WHAT IS THE SONOTONE? (See Inside)

Practical Wireless

3D

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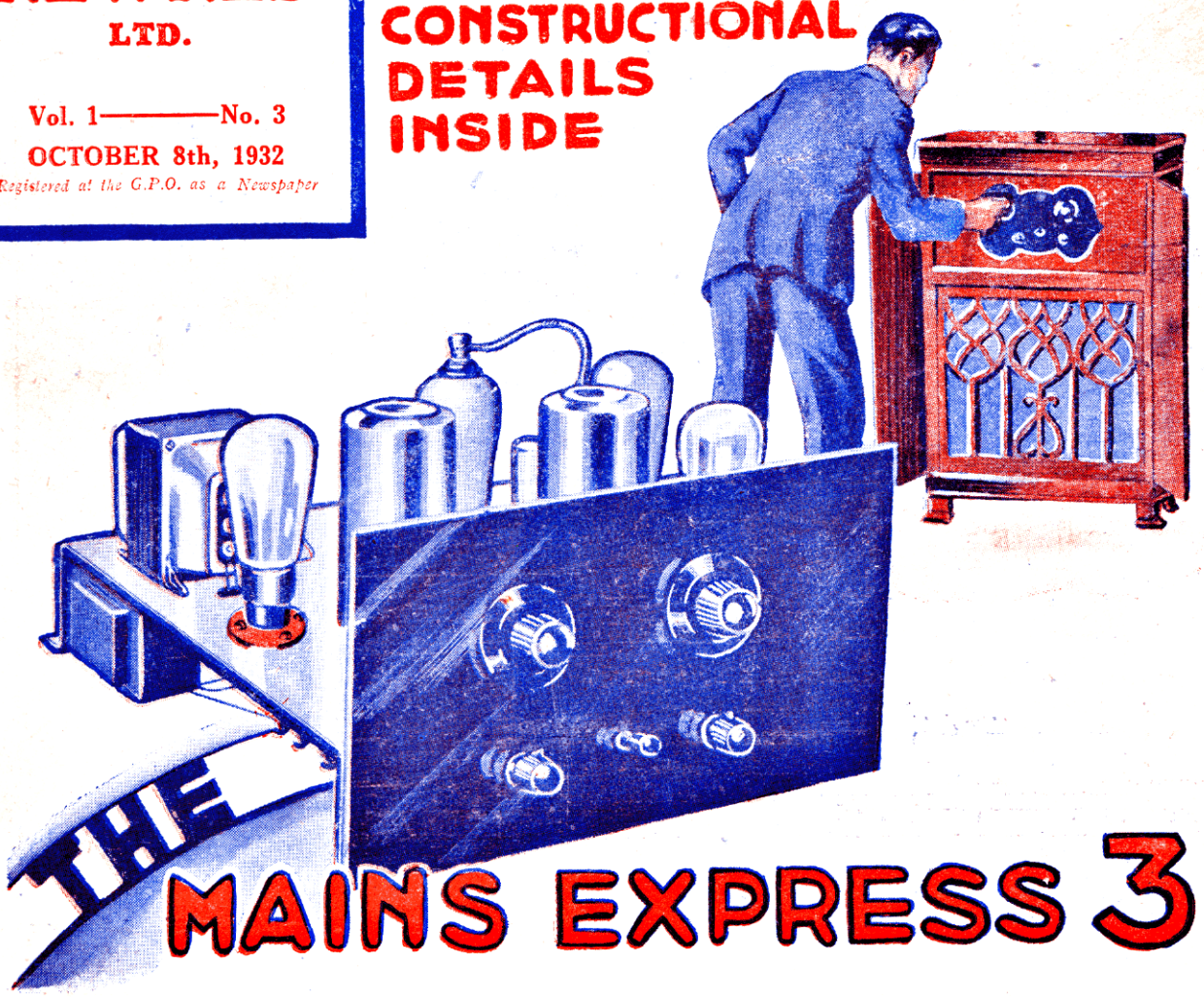
CONSTRUCTIONAL DETAILS INSIDE



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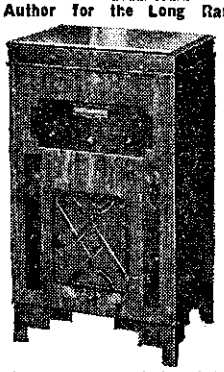
1933 WALNUT ADAPTAGRAM

Trade Mark

Specified by the Author for the Long Range Express 3.



Dimensions: Height, 38½in.; width, 21⅞in.; depth, 15½in.; panel size: 18 x 8in.; baseboard depth, 14in.; Speaker Compartment, 17 x 19½in.; Clearance Between motor board and underside of lid, 4in. Ready fitted with back Baffle Board 3/6 extra if required.

●MODEL A Convert your existing Set to a Radio-gram. Comes to you with vignetted front as illustrated and motor board, ready to take your own Set, Gramophone Motor and Pickup. No skill or expensive tools are required to transform your Radio into a combination instrument, presenting the professionally finished appearance of the most luxurious Radio-Gramophone money can buy. 12 monthly payments of 6/9. Carriage and Packing 2/6 extra England and Wales. **63/-**

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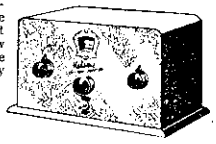
Tunes in the World's Short-Wave Stations on your Existing Set.



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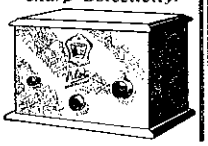
Instantly converts any Set to Band-Pass Tuning with Needle-sharp Selectivity.



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ROUND THE WORLD OF WIRELESS

Instantaneous Success of "Practical Wireless"

OPTIMISTIC as we were regarding the success of PRACTICAL WIRELESS, the fact that the paper went out of print by 10 a.m. on Wednesday, September 21st, the day of publication of No. 1, affords tangible proof that we were right in our belief that there was real need for a paper entirely devoted to the *practical* side of the fascinating hobby of wireless. The avalanche of repeat orders which poured into the publishing department demonstrated in no uncertain way that large as our estimate of the potential market was, it erred on the low side; for notwithstanding the fact that two reprints of many thousands were rapidly rushed through the presses, they were immediately absorbed and on the following day we were again "o.p."

We express our regrets, therefore, to the thousands who were unable to obtain a copy of No. 1.

Further Evidence

IF further evidence were needed of our success, a weighty mass of letters from enthusiastic readers, which descended like a cataclysm upon the editorial offices, would provide it. May we thank the many thousands who have taken the trouble to write in appreciation of our efforts, and assure them that we shall vigorously pursue our practical policy. Regard PRACTICAL WIRELESS as your guide, and one which will provide genuine service to readers in difficulties with their sets.

Half-guineas for Readers

IF you have a practical idea of your own which you think would help other readers, send it in to us, marking the envelope "Wrinkle." For every item used we pay the sender half-a-guinea. It is scarcely necessary to add that all such items must be the original work of the sender.

The Wireless Constructor's Encyclopædia

REALISING that many readers could not obtain No. 1 of PRACTICAL WIRELESS, and so were unable to qualify for the WIRELESS CONSTRUCTOR'S ENCYCLOPÆDIA—the souvenir volume which we specially produced for regular readers to commemorate the publication of No. 1 of PRACTICAL WIRELESS—we have extended the closing date for reservation forms so that *all* readers may have the opportunity of securing one of these valuable works of reference. It is amazingly complete, exhaustive in its treatment, generously illustrated, and the entire contents are arranged in encyclopædic order so that you can rapidly consult the exact piece of information you require. No such volume has ever been published before, a fact which readers of our announcement on pages 56 and 57 of No. 1, and pages 80 and 81 of No. 2, quickly recognised, for thousands have already registered and thus made certain of their copy of this truly comprehensive work. The opportunity for *you*—if you have not already taken advantage of it—appears on page 118 of this week's issue. The conditions are simple, so sign and send the coupon to-day. Don't miss your last chance.

NEXT WEEK!

FREE 1/- BLUEPRINT

of the

SONOTONE FOUR

The very latest four-valver for the home constructor.

Selective, Cheap, and a Station Getter!

Aluminium Chassis or Wooden Baseboard?

WILL the aluminium chassis eventually entirely supersede the wooden baseboard which has held the field for so many years? The aluminium chassis undoubtedly makes a neater and more workmanlike job, but for simplicity and quickness of assembly the baseboard scores. The latter provides little scope for originality of arrangement. We should like to see a little more workmanship in home-constructed sets—and a little more uniformity on the manufacturing side, particularly with regard to holes and mounting lugs.

The One-hole Fixing

THE one-hole fixing is, of course, theoretically ideal, but practically it often gets rid of one difficulty and provides another. This is generally true of variable condensers, most of which require a hole of from $\frac{3}{8}$in. to $\frac{1}{2}$in. in diameter. Most hand drills will not accommodate drills beyond $\frac{1}{4}$in. diameter, and the amateur is therefore left to his own devices to open this out to the required size. Quite often the device consists of a few seconds' brutal work with the tang of a file or any other tool which will make some sort of a hole. The tang of a file will give a hole of conical formation, and the result is that the condenser, when of the panel-mounting sort, does not remain locked for very long. It does not matter so much, of course, when the condenser is of the baseboard-mounting type.

Criticisms of Programmes

MAY we say, in response to those dozens of readers who have written suggesting it (as well as to the many who have offered to write such matter) that it will form no part of our policy to criticise programmes. That self-imposed task is already undertaken by almost every daily and weekly paper, and no useful purpose would be served in adding to the number. A wireless programme is not like a theatre programme, where well-directed and fair criticism often results in the production being improved. A wireless programme is ephemeral in its nature; and much of it is of a non-recurring nature. Criticism must, therefore, be jejune in character and, we feel, not of interest to readers of this paper. While the critics are ploughing the air, let us get down to something practical—and *constructive!*

Recording Plant for German Transmissions

GERMAN listeners miss very few worth-while broadcasts even if the specific relay has taken place at an inconvenient period of the day, as most of the studios operate recording plant. The broadcast is registered on wax and stored for transmission at a more suitable hour of the evening. More use of this system is made in the German studios than on this side of the channel.

Round the World of Wireless (continued)

Exchanged Wavelengths of Dutch Stations

ON September 30th, according to their usual custom, the Dutch broadcasting studios exchanged wavelengths for a further period of three months. The A.V.R.O., V.A.R.A. and V.P.R.O. programmes announced as emanating from Hilversum may now again be heard on 296.1 metres and the K.R.O. and N.C.R.V. broadcasts (Huizen) on 1,875 metres. In the meantime the power of the transmitter on 296.1 metres has been increased to 20 kilowatts, thus bringing the best Dutch programmes well within reach of most set-owners in the British Isles. In the majority of instances the initials of the radio association responsible for the radio entertainment follows the call *Hier Huizen* or *Hier Hilversum* in the announcements. The Dutch broadcasts are carried out by various groups under the direct control of the Minister of Waterways.

New Austrian 100 kW. Station

ALTHOUGH definite confirmation has not yet been obtained, it would appear that the Austrian authorities for the new 100-kilowatt station now under construction on Mount Bisamberg, near Vienna, intend to use one of the long-wave channels, namely about 1,240 metres, for the broadcasts. Tests carried out during the past five months on and around this wavelength have proved it eminently favourable for a transmitter of this high power. It is likely that the 517 metre channel at present used by the Rosenhügel transmitter will be given up.

Danish Exchange of Programmes

EXCHANGES of programmes are to take place shortly at regular intervals between Copenhagen and Stockholm, and in particular on those evenings when one of these cities effects a relay of an operatic performance from a State theatre. This will prove of advantage to listeners in Great Britain inasmuch as it offers alternative long-wave channels on high power, namely, Kalundborg and Motala. These broadcasts will also be put out through OXY, Skamlebaek (Denmark) on 31.51 metres.

Picture Transmissions from Paris

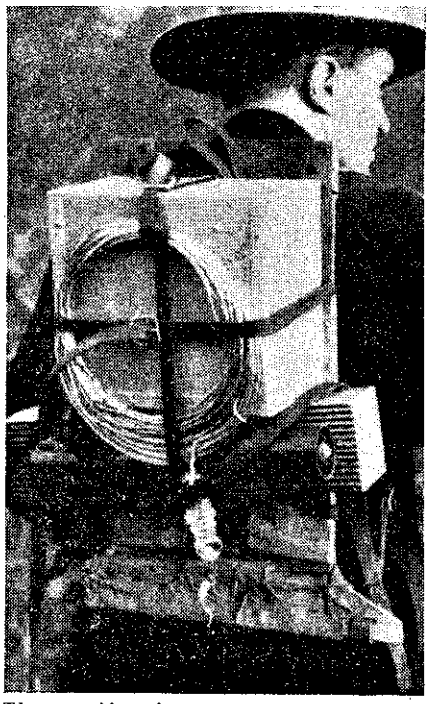
PICTURE transmission as distinct from television has not yet died out, although but little is mentioned in the Press of any striking new developments. On 1,190 metres, however, towards 10.0 p.m., the Bélin Laboratory at Rueil-Malmaison (Paris) occasionally transmits experimentally interesting pictures and documents. It is stated that these broadcasts can be recorded by instruments which were sold previously in this country for another system. The call is F8BO in morse letters and announcements in regard to the broadcasts are regularly made in the French language.

Radio Normandie Transmissions

TO attract attention to its broadcasts Radio Normandie (Fécamp) has organised a series of competitions for listeners in the United Kingdom. Although during the day entertainments are given which are of interest to local subscribers, most of the sponsored transmissions in the later hours and particularly on Sundays are intended for listeners in the British Isles.

INTERESTING & TOPICAL PARAGRAPHS

A REAL PORTABLE



This portable radio set is an important part of the back pack of this member of the United States Forest Service. It is used in quick reporting and communication during fire emergencies in national forests. The two types of portable sets weigh 10 and 35 pounds and have average radii of 10 and 50 miles respectively.

Germany's New 5 kW. Station

WORK is to be started soon on the new 5-kilowatt station destined to Freiburg-im-Breisgau (Germany) to replace the present low-power transmitter. When completed the station will operate on a common wavelength (259.3 m.) with Frankfurt-am-Main, Cassel and the proposed relay at Treves. It is expected to get this new broadcaster ready by the spring of 1933.

SOLVE THIS!

Smith made up a dual range coil—on the lines of most of the commercial articles. Medium waves were to be received on a solenoid section of the coil, the long waves being provided for by a section-wound winding in series with the first winding. When tested out the normal waves were O.K., but on the long waves the Regional could be heard over nearly half of the tuning dial. Why?

SOLUTION TO PROBLEM No. 2

The anode of the detector valve was isolated by the insertion of the fixed condenser between the H.F. choke and the transformer primary.

The following readers receive books in connection with Problem No. 1: John Rough, 6, Burns Terrace, Bathgate, West Lothian; W. K. Hinningham, 3, Swarbrick Street, Kirkham, Nr. Preston, Lancs; G. Poulton, 292, Caledonian Road, Kings Cross, London, N.1

German Exchange of Broadcasts

AS a further development of its international interchange of programmes, Germany, in addition to relays of entertainments to and from the United States, has concluded arrangements for the exchange of wireless broadcasts with Buenos Aires (Argentine Republic) and Rio de Janeiro (Brazil). As a preliminary step to the establishment of a regular schedule the Berlin studio will carry out this feature every Tuesday and Friday between 10.0 and 10.30 p.m., G.M.T. It will be possible to pick up these special broadcasts through Königs Wusterhausen (1,634 metres) and Zeesen (DJA) on 31.38 metres alternately through a number of German provincial transmitters which are taking the relay.

Broadcasts in Hebrew and Arabic

AT Tel-Aviv (Palestine) a small transmitter has been erected for the purpose of broadcasting programmes in Hebrew, English and Arabic on 456 metres. It is the intention of the organisers to equip the station with short-wave transmitting plant in order that special entertainments may be relayed to the United States. Although the wavelength has not been definitely fixed it is likely to be on or about 50 metres. Experiments in re-transmission will be shortly carried out through the intermediary of a private yacht in the port of Haifa.

Hungarian High-Power Station

FOR the purpose of finding a suitable site for the 200-kilowatt station which the Hungarian authorities propose to erect in the neighbourhood of Budapest, a 1-kilowatt transmitter has been temporarily installed at Craciunelu. It works on 2,000 metres and its rebroadcast of the Budapest programmes has already been picked up in many parts of Western Europe. According to the latest statistics there are now 1,423 broadcasting stations in the world to which, it is estimated, some twenty-six millions of listeners tune in daily.

New Belgian Station

THERE is talk in Belgium of opening a special broadcasting station in the neighbourhood of Liège or Verviers with a view to making special transmissions for the inhabitants in the Eupen and Malmedy districts, which, according to the Treaty of Versailles, were compulsorily ceded by Germany in 1919. Belgium, although a small kingdom, is hampered by the fact that the Flemish, French and German languages have all to be used if the greater part of the population is to enjoy radio entertainment.

