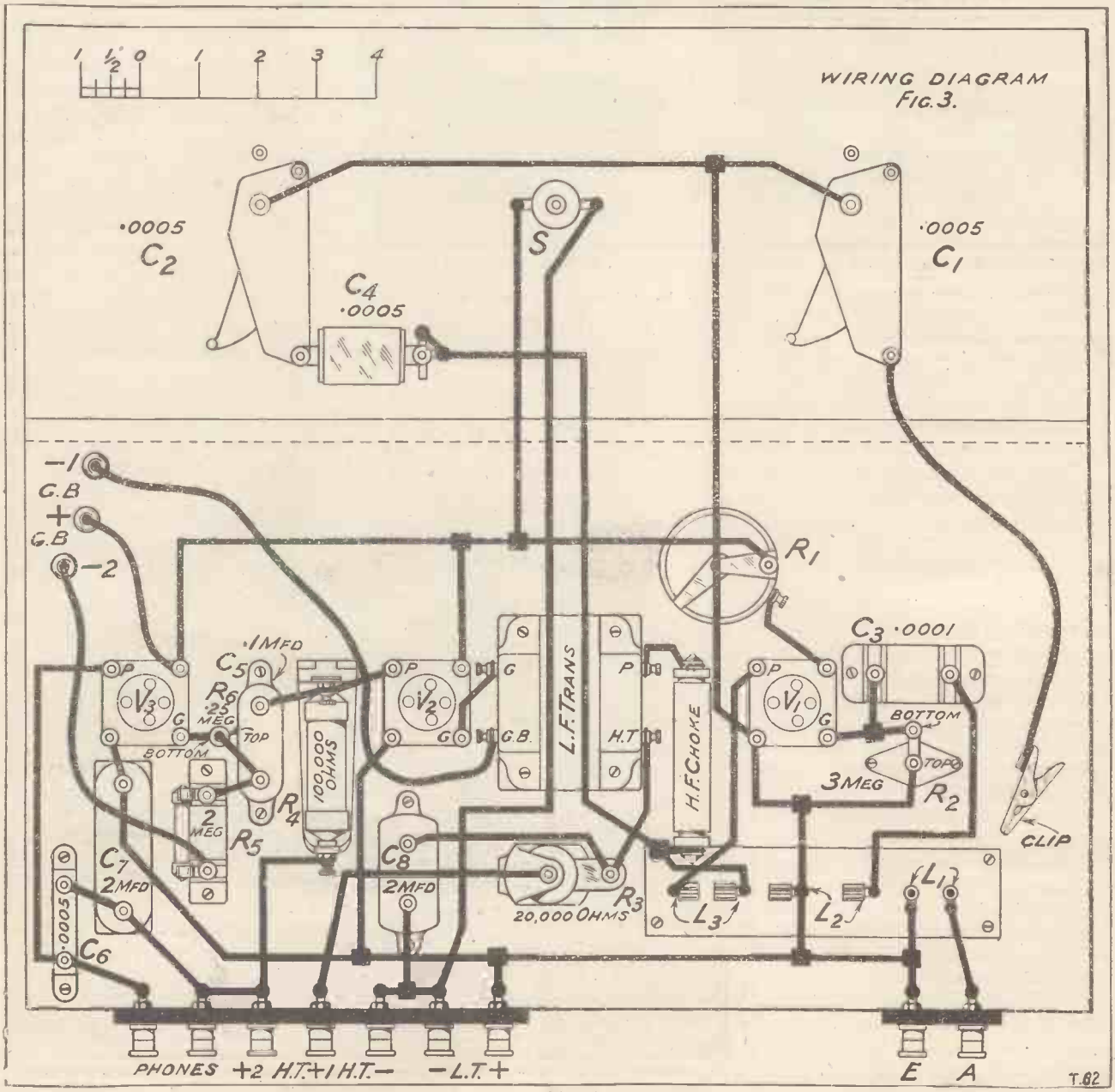
At night, W 2 X A F (Schenectady) may be found at 30° or thereabouts, provided, of course, that one chooses a night on which he is transmitting. Do not blame the set too hurriedly, for transatlantic programmes are a trifle irregular nowadays. When one has found these stations the position of the condenser tap may be shifted as desired.

With the five-turn coil a range of roughly 16–30 metres can be covered. Personally, I reduce this range, since there is nothing of great interest between 25 and 30 metres, so that I tap the condenser clip on the second turn up from the filament end, giving a range of roughly 16–25·5 metres.

At the very top 5 S W will be heard. Somewhere near the centre of the dial W 2 X A D, on 21·96 metres, should be found, although at the time of writing conditions for reception from U.S.A. are so bad that he has been inaudible for weeks. Down near 16 metres one can only explore, since there are so many curious stations doing peculiar things that it is impossible to describe them all. For those interested in amateur Morse signals from all over the world, this wave-band is undoubtedly the most interesting.

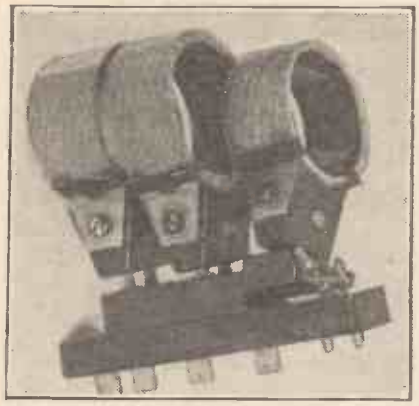
Australian Signals

I have logged upwards of a dozen stations in the Antipodes between 2 p.m. and 2.45 p.m. on the day of writing, and the South Africans have been coming in well at 5.30 or 6 p.m. for some days. The actual band is between 20·8 and 21·4 metres.



The "Digger"—*continued*

Regarding broadcast work, one simply inserts the "broadcast adaptor" and plugs in the necessary coils, clipping the condenser on the lead



Ordinary plug-in coils used in conjunction with an adaptor and the special coil holder incorporated in this set.

from the grid condenser to the top of the coil, and the change is complete.

The adaptor provides for variable coupling of the aerial coil, and with a No. 25 for this, a No. 60 as secondary, and a No. 30 or 35 for reaction, the whole of the useful broadcast band can be covered with the exception of the very lowest section, which needs a No. 50 as secondary.

With quite a tightly-coupled aerial coil selectivity was found to be distinctly good, and during a period of about forty-five minutes some twenty stations were identified on headphones, quite a number of them being quite usefully loud on a speaker. There has never been any difficulty in receiving Langenberg, Stuttgart, Toulouse and Newcastle on the loud speaker fairly early in the evening.

Unlimited Wave-length Range

The set has also been in use for listening to the Imperial Airways 'planes in communication with Croydon, as well as for all the usual long-wave broadcast stations, so that its wave-length range appears to be limited only by the number of coils one possesses or has the patience to wind.

In conclusion, I propose to give details for the winding of home-made coils suitable for the set.

If this is to be tackled by the average constructor I suggest that a base be made up with four valve sockets (or "Clix" sockets of a suitable nature), mounted on a small ebonite base, about 5 in. by 1 in.

Two terminals or two more sockets should be provided for the aerial coil. Guidance may be obtained from the plan of the coil base in the back-of-panel diagram.

The home-made coils with which I have been experimenting consist of short lengths of Pirtoid tubing with the wire wound on flat and unspaced. Plugs are simply screwed right through the tube itself. These seem perfectly efficient, and it certainly does not seem necessary to go to the trouble of cutting away the former.

If these coils are wound with D.C.C. wire, as my own were, a tapping should be provided half-way up for the variable condenser clip.

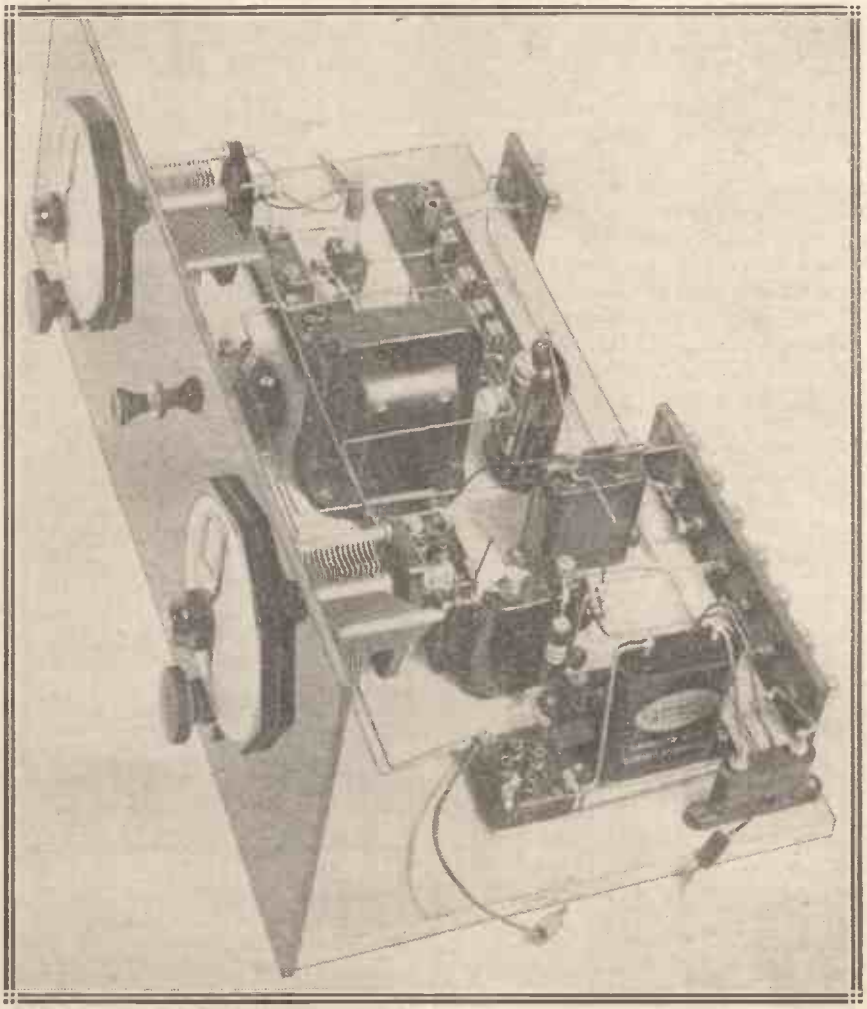
The two useful coils for short-wave work have the following dimensions:

Diameter of former, 2¼ in. Secondary turns, 8 and 4. Reaction turns, 5 and 3. In each case the windings are separated by ½ in., and the wire used is No. 24 D.C.C. The end of the secondary connected to filament should be adjacent to the end of the reaction coil connected to the H.F. choke, and the two windings should be in the same direction.

The wave-length ranges covered by these two coils are roughly 27–52 metres and 17–28 metres, with an effective capacity of about ·0002.

The aerial coil may be fitted round the end of the Pirtoid tube, and should consist of 5 turns. Coupling may be made variable.

I have purposely been fairly accommodating in these details, since readers may, in some cases, have their own favourite form of coil construction, which may be used in this set without alteration, providing that the secondary and reaction coils are entirely separate.



Three knobs on the panel—two for tuning and reaction respectively, and one for the on-off switch. Such is the simplicity of the panel layout of the remarkable short-waver described in these pages.

Some typical faults and remedies reviewed.

By P. R. BIRD.

Battery Coupling

A good many questions have of late been raised with regard to battery coupling, some of these being in the form of questions on the technical side of the affair, and others taking the form of appreciations of great stability and remarkable purity which is now obtained on account of the use of anti-motor-boating devices in the design of WIRELESS CONSTRUCTOR sets.

Those readers who like to ponder over the design of their sets have long ago realised that in general an anti-motor-boating device consists of a fixed resistance and a large condenser. To many the resistance is a complete puzzle, for it has frequently been mentioned in the WIRELESS CONSTRUCTOR that "battery coupling troubles are in the main due to the high resistance developed in an out-worn H.T. battery." How then can an added resistance improve matters?

Effect of Resistance

Those who have been puzzled upon this point should turn back to the theoretical diagram of the "Air Commander," which appeared on page 402 of our last issue. Joined to the plate of the third valve it will be seen we have the usual reaction condenser (of ·0001 mfd.) connection and an R.F. choke. On its other side this choke is connected to the primary of the transformer, and a year or so ago the other side of that primary would have been taken direct to the H.T. positive lead. In the case of the "Air Commander," however, it will be seen that OP is joined to a 20,000-ohm resistance and to a 2-mfd. condenser, the other side of the resistance being taken to the H.T. positive lead, and the other side of the condenser to the filament lead.

An inspection of this diagram will soon show how it is that the resistance tends to prevent battery coupling, and not to make it worse.

If we imagine that the 20,000-ohm resistance and a 2-mfd. condenser have been left out of the circuit, the OP connection would go direct to H.T. positive (via the fuse, etc.). Suppose then that a rather old H.T. battery were in use, and that this had developed a high resistance, we can see its effect by tracing out the circuit of the last two valves.

As the diagram shows, the H.T. circuit of the last valve is from H.T. negative to L.T. negative and filament of the last valve across the space inside the valve, past the grid to the plate, through the L.F. choke, and back via the fuse to H.T. positive. Similarly the H.T. circuit of the third valve is from H.T. negative to L.T. negative and its filament, across the space inside V_3 to the plate, and from there via the R.F.C. to IP, out from OP and—in the absence of the 20,000-ohm resistance—straight back to fuse and H.T. positive.

The Fundamental Cause

Now remembering that the effect of current flowing through a resistance is to set up voltages across that resistance, it will be seen that the comparatively large current taken by V_4 will set up comparatively large voltage impulses across the resistance which is represented by the H.T. battery and as this resistance is directly in the H.T. circuit of V_3 as well, these two valves are in fact coupled by the resistance, and the current taken by V_4 will tend to upset V_3. This is the fundamental cause of battery coupling trouble.

If now we imagine that an anti-motor-boating device is inserted, as in the "Air Commander" just referred to, the effect of the extra resistance can easily be imagined. In the first place, whatever happens in the H.T. circuit of V_4 will not affect this resistance, for, unlike the H.T. battery, it is not in that circuit at all.

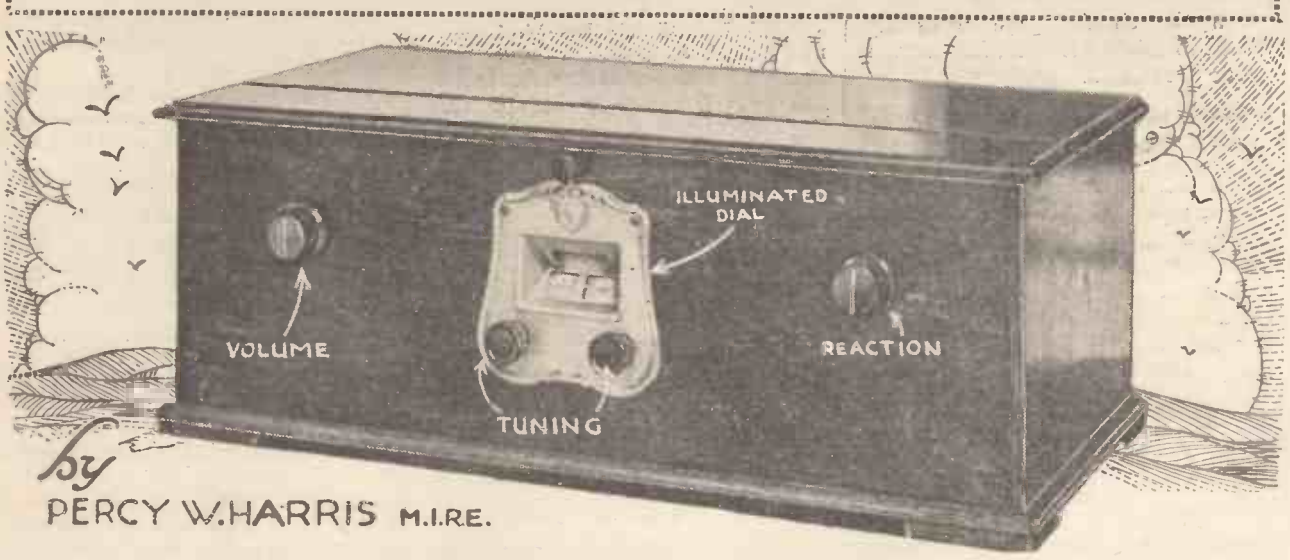
An Alternative Path

In the second place it will be seen that even if the current of V_4 tried to upset the working of V_3 the 20 000-ohm resistance is directly in the path between the valves, and consequently would tend to prevent mutual interaction; and, finally, not only is the resistance placed between V_4 and V_3 in such a position as to discourage interaction, but a direct path from filament to plate is provided for the L.F. voltage variations of V_3 by means of the 2-mfd. fixed condenser connected to one end of the resistance and to the screen.

As everyone who has used an output filter will know, speech variations do not need a direct metallic path, but can be passed through a large fixed condenser which offers very little obstacle to their progress. And thus the provision of the 2-mfd. condenser in an anti-motor-boating device means that the low-frequency currents of

(*Continued on page* 61.)