League of Nations Broadcasts

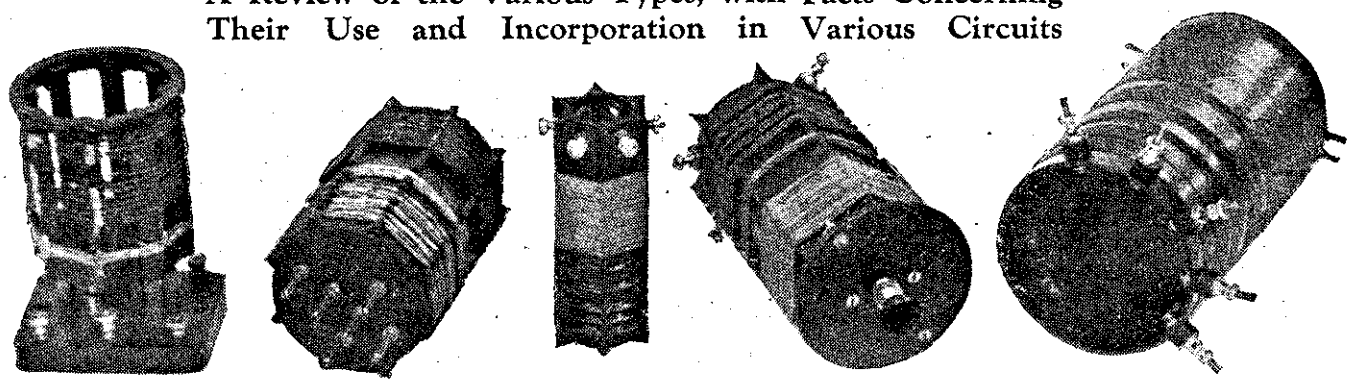
ON September 26 the League of Nations' short-wave station at Prangins (Switzerland) started its broadcasts of official news relating to the workings of its various commissions. The channels used are 20.74 metres and/or 403 metres. Transmissions are made in the French, English and Spanish languages.

Ecole Supérieure's Identification Fanfare

PARIS PTT (Ecole Supérieure) now opens its daily broadcasts with the playing of a gramophone record; it is a fanfare of trumpets by the famous band of the *Garde Republicaine*

MAKING AND USING TUNING COILS

A Review of the Various Types, with Facts Concerning Their Use and Incorporation in Various Circuits



A set of home-made tuning coils: Reading from left to right the coils are: A short-wave tuner with 6-pin base; a broadcast tuner with 6-pin base; a smaller dual-wave tuner suitable for use in screen-grid receivers; a broadcast tuner with built-in wave-change switch, and another broadcast tuner for baseboard mounting. The first coil shown is wound on a skeleton former, the second, third, and fourth use ribbed ebonite formers, and the fifth is wound on a paxolin tube.

By FRANK PRESTON, F.R.A.

ONLY a few years ago, when the honeycomb or basket type of plug-in coil was in popular use, practically every experimenter made his own set of coils. Such coils often required special formers for their construction, and not a little patience was required in winding them. These facts are mentioned to show a contrast with present practice, for now almost every constructor buys a ready-made tuner without thinking twice about it. This does appear rather peculiar to me because, for less pretentious receivers at any rate, a dual range tuner can be made much more easily and quickly than could a set of honeycomb coils. Admittedly, good tuners can now be purchased very cheaply, but even so it costs still less to make them. Besides, the making of a tuner provides a fascinating addition to the usual process of mere component assembly and gives a deeper insight into the working of the set. In my opinion anything which tends to drive home in a practical manner the principles upon which one's receiver works is particularly stimulating to one's interest in Radio, the finest of all hobbies. But that is not all, for after making one tuner you are sure to make another; comparison is the next step and the reason for the superiority of one leads on to a spirit of inquiry. That soon causes the active mind to draw conclusions and to develop ideas, and no one can say to what goal those ideas will eventually lead. They cannot do other than achieve some successful results, and who can say that an entirely new and revolutionary system of tuning might not be the outcome.

The First Essentials of Coil Design

By now I hope my readers have become sufficiently interested in this subject as to inquire how to set about the construction of a tuner. Before deciding upon such vital factors as the number of turns, gauge of wire required and so on, let us consider the primary requirements of tuners for different purposes. In designing a tuner for a simple non-S.G. receiver of the Det.-L.F. class the size of the complete unit is not of great consequence, but in a set having one or more screened-grid stages it is very desirable to keep each tuning unit to the smallest dimensions compatible with efficiency. The reason for keeping down dimensions is not merely to obtain compactness in the receiver, but to avoid interaction and feed-back between the various tuning circuits. As many readers are aware, the magnetic field created by a coil can easily extend to six times the size of the coil itself. And it will be clear that when the "fields" of two coils overlap each other there will be a feed-back or reaction effect between the coils concerned. The reaction might not in all cases be harmful, but in many it will cause uncontrollable oscillation; at any rate, it will not be under direct control, and should therefore be avoided. Of course, we can prevent the magnetic field from "running wild" as it were, by enclosing the coil within a metal screening compartment, but even then the small coil has the advantage of enabling the receiver to be made more compact. It might be argued that a larger coil is more efficient, since it can be wound with heavier gauge wire having a low resistance. Whilst this is true of a coil to be used in, say, a crystal set where reaction cannot be applied it is not so in any other case. Let me explain further. The application of reaction (by which is meant legitimate reaction which is fully under control) gives to a coil a result equivalent to "negative resistance," and so when reaction is employed a comparatively high initial resistance is of little consequence. When a coil is screened its measured efficiency is reduced, but, as we have already seen, screening is often a practical essential. Even this factor does not cause us to experience any qualms, because the loss can again be restored by the use of reaction if necessary. This is not always necessary, however, because we do not generally want a coil which is "too" efficient, paradoxical as this may seem. One which is too efficient, if used in a highly efficient S.G. circuit, will provide too great an amplification, which will result in instability.

Up to now I have generalized in my statements, to avoid going too deeply into the theory of this subject and with a view to presenting only the most important facts for consideration. But from now on I propose to give more definite concrete practical details to guide you in making whatever form of tuner you might be in need of. Rather than give difficult mathematical formulæ for calculating the number of turns of any particular gauge of wire required on a former of such and such a diameter to provide an inductance of so many microhenries, a series of definite figures obtained after both calculation and practical experiment will be presented. (See page 130).

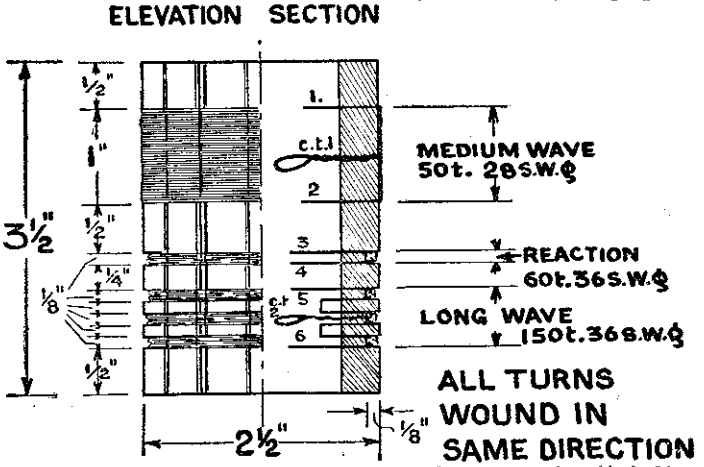


Fig. 1.—Constructional details of a tuner made on an eight-ribbed 2½in. diameter ebonite former.

A Tuner for Det.-L.F. Sets

As explained above, there is no need to restrict the dimensions of a tuner required for a non-S.G. receiver. In general, it will be found most convenient to employ a former from 2in. to 3in. in

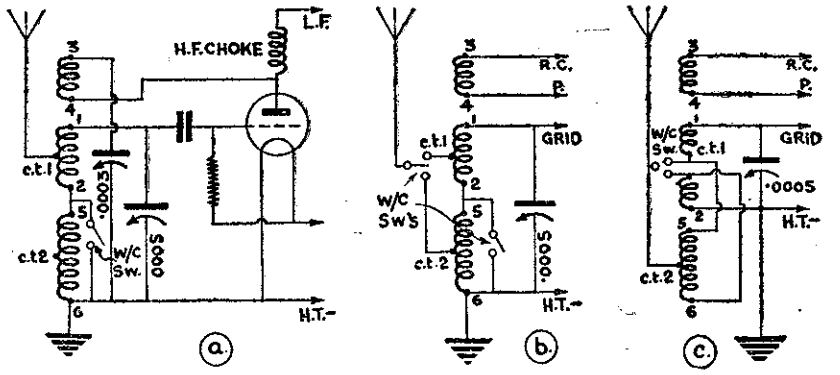


Fig. 2.—Three methods of connecting the tuner shown in Fig. 1 into a detector circuit.

diameter by some 4in. long. The former may consist of well-shellaced cardboard, paxolin or ebonite, but the latter is usually to be preferred. Fig. 1 gives all constructional details of an excellent tuner made on an eight-ribbed ebonite former 2½in. in diameter by 3½in. long; a number of 1/8in. deep slots are made in it, as can be seen. The slots are most easily made in a lathe, but where such a machine is not available a small warding file can be used. In the latter case it will be found very helpful to bind a piece of wire round the former to act as a guide in keeping all slots in line. The winding process is not difficult, but care should be taken in putting on the single layer winding to keep a good tension on the wire. To anchor the ends of the winding, a pair of 1/16in. holes should be drilled, and the wire threaded through.

The numbers of turns indicated in the drawing assume the use of enamelled or single-silk covered wire, which is thinner than other kinds. It will be noticed that both long-wave and medium-wave windings are centre tapped by making a loop in the wire and passing it through a hole in the former. Connections from the various tapping points can be made in two or three ways, such as are illustrated by the photograph showing a number of finished tuners. One way is to attach terminals round one end of the former and another is to bring them out to valve pins on a six-pin base. Yet another is to bring some of the connections out to terminals and take the others to the terminals of a suitable wave-change switch mounted on an ebonite end plate secured to the former by means of small angle brackets. The latter method makes the tuner suitable for single-hole panel mounting, the switch bush being used for mounting purposes. Where it is preferred to use a cardboard or paxolin former, the same numbers of turns will be approximately correct and the same spacing between the ends of separate windings should be allowed. As, however, all three windings will have to be wound as single layers, the length of former must be increased.

Alternative Tuning Circuits

Fig. 2 shows three entirely different methods of connecting the tuner just described in a detector circuit. At (a) the aerial lead is joined to c.t. 1 (the medium-wave centre tap) and a simple on-off switch serves for wave-changing by short-circuiting the long-wave winding. The other centre tapping, c.t. 2, is not used at all, being left disconnected. Reaction is obtained by means of a .0003 mfd. reaction condenser wired between one end of the reaction coil and earth. An H.F. choke of sound design is necessary in the detector anode circuit. This particular circuit gives good selectivity on the lower waveband, but only moderate selectivity on long waves. The latter is compensated for by slightly higher long-wave efficiency, and the arrangement is thus most suitable when extra volume is required from a long-wave station.

The circuit given at (b) provides equal selectivity on either waveband, because the aerial is transferred from one centre tap to the other by the wave-change switch, which must be of the double-pole-double-throw variety. Reaction connections are not shown, but are exactly as for circuit (a). Circuit (c) gives exactly the same effect as (b), but requires only an ordinary three-point wave-change switch. The looped centre tap of the medium-wave winding (c.t. 1) is broken to provide the same effect as two separate windings. The long-wave winding is connected between the two portions of the medium-wave one and is short-circuited by the switch when medium-wave reception is wanted. On long waves the aerial goes to c.t. 2.

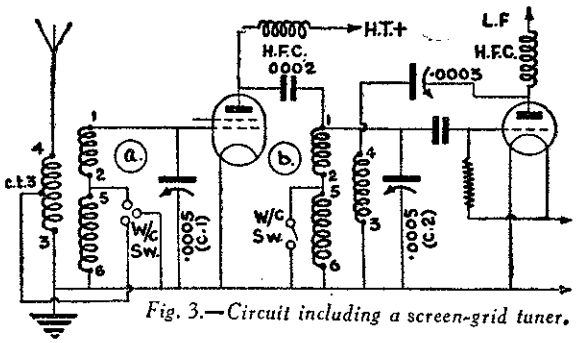


Fig. 3.—Circuit including a screen-grid tuner.

A Tuner for S.G. Receivers

It has been pointed out that it is desirable to employ a smaller tuner (physically smaller, that is) for a set having two or more tuning stages, and the writer finds a 1½in. diameter six-ribbed ebonite tube to make an excellent former. The former should be the same length as that shown diagrammatically in Fig. 1, and should have similarly-placed slots. All windings should consist of 36 gauge enamelled wire, the correct number of turns being as follows:—

Medium wave: 80 turns.
Reaction: 84 turns, with centre tap.
Long wave: 220 turns.

In this case it will be seen that the tuned windings are not centre tapped, although the reaction is. The reason will be made clear a little later on. This tuner, which is very similar to that seen in the centre of the photograph, will cover the same tuning ranges as the larger one described above.

Tuner Connections for S.G. Sets

Fig. 3 (a) shows a tuner of the latter type connected in the aerial circuit of a S.G. valve. The numbered connections correspond with those of Fig. 1, and c.t. 3 is the centre tapping of the "reaction" winding. Actually this winding is not used for reaction in this instance, but acts as an aperiodic aerial coil. A three-point W/C switch short-circuits the long-wave winding and half the aperiodic winding for medium-wave reception. The circuit of Fig. 3 (a) provides a very selective arrangement, and may be followed by another similar tuner used for tuned-grid coupling as at (b) in the same diagram. The centre tapping is not used at (b), and the reaction winding is employed for its legitimate purpose. Provided care is exercised in making both tuners identical, condensers C.1 and C.2 may be ganged together with every satisfaction. In making a set to the circuit of Fig. 3 care should be taken to arrange both tuners with their axes at right angles to each other and to erect an aluminium screen somewhere between them.

Band-pass Circuits

Either of the tuners described may be used in matched pairs for band-pass tuning. The circuit of Fig. 4 (a) employs two of the larger coils for B.P. tuning in a Det.-L.F. receiver. The two coils are coupled together by a small-capacity pre-set condenser which can be adjusted to provide an optimum band width. A screen should be erected between the coils, and it is preferable to include a small condenser in series with the aerial lead to prevent the aerial capacity influencing the first tuner unduly. Reaction is applied to the second tuner as in Fig. 2 (a), but the reaction winding of the first tuner is not

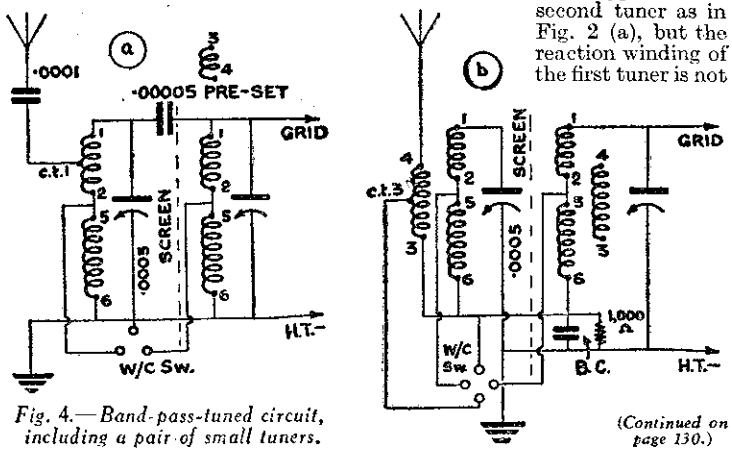


Fig. 4.—Band-pass-tuned circuit, including a pair of small tuners.

(Continued on page 130.)

NEW IDEAS IN CABINETS

In this Article our Contributor Concludes His Suggestions for Novel and Really Useful Cabinets

By W. B. RICHARDSON

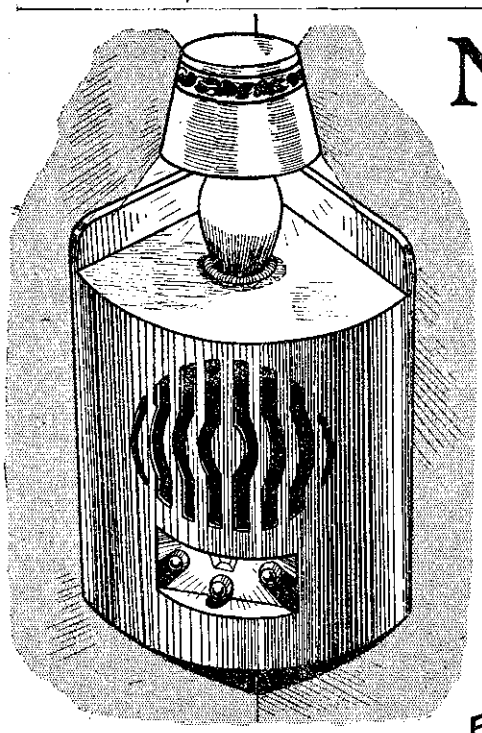


Fig. 1.—The finished corner cabinet.

I AM giving this week full details of the corner cabinet mentioned in my last article. As you will see from the illustrations it is quite a new idea in the housing of receiver and speaker and is intended to hang on the wall in a similar manner to a china cabinet. In this position it takes up the minimum of space while harmonizing with the general scheme of decoration. If surmounted by one of the popular corner lamps the effect at night is particularly pleasing.