The "Air Commander" Proves Its Claims



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

WE are not surprised to hear of the very great interest aroused by the publication of the "Air Commander" in our last issue. Not only is it, in performance and appearance, the best four-valve design yet published in the WIRELESS CONSTRUCTOR, but the cost of construction is most reasonable even if all new parts have to be purchased. The utilisation of standard components, and the number of good alternatives possible, has enabled many readers to build this set with a small additional expenditure.

Using Ordinary Dials

Those readers who are anxious to obtain the full results in the way of sensitivity and selectivity given by the "Air Commander," and who do not mind sacrificing something in appearance in order to reduce the cost, will be pleased to hear that some little saving can be effected without any reduction of sensitivity, selectivity, or efficiency, if the ordinary dial types of condenser are used. An examination of the design will show that there is ample room each side of the centre line (indicated by the vertical screen) to mount any of the standard makes of variable condensers with vernier dials.

The volume control resistance and the reaction condenser should be left in the same position as at present, and all other components mounted exactly as before. If one-hole-fixing condensers are used, then the drilling points will come 7½ in. from each end, and 3½ in. from the bottom of the panel. The saving here will be that of the double drum dial and light, two brackets, and the two small ebonite panels; but, of course, one must add the cost of the vernier dials which take the place of the double drum. Any good variable condensers previously used in the WIRELESS CONSTRUCTOR sets, or reviewed in our "What's New" pages, can be used with complete satisfaction.

Since the publication of the details of its construction the "Air Commander" has been the object of great interest, and has frequently been demonstrated before members of radio clubs. The results have been astounding, and the enthusiasm of those who have heard the receiver proves that the set has indeed lived up to the claims made in last month's "Wireless Constructor."

I would again draw attention to the importance of choosing the correct radio-frequency choke in the first high-frequency stage. The use of a radio-frequency choke here is different from that to which it is normally put in a reaction circuit, and while there are dozens of chokes which will prove perfectly satisfactory in a normal reaction circuit or in the position of the second choke (following the detector valve) in the "Air Commander," there are very few suitable for the first H.F. stage. Readers who have not yet built the "Air Commander," and desire to do so, are again referred to the notes on page 409 of the last issue.

On Tuesday, March 5th, the "Air Commander," together with the "Stedipower" L.T. and H.T. units (forming a complete mains-driven outfit), was demonstrated before the Thornton Heath Radio Society. In a lecture, the purposes of the various parts were explained in detail, together with the reasons which led to the gradual building up of this particular design.

Demonstrations were given, on the club aerial, of reception from a large number of different stations on both wave-bands, attention being specially drawn to the chief claim of the Air Commander," namely, the provision of programmes of quality comparable with that received from the local station.

Great Sensitivity

All members present agreed that this claim was in no way exaggerated, and the high quality and complete freedom from the slightest hum when used with the "Stedipower" units were widely commented upon.

As an example of the great sensitivity of the "Air Commander," reception of foreign stations at loudspeaker strength was effected on an aerial consisting of a piece of wire 6 ft. or 8 ft. long, hooked on to a window catch. The high selectivity on both wave-bands was also demonstrated, together with the freedom from pick-up due to the use of binocular coils, for when the aerial and earth were disconnected it was quite impossible to obtain a sound from London, even

The "Air Commander" Proves Its Claims—*continued*

when the circuits were accurately tuned to this station and full use was made of reaction.

The Valves Used

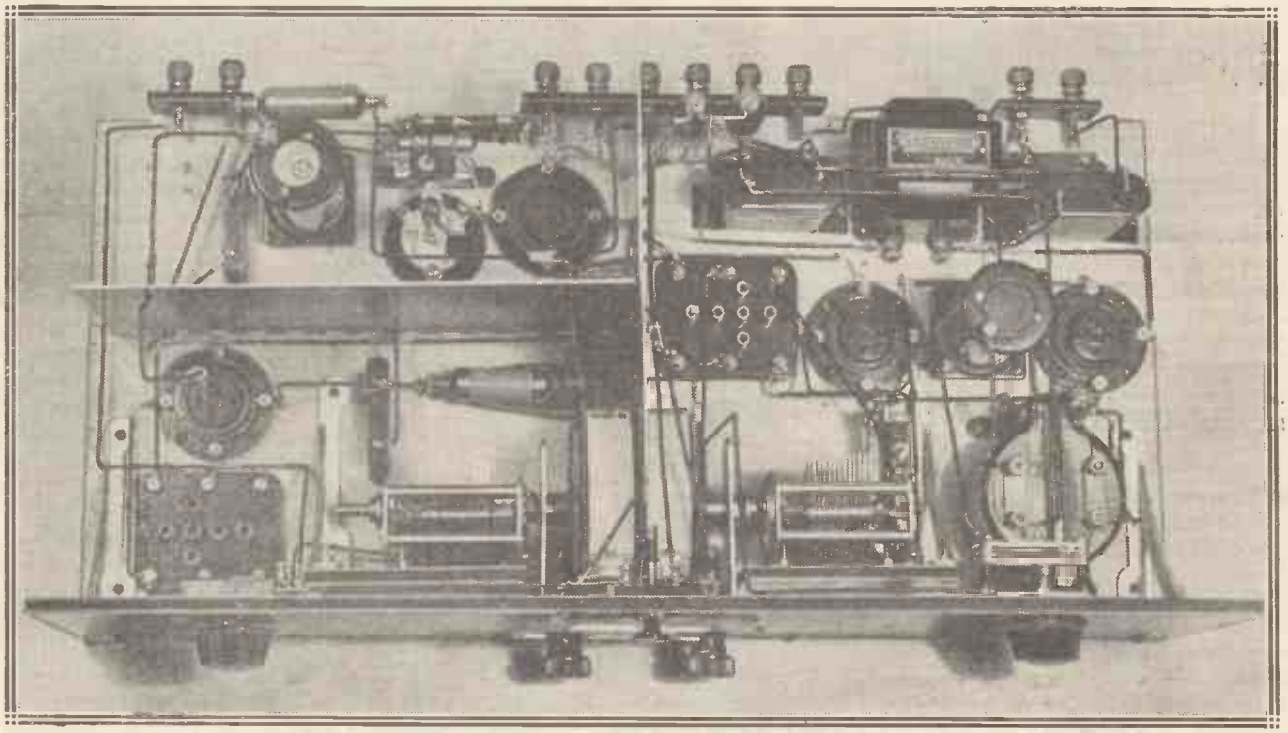
Another interesting point, showing the comparative freedom of the set from changes introduced by different aerials, was that prior to the lecture and in the laboratory it was tuned to Vienna. The set was then taken off the bench, put into a car and taken off to Thornton Heath. Directly the club aerial and earth and the "Stedipower" units were connected, Vienna came in at once without further tuning on the Amplion Lion loud speaker which was used for the demonstration.

The valves used in this demonstration were a 4-volt Mullard screened-grid in the first socket, no additional rheostat being used, as the volume-control resistance, when turned to its low point, brings the filament voltage from six down to the required figure of four. In the second and third sockets, Six-Sixty H.F.610 valves were used, and in the output an Ediswan P.V.625X.

Since writing last month, a large number of experiments have been made with different valves, and it has been found that there is very little difference—in fact no distinguishable difference—between an R.C. type of valve in the second H.F. socket and the H.F. type. The R.C. type, however, neutralised far more sharply, the selectivity and signal strength being the same in both cases.

Some readers have asked whether they cannot incorporate a wave-change switch in this scheme to avoid changing coils when going from one band to another. Unfortunately, at present it is not possible without sacrificing efficiency. It can be done without any great sacrifice in the aerial circuit, for here the number of connections to be changed over is comparatively small. The H.F. transformer preceding the detector, however, would require a very complicated change-over arrangement, and no suitable scheme of doing this without considerable sacrifice of efficiency exists at the present time. Nevertheless, experiments in this connection are being carried on continuously, and directly it is possible to evolve a really satisfactory scheme particulars will be published.

A GENERAL VIEW OF THE "AIR COMMANDER"



The above photograph of this remarkable set shows how the layout of components is arranged.

A NOVEL EARTH

I HAVE recently been carrying out tests with several different kinds of earths, and one that gave conspicuously good results was as follows.

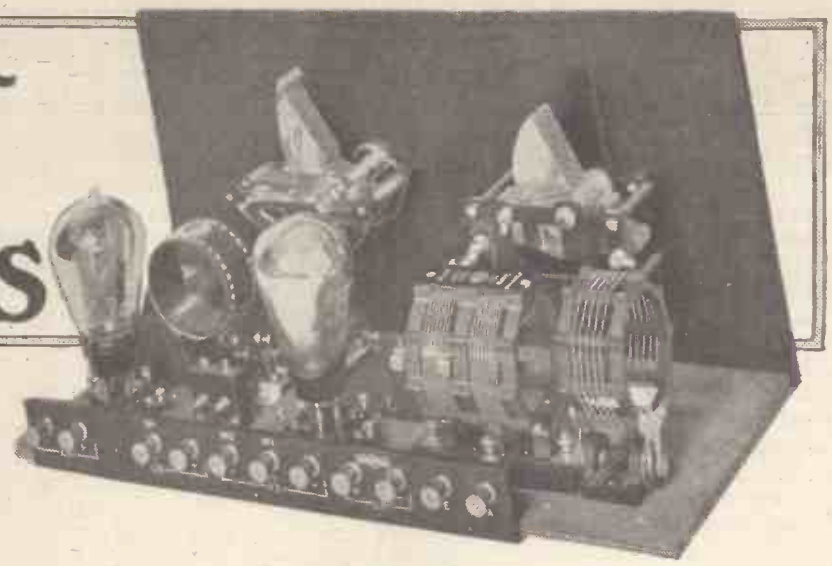
It consisted simply of a coil made from 6 ft. or so of copper gas tubing, such as is used for "remote control" of bypasses. This may be obtained from almost any ironmonger or gas supply company, and is about ¼ in. in thickness.

Petrol piping from a car is equally good, though rather more expensive to buy.

The tubing is formed into a coil of about 6 in. diameter, and buried with one end just protruding above ground. To this end the earth lead is soldered.

The edges of the tube at this end are hammered out into a small funnel, into which water may be poured from time to time.

SHORT-WAVE CIRCUITS



Some tried and tested hook-ups guaranteed to give you reliable results.

By L. H. THOMAS.

I DO not wish the title of this article to lead the reader into believing that a short-wave set differs to any serious degree from any other type of receiver, or even to imagine that special circuits are ever necessary in a short-waver. Rather is it intended to rub in the fact that almost any circuit can be a "short-wave circuit" provided that the necessary modifications and improvements are understood and carried out with a fair amount of common sense.

A Searching List

Any reader who has had a few years', or even a few months', experience of short-wave work will know by now that there are two or three special points in a receiver of which more than ordinary care has to be taken if we wish the set to work efficiently on short waves. Incidentally, by "short waves" nowadays I mean anything below about 100 metres, although it seems as if the term will soon mean only waves below 15 or 10 metres or so!

A dose of "short waves" is an excellent tonic for anyone who is keen on getting the most out of a

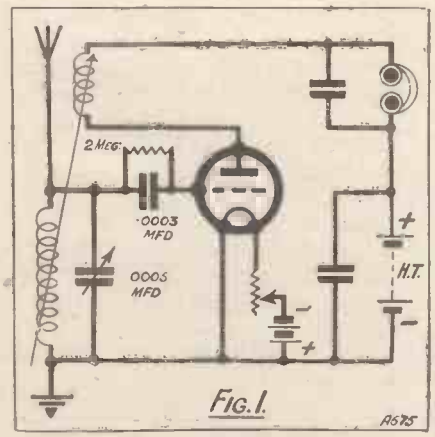


FIG. 1.

receiver. A broadcast receiver may be functioning perfectly well and affording its owner every satisfaction, and yet there may be something radically wrong with it. Nine times out of ten, if he tries to get this set down to, say, 30 metres, to try to receive short-wave "Empire broadcast" or other stations on it, that fault will reveal itself.

If he has been sufficiently assisted by the time he reaches the end of this article, the owner of the set will say "Something is wrong with the set," and *not* "The circuit is no good for short-wave work."

I always think of short-wave sets compared with broadcast receivers in a similar manner to racing cars compared with comfortable touring cars. A few days' work on short waves will show you more things wrong with a set than perhaps a whole year of listening to 2 L O or 5 G B!

Showing Up Defects

Motor-car racing has shown itself to be valuable for exactly this same reason—that it will show up defects in a car in a few moments, which might not otherwise have revealed themselves for months. So let us begin a "destructive criticism" of some of the well-known straight circuits as applied to short-wave working before dealing with the more specialised arrangements.

Fig. 1 shows the circuit that is probably used by quite 90 per cent of the beginners at radio. It is the ordinary single-valver, with "flopping coil" reaction control, aerial straight on the top of the grid coil, and just the one tuning control—a variable condenser across this latter coil.

On broadcast waves and skilfully handled it probably gives just as good results as the average "fancy" single-valve circuit, and doubtless thousands of listeners are using it just in this form and deriving perfect satisfaction from it. Now try to work the set on short waves, by plugging in, say, a five-turn coil as grid coil and a six-turn for reaction.

The first thing you will probably find is that the set will not oscillate. This is to be expected, since the damping effect of the aerial, attached right to the top of the grid coil, is so great on wave-lengths of this order that no set could be reasonably expected to oscillate through such difficulties! Take the aerial off, and the set should oscillate quite vigorously.

"Floppy" Reaction

Point No. 2 will most likely be that the reaction control obtained by "flopping" coils in the usual manner will be of such a kind that the set is pretty well unmanageable. It will shoot into oscillation with a loud click and there will be no nice "sliding in" effect.

Point No. 3 will certainly be that if you are lucky enough to hear any

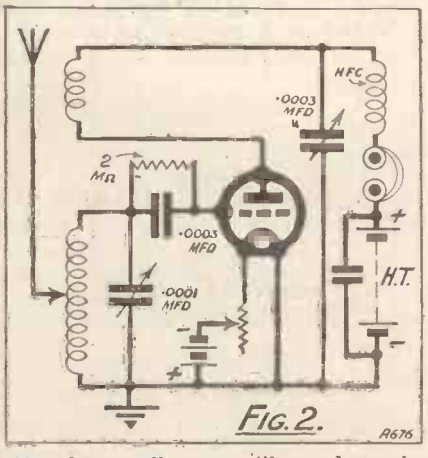


FIG. 2.

signals at all, you will need to be a conjuror to tune them in and hold them with your ·0005 variable

Short-Wave Circuits—*continued*

condenser. About fifty different stations will probably be accommodated within a five-degree sweep of the dial, and then if one is found he will almost certainly be "a mile away" by the time you have withdrawn your hand from the panel.

Now having proved thoroughly and conclusively that the circuit is not of the least use for a would-be short-waver, let us make it work! Fig. 2 shows the same circuit with a few alterations. First of all, the aerial is equipped with a spring clip and is tapped on the grid coil, instead of at the top, nearer the bottom end. About half a turn up from the filament end of the coil will give sufficient coupling for the average aerial.

Avoiding Hand-Capacity

It will probably go against the grain to tap the aerial on a bare half-turn away from the earth, but there is no need to worry. The arrangement will be perfectly efficient. Secondly, the "flopping coils" have been done away with, and the coupling is now fixed. The coils may be mounted in two separate baseboard-mounting coil sockets, placed about three-quarters of an inch apart on the baseboard. To provide a control for reaction, a high-frequency choke has been placed in series with the 'phones, the by-pass condenser across the latter has been scrapped, and a variable

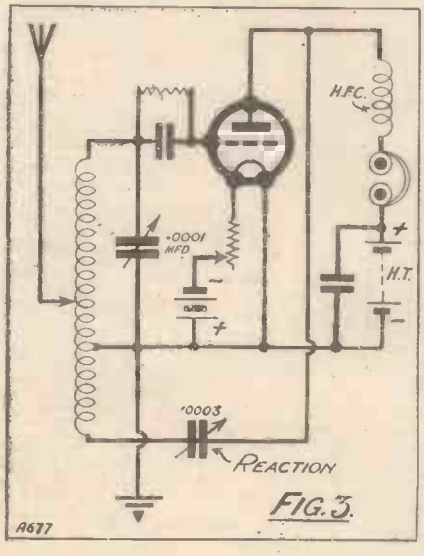


FIG. 3.

condenser of ·0003 mfd. has been taken from the choke end of the reaction coil down to the filament.

Incidentally, see to it that it is the moving vanes of this condenser which are connected to the filament, and you will not be troubled by "hand-capacity" effects. You should now find that the set oscillates in a gentlemanly fashion when the aerial is tapped on, and that reaction is controlled perfectly and smoothly by the new variable condenser.

Better Tuning

The average set will slide into oscillation when this condenser reaches the "half-in" position, or thereabouts, and the point at which oscillation commences should remain fairly constant while the other condenser is swung round the scale.

Point No. 3 is cleared up by the use of a very small variable—·0001 or so—across the grid coil, instead of the ·0005 previously used. This will give quite sharp enough tuning for short-wave work, although the capacity will probably seem ridiculously small to you if you have not done anything in this line before. The grid leak and condenser remain unaltered, and should be quite satisfactory as they are.

There, then, is short-wave circuit No. 1. It should behave itself perfectly well, and, incidentally, if the original set was a two-valver instead of a "single," that need make no difference to my remarks; the H.F. choke is simply inserted in that case between the reaction coil and the transformer primary, and the reaction condenser placed just as before. Now put the set back on the broadcast waves as it is, and you are certain to notice an improvement.

Reaction control will be easier, the set will be more selective with the aerial "tapped down" (keep it about 20 turns up from the filament end if you are using a 50- or 60-turn coil), and the whole "feel" of the set will be much better. The ·0001 condenser will, of course, be too small to cover the broadcast range properly, and you will have to put back the old ·0005 or ·0003 again. I am coming, however, to a method of getting over this difficulty.

A Useful Scheme

In the short-waver it is not really necessary to substitute another condenser, since if we have a condenser in the set with a capacity of ·0005 it is possible to reduce its *effective* capacity to ·0001 or so by other means. One plan is to connect a small fixed condenser *in series* with it.

A ·0005 fixed condenser in series will reduce the effective capacity of the other to ·00025, and a ·00015 fixed condenser in series will reduce it to approximately ·0001. I advise the use of a ·0001 fixed condenser in series with your ·0005 variable, which will give an effective capacity somewhere in the region of ·00008, which is an excellent figure for short-wave receivers.

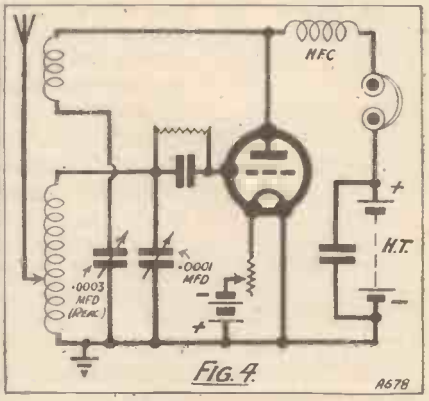


FIG. 4.

I do not propose to dissect other circuits in detail, but after outlining one or two more small points in connection with this first one, we can pass on to some slightly different arrangements. If your coils are of the plug-in variety, on the standard bases, you need not worry unduly.

The S.-W. Coils

It is true that certain short-wave coils are rather spoilt by being mounted on standard plugs; but if the plugs are of good material, and do not contain too much of it, the losses are almost negligible. The same remarks apply to the baseboard sockets. See that they really are of good ebonite, and select those with the smallest amount of ebonite in them.

If you do not want to use the same set for broadcast reception, by all means scrap the plugs and sockets and invest in some proper short-wave coils. But the other method is convenient if you do want to listen to broadcast occasionally, and do not wish to have two separate sets about the house.

Since the purpose of this article is to discuss the actual circuit arrangements rather than the

Short-Wave Circuits—*continued*

constructional details, I will leave the choice of short-wave coils to the reader's own imagination. Numerous articles will be found in old issues of the WIRELESS CONSTRUCTOR which should help him to make up his mind. He may, however, take comfort from the thought that home-made coils are usually quite as good as, if not better than, commercial articles.

Fig. 3 shows another arrangement of the first circuit, using parallel feed for the H.T. supply, and one coil, tapped to provide a reaction section.

The coils may either be made up as plug-in units, with a spring clip making the "tap," or a single coil with several tappings at the grid end for the different bands of wave-lengths may be used. The aerial should be tapped, as before, a short distance "gridwards" from the filament tap, and about half a turn or one turn will usually be sufficient.

Another Arrangement

The reaction winding should have about two turns fewer than the other section. For 2 X A D and the other broadcast stations between 20 and 30 metres the grid section should have five turns and the reaction three, while for 2 X A F and the other stations working above 30 metres the grid coil should have seven turns and the reaction five.

As an alternative, Fig. 4 shows another arrangement of exactly the same circuit, two separate coils being used in place of the one tapped coil. Another alteration that has been made is that the reaction condenser has been shifted from the plate end of the coil to the other end. It performs exactly the same function, but in this position it is possible to connect its moving vanes to the filament circuit, which is always to be recommended where possible. It will be seen that in the position it occupies in Fig. 3, it is impossible to arrange this, and some slight trouble with hand-capacity effects may be encountered.

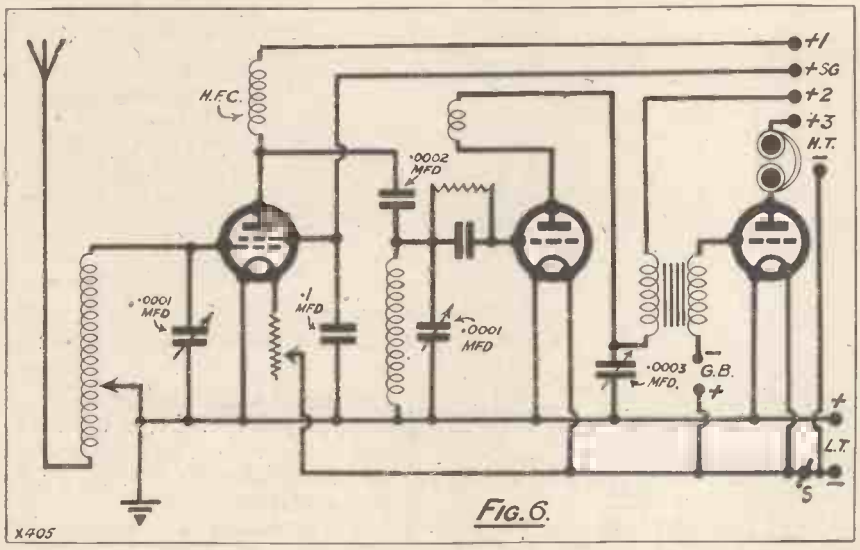


FIG. 6.

The same remarks about the size of the coils still apply, except that there are two separate coils instead of two sections of the one coil under consideration.

In my own opinion, this particular arrangement is always preferable to that of Fig. 3, which became popular about the time that the single-layer coil was widely used (meaning the long single-layer coil wound on a cardboard former and tapped at frequent intervals, not the more efficient coils of to-day).

There is no particular advantage nowadays in striving to produce a "one-coil" set, and I think that on the whole this Fig. 4 makes the most satisfactory single-valver it is possible to devise.

Fig. 5 shows a two-valver similar to that which is in everyday use at my own home, its chief duty being to work in conjunction with a short-wave transmitter on the 20- and 40-metre wave-bands, and also to pick up any short-wave broadcast that is going between these two wave-lengths. The detector portion of the circuit is, in effect, Fig. 2, but some modifications and additions have been introduced which make it worth sketching separately, and may perhaps interest the reader.

Grid-Leak Noises

In the first place, the aerial is tapped somewhat higher up the coil than is possible with the other circuits, since a neutralising condenser is wired in series with it; this, of course, reduces its damping effect so considerably that it is possible to work with the aerial lead directly on the top end of the coil Also, the usual 2-megohm grid leak has been replaced by one of 5 megohms, this giving a quieter background and greater freedom from what our American friends boast of as "tube noises."

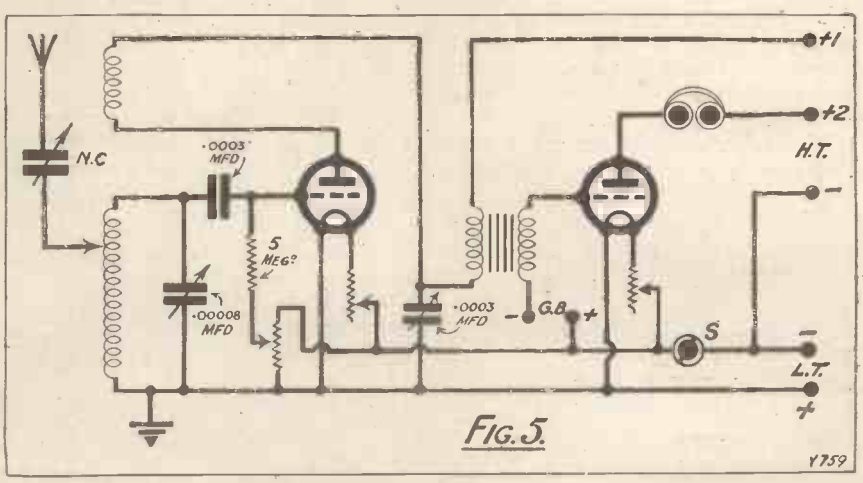


FIG. 5.

Unfortunately, many grid leaks are themselves noisy, and I had to go through at least half a dozen of a well-known make before I could find

(*Continued on page* 59.)

RADIOGRAMOPHONICS

A monthly article for the gramophone enthusiast.

This month the question of pick-up adjustment and volume control is discussed.

By A. JOHNSON-RANDALL

THE question of pick-up adjustment and volume control seems to worry a great number of people, though it is not a difficult one by any means.

In the case of volume control, a 500,000-ohm potentiometer should be placed across the pick-up and the slider of the potentiometer connected to the grid of the detector valve of the set—assuming that you are going to use the detector as the 1st L.F. when the pick-up is employed.

Pick-up Adjustment

This potentiometer should be well made and will give perfect volume control besides assisting in increasing the stability of the set, a quality that is sometimes lost to a greater or less degree when a pick-up is fitted.

As regards pick-up adjustment, this is a more difficult matter, though it is easy enough in the case of many pick-ups which have adjusting screws. These either operate on the armature or on the damping device, but the effect is the same—to make the pick-up more or less sensitive.

Sometimes, however, the pick-up is of a more intricate construction, such as in the case of the Woodruffe, and R.I.-Varley, which are more difficult to adjust, or in the case of the Phonovox, B.T.H., Crossley Merola, etc., which have no apparent means of adjustment. In such instances it is advisable, should the pick-up go out of adjustment, to send the instrument to the makers, who will be pleased to readjust it for you.

Overloading Valves

In the case of the R.I.-Varley pick-up the adjusting screws are sealed, and the makers state that they prefer to have it sent back if it goes out of adjustment, adding that they take no responsibility if the seals are broken.

Before blaming the pick-up, however, make sure your set is in good order, for an overloading valve will often give the same result as a pick-up whose armature is out of adjustment and is occasionally touching and momentarily adhering to the magnet pole-pieces.

And talking about overloaded valves, make sure that your first valve is not getting from the pick-up more than it can carry, by fitting a potentiometer volume control across the pick-up. Very often, if the pick-up is at all sensitive, an R.C. valve may be badly overloaded on loud record passages, and the writer prefers to use the ordinary H.F. valve, with an impedance of about 20,000 ohms and a magnification factor between 15 and 30, as detector, if the set is to be used for pick-up work.

Also, if you would avoid instability, don't take your pick-up leads over the loud-speaker leads, and don't have longer pick-up leads than you can possibly help. Earthing the tone-arm and sometimes the motor of the gramophone also often helps in cases of tendency to howl or squeal when the pick-up or tone-arm is touched.

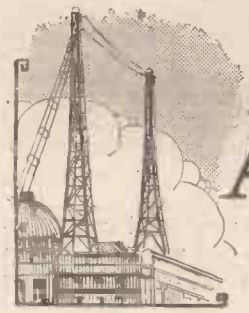
The choice of needles will make a difference in the reproduction, of course, and the half-tone needle seems best suited to the majority of highly damped pick-ups. Others work better with loud-tone needles, especially the Woodruffe and R.I.-Varley, but loud needles on highly damped pick-ups seem to cause unnecessary record wear.

Change the Needle

A little experiment with various types of needles is always worth while, and it is wise to remember that a once-used needle often acts as a miniature chisel upon the record, especially if the needle is given a half turn to "use a fresh point," as so many people do.

The inventor of the phonograph, Mr. T. A. Edison, recently celebrated his eighty-first birthday, and here is seen his first instrument for the recording and reproducing of speech. The recording was carried out on tin-foil, wax being used at a later date.

Steel needles should be used for one side only, when the needle "grinds itself in" to fit the particular record and should on no account be used again—not even on the same side.



HAPPENINGS AT SAVOY HILL

By OUR SPECIAL COMMISSIONER

The B.B.C. and Reception

THE ideas on reception held by the engineers at Savoy Hill are being put forth by the B.B.C. with more confidence and persistence than in the past. Several firms appear to have had the benefit of special B.B.C. reports on their apparatus. Of course, it remains to be seen whether the suggestions contained in these reports can be applied under competitive commercial conditions. There is, however, one aspect of the matter which can be applauded right away. I mean the policy of the B.B.C. to give active help, encouragement and reasonable preference to British manufacturers and apparatus.

The Old System Passes

The approach of the Regional Scheme is heralded by the progressive demobilisation and disbandment of relay station programme staffs. There is now in process a particularly drastic reduction in Scotland. Dundee, except for the transmitter, has ceased to exist; all its programmes must originate outside. Aberdeen's orchestra and octet have gone, and I hear that it, too, will follow Dundee into the obscurity of a non-originating station. There is a strong rumour that Neil MacLean, the popular station director at Aberdeen, will assume the new role of B.B.C. "representative" for the north of Scotland, with headquarters at Inverness, whence he will gather Celtic talent to enrich the programmes generally. I hear also that Edinburgh and Glasgow staffs have been cut down by a third.

If London programmes are provided in place of the local ones, then there is not likely to be much weeping and gnashing of teeth. The gulf between London and provincial standards in programmes is now so great that, except in the case of Birmingham, the most rabid local patriot finds it hard to hold out.

More Studio Dance Music

One result of the recent row about song-plugging is that, beginning in the autumn, listeners will get a much larger proportion of dance music from the studios. There was real danger at one time that the interests at variance with the B.B.C. would stop the provision of all copyright music. Although this difficulty has been surmounted, Savoy Hill had a nasty shock, and decided to become more self-supporting in future. Thus not only will Jack Payne's orchestra play more, but he will probably have a second dance orchestra ready to perform for listeners by the autumn.

Jack Payne's Future

There can be no gainsaying the fact that Jack Payne has made a tremendous success of radio dance music, and I suspect that Savoy Hill will soon have to face American competition for his services.

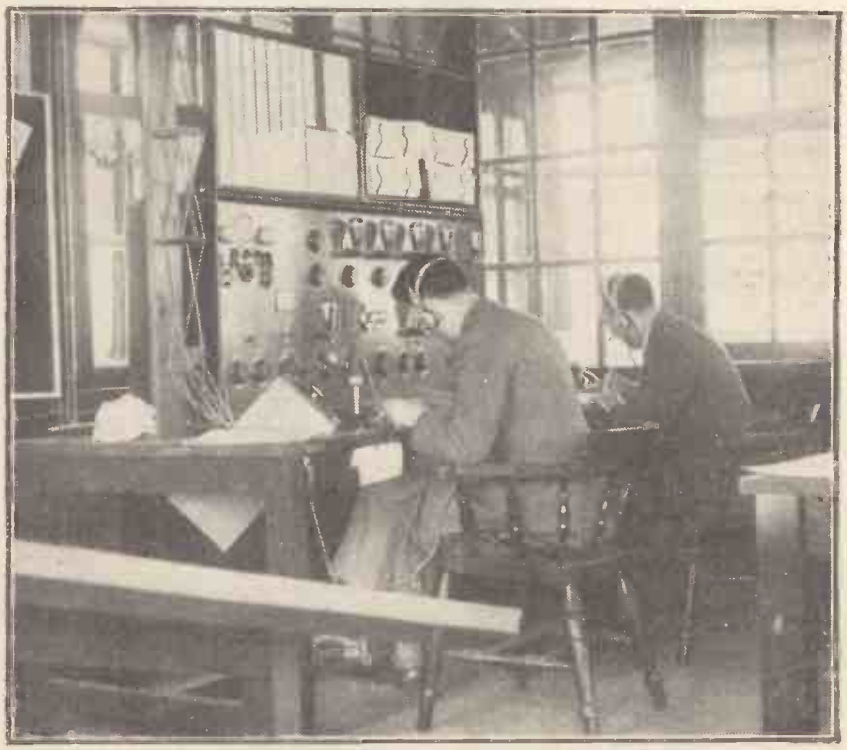
On the general issue of whether listeners prefer restaurant to studio dance music, there is no doubt some attraction in the "atmosphere" of restaurants, but this is hardly a strong enough factor to out-balance the greater efficiency and variety of the studio programme.

The National Symphony Orchestra

The recent announcement by the B.B.C. that it was ready to accept applications and arrange auditions for posts in the new permanent symphony orchestra makes the fruition of the long-discussed plan a certainty. Sir Thomas Beecham is now busy sorting out his material, and there is, of course, keen competition among musicians. But I hear that at least one of the gramophone companies, contemplating a similar project, is also in the field for musical talent for a permanent orchestra.

Thus at long last it seems that the mechanisation of music is conferring

"CROYDON CALLING"



This photograph shows wireless operators at Croydon in communication with air liners on their way to and from the Continent.