Simple Construction

Fig. 1 illustrates the finished cabinet. It is made up of a simple framework to which is nailed a thin plywood panel curved to form the round front, while the back is enclosed with two flat panels and doors. First of all build up the frame as in Fig. 2. The uprights are 1in. square and are nailed and glued to the quarter circles of wood which form the top and bottom. These latter should be about half an inch thick. A similar piece of wood to the top and bottom pieces, but with the corners cut away to fit the uprights, is fixed as a shelf for the batteries. Since the front is curved, it is necessary to fix up a small baffle board on which to mount the speaker. This is shown in Fig. 2, and a plan is given in Fig. 3. If the board is placed a little way back, sound waves from the back of the speaker as well as from the front will pass out through the fret. When the frame is complete you should cut out the front. This is made from a sheet of $\frac{1}{16}$in. plywood. If this is veneered with mahogany or some nicely marked wood the appearance is much enhanced. Veneered plywood is quite inexpensive, Now cut out a suitable design, such as the one shown, for the speaker fret, and another opening for the panel. This work is best done with a fret machine, but if the design is simple, a key-hole saw can be used. To fix the front, it is simply bent to conform to the curved frame and nailed on. The heads of the nails should be punched in slightly and the holes filled with stopping. Before adding

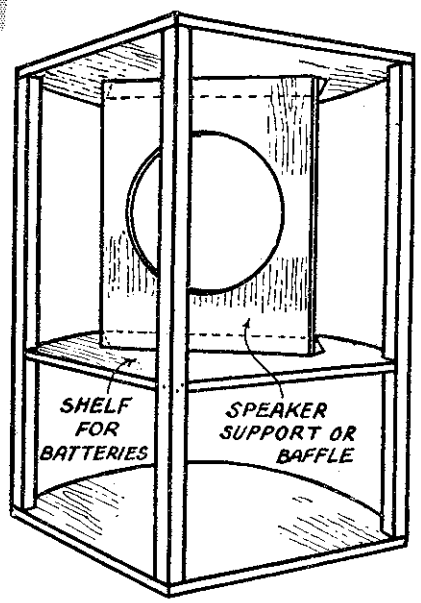


Fig. 2.—The main framework of the corner cabinet.

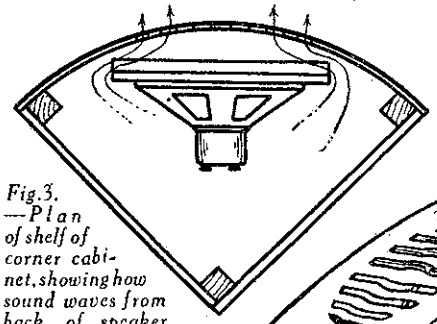


Fig. 3.—Plan of shelf of corner cabinet, showing how sound waves from back of speaker pass round the baffle.

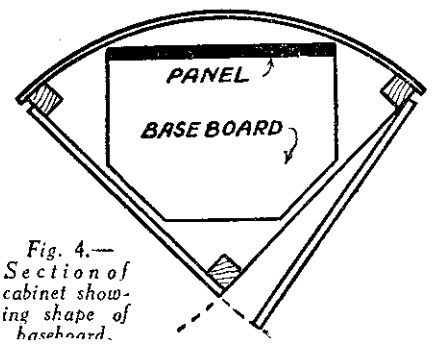


Fig. 4.—Section of cabinet showing shape of baseboard.

the back fit the loud-speaker in position. The construction of the back and doors will be apparent from Fig. 6. The two holes in the doors allow you to reach the catches which are fixed on the inside so as not to stick into the wall. The set, composed of the usual panel and baseboard, slides in position with the panel opposite the opening in the front. If the baseboard is cut to the shape shown in Fig. 4 more room will be available for the components, and it will slide in or out easily between the uprights of the frame.

The corner cabinet must, of course, be fixed securely to the wall. If the plaster is good, two Rawlplugs at the top may be sufficient, but I strongly recommend the fixing of two wooden bearers to the wall to support the cabinet underneath, as in Fig. 7. A refinement here is the inclusion of a strip of wood fixed in the angle of the wall to act as covering for the aerial and earth wires, and mains wires if the set is to be run from the mains. If the eyelets, known as mirror plates, which are fixed to the top of the cabinet are of the slotted type, the cabinet can be lifted from the wall without removing the screws, thus allowing easy inspection.

Another Wall Cabinet

If you examine Figs. 8, 9 and 10 you will see how to make another version of the corner cabinet. Apart from the appearance, this has perhaps some advantages from the constructional point of view. The top and bottom, for instance, do not require the use of a fret saw or keyhole saw in cutting out as there are no curves. Again, the internal baffle board can be dispensed with as the speaker can be mounted direct on to the front. If there is room, the panel may be set back a little way from the opening in the front, so as to give a similar effect to the first model, where the panel was of necessity recessed owing to the curved front. A panel light is then fixed to the inside of the front just above the panel and shines down on

Fig. 5.—Nailing on the front of the cabinet.

it, thus illuminating the controls in a similar manner to those on the dashboard of a car. This device may of course be adopted with both models and the effect is very striking.

There are two ways of constructing the faceted front of this second model. It has the angles of a regular octagon, and corner mouldings can be obtained containing rebates into which the panels fit flush, or else corner posts can be made from the same square stuff as is used for the other corners. The inset Fig. 10 will show you how the posts are planed down to the right angle. If you find this rather too difficult to tackle yourself, I suggest you give this part of the work to a joiner or use the ready-cut mouldings shown in Fig. 9. Whichever method you use, the cutting of the panels must be carefully done so as to get an invisible joint at the corners. Panels machine-cut and dead square can be supplied to your measurements from your local woodwork shop. As I explained in my last article, with cabinets of simple design the finish is of great importance. Stop

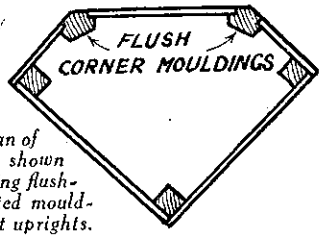


Fig. 9.—Plan of the cabinet shown in Fig. 8, using flush-fitting rebated mouldings for front uprights.

up any nail holes with stopping and smooth all joints with glasspaper before attempting the application of stain or polish. A polish similar to French polish, but specially prepared for amateur use, is now on the market, and I can recommend

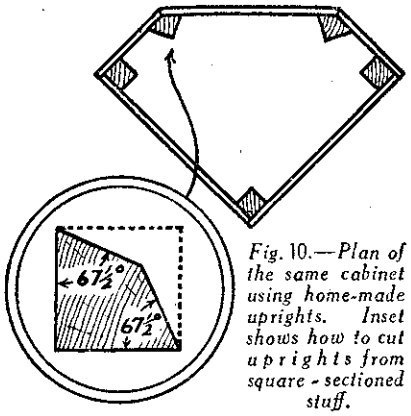


Fig. 10.—Plan of the same cabinet using home-made uprights. Inset shows how to cut uprights from square-sectioned stuff.

this if you wish to do the final polishing yourself.

A Distinguished Radio-gram Cabinet

Fig. 11 shows the finished effect obtained by constructing a radio-gram or self-contained radio cabinet on simple lines, but using nicely marked veneered plywood panels. The main structure consists of four ready-turned legs framed up with deal rails. Fig. 12 gives some of the patterns of these legs, which can be obtained in a variety of styles. They are usually 36in. high and about 1½in. square. The rails are 2in. by 1in. and are secured with

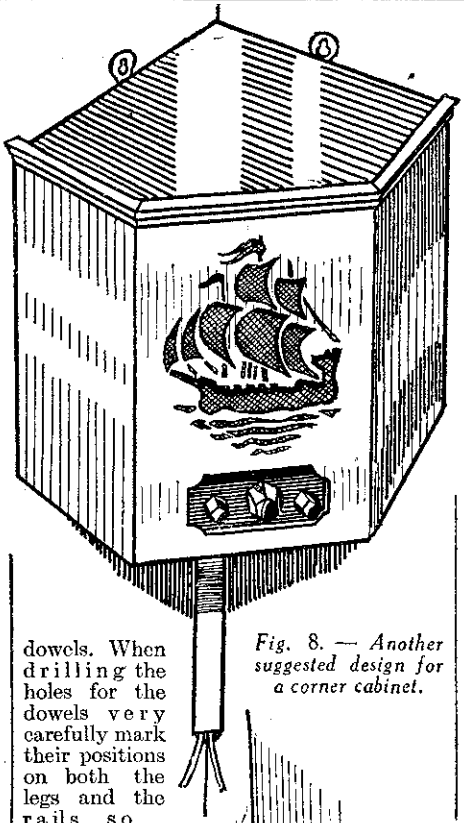


Fig. 8. — Another suggested design for a corner cabinet.

dowels. When drilling the holes for the dowels very carefully mark their positions on both the legs and the rails so that they coincide properly when fitted together. Also hold your twist-bit perfectly level. You might get a friend to see that you are holding the brace straight while drilling. Figs. 13 to 15 give full details of this constructional work. The measurements of width and depth will be such as will suit your requirements, but the proportions shown are rather pleasing. The veneered panels are simply cut to shape and nailed to the cross-rails. Any additional support can be in the form of fillets glued in the corners. The speaker and panel openings are finished off with curved beading obtainable at picture-frame makers and similar shops. To mark out the speaker opening as shown, draw four circles so that the arcs cut one another. A plain opening of this shape, backed with speaker gauze, looks as well as anything. The lid is made up of four lengths of moulding and a plywood panel. Again, suitable moulding can be bought rebated along the top edge to take the panel. The corners are mitred together, the joints being made with screws and glued.

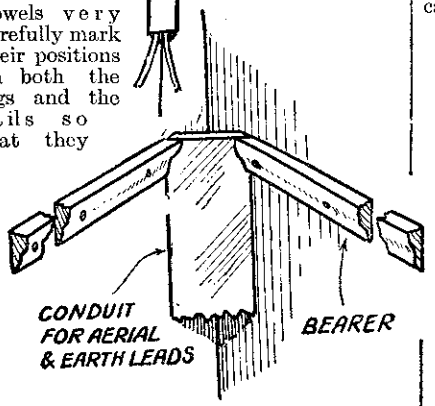


Fig. 7.—Wall bearers support the base of the cabinet—and aerial and earth leads are concealed by a wooden strip in the corner.

Housing the Gramophone

If a gramophone is included in the cabinet the lid will have to be hinged. Three shelves will be needed inside the cabinet. One is fitted below the top rails

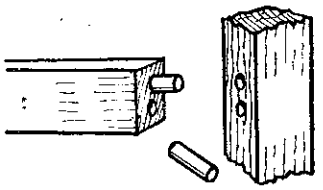


Fig. 15.—The framing rails are fixed to the legs with dowels.

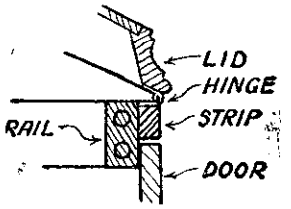


Fig. 16.—How the lid is hinged.

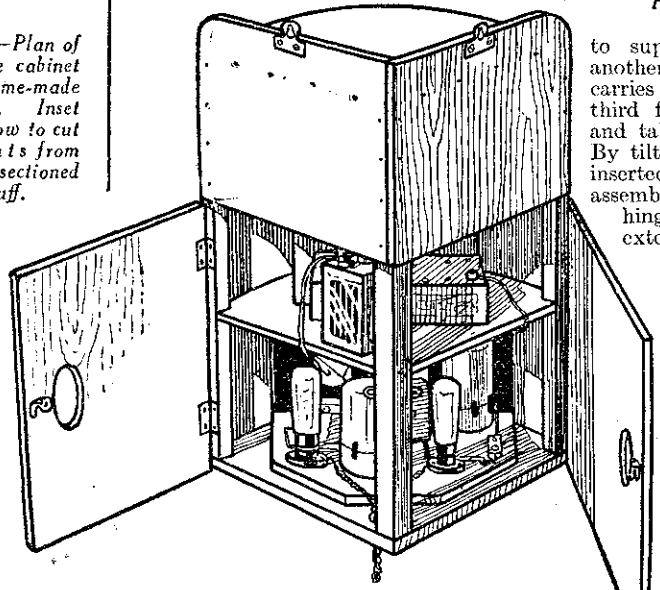


Fig. 6.—Rear view of the completed cabinet, showing set and batteries.

to support the motor and turntable; another rests on the middle rails and carries the radio baseboard; while the third forms the bottom of the cabinet and takes the batteries or mains unit. By tilting them, these shelves can be inserted after the main framework is assembled. The back of the cabinet is hinged to form a door. It should not extend quite up to the top, otherwise it will foul the lid. The best way is to make it an inch or so short, and to fix a strip 1in. by ½in. to the top rail above it. This strip should then be flush with the top and back of the corner posts or legs. If the lid is then hinged to this, it will not foul the corner posts or the door when raised (see Fig. 16). Finally, I must mention a little refinement which will be worth while from the acoustical point of view, namely, the provision of a gauze-covered opening in the back of the cabinet as well as the front. This will give the best results from your speaker.

FIXING THE OUTDOOR AERIAL

Some Practical Advice About an Important Link in Wireless Reception

By W. H. DELLER

Fig. 1.—Method of attaching aerial to the point of the roof.

AN outdoor aerial is usually suspended between a suitable mast, at the end of the garden, and a point on the house itself. The mast may be in the form of a wire-stayed steel tube or a stout fir pole. Where conservation of ground space is a consideration a good pole with 3 to 4ft. of the end buried in the earth, with some brick rubbish well rammed in round it when filling in the hole, should provide a rigidly anchored mast without the use of bracing wires. The point of fixing the end of the aerial to the house is governed by the lead-in position, which should be as near to the ultimate position of the receiving set as possible. The lead-in wire requires arranging in such a manner that it is not capable of being blown to and fro against the wall or projecting parts of the house by the wind, and it is an advantage to make this end of the aerial also readily lowerable by means of rope and pulley.

The photographs, Figs. 1 to 5, show various lead-in positions and suggested convenient points of anchorage of the aerial in relation to the same, and one of these examples, with perhaps a slight modification, will cover most requirements in this direction. It is the purpose of this article, therefore, to describe the various simple means that may be employed to provide these types of fixing.

Points About Mast Erection

Before proceeding it would perhaps be advisable to mention one or two points in connection with the erection of a mast. One of steel tube should rest on a solid foundation, otherwise the pull of the bracing wires will soon force the bottom end deeper in soft earth. With a mast of this variety the ideal means of overcoming this is to fit a flange drilled for bolting on the lower end, and make a concrete base in the ground with bolts set in spaced to suit the holes in the flange. Protect the part of a pole that is to be buried in the ground from rotting by giving it a good soaking with creosote. Keep the hole in the ground as small in diameter as possible and attach the pulley securely to the top end of the mast, preferably with galvanised wire rope. Thread the aerial hoisting rope through the pulley, knotting the loose ends together and, after placing the butt of the mast against the hole, use the rope to assist in raising it to a vertical position.

Supporting Aerial at House End

Fig. 1 shows the aerial attached to the point of the roof. A single pulley block is wired to a heavy screw eye in the woodwork at the top of the building, and a second pulley is similarly fixed on the right lower down. This arrangement keeps the hoisting rope clear of the windows, and a cleat placed below holds the free end. The aerial wire is carried round an insulator, which is fastened to the rope end, and down the lead-in insulator terminal.

The second arrangement employs a short mast. That illustrated in Figs. 2 and 8 is made up from galvanised water piping and fittings, and is comprised of a short piece of ½in. or ¾in. pipe, (these sizes by the way relate to the bore), of a suitable length with a short thread on each end. A "cap" is fitted at the top, and at the opposite end with an elbow screwed to a "flange." As both of these parts are screwed internally it will be necessary here to use a "nipple"

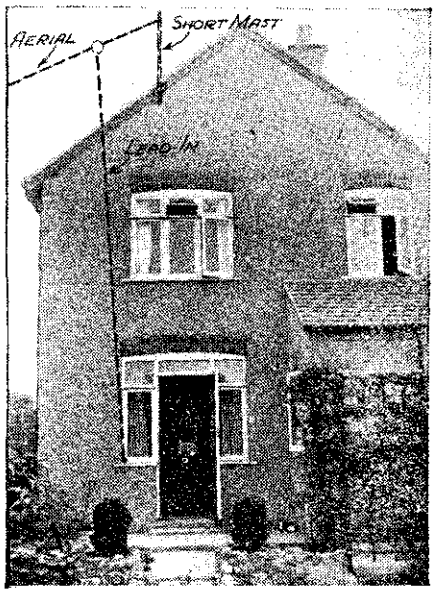


Fig. 2.—Using a short mast for anchoring the house end of aerial.

or, if this will not give sufficient distance from the face of the "flange" to the inside edge of the vertical pipe, a short piece of piping should be substituted to give the clearance required by the overhang of the roof. The parts must be very tightly screwed together and a hole drilled at the top to take an eyebolt, which is nutted into position, for the pulley. Coach-screws (large wood-screws with square heads for spanner driving) may be used for fixing the flange to the woodwork.

Alternative Methods

For the third example the lead-in is carried down at the side of the house and, for keeping the wire away from the gutter and wall, a short stay will be required (see Fig. 3). This can be made in the same form as the mast just described, excepting that the "elbow" fitting is not required and the piping is screwed directly into the flange. Where the ends of the rafters are available as a fixing, an iron, bent edgewise at an obtuse angle to suit the pitch of the roof and drilled for screwing to the side of a rafter with a couple of coach-screws, may be utilised.

A stay fastened to the chimney is shown in Fig. 4. This consists of similar tubing capped at one end as previously described. Holes are drilled to suit the width of the brickwork and a "U"-shaped clip with square corners threaded at the ends and fitted with nuts is required to keep it in position. Reference to Fig. 6 should make these remarks clear.

The clip shown in Fig. 7 is useful for attaching a pulley directly to a chimney: made from 1in. by 3/16ths in. mild steel bar (which is easily bent cold) and fitted at the

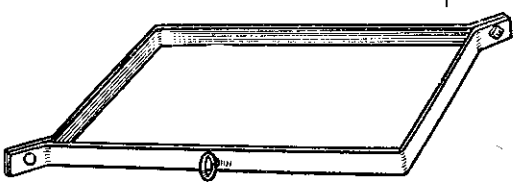


Fig. 7.—Clip for attaching a pulley direct to a chimney.

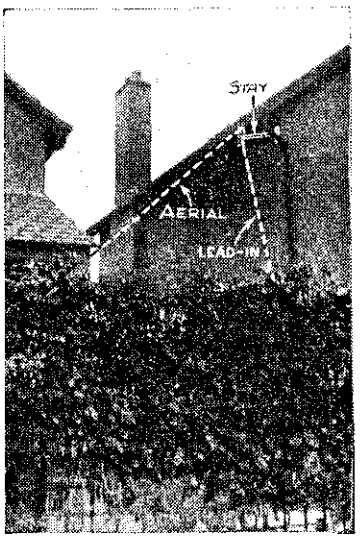


Fig. 3.—A stay can be used for keeping the lead-in away from the house wall.

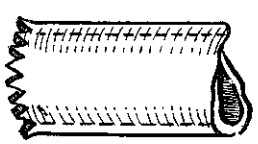


Fig. 9.—The cutting end of a wall drill.

corners with 3/8ths in. Whitworth nuts and bolts, it will provide a strong fixing and one that will stay put for years.

In cases such as that shown in Fig. 5, where the aerial is taken over the top of the roof, a short mast is again required. This may be made as shown in Fig. 6, but in order to keep the pulley insulator and wire clear of the vertical tube the top of the mast is returned to one side at right angles. An "elbow" in place of the cap, with a short piece of pipe in it, will serve this purpose. It is also desirable to provide a small insulated stay at the bottom, at a point approximately level with the lead-in insulator. The down wire can thus be kept reasonably taut without imposing undue strain on the terminal.

Fig. 5.—A short mast can be used where the aerial is taken over the top of roof.

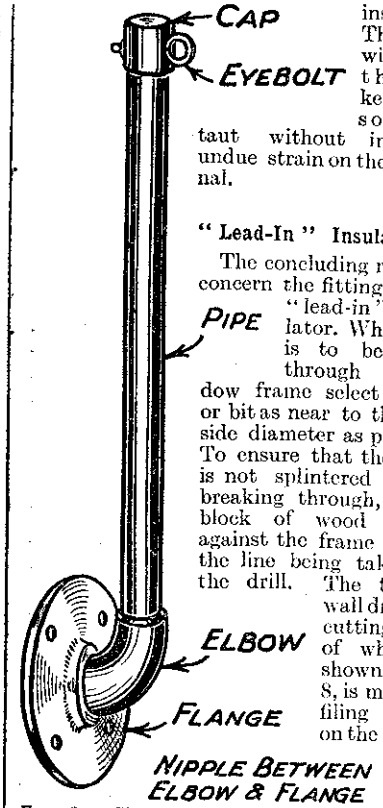


Fig. 8.—Showing metal fittings for making a short mast.

"Lead-In" Insulator

The concluding remarks concern the fitting of the "lead-in" insulator. Where this is to be fitted through a window frame select a drill or bit as near to the outside diameter as possible. To ensure that the wood is not splintered when breaking through, hold a block of wood tightly against the frame behind the line being taken by the drill. The tubular wall drill, the cutting end of which is shown in Fig. 8, is made by filing teeth on the end of a piece of piping. It is an advantage to splay the end of the pipe after cutting the teeth on it. This drill is used as one would a chisel, but do not use the hammer too hard. An occasional twist given to the tube will assist the cutting operation, and a heavy block of wood held against the inside of the wall, behind the point of percussion, will prevent the breaking away of material and produce a clean hole of the same diameter as the drill.

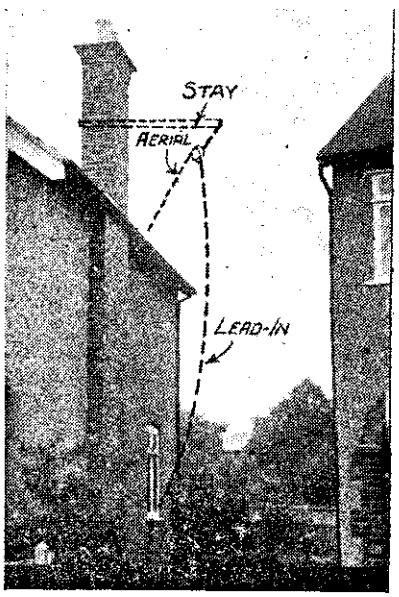


Fig. 4.—Supporting the aerial from a short stay fixed to a chimney.

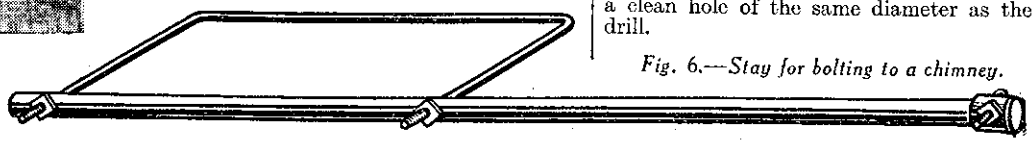
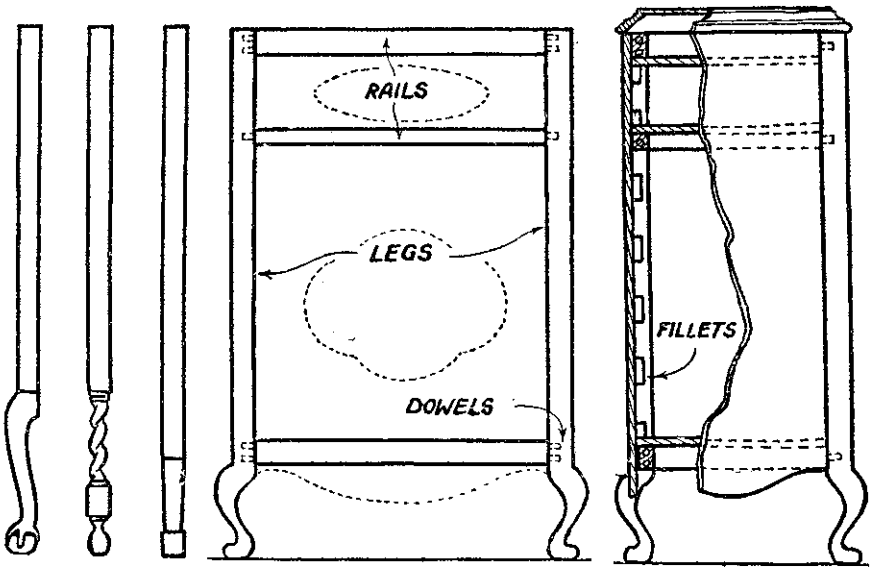
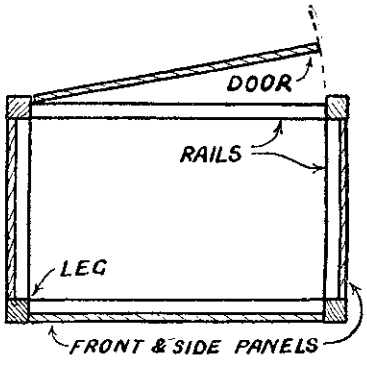


Fig. 6.—Stay for bolting to a chimney.

SOME NEW IDEAS IN CABINETS

For Explanatory Text see Pages 125 and 126





Figs. 12 to 14—(Left to right). Details of the turned legs and method of attaching them to the main frame. A cut away side view showing the position of the fillets. Plan of the radio-gram cabinet showing the assembly of rails and panels.

In Quest of Quality

An Article Explaining How Both Manufacturers and the Home Constructor Have Striven to Get More Realistic Reproduction from Radio.

By W. J. DELANEY

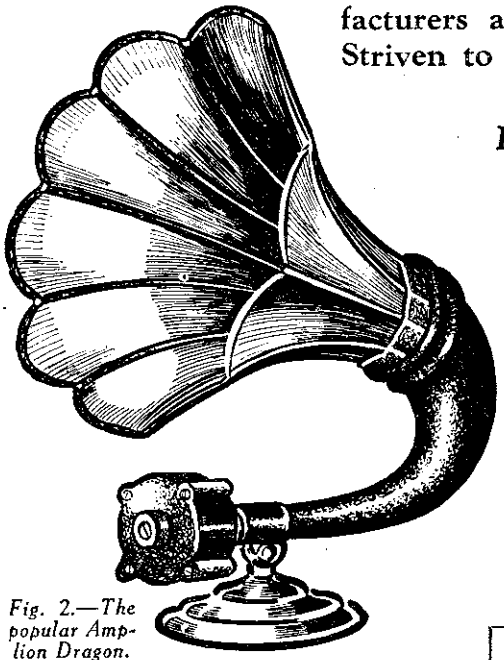


Fig. 2.—The popular Amplion Dragon.

BEFORE we can go into this question it is necessary for us to decide just what is meant by "Quality." Your next-door neighbour, or your radio companion will perhaps tell you that he gets "perfect quality" on his set, and you go round to hear it. A few minutes convinces you that the reproduction is not nearly so good as yours. But, when he hears your set he probably says that your reproduction is not so good as his. That brings us to the first point—individual taste. No two people can agree on the kind of reproduction which can be voted "perfect." One prefers a high pitched tone, because "it has the brilliancy of the top notes," whilst another likes a deep tone "because you can hear the bass." But after all, "perfect quality" can only be one thing, and that is a reproduction which is a faithful copy of the original, and this is unaffected by personal likes and dislikes.

At the Talkies

If you go to the talkies and study the reproduction, instead of following the picture or story, you will find that the range of tones is very complete indeed, in fact, at a good house, it is far in excess of those you hear from the wireless. Note the extremely high notes, such as jingling coins or jangling chains; the piercing effect of escaping steam, and the low full-powered roll of heavy guns or thunder. Some of these effects are not produced by the B.B.C. because of the inability to "get them over." There are so many defects in receivers and speakers, that if a play was broadcast in which certain effects played an important part, the majority of listeners would fail to appreciate the play, because of the inability to hear them. It is not so very long ago that the B.B.C. held a competition in which such effects as washing-up, striking a match, jangling keys, etc., were broadcast, and listeners were asked to write down what they thought the sounds they received represented. Many and varied were the replies. However, the aim of us all should be to endeavour to reproduce the original, and this article describes some of the schemes which have been employed in this search for realism.

Loud-speakers

The loud-speaker used in the early days of broadcasting, consisted of a small telephone receiver over which was mounted a small horn (Fig. 1). With the receivers and valves of those days, however, this reproduced probably the entire range of frequencies which was dealt with by the receiver. At this time, too, the matter broadcast was limited as there was obviously no necessity to broadcast notes that nobody could hear. As the art progressed the orchestras were augmented, and gradually the listener found that traces of bass instruments could be heard. As soon as the Octets and similar combinations employing a 'cello became popular, the need was felt for a better reproduction of this instrument to give "body" to the music. The first attempts in this direction consisted in enlarging the size of the horn, and as this got larger the reproducing units were found to be too weak to satisfactorily influence the column of air in the horn. Therefore the power and size of the units increased. Probably the most outstanding of this type of speaker was the well-known Amplion Dragon (Fig. 2).

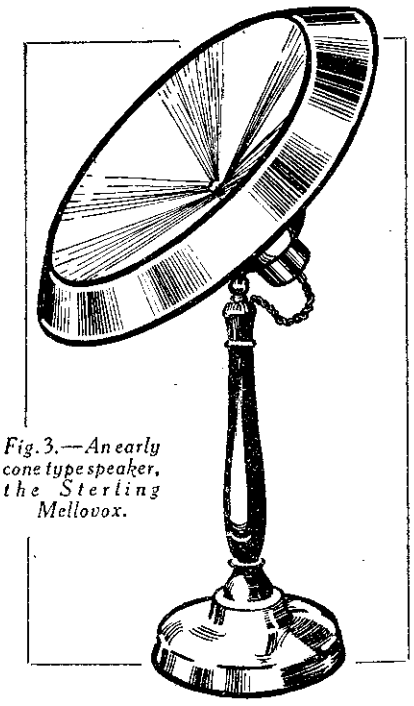


Fig. 3.—An early cone type speaker, the Sterling Mellovox.

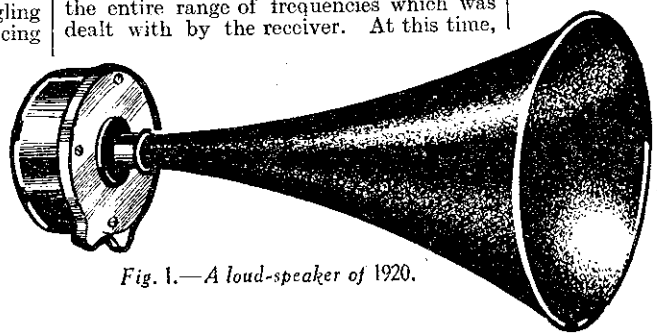


Fig. 1.—A loud-speaker of 1920.

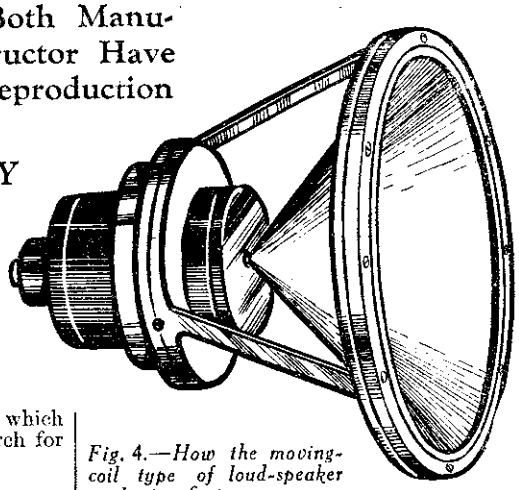


Fig. 4.—How the moving-coil type of loud-speaker made its first appearance.

Cone Units

Broadcasting steadily improved, and as the speakers could now put up such a good show the components in the receiver began to improve. With an improvement also in valves the horn type of loud-speaker began to show up its deficiencies, and so once again the designers got to work. The horn was considered to be unsatisfactory for good reproduction, unless of tremendous dimensions, and, therefore, means were devised to enable the size of the diaphragm of the unit to be increased. This naturally led to the cone type of loud-speaker (Fig. 3). Many and varied were the types of units and cone produced at this time, and size, material, method of support, etc., were all given the credit for the improved results obtained. The cone diaphram was found to give such a true response that only the operating mechanism was improved, and this naturally led to the moving-coil type of speaker (Fig. 4). However, valves and components steadily improved, and at the present day the moving-coil loud-speaker is regarded by many as ideal. But, to return to the cinema, most of the talkie installations

(Continued on page 164.)

How to Wire Your Set

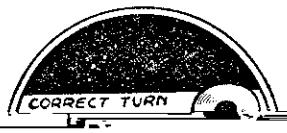
A Useful Article Explaining How the Wiring of a Receiver Can be Carried Out in a Workmanlike Manner

NEATNESS in laying out and wiring up your receiving set will reflect itself in the results you ultimately obtain when using the receiver on the aerial.

Various tools necessary for wiring the set.

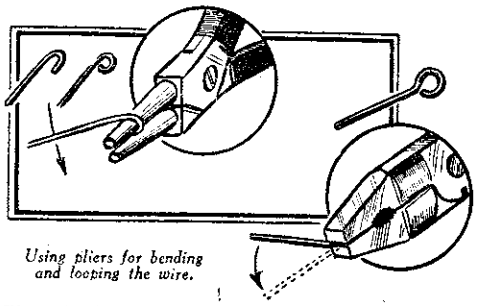
If the work is slip-shod and careless, then you can rest assured that either the set will not work or, if it does, poor reception will be the reward. On the other hand, if your lay-out has been undertaken with due care and the run of wiring executed in a workmanlike manner, then your efforts will reap their just reward of excellent reception.

The task is quite a simple one if tackled in the proper way, and these few notes will put you on the right road. First of all a word as to component arrangement. If there is a baseboard plan given, then the work is merely one of copying, but if a pictorial diagram is featured, then you must place all the components on the board and, noting their individual function, *i.e.*, aerial coil, aerial condenser, grid leak, transformer, etc., dispose them so that the resulting connecting wires take the shortest runs possible. If you make a haphazard lay-out, the wiring business becomes so complicated that you are likely to make mistakes and, furthermore, the set is sure to exhibit some peculiar fault and be unreliable in working.



tuned circuits in your set, separate as widely as possible and place the coils at right-angles (this assumes an absence of screens). (3) Keep the filament wiring distinct from the H.T. wiring. (4) Take advantage of any earth points on your set in order to save long leads, *i.e.*, do not join every "earth" wire to the earth terminal, but to the nearest point on the one wire which ultimately passes to the earth terminal. (5) Keep H.F. wiring well away from L.F. wiring.