Happenings at Savoy Hill—*continued*

some benefit on struggling musicians! Naturally the competition will be reflected in higher rewards for the artistes taken on. I look forward with keen interest to the debut of the new B.B.C. symphony orchestra, which should not be deferred later than October of this year.

Sir Thomas Beecham is handling the scheme with his characteristic zeal and wholeheartedness. The critics are sure that trouble will come before very long. One of them told me the other day that the scheme would explode and go up in a cloud of smoke with Sir Thomas taking the field in a terrific campaign against the B.B.C. While I should not be surprised to hear of "ructions," I do not believe for one moment that the great enterprise will be wrecked by disputes of this kind. The B.B.C. must go through with its National Symphony Orchestra, and Sir Thomas knows full well that his ambition in this direction can be attained only through Savoy Hill.

Cecil Graves of the B.B.C.

When the other day I called attention to the rapid rise and success of Cecil Graves (nephew of Viscount Grey), who is "Programme Executive" at Savoy Hill, I speculated on the possibility of his taking over from Mr. R. H. Eckersley, the present programme chief. My impression then was that Mr. Eckersley was contemplating retirement. I am now glad to be able to say I was quite wrong. Mr. Eckersley is going strong in the full enjoyment of robust health and of the unqualified confidence of Governors and colleagues alike.

Transatlantic Relays and Empire Exchanges

The success of the United States relay of dance music from London, followed a few days later by the failure to relay in Britain the inaugural address of President Hoover, has given some B.B.C. critics an opportunity to suggest that Savoy Hill is behind the Americans in handling these exchanges.

I believe that there is very little difference in equipment. The spaced aerials and other apparatus for reception, amplification, and relay are much the same on both sides of the Atlantic. But there is certainly a fundamental difference of attitude. Savoy Hill is still very reluctant to undertake any of these relays because its prospect of success is so remote. On the other hand, the Americans are "mad keen," and will take a chance on almost anything in the nature of a relay.

This difference in attitude was commented on by members of the Canadian Commission on Radio who have investigated wireless conditions on both sides of the Atlantic. They expressed the hope that the B.B.C. would be a little keener on developing Empire programme exchange. Indeed, Sir John Aird was quoted in an interview as advocating that the new Canadian broadcasting system should take at least one British programme a week "S.B." for the Dominion. Such a step, if feasible, would certainly force the pace in British Empire radio, at present so backward.

The Future of Talks

I happen to know that the future of broadcast talks is now in the melting-pot. Although they have improved almost beyond recognition under the guidance of Miss Hilda Matheson, they are still regarded as being too remote from entertainment. The whole so-called "serious" side of broadcasting is being overhauled for the first time from the general as distinct from the specialist standpoint.

It appears that the separate handling of talks, adult education, and schools' work is to be superseded by an attentuated but centralised organisation definitely subordinated to music and drama. The new idea is that music and drama should have priority constantly, leaving for talks and education corners here and there that need filling.

The abandonment of the more adventurous schemes of education probably reflects the failure of the outside organisations concerned to play their rightful part in the co-operation fundamental to the scheme. Anyway, the tendency is thoroughly sound from the standpoint of the average listener, who will hope that the reforms are really applied in the way now favoured at Savoy Hill.

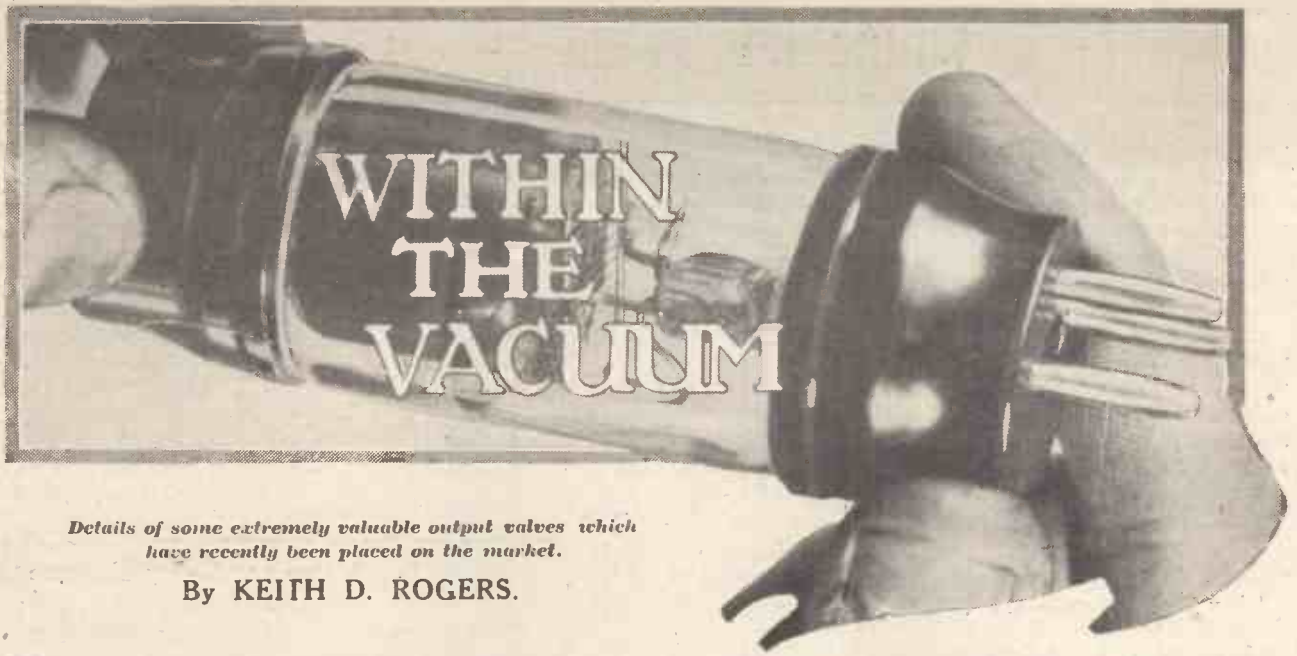
A RUSSIAN RADIO SCHOOL

Training wireless operators at the Central Radio House in Moscow. The picture shows the class undergoing a lesson in the Morse code.

SWITCHING OFF A.C. MAINS UNITS

STRANGE though it may seem, there is a definite way in which an A.C. eliminator should be switched off. In all cases the mains switch should be turned to the off position *before* the valves are switched out.

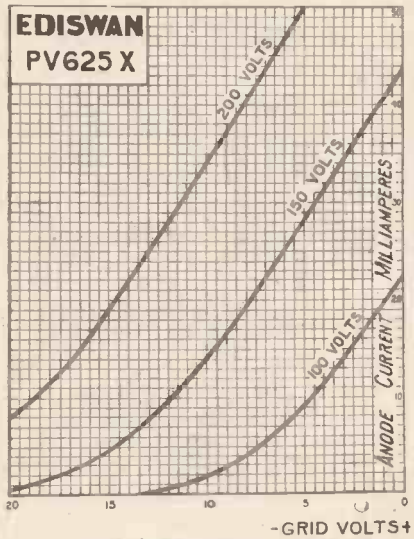
Switching on is not so important. It is as well, however, to turn on the set last, since the filaments are not then subjected to a sudden strain.



Details of some extremely valuable output valves which have recently been placed on the market.

By KEITH D. ROGERS.

THERE are a few new valves which I want to talk about this month and which will be of interest to the majority of my readers. The first of these is the 6-volt Pentone valve just issued by the Mullard



This shows useful characteristics, with a magnification factor of 7 and impedance of 2,500 ohms at 100 volts H.T.

Valve Co., and having an impedance of 25,000 ohms, with a magnification factor of 50.

A "Bigger" Valve

These it will be seen are less than those of the corresponding 2- and 4-volt of the same series, but the valve has a greater grid swing and is a still more successful output valve than the other two. It has, of course, a correspondingly increased high-tension current consumption and requires the special form of output circuit as do the 2- and 4-volt pentodes.

It will be remembered, of course, that in order to get the maximum from the pentode valve an output transformer with high impedance primary is an essential feature, whilst it is also advisable to place some sort of choke anti-motor-boating device in between the priming grid and the H.T.

The Priming Grid Voltage

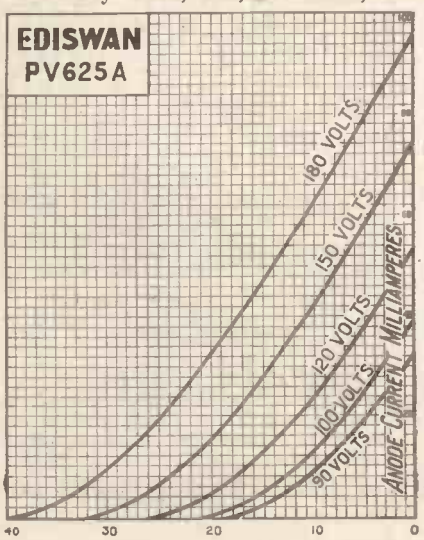
And while talking about the priming grid and its H.T., it should be remembered that unless a fairly high resistance anti-motor-boating choke device is inserted in that lead, the lead should not be taken to the "maximum —H.T." positive terminal, that is, the terminal to which the *plate* circuit of the valve is connected, as then the priming grid is getting a higher H.T. voltage than the plate, for the simple reason that the plate voltage drops considerably through the output transformer primary, and so the voltage actually applied to the anode of the valve is much less than that applied to the priming grid.

It is best as a rule to have the priming grid taken to a separate tapping on the H.T. battery, as this tapping can be varied at will until the best results are obtained. There is obviously no sense in using a higher high-tension voltage on this grid than is necessary for the best results. Where an anti-motor-boating device is inserted, of course, the H.T. voltage will drop somewhat across that, but as the current flowing in the priming grid circuit is nothing like as high as that flowing in the plate circuit, the voltage drop across this choke is not likely to be so great as the voltage drop in the primary of the transformer in the plate circuit.

Even when a motor-boating device has been inserted, it is best to plug the priming grid connection into an H.T. tapping having a lower reading than that used for the plate circuit.

Careful Use Required

The results with this new Pentone, the P.M.26, as it is called, were excellent, and we can thoroughly recommend it to our readers provided they take care how they use the valve. Such a valve is capable of giving wonderful results provided it is used properly, but care must be taken to see that the grid is not overloaded, while pentode valves are rather particular as to the amount of grid bias they have, and, of course, the



This valve is of the lower impedance class (1,000 ohms) with a magnification factor of 4.

Within the Vacuum—*continued*

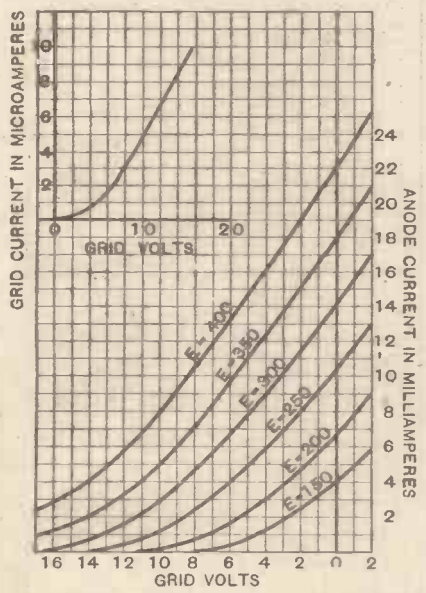
remarks about the output circuit must be borne in mind.

Two more valves of the power and super-power variety have been added to the Ediswan list, in the P.V.625A and the P.V.625X, the former of these being a low-impedance valve having an impedance of about 1,600 ohms with a magnification factor of 4, while the other has an impedance of 2,500 ohms with a magnification factor of 7 at 100 volts H.T., with an impedance of 2,000 at 200 volts. Both require six volts and take ·25 amp. in filament current.

Excellent Valves

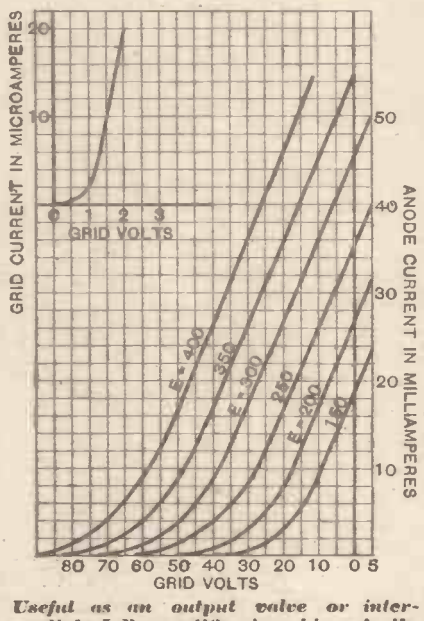
They are both excellent valves, and although the former has the larger grid swing, and it takes a lower maximum high-tension voltage, the latter is really the more useful valve to the average man. It certainly has a much higher magnification factor, and if a good choke output circuit is employed this magnification factor can be used with advantage. Both the valves are constructed very strongly and on test have given every satisfaction.

Finally, I must mention that the Osram Valve Company have lately



An excellent R.C. valve or anode-bend detector where big inputs have to be handled. The curves of the L.S.5B.

revised their list of real power amplifiers with some under the L.S.5 series. This will be welcome news to real big-noise enthusiasts and those using moving-coil loud speakers. The L.S.5B—a wonderful detector valve or resistance-coupling amplifier—has been improved, as also have the L.S.5 and L.S.5A.



Useful as an output valve or intermediate L.F. amplifier in a big set—the L.S.5 has been redesigned and now has the above characteristics.

The valve we are immediately concerned with is the L.S.5A, an output valve with an impedance of 2,750 ohms and a magnification factor of 2·5. All these valves take 4·25 to 5·25 filament volts and consume ·8 of an amp.

They obviously are not the valves to use with a small accumulator or small H.T. batteries, or in fact with any type of dry high-tension battery, but for those who can charge their accumulators at home and who have either H.T. accumulator or mains H.T. units, these valves form ideal amplifiers when big volume is required.

Large Grid Swing

A wonderful amount of bass can be got out of the L.S.5A super-power valve. The curve is shown here, and it will be seen that as grid bias at 400 volts is somewhere of the order of 120 volts, the valve has a useful grid swing of about 200 volts, or 100 volts on either side of the grid-bias point. The plate current, of course, is not low—somewhere about 30 to 45 milliamps when properly biassed—but if a mains H.T. unit is employed this is not a serious matter.

One point, however, must be borne in mind, and that is, that with this current the output choke must be of good design or otherwise the inductance will drop seriously and the efficiency of the output system as a whole will be very greatly impaired.

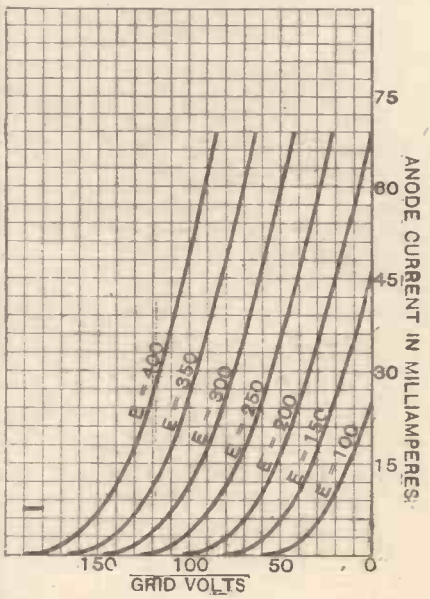
There is also, I hear, another type of L.S. valve in preparation, and I hope to be able to report on this in the very near future. It will, I believe, give still greater power in the output circuit and will be very welcome to those constructors who want to fill large halls and unusually large rooms and to dance to, broadcast music or pick-up programmes.

Valve for Every Purpose

Also, I have heard a rumour that a new 4-volt screened-grid valve of the upright variety is shortly making its appearance on the market, and this, too, coming from a very good valve company, should prove very popular.

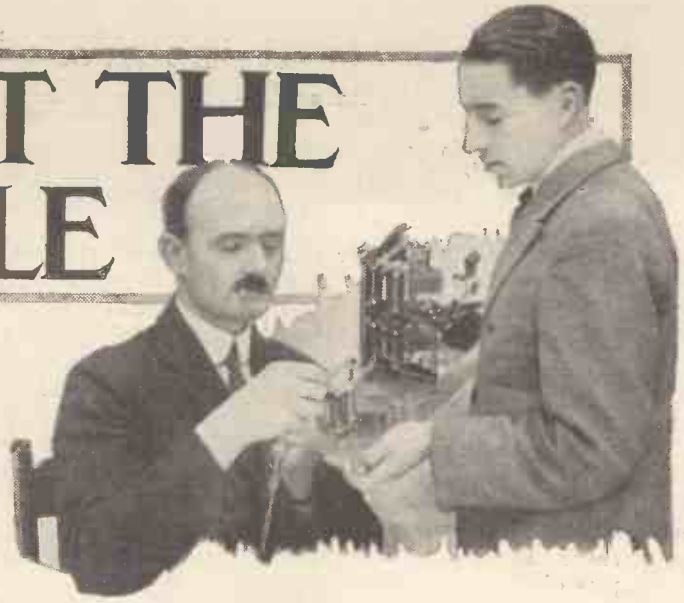
With all the new valves placed on the market in the last twelve months, there is no excuse for blaming your valves if your results do not come up to scratch.