By following these simple general principles you cannot go wrong, the problem of component positioning being, of course, linked with the question of wiring runs. Often a compromise has to be struck in situations where there appears to be a little difficulty in fulfilling all the rules just enunciated.



Using pliers for bending and looping the wire.

The Right Gauge of Wire

Now a word as to the actual wire. Do not choose a wire of too fine a gauge or it will sag, and the most suitable gauge recommended is No. 18. It does not matter whether you use square or round section, just satisfy your own individual taste. Where wires run very near one another or cross rather close and are likely to touch and cause a short circuit, it is advisable to slip lengths of insulating sleeving over them or, if preferred, use the Glazite wire, which carries its own coloured insulation.

Since nearly all the components now used in reception are supplied with terminals, it is possible to wire a set without a single soldered joint. One or two tools are necessary when wiring up a set, and the most important are a penknife, round-nosed pliers, flat-nosed pliers with cutting edge, screwdriver, and brush. When wiring two points together, measure off the length of wire required and then loop each end with the aid of a pair of round-nosed pliers. Bear in mind that when placing each wire over the particular terminal shank it should be arranged that the screwing down of the terminal tends to close the loop and not open it.

Screwing the terminal down in a clockwise direction will then grip the wire and tend to close it tighter round the screw thread. This point should be noted particularly when holding flex wire under terminal heads, otherwise the strands of wire are liable to work loose.

Keep the Wire Insulated

If you use the Glazite wire, cut round the insulation with a sharp knife about ½in. from the end, and then pare off the covering before looping.

A small cleaning brush (a 6d. one-inch brush from any stores is quite suitable) enables you to clear away any dust or dirt that has accumulated while you are working and is always handy to keep by you.

The problems arising when you prefer to solder all your joints are really only small ones, but there is one point you are liable to overlook. To avoid softening ebonite or moulded components while joining, the soldering iron should only be held on the joints for the shortest possible time. If the parts are clean and well "tinned" the solder will "run" almost as soon as the hot iron is applied, but if not, clean and tin the parts again rather than hold the iron on and overheat to no purpose except to soften the material as previously mentioned.

MAKING AND USING TUNING COILS

(*Continued from page 124.*)

the two circuits. When used in an S.G. receiver, this band-pass arrangement might well be followed by a tuned-grid coupling as in Fig. 3 (b). In that case tuning could

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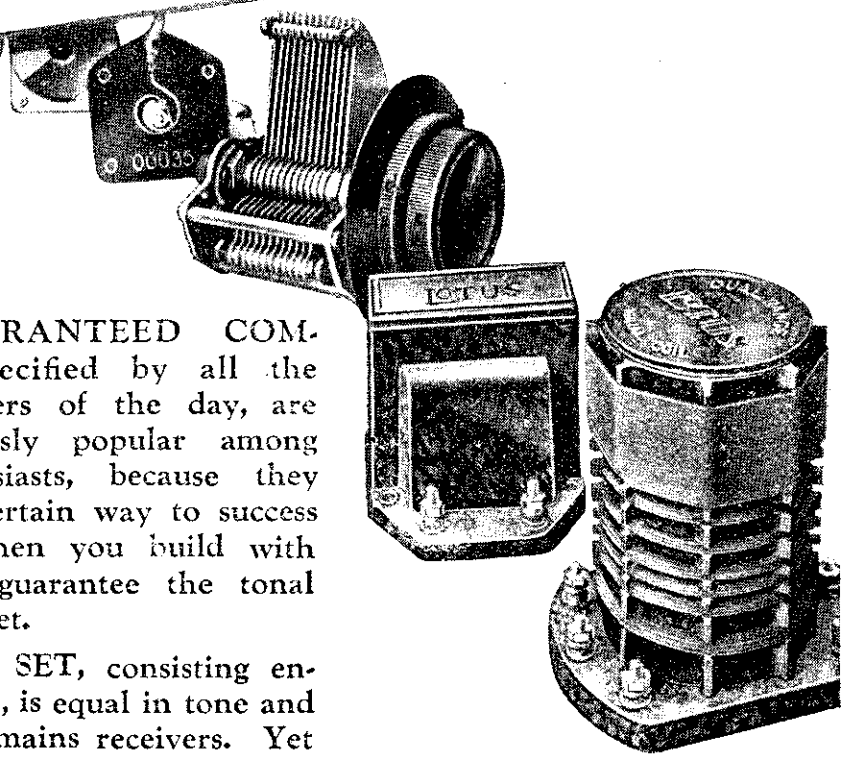

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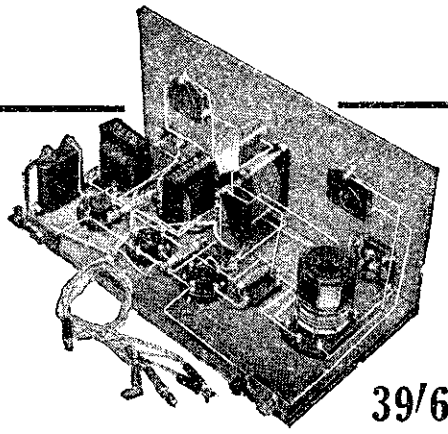

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LANDMARK THREE KIT SET

THE HEART OF YOUR SET

Part 1.—THE VALVES OF YESTERDAY AND TO-DAY

By
H. J. BARTON CHAPPLE,
Wh.Sch., B.Sc.(Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

THE analogy between the valves in a radio receiver and the heart of a living body, although not complete, is remarkably apt in many respects. Just as the heart controls and directs the life-giving blood stream, so does the valve control the electric currents which bring to life the radio programmes, and in the same way that valvular disease of the heart reduces a person's capacity for work and eventually produces death, so worn-out or faulty radio valves reduce the output of a set, and ultimately make it cease to function. Because efficient and correctly-applied valves are so essential to successful broadcast reception, it is important that listeners who build their own receivers or take a technical interest in radio should have some knowledge of the principles upon which valves work, the various types of valves available, the factors which govern the choice of valves for any particular application, and the correct working conditions for different classes of valves and similar matters.

It is, of course, impossible to treat this vast subject exhaustively in a few short articles, but the present series of notes cover the ground generally and, it is hoped, in a practical manner, and may pave the way for a more detailed discussion of specific problems at a later date.

Why "Valve"?

In engineering language, the term valve is applied to any apparatus which controls the flow of a gas or liquid. This control may be in the direction of the flow or in the quantity of the stream. Thus a throttle valve is used to vary the flow of steam to an engine, and a non-return valve is used to admit water to a boiler, but at the same time to prevent the water from being forced out again by the steam pressure. Again, some mechanical valves are so designed that a small effort can control a powerful flow as, for example, the homely bath tap, which can be turned by the mere pressure of two fingers, but will allow a strong stream of water to flow into the bath. Radio valves, of one sort or another, perform precisely similar functions with respect to electric currents.

Like many other notable inventions, the development of the radio valve was the result of researches undertaken in connection with problems which, at the time, had nothing whatever to do with wireless or any other form of communication. The familiar story of how Dr. (now Sir) Ambrose Fleming, while investigating causes of failure in early types of electric lamps arising out of the phenomenon known as the Edison effect, discovered that if an exhausted bulb contained a heated filament and a metal plate, currents could pass in one direction—from filament to plate—but not in the other direction, need not be retold here.

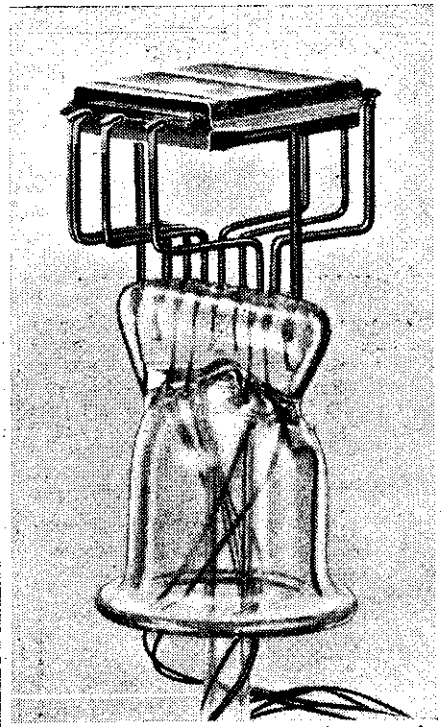


Fig. 1.—Internal construction of a typical battery-heated three-electrode valve.

Fleming's first valve was employed for the detection of wireless morse signals, and from it has been developed the whole range of valves with two, three, four, five and even more electrodes, suitable for a wide variety of purposes—radio detection, amplification and transmission, for rectifying alternating currents in high-tension units and battery chargers, for the production of oscillating currents used in electro-medical work, and in numerous interesting industrial processes.

The Construction of a Valve

The external appearance of a radio valve is familiar to every listener, but it is not everyone who has had an opportunity of examining the internal structure. Fig. 1 shows the construction of a typical three-electrode valve as used in an ordinary battery-operated receiver, the bulb having been removed to disclose the details of the electrodes.

From the central glass support or "foot," as it is termed, rise a number of stout nickel wires to which the various metal electrodes are welded. The electrodes are arranged one outside the other, the innermost being the filament. In a battery-operated valve this is a thin metal wire, treated in a special manner to render it radio-active when heated. Outside the filament, but not touching it, is the "grid"—a spiral or mesh of wire enclosing the filament; and surrounding this is the "plate" or "anode," a box-like metal structure, again supported free of the grid and filament. From the grid and anode, and from the two ends of the filament, connecting wires pass through the glass of the bulb, and are connected to four metal pins in the cap or base. These serve to connect the electrodes of the valve to appropriate parts of the circuit of the radio set in a manner to be described.

The whole process of valve manufacture, whereby hundreds of thousands of valves are produced by ingenious machinery, each perfect and with remarkably uniform characteristics, is most interesting, but far too intricate for description in the space at present available. It should be placed on record, however, that the valves produced by British manufacturers have not only attained a high standard of electrical efficiency, but are justly renowned for their consistently good performance and for their reliability.

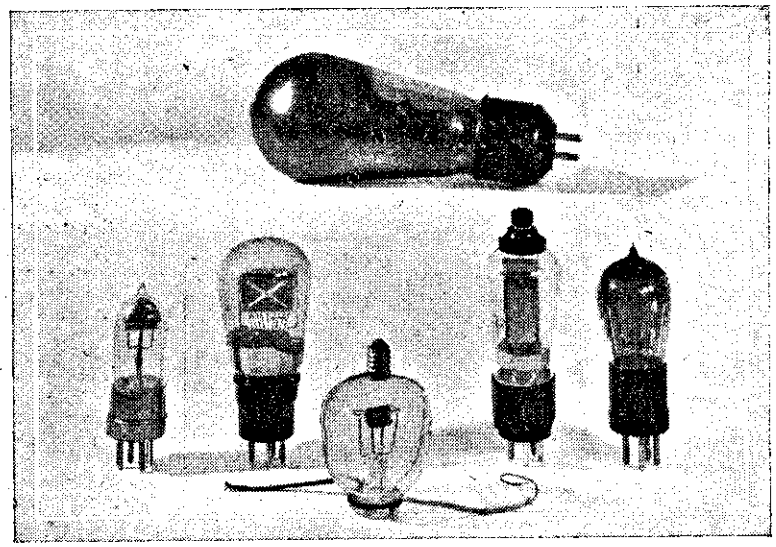


Fig. 2.—A group of Cossor valves indicating various stages in development. Top: Super-power valve of 60-Watt dissipation. Bottom row (left to right): (1) 1921—.6 power valve, Stentor class. (2)—Modern pentode. (3)—1916 valve of peculiar construction. (4)—Modern mains S.G. valve (5) 1923—.3 amp. kalenised filament.

How a Valve Operates

Although the elementary principles of valve action are known to many listeners, a brief summary is here given for the sake of completeness, and for the benefit of the newcomer to radio. In dealing with valves, it is frequently necessary to represent them in diagrammatic form. Fig. 3. shows the conventional representation of a three-electrode valve or "triode," the various parts of the valve being indicated for reference. It is understood

that the bulb—represented by the enclosing ellipse—has been deprived of all the air during the process of manufacture. When used in a wireless receiver the two ends of the filament are connected to the low-tension battery, usually a two-volt accumulator, and a current passes through the filament, the temperature of which is raised to a dull red heat. Under these conditions particles of negative electricity termed electrons are given off by the filament. The anode pin of the valve is connected to a part of the circuit which ultimately makes contact with the positive pole of the high tension battery, and by this means the anode is kept positively charged.

Now it is a well-known electrical fact that a positive charge attracts a negative charge, so that the electrons emitted by the filament will pass in a stream to the anode. A stream of electrons is, in effect, an electric current, and this current, which passes from the filament to the anode within the valve through the external circuit and back to the filament, is termed the anode current. If the valve contained only a filament and anode but no grid, the anode current would be of a fixed steady value dependent upon the high tension voltage and the effective resistance of the circuit.

The Action of the Grid

The production of a steady current flowing in a portion of a wireless set is, however, of very little service in radio reception, which is essentially a process involving the amplification and modification of varying electric currents. It is in this connection that the grid of the valve comes into play. Imagine that by some means the grid is given a small negative charge. Because like electrical charges repel each other, the negative charge on the grid will tend to repel the electrons emitted by the filament. Some of them will return to the filament, but some will pass through the grid and reach the anode; thus anode current will still flow but be reduced in value. The greater the negative charge on the grid the smaller is the anode current.

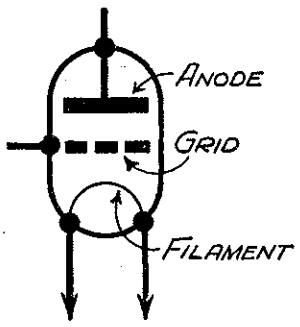


Fig. 3.—Conventional diagram of a three-electrode valve, indicating the essential parts.

Similarly a small positive charge on the grid tends to attract electrons—will, in fact, assist the anode. The anode current will consequently increase. Some electrons are, however, trapped by the grid and flow in the grid circuit as grid current. It will be seen later on that, except when using the valve as a detector, grid current is to be avoided, and for this purpose all amplifying valves are given a permanent negative charge known as negative grid bias.

The action of the grid just described provides a method of controlling the value of the anode current in the following manner. The radio waves intercepted by the receiving aerial set up a varying high-frequency current. This can be used to give a varying charge to the grid of the valve, with the result the anode current is made to vary in sympathy with the incoming signal. By choosing a suitable type of valve, and arranging the circuit conditions correctly, the electrical variations in the anode circuit can be made more powerful than the impulses employed to "excite" the grid. In this way a valve acts as an amplifier of radio signals. By a modification of the grid circuit a valve can be made to amplify only one half of each radio wave, and thus to detect signals in the same way as a crystal detector and to amplify them at the same time.

CONTROLLING TONE

By HAROLD DOWNING.

IT is not always easy to obtain reproduction from the loud-speaker which is pleasing to the ear on speech and all types of music. For instance, your particular receiver and speaker may reproduce speech with all the crispness and brilliancy that could be desired; but when an instrument such as the 'cello is being played this will perhaps lack the deep mellow tone which is characteristic of that instrument. Alternatively, the 'cello may sound beautifully deep and mellow, but when speech is received this may sound woolly or muffled. How then can we alter the tone of the reproduction so that we can obtain the results which are most pleasing to the ear—although perhaps not technically correct?

First and foremost, the receiver should be designed and operated so that it amplifies all frequencies evenly. This means that care has to be taken in the choice of the values of by-pass condensers and grid resistances, as high notes may be easily lost owing to incorrect values of these components. Reaction must be used very sparingly, or again top notes will be lost, giving the reproduction a woolly or muffled tone. The low-frequency transformers must be of good quality in order that there are not any bad resonance points—that is the over-amplification of certain notes in the musical scale. Supposing attention has been paid to all these points (or the receiver has already been constructed), and then, owing to the particular loud-speaker which is purchased, or some other cause, the reproduction is not to your liking. The following arrangements will enable you to vary the tone, giving a fairly wide range of effects.

The "Mellow 'Cello" Tone

The most common tone is the "mellow 'cello" one, which is due in most cases not to over-emphasis of the bass notes but to the lack of top notes. The most likely cause of this, as mentioned above, is the wrong values of by-pass condensers, or unwanted capacities, chiefly in the high-frequency side of the receiver. Unfortunately, it is not possible to put these lost frequencies back, and therefore the only way to cure the defect is to artificially brighten the tone by reducing the amount of bass which is present. A condenser in series with the speaker will do this; although, of course, this is only possible with filter or transformer-fed speakers.

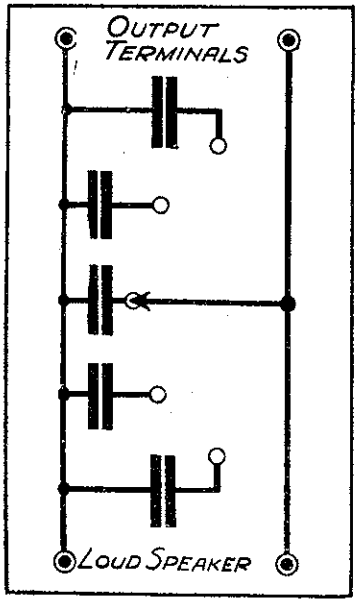


Fig. 1.—How to arrange a number of fixed condensers across the output terminals to vary the tone.