There is now a valve on the market for every purpose, and with careful choice one can make sure that one is getting the absolute best out of the set and out of the components with which it is made. Valves should no longer stand in the way of any constructor, debarring him from obtaining really perfect reproduction.



The latest Osram output valve—the L.S.5A gives the above curves.

CHATS AT THE WORK-TABLE



Many points of practical interest to all radio constructors are dealt with under this heading.

By R. W. HALLOWS, M.A.

An Idea for Screening

IN the ordinary way, either copper or aluminium sheet of fairly stout gauge is used for screening purposes. From the workshop point of view these materials have both their pros and cons. Both materials are easily cut with tin shears, but aluminium cannot be soldered at all by ordinary methods, and stout copper sheet, owing to its high efficiency as a conductor of heat, is exceedingly difficult to solder, at any rate, without the aid of a blowlamp.

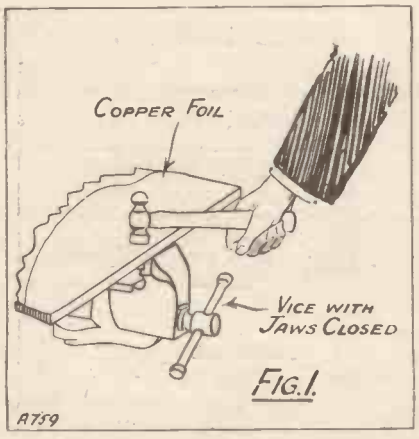


FIG. 1.

Both kinds of sheet are also rather expensive, so that the cost of completely screening, say, the high-frequency portion of the receiving set or the note-magnifier is a distinct consideration. Recently I have worked out a new method of screening which is cheaper, easier to carry out, and perfectly satisfactory. It consists, briefly, in using not copper sheet but copper foil.

The cost of this material, area for area, is only about a fifth of that of ⅛-in. copper sheet; it can be cut with the greatest ease with ordinary shears, and owing to its thinness there is no difficulty in soldering it in the ordinary way.

To make a simple vertical screen, begin by cutting out a piece of plywood to the required size. Plywood ⅜ in. thick, made of three layers of wood, is stocked nowadays by most hardware shops as well as by tool shops and those which deal in workshop materials.

It is sold in sheets measuring 24 in. by 12 in., which cost ninepence each. The best tool for cutting it is a small, sharp saw—see that your saw is sharp, or you will probably make ragged edges.

Next, cut out a piece of copper foil of the same size and fix it to the plywood by means of a few brass pins. The points of these should be cut off after they have been driven through and they may then be secured in the way shown in Fig. 1. The jaws of the vice are closed to form an anvil. The protruding part of each pin is placed on them and its head is given a few sharp taps with a hammer.

A still neater job is made in the way shown in Fig. 2. The foil is cut long enough to overlap the plywood by about half an inch at top and bottom. It is then turned over and fixed with brass pins in the way already described.

Fixing the Screens

Screens so made are easily mounted on the baseboard by means of small brackets, purchasable from any ironmonger for twopence or threepence a pair. Those used for carrying stair-rods will do quite well if nothing else is available. Or brackets may be eliminated altogether by screwing a batten of wood about half an inch square to the bottom of the screen and driving screws through this into the baseboard of the receiving set.

Small holes for passing leads are easily made through the screen after it has been covered with copper. Big holes, though, such as may be required for mounting a 625 type of screen-grid valve, should be cut in the wood before the copper is put on.

Boring the Holes

The best tool for this job is an auger bit used in the brace. Don't go right through from front to back. Turn the bit until you are through the first layer of plywood, then reverse the work and bore through from the other side. In this way a perfectly clean hole can be made, though if one tries to go straight through the wood will be badly torn when the bit makes its exit. The hole in the foil can be made with curved nail scissors.

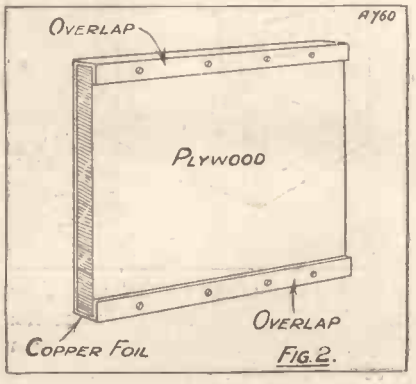


FIG. 2.

Chats at the Work-Table—*continued*

These can be made most simply from ½-in. lengths of ebonite tube, ¼ in. or $\frac{5}{16}$ in. in external diameter. Make the holes in the screen a tight fit for the bushes. The latter can then be pushed in and will "stay put."

Complete Screening

The plywood method can also be used very handily for the complete screening either of individual H.F. valves or of the entire note-magnifying department—that, by the way, is an exceedingly useful tip in short-wave sets, since it helps enormously to minimise body-capacity effects, no small part of which are often due to high-frequency currents induced in leads or metal parts of the unscreened note-mag. in a short-wave receiver.

Let us see, first of all, how a single stage can be screened. The first process is to make a skeleton frame, as shown in Fig. 3, from pieces of wood about half an inch square. Hobbies' "strip-wood," which can be bought ready cut and planed in 24-in. lengths, is admirable for the purpose. Six pieces of plywood are now cut to form two ends, two sides, top and bottom.

All but the top are fixed to the frame, and they are then covered on the outside with copper foil. Any joints necessary in the foil can be soldered so as to make the box perfectly "wave tight." The top or "lid" is finished in the way shown in Fig. 4.

To its underside are fixed two battens made of the same ½-in. wood,

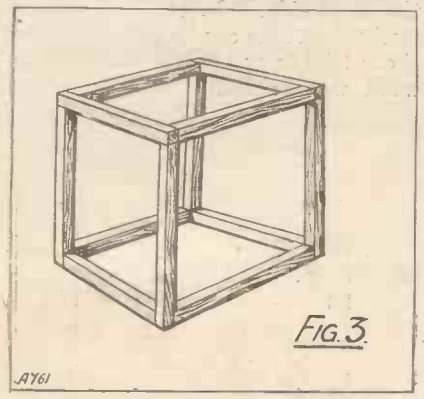


FIG. 3.

so spaced and of such length that they fit tightly into the top pieces of the frame. The outside of the lid again is covered with copper foil, which is best made to overlap the edges in the way already described. It is convenient, by the way, to mount and wire up all components that are to be fixed to the bottom of the screening box before the sides are put on.

Dealing with the Note-Mag.

When we come to a larger problem, such as the screening of a two-valve note-magnifier, there are two ways of dealing with it, each of which is quite effective. The first is to make a box on the lines just indicated large enough to contain both valves with all their associated components.

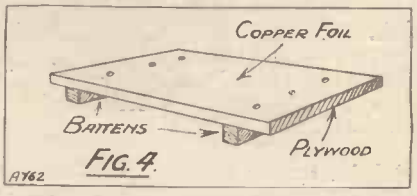


FIG. 4.

The second method is in some ways the simpler of the two, for no box is required; the panel, the baseboard and the lid of the cabinet forming the supports for three out of the six pieces of foil required. The baseboard is first covered with foil, which is simply tacked to it by means of brass pins. The back of the panel is treated in the same way, the foil being attached by means of countersunk screws passed through the panel and the foil from front to back, with largish washers beneath the nuts that secure them.

For components such as jacks, terminals and so on which are not at earth potential and are mounted on the panel, a hole must be made in the foil sufficiently large to give them ample clearance. One of the handiest ways of mounting jacks is illustrated in Fig. 5. In the foil on the back of the panel is cut a hole large enough to give the nipple of the jack ample clearance.

Really Firm Fixing

Behind this comes a piece of ⅛-in. thick ebonite about 1¼ in. in height by ¾ in. in width, in which is drilled a hole of the required size. The body of the jack is pulled up against the ebonite which insulates it satisfactorily from the copper screen. The foil covering the panel should be cut so as to allow an overlap of about half an inch with that on top of the baseboard.

The two pieces can then be soldered together or the flap may be fixed down with brass pins. Two screens of the same height as the panel and wide enough to reach almost to the rear edge of the baseboard are now cut out of plywood and covered with copper foil.

In this case, the foil is placed on the inner face of each screen, and a flap is left both at the bottom and at the edge next to the panel. These flaps are soldered respectively to the foil covering the baseboard and panel.

The back may conveniently take the form of a similar screen, flaps again being left which are soldered to the foil on the baseboard and on the cross screens. The underside of the lid above the note-magnifying unit of the set is also covered with foil.

Another Application

The same method may be used very handily outside the receiving set for screening a wave-trap. As readers doubtless know, it is most important to prevent any interaction between the coil of the wave-trap and any of those in tuned circuits in the receiving set.

The box containing the wave-trap may be lined with copper foil, or if preferred a coat of foil may be applied to its exterior, being held in place by a number of brass pins.

Watch Your Wire

It happens very seldom, as I can bear witness after a good many years of constructional experience, that

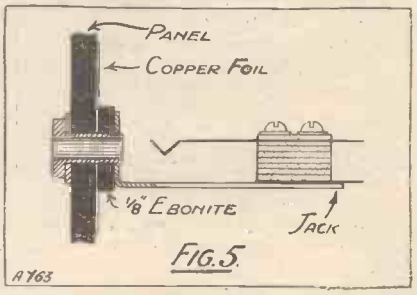
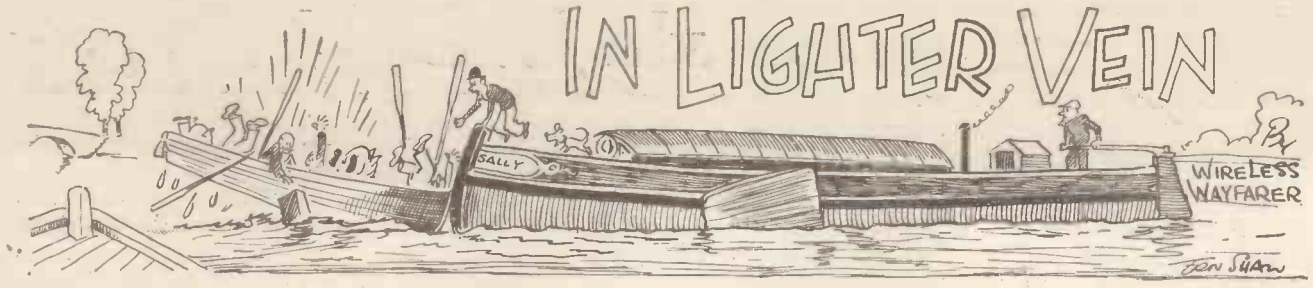


FIG. 5.

makers make any mistake in labelling their reels of wire. Still, these things do occasionally occur; in fact, a rather expensive example of an error came my way quite recently.

I was using a circuit which demanded a high-frequency transformer consisting of a secondary wound on a 3-in. former and an internal primary wound on a former which would fit inside. The secondary was centre-tapped, the tappings being taken to valve pins, whose tips protruded very slightly into the interior.

(*Continued on page 60.*)



"WONDERFUL thing this beam radio business," I remarked, glancing up from my perusal of the *Daily Megaphone*.

"What," inquired Professor Goop, "have you in what I believe you are pleased to call your mind?"

"Why, I was just thinking of the marvel of sending two Morse messages and a telephone talk all at once on the same wave."

"Tck, tck; that's *nothing*," said the professor. "Why, last night when I tuned-in Toulouse I found a jazz band, a symphony orchestra, a soprano, a topical talker, what appeared to be a relay of a boxing match, two C.W. messages, and a

Fate interposed in the shape of Bingo.

spark signal all coming through on the same wave. Give the new wavelength plan its due, my boy, and don't try to make out that these beam people can do greater things than it has accomplished. But, talking about physical jerks——"

"We weren't."

"Well, we are now. Have I shown you the exercise that I have just devised for helping short men to grow tall?"

With a resigned wave of the hand I intimated that he had not.

The professor moved over to the door and placed himself in position facing it and about six inches away from it.

A Little Interference

"You now raise the hands slowly above the head," he explained, proceeding to demonstrate the movement.

"All right, thanks, I'll show myself in," came Goshburton Crump's voice from the hall, and, before you could say "knife," the gate crashing was accomplished.

Goshburton Crump always comes in with a rush, and on this occasion he seemed in a particular hurry. Anyhow, the door knocked the professor flat on the carpet and, rebounding from its impact with his chin, met the on-rushing Goshburton Crump fair and square. Next instant he was on *his* back in the hall.

The Professor and Goshburton Crump recovered simultaneously before I could reach either to render first-aid. Seeing the light of battle in his eye, Goshburton Crump had just time to pull the door shut and turn the key on the outside before his infuriated victim reached it. In a flash the professor had caught up an earth tube and leapt through the french window. Taken in the rear, Goshburton Crump fled into the room, but had no time to shut the door behind him. Across the floor he sped, with the professor hard on his tail. He dashed through the window; the professor, like an avenging fury, followed. In through the front door, across the study and out of the window swept the chase, each lap faster than the one before it.

Bingo to the Rescue!

The professor was gaining several millimetres each time round and things began to look black for Goshburton Crump, whose wind showed signs of giving out. But just as the professor, having closed the range sufficiently, was preparing to deliver the father and mother of a swat, fate interposed in the shape of little Bingo, who, wakened by the uproar, rushed to the aid of his beloved master. His well-meant spring at Goshburton Crump's pants missed by a hairbreadth, and next moment the dog and the professor's feet seemed to be all mixed up.

It was lucky that Professor Goop's latest cone loud speaker happened to be standing near the wall. In this model the cone itself is stuffed with hay in order to prevent resonance effects. It acted therefore to some extent as a buffer for his head when his feet left the ground and he sailed through the air with a velocity approaching that of light. Despite this fortuitous padding any ordinary mortal would have been killed, but such is the amazing growth of bone in the professor's head that his skull was not even dented.

A Spring Picnic

We flung ourselves upon the professor and disarmed him before he could disentangle his head from the works of the loud speaker. His wrath cooled down as rapidly as it had been roused, and after explanations on both sides it was agreed to let by-gones be have-beens.

"The professor," I said cheerily to Goshburton Crump, "was just showing me a new exercise that he has invented for making short men tall."

"My hat," panted Goshburton Crump, "he seemed to be showing me one for making stout men thin!"

Then he unburdened himself of the idea that had brought him round to The Microfarads. Why should not the Mudbury Wallow Wireless Club spend the following day in a glorious picnic in the country?

I objected that it was still only April.

"Just the time for picnics," cried the professor. "What happens at summer picnics?"

"What happens at summer picnics."

"Wasps," I suggested.

"Skeeters," said Goshburton Crump.

"And ants," the professor went on, "and caterpillars and spiders and gadflies and midges. Do these things fall into our tea in the glad springtime? Do they cover our necks and legs and arms with bumps? No, a thousand times NO! Spring, then, is the proper season for the country and a spring picnic we will have." He dashed to the telephone and, after the usual furious altercations with the operator over wrong

In Lighter Vein—*continued*

numbers, succeeded in getting himself connected one by one with all the members of the club, whom he bade betake themselves with all convenient speed to his abode.

When all had arrived the professor rose to his feet, clearing his throat.

"Ladies and gentlemen," he began, with a far away look in his eye, "we are met together to-day to discuss the all-important question of the sporadic incidence of parabolistic toxæmia amongst the lower tunicata. That great man of science, Wurstfresser, tells us——"

I whispered in his ear.

I Come Well Provided

"I beg your pardon," he beamed, pulling himself together; "my mind was running on to the subject of a bright little chat that I have been invited to broadcast in the near future. I have asked you to come here so that I may unfold to you our great project. We are going to have a pink sprignic, or rather, I should say, a sick pinprick."

At this point his jaws appeared to get out of mesh, and Goshburton Crump undertook the task of explaining. Under his persuasive eloquence all agreed that it was a fine idea; but what form should the beano take?

The suggestion that we should hire the "Pride of Mudbury Wallow" was turned down since we had all sad memories of this vehicle's love of wayside ditches. Nor would it be

The professor had lost his licence.

fair to use our own cars, for the professor had only the previous week lost his licence through a little mishap sustained whilst trying out a new periscope device that would enable the driver to sit comfortably with his back to the engine. No one felt like walking. Only a few possessed push-bikes.

We were still debating the point when the professor, having got his jaws uncrossed, waded in.

"We will have a river picnic (got it right that time!)" he announced.

"But we haven't got a——"

"Never mind. We've got a perfectly good canal which will answer the purpose admirably. We'll hire Mr. Glump's whole fleet of boats. Captain Buckett shall be commodore of the flotilla. We will float lazily upon the bosom of the waters, revelling in the beauties of Nature. The ladies will see to the provisions. Everyone is to be at the landing stage at ten to-morrow morning, bringing his portable set."

Hoping for the best we withdrew to prepare ourselves for the adventure. Next morning I took a cab to the landing-stage, as all the taxis were booked. Since there were boats to undertake the transport there seemed no need to bother about weight, and I had come well provided.