Getting Rid of High Notes

When the reproduction is shrill or high-pitched, due to lack of bass response in the receiver, and also to cheap low-frequency transformers, or inadequate high-tension supply, the effect of more bass may be obtained by getting rid of some of the high notes, and this is carried out quite simply by connecting a fixed condenser across the loud-speaker terminals. The actual value of the condenser will depend on the amount of bass which is to be by-passed, and therefore it is most convenient to have several condensers which may be switched into circuit at will. Fig. 1 shows an arrangement by which this may be carried out; the selector device consisting of either a switch or a plug may be connected to the loud-speaker terminal, and sockets fitted to the free sides of the condensers.

The Multitone Transformer

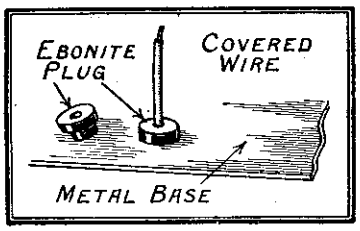
The problem of tone control has been tackled by one firm in quite an efficient manner, and the result has been the production of a special low-frequency transformer known as the Multitone Transformer. This is provided, apart from the four usual terminals, with two additional terminals across which a potentiometer with a value of about 500,000 ohms is joined. The grid of the valve is then joined to the arm of the potentiometer in addition to the G terminal of the transformer. Adjustment of the potentiometer then enables the response curve of the transformer to be altered to give a straight-line response or to emphasize the top or bottom notes. It may be fitted to any existing receiver in place of a transformer which is already in use, and it solves the problem of easily adjusting the tone of reproduction to suit the particular item which is being received.

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

Metal Baseboards

WHEN you build your next set, why not make it up in chassis form, with a metal baseboard? The cost is very little more than if wood is used. The sketch shows a simple assembly, a piece of sheet aluminium of the required size being screwed to two battens at each side. The ebonite panel is screwed to the ends of the battens, and also to two corner brackets. A small angle bracket, bent from sheet aluminium is screwed to the metal base and panel, as shown. By raising the base 2ins., small components, such as fixed condensers and resistances, can be mounted on its underside to save space.



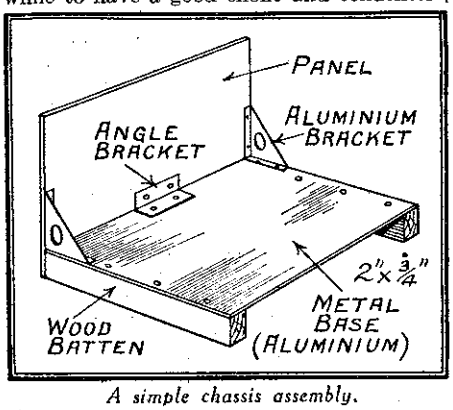
Ebonite plugs for protecting leads where they pass through the chassis.

Special care must be taken where the wiring passes through the metal base. Over each lead that passes through a hole in the chassis, a piece of systoflex can be slipped on. Another method is to fit each hole with a small ebonite plug having a central hole through which the insulated connecting wire is passed, as shown in the above sketch.

H.F. Choke Losses

A POPULAR method of coupling between a screen-grid valve and the detector is a tuned circuit connected to the leaky condenser of the detector and connected also through a fixed condenser to the anode of the screen-grid valve, the anode being fed through a high-frequency choke.

An important point to bear in mind is that there must be few losses in this choke if the full amplification of the screen-grid stage is to be obtained. In quite a number of the inferior chokes, not only is the amount of wire badly skimped, but also the insulation is not by any means what it should be. If you are out for efficiency it is worth while to have a good choke and condenser here, and you should specify a special screen-grid choke for this stage.



A simple chassis assembly.

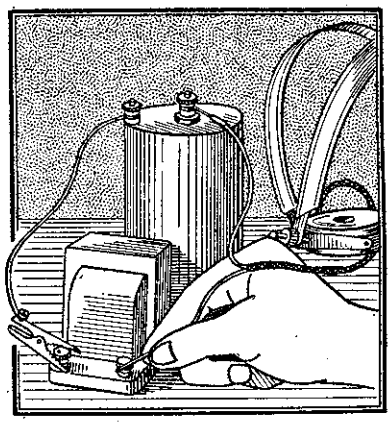
THAT DODGE OF YOURS!

Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? For every item published on this page we will pay half a guinea. The items this week have been contributed, but in future we want readers of this paper to supply the items. Turn that idea of yours to account by sending it in to us, addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., 8-11, Southampton Street, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*.

Circuit Testing With 'Phones

Defects in the wiring of a set, or those arising from faulty components, may often be detected by simple tests with a pair of 'phones and a flash-lamp battery or dry cell. One tag on the 'phones should be connected to one terminal of the dry cell, and two flex leads should be connected, one to the remaining 'phone tag and the other to the remaining terminal of the dry cell.

These two flex leads, if now touched lightly together, will produce a strong double click in the 'phones, one click when they make contact with each other, and another when they are separated again. They may thus be used for testing for continuity in leads, etc., since the loud double click is ample evidence that everything is satisfactory.



A simple method of testing with phones and a dry battery.

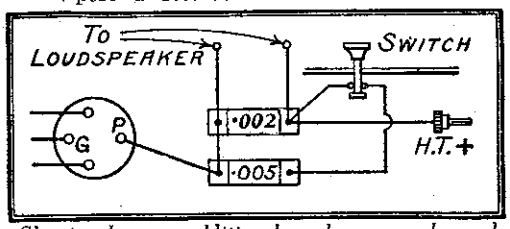
A fault in a coil holder, for instance, such as a break between the terminal and the plug or socket to which it is connected, may now easily be detected, since if one flex lead is connected to the terminal and the other to the side of the holder to which the terminal should make connection, absence of the double click is positive evidence that the component is faulty.

THE FIRST BATCH OF RADIO WRINKLES FROM READERS WILL BE PUBLISHED NEXT WEEK.

It is a good plan to attach a crocodile clip to the end of one of the flex leads for clamping on to a terminal, as in the sketch herewith, which shows a transformer winding being tested for continuity. This method is similar to the voltmeter test, except that it gives an audible response instead of a visual one, and is much more sensitive.

Tone at the Output

CIRCUITS are becoming more and more vigorous, thanks to improved valves and more efficient components. It often happens, therefore, that more smoothing is required at the output end of the set than is usually provided for. For this purpose a reservoir condenser of .002 mfd.

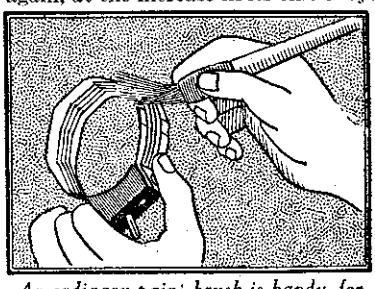


Showing how an additional condenser can be used for smoothing purposes.

capacity is recommended. Even this may not be large enough to give the necessary smoothing effect, especially when heavy orchestral music is coming through, so, to be on the right side, it is a good plan to couple in parallel with the .002 condenser another one of about .005, as indicated in the diagram, Note the switch and its connections. This switch, of the push-and-pull type, can be mounted on a short terminal strip and is arranged to connect or disconnect the .005 condenser as desired.

Keep Your Set in Good Condition

When you have half an hour to spare, place your set on the table under a good light, and having brushed away any dust and tightened up loose terminals and nuts, shorten every wire that is longer than necessary. Carefully dust your coils, especially those of the short-wave type, and for this purpose an ordinary paint brush is very handy, as shown in the accompanying sketch. Where valves are fitted having split leg pins these should be carefully opened with a pocket knife to ensure a tight fit in the valveholders. You should also remove the push-pull switch if one is fitted to your set and clean the contact points with sandpaper. After this little attention, you will be surprised, when you switch on the set again, at the increase in its efficiency.



An ordinary paint-brush is handy for dusting coils.

An Interesting Article Which Tells You All About—

COUPLING AND DECOUPLING

When it is Necessary, and When it is Not, Lucidly Explained

By PERCY RAY

BROADLY speaking, the essence of a wireless set is a string of valves with some means of selecting the required station and some means of connecting each valve to the one following it. A few years ago, when valve efficiency was comparatively low, almost any reasonable number of valves could be coupled together without any special precautions being taken, but in these days of super valves and mains eliminators, almost as much care has to be taken to avoid coupling where it is not wanted as to provide efficient coupling where it is wanted.

The average modern set that has been designed to work on batteries goes up in the air when driven by an eliminator unless, of course, provision has been made to overcome this trouble either in the set itself or elsewhere.

Similarly, far more attention has been paid to coupling in recent years, largely because the efficiency of the latest loudspeakers has been greatly increased, with the result that it will reproduce as much bass as it is given, and, therefore, low notes must not be lost in the intervalve coupling.

It is a great mistake to assume that bass is more important than treble, as very low notes indeed sometimes rely upon very high harmonics for their actual timbre or, if the expression can be used, the personality of the instrument. Generally speaking, the treble is lost in the tuning circuit if these are unduly sharp or, alternatively, by the use of excessive values of condensers connected across, say, the transformer primary, whereas bass is usually lost after the detector valve.

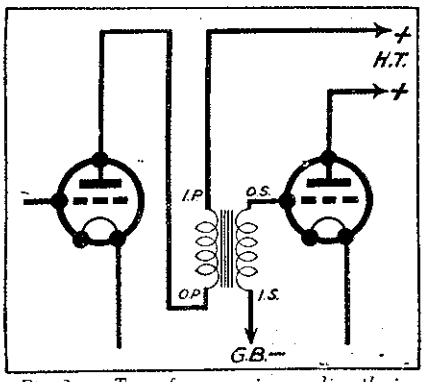


Fig. 2a.—Transformer primary directly in anode circuit.

The question of tuning circuits is dealt with in last week's free gift book, but reference is made below to the question of decoupling these stages. The reader's attention is therefore drawn to the coupling circuits following the detector valve.

Resistance Capacity

Taking the low frequency side in the logical sequence, the anode circuit of the detector valve will first receive attention. This generally consists of a small fixed condenser (connected between anode and earth to bypass unwanted H.F. energy), an H.F. choke, and a transformer primary, anode resistance, or L.F. choke.

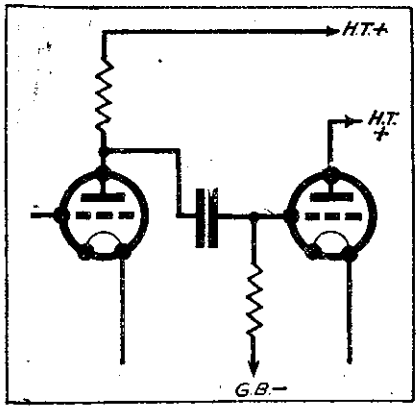


Fig. 1.—R.C.C. coupling.

In passing it might be mentioned that a fair percentage of sets are "half stunned" by the presence of an H.F. choke without an adequate anode to earth bypass condenser. This should not, however, be regarded as an invitation to use an unnecessarily high value, as this will upset both the middle and top notes and cause lifeless reproduction.

When using the resistance capacity method of coupling, as shown in Fig. 1, considerable care must be exercised in choosing the right value. Within certain limits, the higher the value of anode resistance, the greater the amplification, but quality is impaired, as, although few people realize it, the valve is actually in parallel with its own anode resistance.

In general, the anode resistance should be three times the valve impedance, but when the most perfect quality is required at some expense of volume, this value may be lowered to twice the impedance or even less. The grid leak may have a value of four or five times that of the anode resistance; remember that one megohm is a million ohms, so that if the anode resistance happens to be 20,000 ohms, the grid leak might well be 100,000 ohms, or to quote it in megohms—1. This rule holds good except in certain circumstances, unless a really big valve is following immediately after it, when the maximum value should be 50,000 ohms in the interests of safety.

The third component of the resistance capacity coupling unit is the condenser, which should always be a reliable type, as a serious leak would result in the high tension getting on to the grid of the following valve. As there is no simple way of working out the best value for this condenser, a Table, No. 1, has been worked out to indicate the best value of grid leak and condenser for various values of anode resistance.

TABLE No. 1

Anode Resistance	Grid Leak	Condenser
250,000 ohms	1 meg.	.006 mfd.
200,000 "	1 "	.006 "
100,000 "	.5 "	.01 "
75,000 "	.5 "	.01 "
50,000 "	.25 "	.02 "
30,000 "	.2 "	.03 "
25,000 "	.1 "	.05 "
20,000 "	.1 "	.05 "
15,000 "	.05 "	.1 "
10,000 "	.05 "	.1 "

VALUES CORRECT TO NEAREST VALUES LISTED BY MAKERS.

Transformer Coupling

At the present time transformers can be divided broadly into two classes: those containing generously proportioned iron cores and those containing comparatively small cores of a special mixture of nickel and iron. There are, in addition, certain badly designed, cheap transformers, containing very little ordinary iron, but these will not be considered. These two main classes of transformers call for entirely different treatment: the heavy ones, with the big cores, can be connected straight in the anode circuit as shown in Fig. 2a, but the small nickel-iron transformers should be parallel fed as shown at Fig. 2b. The reason for this is that the latter type have relatively poor efficiency when the high-tension current is passing through a primary winding, as the inductance of the latter gets smaller and smaller as larger and larger currents are put through it, and a decrease of impedance means a decrease of bass.

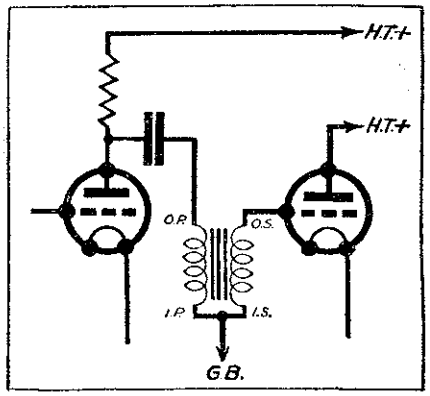


Fig. 2b.—Parallel-fed transformer. With this arrangement no battery current passes through the primary.

Some care has to be taken when selecting resistance in the anode

(*Continued on page 139.*)

TABLE No. 2

M.A. Anode Current	Volts Drop 20 Res.	Cond.	40 Res.	Cond.	60 Res.	Cond.	100 Res.	Cond.	200 Res.	Cond.
1	20,000	2	40,000	1	60,000	1	100,000	1	200,000	1
2	10,000	4	20,000	2	30,000	2	50,000	1	100,000	1
3			15,000	3	20,000	2	30,000	2	70,000	1
4			10,000	4	15,000	3	25,000	2	50,000	1
5					12,000	3	20,000	2	40,000	1
6					10,000	4	15,000	3	35,000	1
8							12,000	3	25,000	2
10							10,000	4	20,000	2

CORRECT TO NEAREST VALUES OBTAINABLE. THE RESISTANCES USED MUST BE CAPABLE OF STANDING THE CURRENT FLOWING. CONDENSERS MUST BE CAPABLE OF STANDING THE VOLTAGE.

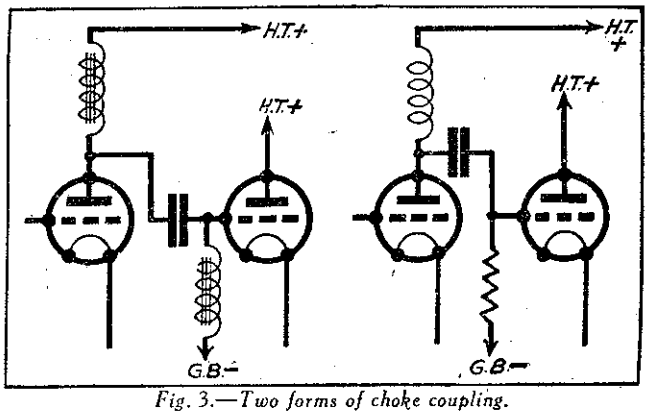


Fig. 3.—Two forms of choke coupling.

(Continued from page 136.)

circuit, but three times the valve impedance is generally suitable, provided that there is a reasonable high-tension voltage, say 120 volts, available. Care should be taken, however, not to use the value of condensers shown in table No. 1, as a very much larger value is desirable, depending upon the transformer used. However, 1 mfd. is a good general value, but if with the transformer used this results in one or two of the bass notes being reproduced out of proportion, condensers having a value of .5 or 2 mfd. may be tried. An L.F. choke is sometimes used instead of a resistance, but as considerable trouble may be caused by an unfortunate selection of values, it is not recommended.

Choke Coupling

Fig. 3 indicates the method of using low-frequency choke coupling. Here, again, a certain amount of difficulty presents itself regarding the choice of grid leak and condenser, but as a rough guide the grid leak may be eight to ten times the value of the valve impedance, and the appropriate condenser selected from table No. 2.

There is the possibility of an additional low-frequency stage in addition to the output valve, but this is rapidly dying out with modern high-efficiency valves, but it is still retained when the detector is not preceded by a high-frequency valve. The great mistake when using two valves following the detector is to arrange for too much amplification, with the result that the output valve is horribly overloaded, and gives terribly distorted reproduction, punctuated by an assortment of resonance points.