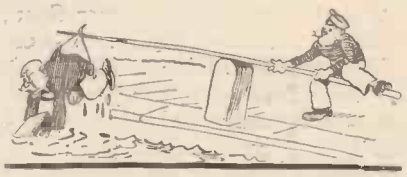
"Here you are at last," cried Captain Buckett; "but what's all that stuff inside the cab and on top of it?"

We Start Off

"My equipment," I explained, as aided by the cabby I proceeded to unload my portable, an oilskin, a sou'wester, an umbrella, a sunshade, a balaclava helmet, a panama hat, a suit of flannels, an air-cushion, three overcoats, a pair of blankets, a cricket bat, a hockey stick, a pair of skis, a hot-water bottle, a case of beer and a packet of sandwiches. "My all-weather equipment for the gay spring. Give me a hand into the boat with it, old chap."

They were most unreasonable about it, and eventually I had to send nearly all of it back. Captain Buckett assigned me to the largest boat. I was to row stroke, he told me; the professor was to be bow, and Goshburton Crump would steer. As it was a big boat we could take six passengers—and he picked out Sir K. N. Pepper and all the other heavy-weights. Our protests having been shouted down, we got our passengers aboard, stowed the provisions in the bows and launched forth upon the vasty deep, to the accompaniment of a cheerful tune brought in by Sir K. N.'s portable.

I was quite enjoying the things that the first bargee, with whose craft we collided, had to say about Sir K. N. Pepper's face when the fellow turned his attention to me. A nasty, unrefined lot, bargees, I think. In his agitation Goshburton Crump must then have pulled the wrong string for we shot wildly across the canal and bumped straight into another barge. Such was the shock that Sir K. N. Pepper's portable was precipitated overboard, and in his efforts to retrieve it with an umbrella its owner followed. He was rescued with a boathook and most unsportingly decided to return home.



He was rescued—with a boathook.

Lightened of his weight we pulled out into mid-stream, where the professor announced that he would demonstrate his theory of rowing. When his oar had four times carried him off his seat backwards into Tootle's salmon mayonnaise, he decided that his system required a little revision. By mid-day we had reached the first bridge, a hundred yards from the landing stage, where we sheltered from a snowstorm. We had made a further fifty yards when rain began to pelt down, so we returned to shelter. At two o'clock, when the rain had changed to hail, the professor announced that he was hungry. We decided to have lunch beneath our bridge and to go on afterwards.

"I wonder where the others have got to," said Tootle, whilst our refuge was protecting us from a thunderstorm a couple of hours later. "They must have flashed past whilst we were having that little bother with the barges."

The End of the "Cruise"

An hour later we decided to brave the sleet that was now coming down and return to the landing stage. As it came into view when we made our way round the corner we were surprised to see that all the boats were there.

"They spent so long a'larfin at you and them barges and the ole gent fallin' in," explained Mr. Glump in answer to our inquiries once we were safe ashore, "that they didn't get started till just afore that there snow comed. So they drops *down*-stream to the other bridge to shelter, and there they been until arf an hour ago, when they comed back."

PICTURES BY RADIO

Two developments in the transmission of pictures by radio have recently taken place. The first is the extension of the Fultograph "programmes" and the second the new Marconi system of facsimile transmission by Beam.

THE transmission of pictures by the Fultograph method is now taking place regularly from 5 X X, on Mondays from 12 to 12.15 a.m., on Tuesdays from 2 p.m. to 2.25 p.m., on Thursdays from 2 p.m. to 2.25 p.m., on Fridays from 12 midnight to 12.15 a.m. London sends picture transmissions on Mondays and Fridays from 12 midnight to 12.15 a.m.; while 5 G B sends them on Wednesdays and Saturdays from 11.15 to 11.45 p.m. It will thus be seen that every listener has some opportunity of still-picture reception from English stations.

Berlin (Konigswusterhausen) sends out pictures on Mondays, Wednesdays, Thursdays and Saturdays, at lunch-time, namely, 12.45 to 1.15 p.m. On Sundays this station sends out pictures from 12.45 to 1.30 p.m., this being a very popular transmission with British listeners, as 5 X X transmissions are not occurring on Sundays at this time.

Fultographs from Vienna

On Tuesdays and Fridays Berlin sends out pictures from 9.45 to 10.15 p.m. As the wave-length of this station is very close to that of 5 X X, and as for proper picture reception it is necessary to have the Berlin signals quite clear from 5 X X, readers should use the extra selectivity unit described in the last issue of the WIRELESS CONSTRUCTOR. This unit, while cutting down signals somewhat, gives all the selectivity necessary to obtain Fultograph pictures from Berlin when 5 X X is working, and thus enables pictures to be received on fairly sensitive sets from this station every day of the week.

Vienna gives an afternoon transmission of pictures every day, including Sunday, from 2.15 to 2.45 p.m., but this is of no real interest to British listeners, as the transmission cannot be received in this country during daylight, except with extremely sensitive receivers of the super-heterodyne type, and then not regularly owing to Morse interruption. The useful transmission from Vienna on 518 metres takes place after the evening programme.

Unfortunately it is not possible to say just when the programme ends, and in the WIRELESS CONSTRUCTOR laboratory, when we try to receive Vienna pictures, we tune to this station about ten minutes to ten in the evening and wait. Sometimes the pictures come through about 10 o'clock, and others as late as half past ten or quarter to eleven. There is no need to understand German in order to benefit by these transmissions which start a minute or two after the usual "good-night," the tuning note being sent out and the same procedure adopted as with the other Fultograph transmissions.

Probably before these lines appear in print, transmissions will have started from Radio-Paris, thus adding still further interest to picture reception.

A section of one of the new German "radio talk" classes now held for prospective broadcasters in Berlin.

New Picture Receiver

We have recently had the opportunity of examining a new picture receiver known as the "Colvergraph," made by the Collinson Precision Screw Co., Ltd. This receiver utilises the Fultograph signals, but mechanically and electrically is arranged quite differently. Results obtained are exceedingly good, the synchronism being as near perfect as anything we have yet seen, and the operation even easier, if that is possible, than that of other picture receivers.

A particular feature of the "Colvergraph" is the interchangeable cylinder, which enables the user to be wrapping a new piece of paper round one cylinder while the other is being used for reception. Immediately the reception of one picture is finished, the cylinder can be taken off and the new one slipped on, just as one used to change the old phonograph records. A fuller description of this new receiver will be given in an early issue. It is not yet on the market, but we understand will be available later in the year.

Photographs by the Beam

The wonders of the new Marconi system of facsimile picture transmission were demonstrated recently by Marconi engineers in a tiny hut at Somerton, Somerset.

This new development, by which it is hoped ultimately to be able to transmit telegrams in the actual handwriting of the sender, should undoubtedly be regarded as a milestone in the successful transmission of pictures by Beam radio.

For three years the research department of the Marconi's Wireless Telegraph Co., Ltd., has been experimenting with a view to producing a scheme by which it would be possible to commercialise picture transmission by radio on a larger footing than at present, and from the results that we were able to see it would appear that the day of "Facsimilegrams" is not far distant.

Technical Difficulties

There are at present certain technical difficulties in the matter of finding suitable landlines for relaying the pictures from the Beam receiving station to various parts of the country, but as far as the wireless link is concerned, a stage has now been reached when it is possible to send a picture 10 in. by 8 in. across the Atlantic in ten minutes or less.

The pictures received at Somerton during the course of the demonstration included cartoons, fashion plates, sections of newsprints, etc., and in every case the quality of the received image was of a very high order.

It is interesting to record that a considerable amount of trouble has been taken by the Marconi Co in their experiments to determine the wave-lengths best suited for transmission at different times of the day, and that it is sometimes necessary to change the wave-length as many as three times during the twenty-four hours in order to obtain a constant service.

An Ingenious Vernier Dial

FROM Messrs. Wilkins & Wright, Ltd., we have received specimens of several interesting vernier dials, a group of which is shown in the photograph. All are characterised by the extremely smooth action and convenient operation. The cursor pattern is supplied with an aluminium dial, engraved so that either right- or left-hand condensers can be used with it.

The aluminium dial is fixed to the panel under the fixing nut of the condenser, and two large concentric

A MONTHLY REVIEW OF TESTED APPARATUS

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

knobs are mounted on the shaft so that either quick- or a slow-motion action can be obtained. A cursor with a hair-line enables "split-division" tuning to be accurately carried out, and we lost no time in mounting this dial on some of our laboratory apparatus requiring very fine control.

A very ingenious adapting device enables this dial to be used not only on one-hole-fixing condensers, but also with those which are attached to the panel by screws, so that it is truly a universal vernier dial. A 70 to 1 reduction is claimed, and the price at 7s. 6d. represents excellent value.

The same 70 to 1 reduction is also obtained with the pattern which resembles the ordinary plain dial, but has the two knobs and the same smooth action which characterises the device. It can also be used with one-hole-fixing condensers and th se attached to the panel by screws. The action, of course, is identical with that of the cursor type, and both are equally efficient.

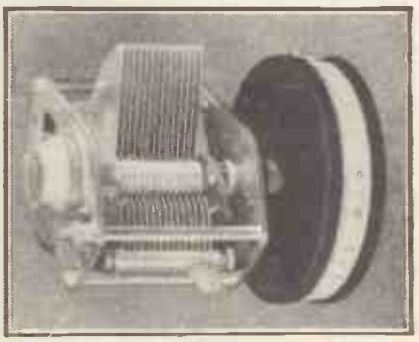
The same makers' drum control, a still further adaptation of an ingenious principle, enables both direct and slow-motion movement to be obtained with edgewise control. The particular drum control illustrated is designed to work with the Utility low-loss condenser. All three dials can be recommended.

Drum-Controlled Condenser

We have already reviewed in these columns the Polar Ideal condenser, and we have recently had an opportunity of testing the Polar Ideal drum-controlled condenser, illustrated herewith. Fitted with the same vernier movement as before, this condenser is made up in such a way that it can be easily secured to a panel by two screws, insulated washers being provided for adjustment should the panel be less than a quarter of an inch thick.

A pleasing but simple design of window is provided, together with a clearly marked template for mounting. Fitted to a panel a good job can easily be made, and the provision of a vernier movement as well as a direct drive is a distinct advantage. Practical tests showed that the action was smooth and easily controlled by the thumb, and there was no difficulty in reading the setting on the drum dial.

The condenser, when measured, was found to have a maximum capacity of ·00058, or 16 per cent above its rating. While we would rather have a nominal ·0005 mfd. condenser, with

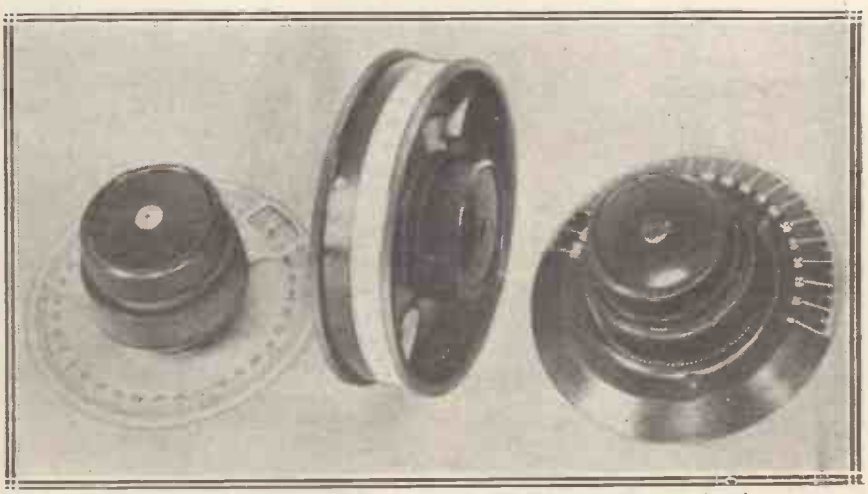


The Polar drum-drive condenser.

a capacity slightly above rather than slightly under the rated figure, the error mentioned is greater than should be permitted by the manufacturers. But for this criticism the device is excellent, and can be recommended to our readers.

High-Voltage Electrolytic Condensers

The mention of electrolytic condensers immediately suggests "Stedipower" units with thousands of microfarads in a small compass and low



A group of vernier condenser dials (Wilkins & Wright, Ltd.).

What's New—*continued*

voltages. There are, however, high-voltage types, and we were very interested to receive direct from the

One of the compact self-healing electrolytic condensers described on this page.

Amrad Corporation, Medford, Hillside, Massachusetts, a most interesting parcel containing two 16-mfd. Amrad Mershon condensers.

Externally, these appear as quite small copper canisters, 2½ in. diameter by 4 in. high, provided with two electrodes. These two electrodes are for positive connection to the two halves of the condenser (8 mfds. each), while the copper can itself forms the negative electrode. On shaking the canister one can hear the liquid inside, but the device is quite leak-proof, and not a spot of moisture escapes even with the most violent shaking.

These condensers, incidentally, are made in a variety of capacities, and are designed to stand a peak voltage of 400 volts D.C., the maximum operating voltage being 300 volts D.C., so they can be used very efficiently in any of the ordinary high-tension mains units, where their compactness stands them in good stead.

The chief advantage, however, of these condensers is that they are self-healing. If a sudden voltage surge should bring about a breakdown, insulation is immediately restored directly the excessive voltage is removed. Any experimenter who has had a mains condenser break down and perhaps ruin a whole mains unit will appreciate the self-healing feature.

Insulation Resistance

These condensers are not untried, for they have been on the market in the United States for some time. The makers state frankly that the insulation resistance and power factor values for the Mershon condensers are not comparable with those of paper condensers, the resistance being dependent on the leakage current, which, however, is quite small.

The internal construction of the Mershon condenser is, broadly speaking, a pair of rolled aluminium electrodes in a copper case, these electrodes being covered by an oxide film, and immersed in electrolyte which itself forms the cathode, the copper can being not the cathode itself but merely a means of making convenient electrical contact with it.

The two condensers sent to the WIRELESS CONSTRUCTOR for test were each of a total capacity of 16 mfds., made up in two halves of 8 mfds. each, but single, double, triple and quadruple condensers are made in a variety of capacitites. Thus it is possible to obtain a quadruple condenser with two of 18 mfds. and two of 9 mfds. each, or a single condenser with a capacity of 72 mfds. The prices are quite reasonable compared with

This Igranic transformer is specially designed for use with a pentode.

the ordinary paper condensers, and the condensers satisfactorily stood up to the tests to which they have been submitted in the WIRELESS CONSTRUCTOR laboratory. The English agents are The Rothermel Corporation, from whom all particulars can be obtained.

A Fuse for Mains Units

Gambrell Radio, Ltd., always well known for high-grade components, have sent us the Gambrell Twin-fuse unit illustrated herewith, and designed to work with mains units so as to provide adequate safety. It will be noticed that the two fuse cases are mounted on a block so that one fuse can be placed in each mains lead. The act of withdrawing the fuse casing automatically breaks the circuit, so that there is no danger of shock. The fuses, which are enclosed in small glass tubes, are immediately replaceable, and the whole device, which sells for 6s. 6d., is well made, reliable, and good value for money.

Gambrell twin fuses for mains units.

NOTES AND JOTTINGS

Some useful and interesting practical tips that will assist many a puzzled constructor.

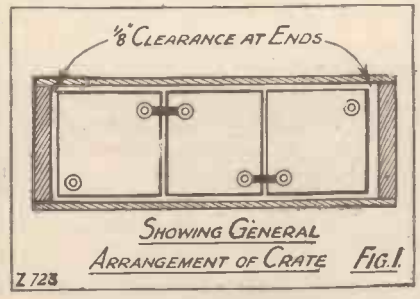
By A. V. D. HORT, B.A.

An "Attractive" Idea

STEEL bolts and screws are not much used in wireless constructional work, because of their undesirable magnetic properties. If you do have occasion to use steel bolts, as for instance in dealing with L.F. chokes and transformers or loud-speaker units, you can adapt your screwdriver to help you considerably in handling them. Magnetise the blade of the screwdriver by drawing it a few times across one pole of a permanent magnet. You will then be able to pick up the minutest bolt with the screwdriver alone, and it will be delightfully easy to guide it into even the most inaccessible position.

A Home-Made Accumulator Crate

THE task of carrying the wireless accumulator to the local charging station has become almost proverbially onerous. The heavier the accumulator is, the more difficult it is to carry it without damage to the cell containers and connecting lugs, or without getting acid on one's clothes. For comfort and convenience a carrying crate is practically a necessity. The crate described here can be put together quite quickly once the materials have been prepared.



SHOWING GENERAL ARRANGEMENT OF CRATE FIG. 1.

The wood used should preferably be a hard wood, such as teak. The dimensions of the pieces required will, of course, depend on the size of the battery, but in any case, ample clearance should be allowed for: about ⅛ in. at the ends of the battery and rather less at the sides. After cutting the pieces of wood, put them in a shallow tray in hot paraffin wax until they are thoroughly soaked.