Suppose, for example, that the detector valve gives a 2 volts swing in its anode, which is not unreasonable on a high-powered station, and that a 3½ to 1 transformer is used, we shall get almost 7 volts on the grid of the next valve. Assuming that this is an L.F. type, it might well have a working amplification factor of 12, which will give 84 volts in the anode. Assume a 3 to 1 transformer: this would give almost 252 volts to the power valve, which, with an amplification factor of 7, would give 1,700 volts odd. This is, of course, ridiculous, but it indicates what would happen *if* either the second or third valve overloaded. As, however, an ordinary power valve would not develop without distortion more than about 30 volts in its anode,

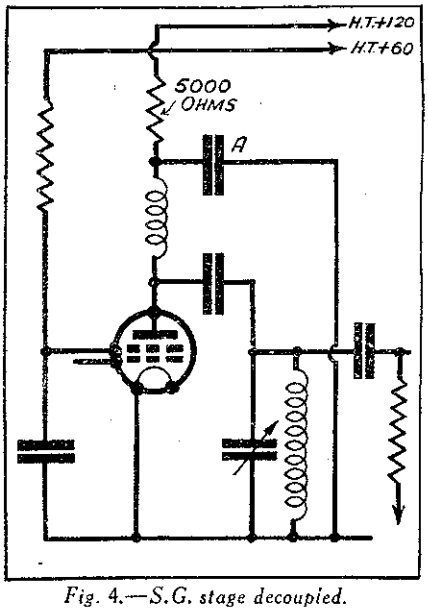


Fig. 4.—S.G. stage decoupled.

the discrepancy between this and 1,700 indicates in a very definite manner the overloading that will take place, and it is obvious that under such conditions one resistance and one transformer, or two resistance stages, would be more useful.

Decoupling

In the ordinary straightforward three-valve set, the H.T. side of each of the components in the anode circuit are joined together either directly or through the few intervening cells of the H.T. battery, with the result that the major portion of the battery is between the anode leads and earth. This portion of the high-tension battery may have a considerable high-frequency resistance which, being common to all three valves, redistributes such stray currents that are flowing in each anode circuit to the other anode circuit, thus causing instability, motor-boating, or violent oscillation. This effect is considerably more marked if an eliminator is used, as usually the resistance between the positive tappings and H.T. minus is greater than that of a battery.

In order to stop this trouble, it is necessary to give other than battery current a direct path to H.T. minus, and to separate the anodes from each other by a resistance or choke and a condenser. In general practice the choke is very seldom used, as it only becomes useful when a very heavy high-tension current is passing. It is, however, generally used in the output stage to choke-feed the loud-speaker and direct the speech current through the loud-speaker winding to earth. Fig. 4 shows the anode and screen circuits of a screen grid with decoupling added. The screen resistance may be 600 to 1,000 ohms, while a reasonable value for the anode circuit is 5,000 ohms. As the screen is provided with a condenser in any case, an additional one is not necessary, but in the anode circuit the condenser marked A has to be inserted. This might be a 1 mfd., non-inductive type. When using a mains screen-grid valve the screen is usually fed by a fixed or variable potentiometer as shown at Fig. 5. The top part of this, marked B, acts automatically as a decoupling resistance, so no further precautions are necessary.

The decoupling of the detector is probably the most important. Here, it is necessary to make certain that the values are adequate. Unfortunately, however, if too high a resistance is used, the H.T. value will be lowered, which is undesirable below a certain point. In order to ensure that decoupling is efficient, the resistance in ohms when multiplied by the capacity of the condenser in mfds. should not be less than 40,000. For example, 30,000 ohms associated with 2 mfd. will be 60,000, which is in order, as would be 20,000 and 2 mfd., but 15,000 and 2 mfd., or 30,000 and 1 mfd., would both fall below 40,000 and would be inadequate. It does not follow that in every case figures arrived at by this method would be high enough, but such cases are rare, and are not likely to be met with by the constructor. In big amplifiers, however, it is not unusual to

(Continued on page 162.)

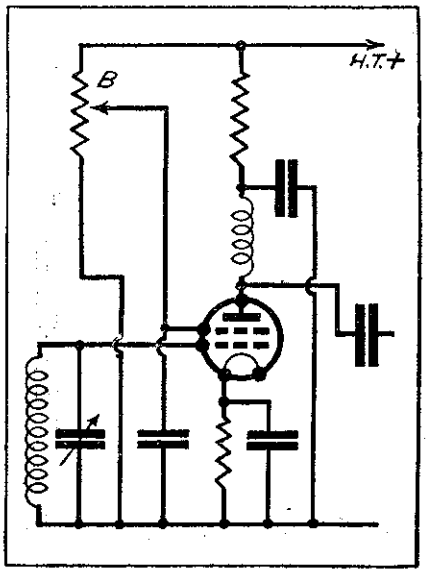


Fig. 5.—With the usual arrangement of a mains set the potentiometer acts as a decoupler.

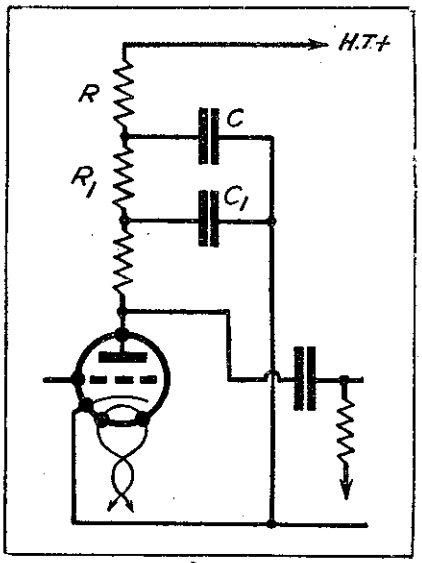
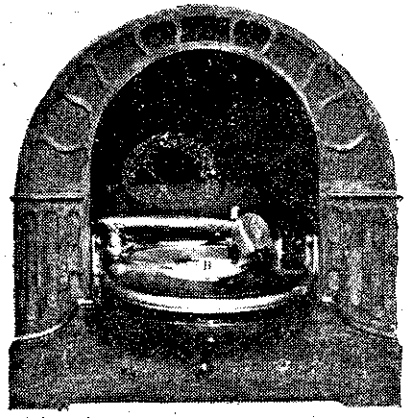


Fig. 6.—R.C.C. stage with double decoupling by resistance R and R_1, C and C_1.

MAKING THE MAI

A Mains Operated Version of the Receiver which was Described in th Variable Mu and Pentode Valves this Receiver will Undoubtedly



The set may be fitted into this novel cabinet, and thus be converted into a radio-gram. Note how the turntable and pick-up are fitted to the drop-down front.

THE multiplicity of receivers available for the constructor to build leaves him the very difficult task of making a choice between them, and those who have tried a number of such sets must agree that only a few can justify their existence. Some are frankly stunt sets that reflect credit to the ingenuity rather than to the practical experience of the designer, and fail to satisfy their owners, as they are tricky and unserviceable.

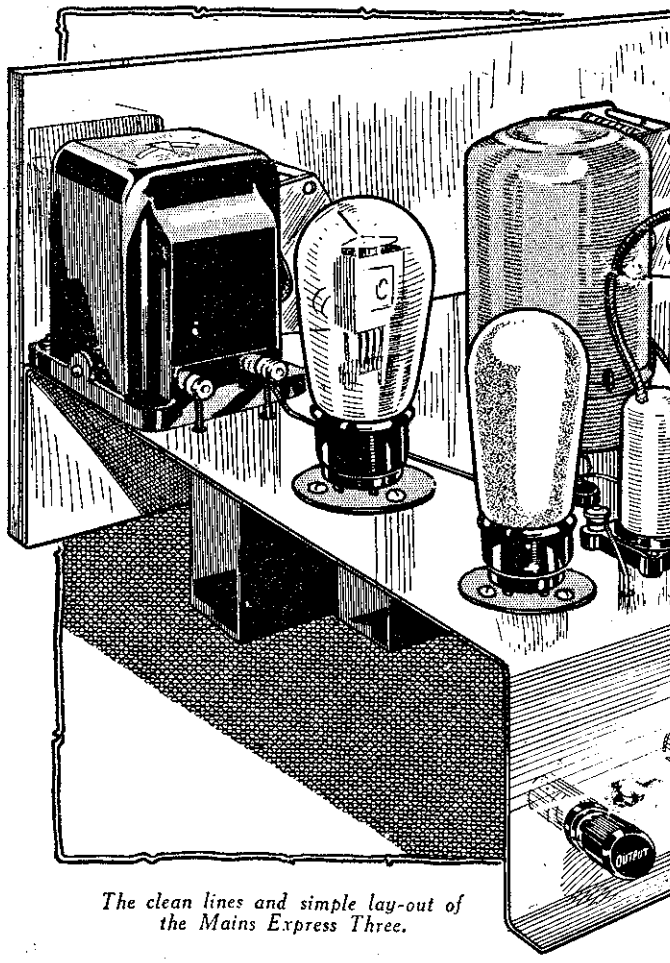
There is definitely a need for a three-valve all-mains set, free from the trouble of frequent accumulator recharging and the expense of H.T. battery renewals, which, although of well-tried principles, embodies the very latest developments of radio technique and at the same time has been designed as a musical instrument that is an acquisition to the family life of every home. The Mains Express Three has been designed to fulfil to the utmost limit these ideals, and is the result of many months of patient experiment. The Mains Express Three is an outstanding example of a modern receiver capable of a wonderful performance, a set that will bring station after station rolling in with perfect quality and freedom from interference, while every care has been taken to ensure that it is mechanically sound and will, therefore, give months of uninterrupted service.

Special Equipment

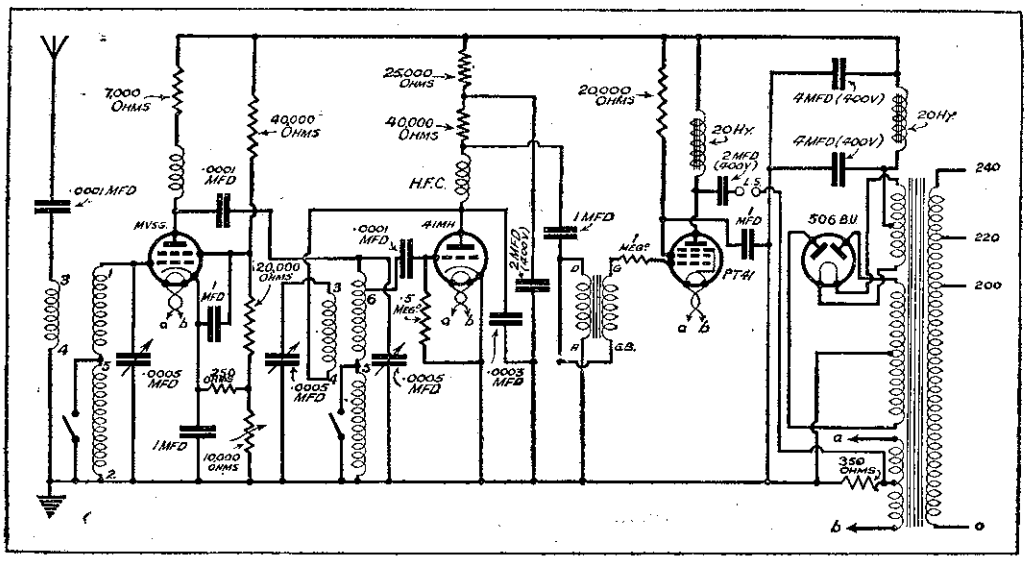
It has been pointed out that modern coils leave much to be desired from a mechanical standpoint; therefore special coils have been designed, equipped with plated brass screening-cans provided with really rigid fixing, while ready-soldered leads do away with the nuisance of tiny terminals working loose because they cannot be tightened sufficiently in the first place.

Arrangements have been made for the chassis to be available with every hole correctly drilled, thus making mistakes impossible, and every constructor knows that the set he builds will be identical to the original. On the other hand, economy has been considered, but not at the expense of efficiency; for example, the Dubilier type resistances used dispense with the use of holders in most cases, and owing to their ingenious construction they offer a reliable article at a low price and effect a saving of nearly £2.

Before beginning to describe the receiver, a very definite warning is necessary: that is, that serious trouble will result if the specification is varied; not only will the efficiency be impaired, but some components above the panel use the same fixing bolts as some of those below the panel, and if others of different sizes are used construction becomes impracticable.



The clean lines and simple lay-out of the Mains Express Three.



Theoretical Circuit of the Mains Express Three.

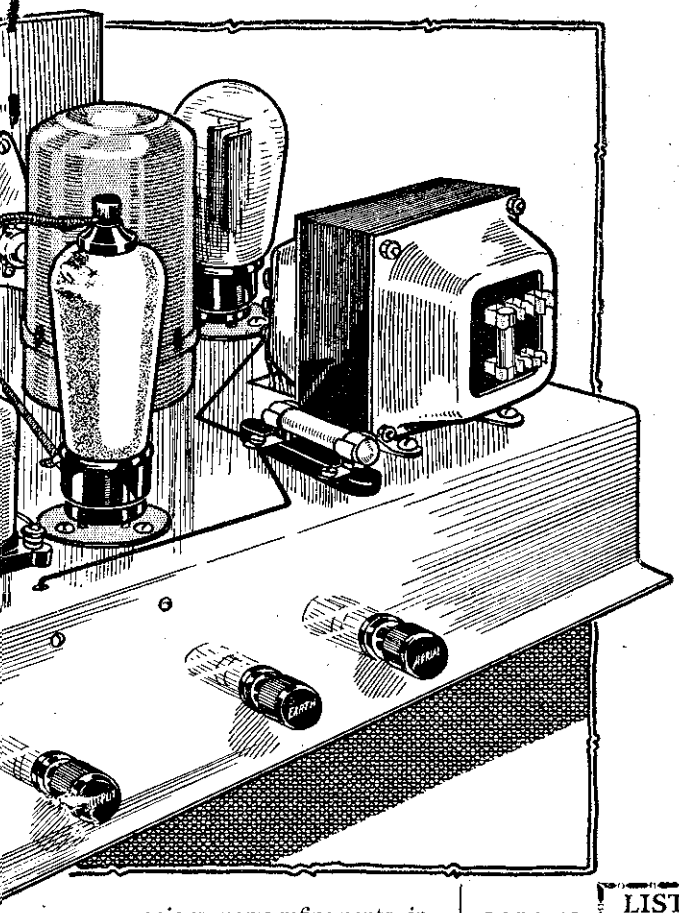
Reference to the photographs will show that a special type of H.F. choke is used having a screened lead already attached, which does away with an unsightly lead to the S.G. valve and at the same time effectively earths the metal covering without the use of a special clip. It is absolutely essential that this choke should be fitted the correct way round exactly in accordance with the blue print, otherwise the anode of the S.G. valve will be connected to H.T.+ instead of to the grid coil.

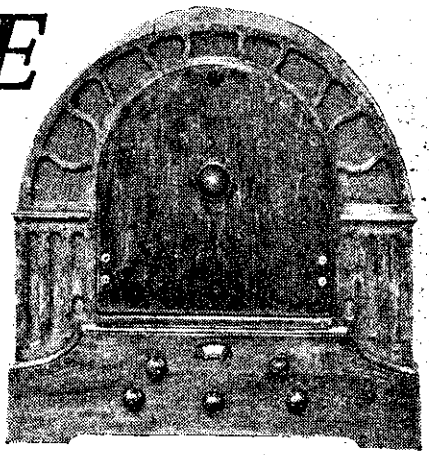
Selectivity Control

The Mains Express Three

VS EXPRESS THREE

e First Issue of "Practical Wireless." Employing the Latest Types of be Recognised as the Last Word in Mains Sets. By PERCY RAY.





A view of the cabinet closed, showing its neat appearance.

enjoys many refinements, including double-wound transformer aerial coupling, which gives excellent selectivity combined with reasonable latitude for various types and sizes of aerials. The variable mu screened-grid mains valve has numerous advantages over the ordinary screen-grid, among which are the distortionless volume control, from a shout to a whisper, and very precise control over selectivity. The tuned grid coil will be found to work well with this particular valve (Cossor MVSG). The detector stage employs a resistance-fed transformer, which ensures that the bass response is reproduced at full volume with a degree of fidelity that is refreshing after listening to the average receiver, which caricatures the low notes with a deep booming noise like heavy weights being dropped on to an empty dance floor.

The output stage employs a power pentode which is capable of really generous volume, enough to fill a small hall, but this volume can be reduced to a whisper by the variable mu control when desired. The intention is to use this colossal power as reserve, so that the loud-speaker can pour out perfect melody without the strain and chatter associated with sets possessing little or no margin; the same principle is used with modern motor cars to achieve the perfect and effortless running of an up-to-date limousine.

Construction

The existence of an all-metal chassis ready drilled has been pointed out; in addition, a blue print is available which renders mistakes impossible. First of all, mount the valve-holders in position. Be careful to put the four-pin-holder nearest to the mains transformer, and see that the valve-holders are so fixed that their terminals are in the position shown in the blue print. It will be noticed that the variable mu valve-holder is secured with only three nuts and bolts; this leaves a convenient hole through which to feed the long wire that runs *through* the metal screening-tube that is already fixed to the chassis; the wire must, of course, be insulated.

Next mount the .0001 fixed condenser, as this cannot be fitted after the choke has been attached. It is essential that this condenser is fixed with screws having counter-sunk heads, otherwise there is danger of accidental contact being made with the underside of the choke. For similar reasons the holder for the 20,000 ohms resistance, situated near the pentode valve-holder, should now be fitted. The resistance-holder on the upper side of the baseboard that accommodates the 5,000 ohm resistance has holes so spaced that it shares fixing bolts with the three-terminal grid condenser, consequently these should be fitted at the same time.