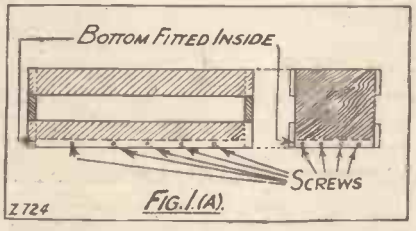


FIG. 1 (A).

As will be apparent from the diagrams, the bottom and ends of the crate my be cut from one piece of wood, not less than ⅜ in. thick. The side pieces may be ¼ in. or 3-16 in. thick. The strongest job will be made if the bottom and the ends are dovetailed together at the corners. The bottom must fit *inside* the ends and the sides, however the jointing is carried out. If it is merely nailed on underneath them, the weight of the battery will push it off. The side pieces are screwed to the ends and bottom.

A Useful Refinement

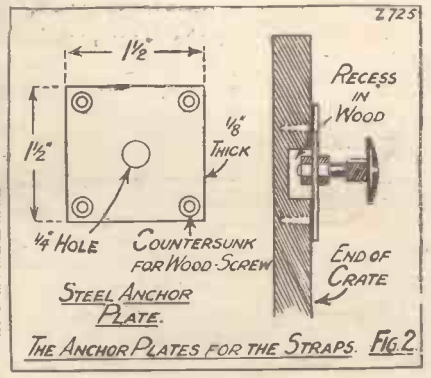
Unless the battery is small, single screws in the ends will not be strong enough as anchors for the ends of the carrying strap. Plates with projecting knobs for the strap may be purchased ready-made, or they can be constructed as shown in Fig. 2. A ¼-in. steel bolt passes through the centre of the steel plate and is secured with nuts on each side, a recess being cut in the end of the crate to accommodate the inner nut. The plate itself is held to the end of the crate with four short, stout wood-screws.

The strap for lifting the cells out of the crate is a refinement which is well worth fitting. It is not good practice to lift the battery by the terminals or connecting lugs, as this throws a considerable strain on the tops of the containers. The strap should be a broad band of webbing or leather. Normally, its ends are fitted over the bolts for the carrying strap. To lift out the battery, remove the carrying strap from the crate and undo the ends of the lifting strap, when the battery can be lifted straight out.

The paraffin-wax dressing of the wood will prevent damage from slight splashing of the acid, but acid and dirt should not be allowed to collect in or on the crate.

Buzzer Contacts

A BUZZER for a wave-meter or for crystal testing is simple enough to make, but the home-made buzzer very often fails to buzz consistently and steadily after it has been in use a short time. The fault nearly always lies in the contact point, where the contact screw rests on the armature. In the commercially



THE ANCHOR PLATES FOR THE STRAPS. FIG. 2.

(Continued on page 48.)

TWO USEFUL TIPS

THE GUILTY COBWEB—DUST IN CONDENSERS.

By A. S. CLARK.

The Guilty Cobweb

WHO would have thought that a spider, that useful accessory of the gardener, could have completely upset a wireless set? Well, read on and see!

The set in question was a two-valve receiver with the lead-in coming through a downstairs window. It was held away from the wall, in the approved manner, by means of an insulator about three feet above the ground.

One day a spider, looking for new quarters, decided that the conveniently arranged angle between the lead-in and the guy rope made a fine foundation for a new abode. So he set to work and produced a complicated network between the two. Everything still went well until one foggy day the rope and cobweb were saturated with moisture, and results were decidedly "off colour."

They were not sufficiently bad to indicate any particular trouble, so a careful search was made, which failed to show any defect. Next day all was well again and the trouble was put down to bad conditions.

It appeared again, however, later, and this time remained, due, it was later proved, to a spell of dampish weather. Quite by accident one morning the cobweb was spotted through the window, and an ejection notice was immediately served on Mr. Spider.

After this all went well, the effect of working the set on an apparently poor aerial having disappeared. We shudder, however, to think what would have happened to Mr. Spider if the set had been a "beefy" transmitter.

Dust in Condensers

DUST and small pieces of fluff between the vanes of variable condensers, like sulphated accumulators, are never found on the set of an experienced constructor. It is, nevertheless, surprising how many people do not appreciate the necessity for a cabinet which encloses the set completely. Some who have a good cabinet leave the top open, with the result that everything inside the set eventually becomes covered with dust, and variable condensers are only one of the points where trouble may consequently appear.

What actually happens is that the particles of dust bridge the small gap between the moving and fixed plates.

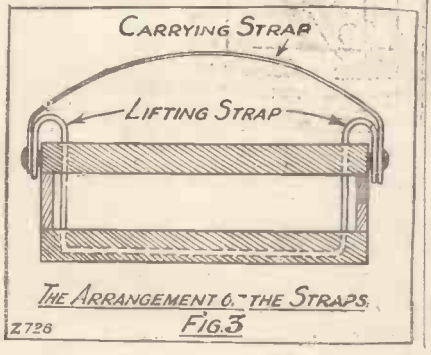
It is not altogether easy to get rid of the dust. Blowing is of very little avail. The old scheme of pipe cleaners and a little patience is the best to employ. It is certainly a case where prevention is easier than cure.

NOTES AND JOTTINGS

—continued from page 47

made buzzer the contact screw is tipped with some metal which does not readily oxidise, and a small piece of a similar metal is let into the armature at the point of contact. If this precaution is not taken the minute sparks at the point of contact oxidise the screw and the armature, and the result is an imperfect electrical contact.

Contact pieces of the rarer metals, such as platinum, are too expensive to fit to a small buzzer, but silver will answer the purpose quite well. Two very small fragments of silver may be soldered to the screw and the armature and filed smooth. Alternately, the contact points may simply be tinned with solder to which has been added a few scraps of tinfoil to provide more tin than lead in the solder. The points will then not often require cleaning, while a touch with a hot soldering iron will make the points as bright and clean as when they were first put on.



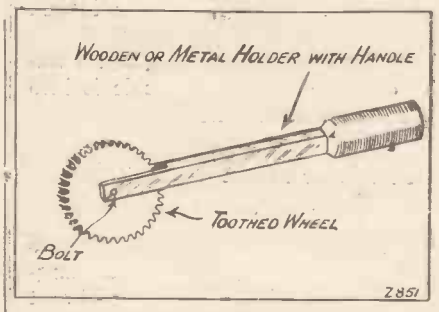
THE ARRANGEMENT OF THE STRAPS.

Z728 FIG. 3

"Blind" Holes in Ebonite

IF you have tried to drill and tap "blind" holes in a panel which was only $\frac{3}{16}$ in. thick, you will know that it is a ticklish job. The bolt, too, cannot get much grip when it is put in. For neatness sake I always prefer to put bolts in from the back of the panel in this way, rather than to drill clearance holes and insert the bolts from the front.

You can make a tidy job by drilling the hole right through the panel and using a bolt not quite long enough to reach to the front surface. Then fill in the hole from the front with a little black wax, rub it to a good polish with a soft rag, and you will hardly notice the mark. You will have the satisfaction of knowing that the threads of the bolt have as firm a grip as possible.



Grooving Coil Formers

GROOVES cut in the "fins" of a ribbed ebonite coil former make it easier to put on spaced windings without risk of the turns slipping. This applies also to the skeleton coil formers often used for short waves, consisting of parallel ebonite rods held together by end-plates. If you try to cut the grooves with a saw you will probably find it difficult to space the cuts evenly, unless you make a special jig for the purpose. A good tool with which to do the grooving can be made with a small toothed wheel taken from a clock or similar mechanism. Mount the wheel in a holder, as shown above, and warm it before running it along the ebonite. Press fairly hard, and the teeth will make evenly spaced indentations.

PIONEERS OF WIRELESS

During a lecture at the Patent Office Dr. W. H. Eccles, F.R.S., emphasised the value of invention in the science of radio.

By SEXTON O'CONNOR.

IN a recent lecture given at the Patent Office, with Mr. Herbert Williams, Parliamentary Secretary to the Board of Trade, in the chair, Dr. W. H. Eccles, F.R.S., gave an interesting account of the outstanding inventions and discoveries from which modern wireless science has been developed.

All wireless telegraphy, he said, is based upon the discovery made

Senatore Marconi.

The man who made radio a commercial practicability, and who has been responsible for many important developments.

by Hertz, in 1888, of how to generate electric waves and detect their arrival at a distance. Crookes, in a famous article in "The Fortnightly Review," wrote eloquently in 1892 of their possibilities. Oliver Lodge, in 1894, demonstrated at the British Association meeting in Oxford the first complete wireless signalling system—a Hertzian oscillator for making electric waves, a coherer for receiving them at a distance of a hundred yards, and a Morse key and relay for handling the dots and dashes. None of this apparatus was patented.

The First Patents

But, in 1896, Marconi filed a patent for wireless transmission and reception, and in 1897, before Marconi's patent was published, Lodge filed another patent embodying certain fundamental principles which still survive in every modern wireless station. Marconi's pioneer patent showed that only one-half of the theoretical Hertz oscillator rod or aerial need be used when arranged vertically. The other half is supplied by the electrical reflection which takes place on the surface of the earth.

Lodge's first patent included, among other things, the introduction of tuning coils into transmitting and receiving aerials, and the use of high-frequency transformers, thus bringing "tuned" wireless waves into the world. Before Lodge's patent no one talked of using coils to adjust the wave-length of the transmitter, or of "tuning" one's receiver to the incoming signal.

Dr. Eccles then spoke in detail of other pioneer patents, such as the famous "four sevens" patent of 1900, covering the use of coupled circuits, and the invention of the Poulsen arc which first made continuous-wave telegraphy—the ideal method—possible, at any rate, in moderate power.

The Triode Valve

He passed on to Fessenden's discovery of the method of heterodyne reception, and of its later developments. This wonderfully sensitive system is employed in one form or other all over the world.

Speaking of the thermionic valve, and of the many inventions relating to its manufacture and use, Dr. Eccles pointed out that one patent, covering De Forest's introduction of the grid into the early Fleming type of valve, never came to fruition. In 1912, De Forest endeavoured to find business men in London willing to help him in exploiting the three-electrode valve.

A number of large and small firms were approached, but none of them saw any value in the invention. As a result of this disappointing response, De Forest, in 1912, failed to pay the first renewal fee. The patent accordingly lapsed, and became the property of the British public.

As the sales of triode valves, in this country alone, must have run into many millions since 1913—when its merits first came to be recognised—De Forest, in effect, threw away one of the most valuable inventions in the annals of patent history.

Tuning-Fork Control

The use of a tuning-fork or quartz crystal, in combination with a valve, for the mutual sustaining and linking together of electrical and mechanical oscillations, is another noteworthy invention. It is at present in use at the Rugby station in connection with the Empire chain of wireless stations.

The mechanical vibration of the fork or crystal, once started, produces an electrical current which is applied to the grid of the valve and magnified. This magnified current is turned back to the vibrator to keep the latter going. In return the mechanical vibrator imposes its own steady jog-trot on the electrical currents and produces well-timed, sustained oscillations.

The "Discovery" of Short Waves

During the years 1922 and 1923 another remarkable fact was emerging into the realm of knowledge. It was of the nature of a pure discovery, and so could not be patented; but it will stand out in the history of radio-telegraphy as an instance of how such knowledge may turn out to be as valuable industrially as any patented invention.

This was the realisation that short waves (of 100 metres or less) could be transmitted over longer distances, in greater strength, than the long waves (several kilometres in length) previously used. In July, 1924, the British Government ordered a number of short-wave reflector stations—now called Beam stations—for direct communication with the Dominions.

In conclusion, Dr. Eccles said it seemed to him that the early inventions had the best chance of immortality; those coming later naturally tend to concern themselves more and more with detail improvements. Sometimes, however, a minor or detail improvement will reap the greater financial reward.

One of the latest developments in radio is the Fultograph picture receiver.

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."

So Much Secrecy

A SOCIALIST member of Parliament put a very pertinent question to the Postmaster-General the other day in the House of Commons when he asked why the recent television demonstration in the Post Office was only given before a limited number of M.P.'s, and why there was so much secrecy.

The Postmaster-General pointed out that the number of invitations was limited because the nature of the apparatus made it impossible for more than a few persons to witness the experiment simultaneously.

"All the Relative Facts"

Then Mr. Thurtle, a member of the House, asked whether the Postmaster-General would bear in mind that there was exploitation on the Stock Exchange in regard to this question of television, and would he see that his department did not lend itself to any of this marketing. The Postmaster-General said there were a great many factors to be taken into consideration before he could make any representations on this question. All the relative facts were taken into account.

The P.M.G.'s Report

The demonstration, which, of course, was by no means as secret as the organisers could have wished, was attended by Lord Clarendon and many other people well-known in connection with politics. But both sides having agreed not to make any comment to the press, the public will have to wait now until the Postmaster-General sees fit to publish the concensus of opinion of those who were present at the television demonstration.

No Sex Prejudice

Applications from musicians all over the country are said to be pouring in to the B.B.C.'s offices, following the announcement of the formation of a permanent orchestra. At the time of writing, over 300 applications have been received. About 25 per cent of the applications are from women, said an official the other day, and we want to make it clear that there will be no sex prejudice, the players being chosen entirely on merit."

Rehearsals Soon

Sir Thomas Beecham, who is conducting the orchestra, has himself been conducting the auditions, at the conclusion of which the orchestra will be formed, and it is likely that Sir Thomas will commence rehearsing for the trial season starting next autumn, as a preliminary to the formation of the permanent orchestra in 1930.

B.B.C.'s Dance Music

The Hotel Cecil have officially informed the B.B.C. Directors that they have decided to discontinue the facilities for broadcasting their dance music. Broadcast dance music from

(*Continued on page 54*).

OUR NEWS BULLETIN

—continued from page 52

the Savoy Hotel also ceased recently on (February 8th), by mutual arrangement—an explanation, by the way, which did not by any means satisfy listeners; and early this month differences of opinion between the B.B.C. and the Kit Cat Restaurant resulted in the discontinuance of broadcasting of dance music from the Kit Cat. The B.B.C. has officially stated that there is no connection between the Hotel Cecil announcement and the other two cases.

Those Names

The B.B.C. certainly made another *faux pas* when it recently stated that the names of artistes taking part in radio dramas should not be announced. The reason given for the change was that listeners would then be more likely to concentrate on the play itself and less on the personalities of the performers.

Derision and Disappointment

As was to be expected, this decision caused a certain amount of derision and disappointment, and again the B.B.C. had to stand up and be the butt of a lot of chaff and ridicule. This sort of thing must be bad for the morale of those in subordinate positions at Savoy Hill and in the provinces; and the fact that certain Provincial Station Directors refused compliance with the new rule and announced their intention to continue to give the names of artistes acting in radio plays was a sign of the times which the B.B.C. should not lose sight of.

"Dora" at Savoy Hill

However, as was to be expected, the B.B.C. realises that this stupid rule could not possibly be carried out in actual practice, and a certain modification has now been made. If would, of course, have been perfectly ridiculous to engage such a great actress as Miss Sybil Thorndike to broadcast "St. Joan," and then not to announce it to the public except via the B.B.C.'s official programme organ.

It is a pity the B.B.C. doesn't think of these fatuous possibilities of their red-tape orders before making them. Even the best friends of the B.B.C. are getting a little tired and a little irritated by these "Dora"-like fiats.

We understand this original idea came from Mr. Val Gielgud, the Dramatic Director. In all friendliness, we advise Mr. Gielgud to get on with his job and not to start thinking out original ideas for denying actors a legitimate amount of publicity.

Radio in the Arctic

It is reported in the "Yorkshire Post" that ships returning from the Arctic have brought reports of reception conditions in the most northerly parts of Canada, and it is pointed out that there are now very few trading posts there not possessing a wireless set. The Royal Canadian Mounted Police are stated to be able to gauge the popularity of broadcasting among the trappers and traders and have been

(*Continued on page 56.*)

OUR NEWS BULLETIN

—continued from page 54

able to compile reception records which are very interesting.

Seven B.B.C. Stations Regularly

For instance, the Post at Bernard Harbour, in the North-West Territories, holds the record for good reception conditions. The Post on Coronation Gulf, in the Arctic Ocean, is 150 miles north of the Arctic Circle, and seven British broadcasting stations are heard there regularly.

Japan, Too

During last year London was heard sixty-seven times, and Bournemouth and Daventry (5 G B) forty-three times each. Newcastle, Aberdeen and Glasgow also were picked up. The Japanese station, J O A K (which was recently described in our contemporary, "Modern Wireless"), and Brisbane, Australia—at a distance of 9,000 miles—have also been received clearly.

B.B.C.'s Income Tax

According to the "Electrician," assessments of Income Tax have been made on the B.B.C. in respect of its profits, including any profits obtained from publishing newspapers, etc. But the B.B.C. has disputed liability. The exact outcome of this dispute will be of great interest to listeners, for it has always been one of the arguments held up against the B.B.C.'s financial position that it is unduly favoured in the sense that it does not pay official Income Tax. Nevertheless, it must be remembered that quite a lump sum is taken from the B.B.C.'s revenue, not only by the Post Office, but by the Treasury.

For instance, the grant to the B.B.C. this year is £925,000, against £880,000 in 1928.

The Broadcasting Bosses

It was recently pointed out in the "Daily Telegraph" that in the event of the Earl of Clarendon retiring from the chairmanship of the Board of Governors of the B.B.C.—although, of course, there is not the slightest indication of His Lordship doing so at the moment of writing—it is calculated that Lord Gainford's name would come up for early consideration for the post.

Captain Ian Fraser, the "Daily Telegraph" Wireless Correspondent understands, would probably be suggested as Vice-Chairman, the post at present held by Lord Gainford, at a salary of £1,000 a year. There have been many rumours about Sir John Reith retiring from his post of Director-General, but we understand on good authority that all these are without foundation. Sir John Reith, who may be regarded as the founder and organiser of British broadcasting in this country, would be a great loss to the B.B.C. if he did retire. It is understood, according to Whitaker's Almanac, that his post carries with it a salary of £6,000 a year.

Invaluable to

THE HOME CONSTRUCTOR

Two New

"BEST WAY" WIRELESS BOOKS

"Best Way" No. 328.—Modern Valve Sets. Contains full constructional details of four receivers. A "WAVE-CHANGE ONE-VALVER" to cover long and short waves by the operation of a switch, a "TWO-VALVE AMPLIFIER," the "'BEST WAY' WAVE-CHANGE THREE," and "THE HOME CIRCLE FOUR," a set specially designed for family use.

"Best Way" No. 329.—This Year's Star Sets. Tells you how to build another four specially-designed receivers. "AN ALL-WAVE TWO-VALVER" which covers all wave-lengths from 2,000 to 20 metres, "A ONE-VALVE AMPLIFIER," "A REGIONAL CRYSTAL SET," and the "S.G. AND PENTODE THREE"—a receiver of the most up-to-date type, capable of remarkable results.

EVERY SET MINUTELY DESCRIBED

On Sale Everywhere. *PRICE 6d. EACH.*

EXPERIMENTING WITH THE 31 NEW CIRCUITS

—continued from page 15

limits, and the whole eliminator circuit is one of those recommended by the manufacturers of the Raytheon valve. This particular arrangement is one of those having the advantage that even if the high-tension load is suddenly taken off the eliminator there will be no sudden strain on the eliminator condensers due to high surge voltages.

Circuit No. 19 shows an arrangement with two single-wave rectifying valves, the filaments of these valves being lit by raw A.C. from a special filament winding on the transformer. This method is quite practical and we have used it very successfully in the laboratory. The filter is the same as that used in Circuit 18, and the voltage control output is continuously variable on H.T. positive 2 from approximately half the maximum to the maximum, while H.T. positive 1 can be varied from half the maximum down to zero.

Circuit No. 20

R_1 and R_2 should be wire-wound potentiometers, each of 10,000 ohms. The Truvolt potentiometer of the Electrad series is excellent here.

Personally, I prefer this scheme to that given in Circuit 18, as the voltages are more easily adjustable, but, on the other hand, in Circuit 18 there is slightly less tendency to motor-boating with some sets.

Circuit No. 20 shows a double-wave rectifier of the filament type. This is probably the most generally useful type of valve rectifier. The U.5 Marconi or Osram is a typical thoroughly satisfactory rectifier for this purpose. The "Stedipower" H.T. unit had a combination of the double-wave rectifying valve scheme of Circuit No. 20, with the filter and voltage controlling devices of Circuit No. 19, with the addition of a high-resistance voltmeter which could be tapped at will across H.T. positive 3, 2, or 1.

Output Voltage Control

In Circuit No. 20 the filter is arranged slightly differently, with one choke in each high-tension lead. In a few cases there is slightly less hum using this method. The output voltage control is by the series resistance method, and while there is less tendency to motor-boating in some circuits with this scheme, it has the great disadvantage that if the receiver filaments are switched off, and thus no load placed upon the unit, the filter condensers receive a sudden increase of voltage which may puncture them. It will be noticed in Circuits 18 and 19 that even when the receiver is taking no high-tension there is always some load on the eliminator, due to the current flowing through the resistances joined across the whole unit.

Interchangeable Parts

It should be pointed out that the filters and resistance controlling schemes in these three circuits are all interchangeable, and any one of the rectifiers can be used in any one of the filters and any one of the voltage controlling devices. Circuit No. 21 shows a high-tension D.C. mains unit, and here, of course, the maximum voltage is that of the mains, which cannot be stepped-up in any way. D.C. mains units are not quite so safe as A.C. mains units, for whereas the mains themselves are isolated from the receiver by means of the transformer in the A.C. unit, in the D.C. units they are directly connected, and as one of the mains (either positive or negative) is always earthed, while one side of the receiver is also earthed, unless the correct connections are made and great care taken the mains may be shorted through the receiver.

An Additional Tapping

For this reason it is essential that the large condenser C_6 of the H.T. mains unit type, well able to withstand the voltage, is permanently inserted in the earth leads, and similarly an output device of some kind should always be used. The two modifications necessary are shown on the right-hand side of Circuit No. 21. Also avoid metal panels on sets used with D.C. units.

If you have a mains unit and you want to add an additional voltage tapping, Circuit No. 22 shows you how to do it. The lead connected to R can be joined to either A, B, or C, according to the voltage range required on the additional tapping. Thus if you want a tapping giving a voltage above H.T. positive 2, but less than H.T. positive 3, then connect the lead to C. Similarly, if you want a voltage above H.T. positive 1 and below H.T.2, connect it to A. If the voltage is less than H.T. positive 1, then the leads should be connected to B. Condenser C_1 should not be less than 2 mfds., and better if 4 mfds., particularly when a fairly heavy load is being taken out of the extra tapping.

SHORT-WAVE CIRCUITS

—continued from page 27

one that was really silent in operation on short waves! The grid leak, instead of being taken to the positive side of the filament as before, goes to the slider of a potentiometer connected across the L.T. battery This proves an almost unfailing cure for the obscure trouble known as "threshold howl," or "fringe noise."

For the benefit of readers who are lucky enough not to have come across this delightful trouble, it may be explained that it consists of a loud "hoot" just as the set is on the very verge of oscillation, and at the point where it is most important that it should be silent.

I have found many means of curing it which work in nine cases out of ten, but the tenth case usually causes a considerable amount of trouble! Not one has been found as yet, however, which could not be cured by taking the grid leak to a potentiometer in this way, and setting the latter to the best position.

The Aerial Circuit

No choke has been inserted in series with the transformer, since the primary of the latter has a sufficiently low self-capacity to act as a good enough choke to ensure good control of reaction by the ·0003 variable condenser.

Fig. 6 shows another perfectly straight circuit which works admirably "down below." The first valve is one of the standard screened-grid type, and operates with a "roughly-tuned" aerial circuit. Parallel feed is used for the H.T. to this valve, so that the detector circuit remains quite "straight" also, and quite a fair degree of amplification is derived from a stage of this nature.

Further, if one is content to use an aerial circuit of this type, the set is sufficiently stable to behave perfectly with no screening whatever. If one wants a really good stage of H.F., all that has to be done is to screen the aerial coil effectively from the anode coil (or detector grid coil, if parallel feed is used) and to tune the aerial coil accurately. As, however, the arrangement shown is so simple to operate and easy to search round rapidly with, it is thought preferable to sacrifice a certain amount of amplification and to use this.

To produce the "semi-tuned" aerial circuit a tapped coil is provided, and a fixed condenser of ·0001 is

(*Continued on page 60.*)

SHORT-WAVE CIRCUITS

—continued from page 59

included to give a sensible ratio of inductance to capacity. For the coupling condenser from the H.F. stage to the detector ·0002 was found to be the best value. After this the whole set is practically identical with Fig. 2.

Straight H.F. amplification by means of an ordinary valve is also very satisfactory, but the neutralising is a little tricky unless one makes coils to special design, and for this reason I do not propose to say more about this.

In any case, useful as H.F. undoubtedly is, the average reader will find that anything he wants to hear can be brought in at ample strength with a detector only, and in my opinion there is rather more satisfaction to be derived from logging stations at unbelievable distances with a set of the simplest order than with one which is approaching the "multi-valver" stage.

"Every Set a Short-Waver"

Speaking of multi-valvers reminds me that the super-heterodyne is also an excellent short-waver, but so little deviation from the ordinary straight super-het. circuit is necessary that it is hardly worth while mentioning it. And thus we return to the original point—that "any circuit is a short-wave circuit" once the reader has grasped a few simple principles and learnt to apply them.

The modifications that I have suggested in connection with these few circuits I have chosen should help the reader to reason things out for himself, and to make other circuits suitable for his own uses, and he should find, as many have already found, that a good bout of short-wave work will improve his all-round knowledge of radio and help him to build better receivers for all purposes.

CHATS AT THE WORK-TABLE

—continued from page 36

Since the primary was carrying the plate current it will be seen at once that any short-circuiting between one of these pins and its turns might lead to disaster. That, in point of fact, is exactly what happened. The primary was wound with wire from a reel labelled "No. '26 D.C.C." In view of

(*Continued on page* 61.)

CHATS AT THE WORK-TABLE

—continued from page 60

the double cotton covering one did not feel it necessary to protect its windings with insulating tape, or anything of that kind.

Unfortunately, the reel was wrongly labelled, and the wire was actually *single* cotton covered. As it was rather quickly made for experimental purposes the ends were not neatly bared—in fact, all that happened was that the covering was pushed far enough back to allow soldering to be done at the ends.

The absence of a second layer was, therefore, not discovered until the set was switched on. Since the batteries happened to be connected in series, i.e. H.T.— to L.T.+, the short which took place between the point of one of the valve pins and a place on the wire which by an evil chance was not properly covered blew up four valves.

The Real Reel

It is just as well, therefore, to make sure that your D.C.C. *is* D.C.C. Further, it is sound practice to examine reels when you buy them to see that the wire is of the stated gauge. Once, some time ago, when I had carefully worked out the number of turns that could be got on to a former of given length I had quite a shock when I came to wind it.

I had bought a reel of wire of the proper gauge—or, at all events, it was marked as being of the number required—but when I had nearly finished the coil I found that all the turns would not go on. An examination showed that "No. 34" was really No. 30.

QUEER QUERIES

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the valve in question can avoid the H.T. battery altogether, and pass instead from filament to plate through the large fixed condenser and through the primary or other coupling device which is inserted to couple the valve in question to the next one.

It is certainly a little difficult at first sight to imagine how extra resistance can prevent the trouble which is caused by a resistance in the first place, but if it is remembered that the H.T. battery resistance is

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common to all the circuits, whilst an anti-motor-boating device is included in only one circuit (and then in conjunction with an alternative and easy path, via a condenser), it can readily be understood how battery coupling is prevented by this means.

A Hydrometer Query

Apparently the hydrometer is now becoming better known as a useful and cheap accessory for keeping an L.T. battery in good condition. And the very simplicity and dependability of its action must make it appear rather puzzling to those who have never had its working explained.

Generally there are three beads in a hydrometer, of different weights.

After the accumulator has been in use a little time, its electrolyte (acid) gets a little thinner or weaker, and immediately this happens the heaviest of the three beads commences to sink in the acid, although the other two remain floating.

If it is used still further the acid or electrolyte gets still weaker, and when this happens the second bead gets comparatively heavy and it, too, begins to find its way to the bottom of the containing vessel. This shows that the accumulator is about half discharged. If the discharge of the battery continues, its acid or electrolyte gets still weaker, until in the end even the lightest of the three beads will sink to the bottom, and thus will indicate that a recharge is necessary.

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at certain wave-lengths will be found, and at others there may be a loss of magnification. So far as the resistances in their holders and the resistance-capacity coupling unit are concerned, any of the alternatives mentioned in the list will work quite well.

Now attach the panel permanently and wire up the set as shown, taking flexible leads of rubber-covered wire (good quality electric-light flex bared of its silk or cotton covering will serve for this), leaving ample length for securing to the various positions. Now stand the baseboard assembly

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in the bottom of the cabinet, as shown in one of the photographs, and join up the various flexible leads to the points shown.

Notice that there is only one flexible lead coming directly from the frame to the baseboard assembly, i.e. the wire going to the terminal of the reaction condenser, which is also joined to one terminal of the tuning condenser. The flexible leads should be made as short as possible, but do not make them too short, otherwise you will not be able to turn the panel and baseboard assembly through a right angle in order to secure it in its final position.

A few experiments will give you the best lengths of leads here, keeping them in such positions that they foul one another as little as possible. Such wiring is bound to look a little untidy, but if it is carefully carried out it will be quite efficient.

Grid-Bias Connections

A flexible lead should be taken through a hole in the partition and joined at one end to the on-and-off switch, and the other to a black spade terminal for the negative terminal of the accumulator. The same spade terminal should have attached to it an additional flexible lead provided with a red wander plug for insertion in the positive tap of the grid-bias battery, and also a black wander plug for the negative socket of the high-tension battery.

Two grid-bias flexible leads will be necessary, and should have black wander plugs attached to them. These can be passed through the same hole in the partition as that used for the negative L.T. lead (best made between the third and fourth valves).

When all the leads are attached try turning the baseboard and panel assembly through a right-angle so as to bring the panel horizontal. This will show you whether your leads are too long or too short. Aim at making them just long enough for this turn to be made. One flexible lead will still be free, namely, that which goes from one terminal of the ·0003-mfd. fixed condenser on the baseboard to the plate terminal of the screened-grid valve.

Before connecting up the batteries check over every connection very carefully, and when you are sure you

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have made them all correctly put a screened-grid valve in the holder on the side of the cabinet, an H.F. type of valve in the second and third sockets, and a power or super-power valve in the last socket. A power valve will give good results, but a super-power valve will give better quality.

Normally used, a 2-volt super-power valve will drain more current than is advisable from the comparatively small size of high-tension battery that will fit into this cabinet, and so personally I use a 2-volt super-power valve with 18 volts grid bias, which is *more* than the 99-volt H.T. normally calls for. This over-biassing of the output valve reduces the high-tension consumption to a practical figure, and while the results will not be quite so good as if the normal grid bias were used for this high-tension voltage, results will be definitely better than those obtained with an ordinary power valve.

Fixing the Batteries

Two 9-volt grid-bias batteries will be needed in series for this, the negative of one being joined to the positive of the other by a short flexible lead and two small wander plugs. If, of course, you use a power valve, then a 9-volt grid-bias battery will be sufficient. Use 1½ volts grid bias on the first L.F. valve.

With all your valves in their sockets, the panel standing vertically and the reaction condenser set at zero, put the high-tension battery, the grid-bias battery and the 2-volt accumulator in place. They will be found to fit nicely in the compartment provided. The maximum high-tension positive socket is used for the plug joined to the baseboard assembly and the loud speaker, while the negative socket will take the lead which goes also to the positive of the grid-bias battery and the negative of the accumulator.

Tuning Very Sharp

The positive of the accumulator will be joined to the red spade terminal. Now place the wave-change switch in its upper position (for short waves) and tune in your local station on the tuning condenser. You may have to use a little reaction with this, and tuning is extremely sharp. Try the effect of the reaction and you should find it progressively smooth.

Try various positions of the tuning condenser and reaction, and also try rotating the whole cabinet to bring the frame aerial at different angles. You should have no difficulty in picking up your local and the alternative station, and after dark you should be able to find several others on the loud speaker. A little practice is, of course, necessary, as tuning is so sharp. Then push the switch over to the long-wave side (lower position) and tune in 5 X X, Radio-Paris, and the others. You will probably find you will not need so much reaction.

Next month I will tell you more about this receiver and the experiments I have conducted with it.

"STEDIPOWER" AND MOVING-COIL SPEAKERS

READERS will remember that in the March issue of the WIRELESS CONSTRUCTOR, page 346, we dealt with the question of supplying field current to moving-coil loud speakers by means of the "Stedipower" L.T. Unit. We pointed out that we did not advise the use of the "Stedipower" unit for this purpose, owing to the fact that when the loud-speaker winding current was switched off, the surge of voltage produced might rupture the condenser and thus ruin it.

No High-Voltage Surge

On the publication of this article, The Telegraph Condenser Co., Ltd., very kindly wrote to us in great detail, and forwarded a number of oscillagraph records of a coil-driven loud-speaker circuit used with a scheme on the "Stedipower" lines.

It is very interesting to find that owing to the enormous capacity of these condensers no high-voltage surge occurs in any case, although The Telegraph Condenser Company recommend that the switching off should be done at the mains. It will be remembered that in the "Stedipower" L.T. Unit we always recommend switching off at the mains.

We therefore very gladly and happily admit that we were in error in assuming that damage would be done to the electrolytic condensers when used with a moving-coil loud-speaker field. Readers will thus see that the "Stedipower" L.T. Unit has an additional advantage, namely, that it can be used to supply the filament current of a large multi-valve set, together with adequate 6-volt current for a moving-coil loud-speaker field with perfect safety.

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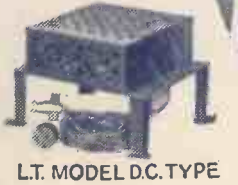

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