Insulating Aerial and Output Terminals

Construction is now perfectly straightforward, but to avoid accidentally breaking or pulling the leads attached to the coils, the latter should be fixed after all the other components have been mounted. In the same way care should be taken not to bend back the armoured lead that projects from the top of the special Wearite choke. Note that the flexible lead from coil to the three-terminal grid condenser *must* be threaded through the screening-tube on the chassis. When mounting the terminals for aerial and output be sure to insulate them from the metal chassis by using insulating washers; it should be observed that the earth terminal must not

LIST OF COMPONENTS FOR THE MAINS EXPRESS THREE

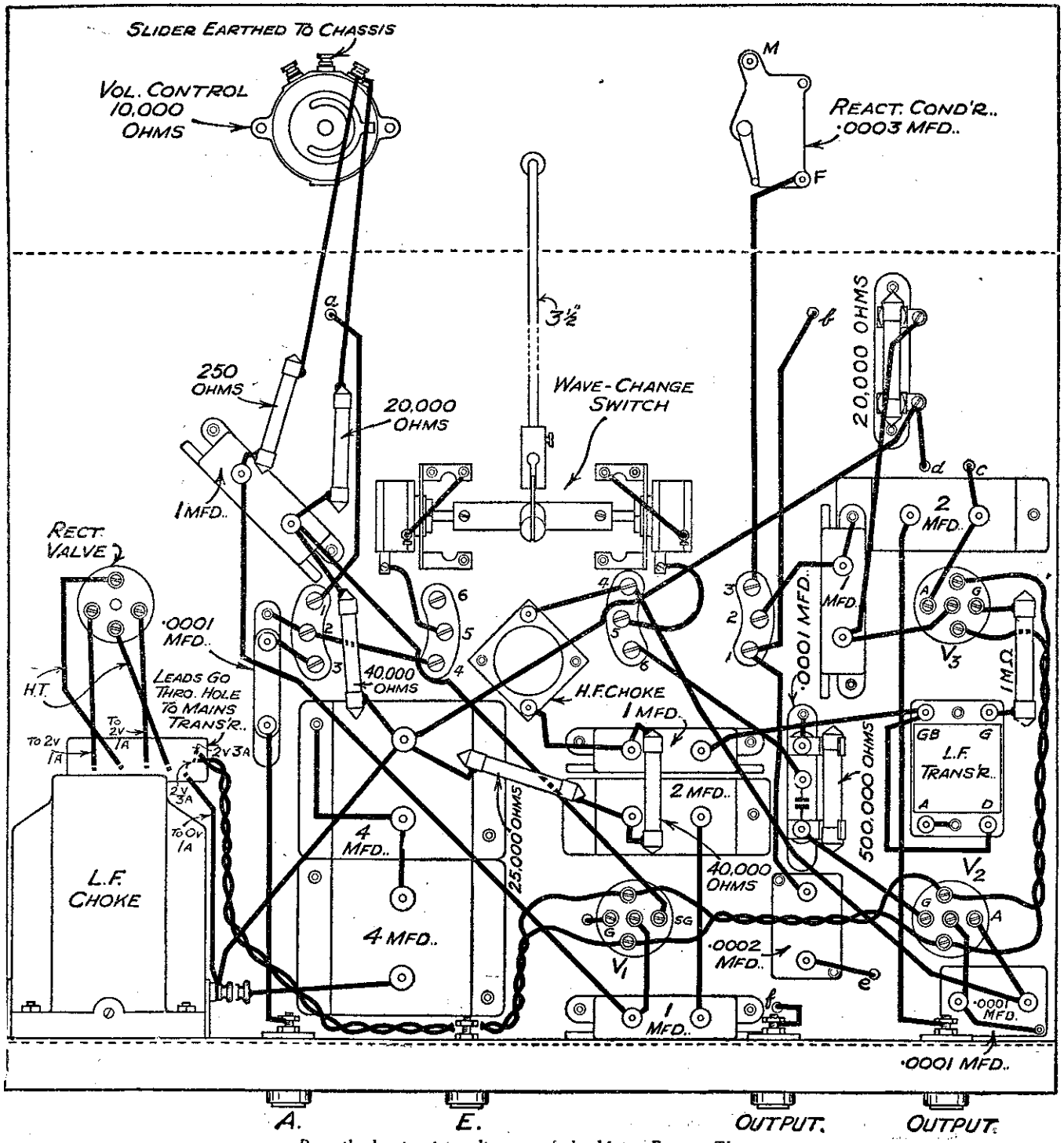
2 variable condensers, type No. 2, .0005, Polar.
1 reaction condenser, Compax type, .0003, Polar.
1 fixed condenser, type "S" .0001, T.C.C.
1 fixed condenser, upright type .0001, T.C.C.
1 fixed condenser, three-terminal upright type .0001, T.C.C.
1 fixed condenser, type "S" .0003, T.C.C.
4 fixed condensers, non-inductive, 1 mfd., T.C.C.
2 fixed condensers, 400 volt working 2 mfd., T.C.C.
2 fixed condensers, 400 volt working 4 mfd., T.C.C.
1 choke, screened standard type, Wearite.
1 choke, screened type with lead, Wearite.
2 tuning coils, Types KBLC and KGR, Colvern.
1 switch, ganged wavechange type, Wearite.
1 potentiometer, 10,000 ohms, Lewcos.
2 L.F. chokes, 20 Henry, Varley.
1 mains transformer, Sound Sales type 250 Shielded Super.
3 valve-holders, five-pin chassis mounting, Clix.
1 valve-holder, four-pin chassis mounting, Clix.
1 resistance, 250 ohms, 1 watt type, Dubilier.
1 resistance, 350 ohms, 1 watt type, Dubilier.
1 resistance, 7,000 ohms, 1 watt type, Dubilier.
1 resistance, 25,000 ohms, 1 watt type, Dubilier.
2 resistances, 20,000 ohms, 1 watt type, Dubilier.
2 resistances, 40,000 ohms, 1 watt type, Dubilier.
1 resistance, 1 megohm, 1 watt type, Dubilier.
1 grid leak, .5 megohms, Dubilier.
1 transformer, Parafeed, R.I.
2 grid leak holders, Bulgin.
4 terminals—aerial, earth, and output (2—insulated), Belling Lee.
3 bushes for above (Belling Lee).
Glazite, Lewcos. Sundry screws, wire, systo-flex, etc.
1 metal chassis, Paroussi.
1 valve, type MVSG, Cossor.
1 valve, type 41MH, Cossor.
1 valve, type PT 41, Cossor.
1 valve, type 506BU, Cossor.
Speaker: Celestion P.P.M.9
1 Cabinet: Chromogram.

be insulated, as it is intended to make connection with the metal chassis. Do not vary the points where wires are taken to the chassis; there are ways that appear more direct, but they will upset the stability of the receiver. It should be noted that the tuning condensers or the 10,000 ohm variable resistance must not on any account be insulated from the metal panel.

Points About the Wiring

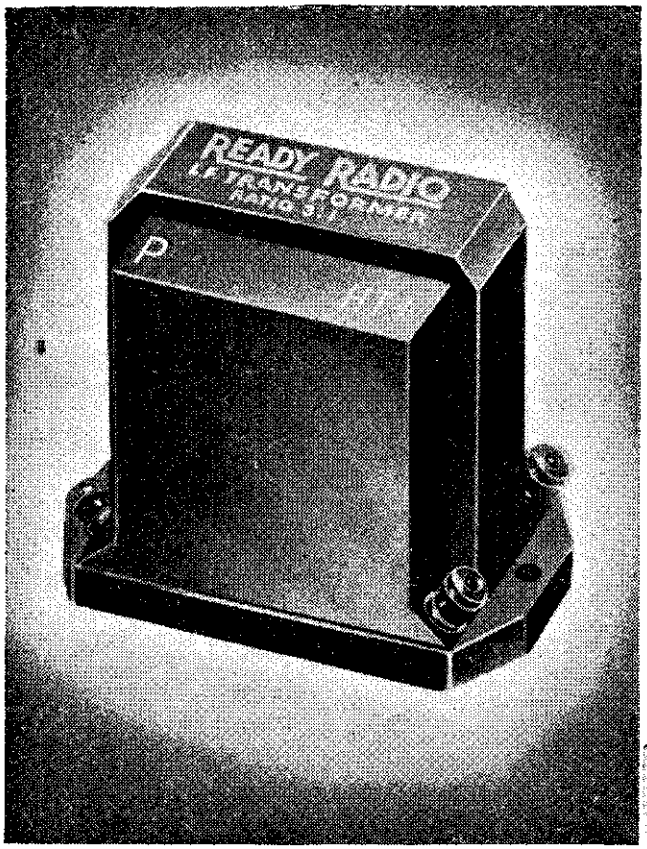
The Dubilier resistances are already provided with connecting wires, so it is only necessary to cut them to the required length, slip on a piece of systo-flex, loop the ends, and place it in position. It is, however, advisable not to fit these until the major portion of the wiring has been accomplished, as they are inclined to be in the way and may get damaged by an unhappy knock with a pair of pliers. It will be noticed that the lead running from the mains transformer to the heater terminals of the valves is twisted: this is to prevent hum. It is difficult to attach more than one wire to each leg of the valve-holder, so the constructor is advised to use bare wire for this connection in the following manner. Take two pieces of 18-gauge wire about 2½ft. long, make a loop in each end and attach it to the correct terminals of the mains transformer. These two connections, like all the leads running to the mains transformer, should be made carefully and be tightly secured, otherwise there is danger of shorting one or more terminals together. Take the two leads and pass them through the hole in the chassis, and slip over each wire a piece of systo-flex that is apparently 1½in. too long to fit nicely between the terminal on the transformer and the valve leg of the variable mu valve-holder in each case, then carefully twist these two wires tightly together. It will be found that the length of wire taken up in twisting will lose the extra 1½in. of systo-flex

(*Continued on page 144.*)



Beneath chassis wiring diagram of the Mains Express Three.

Quality Reproduction for the 'SONOTONE 4'



Everyone who builds the SONOTONE can be sure of quality reproduction. The Ready Radio L.F. Transformer, which is specified, gives a quality of reproduction that is second to none. Its amplification curve covers a remarkably wide range of frequencies.

The windings are particularly robust and carefully wound, whilst the iron is of a new type. The Transformer can be relied upon to give excellent service. Ratio: 3-1 and 5-1. Guaranteed for two years.

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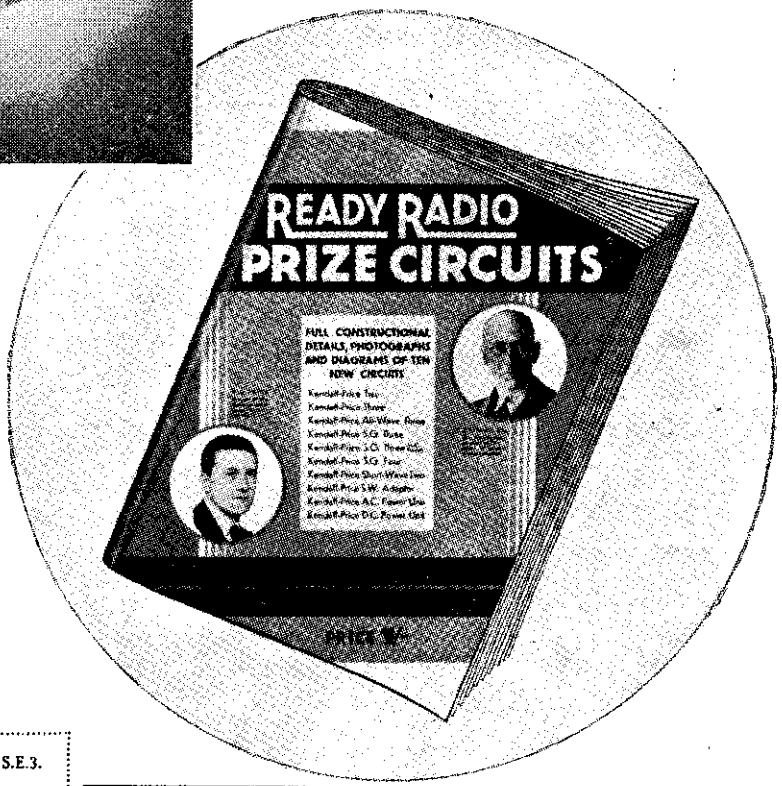

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Announcement of READY RADIO LTD., Eastnor House, Blackheath, S.E.3.

Making the Mains Express Three

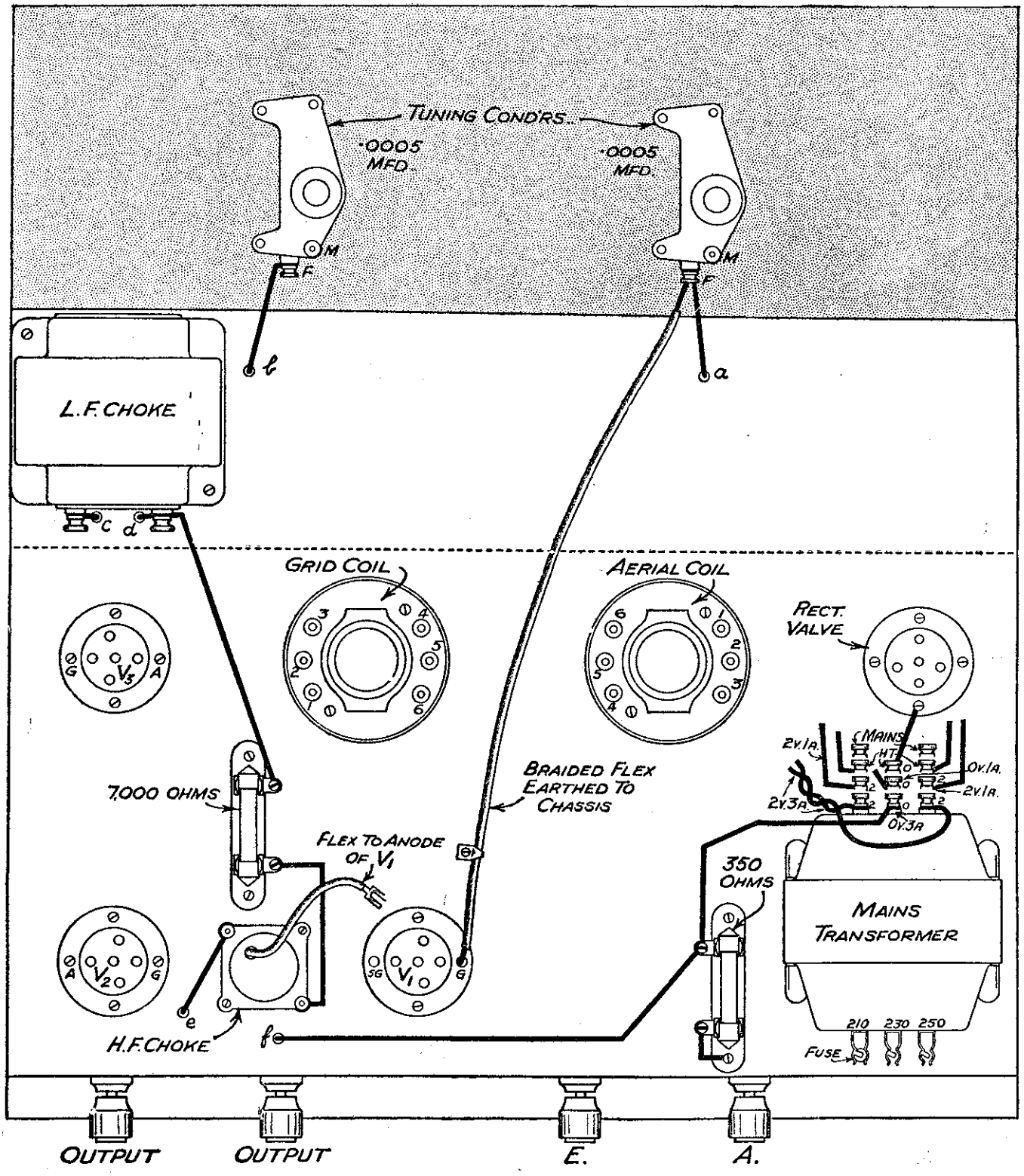
(*Continued from page 142.*)

mentioned above. It will now be necessary to slip the bare portion of the wires under the clamping nuts on the appropriate valve-holder legs. The wiring of the heater terminals should then be continued in the same way, but as the distance between the remaining two valve-holders is much less, it will only be necessary to allow ¼in. of systo-flex in each case. Be careful that the two wires are properly separated by the systo-flex. The rest of the wiring should be carried out with Glazite. Do not use cheap, inferior wire, as the set is a powerful one and consequently the voltages are high, and the use of wire having cheap covering of little insulating value should be avoided.

Connecting the Mains Lead

When the wiring has been completed and checked to see that no mistake has been made, it will be necessary to attach the mains lead for connecting the mains transformer to the electric light supply. It will be noticed that one of the terminals for the mains connection is marked 0. To this terminal one side of the flex lead should

(*Continued on page 162.*)



Above—Chassis Wiring Diagram of the Mains Express Three.

INTRODUCING—

THE SONOTONE FOUR

All About the Wonder Set, Forming the Subject of Next Week's Free-Gift 1/- Blueprint

WHAT constitutes the ideal receiver? This is a question which cannot be answered in a general way, as every listener has an individual preference. Thousands are satisfied with a one-valver, and, on the other hand, there are probably as many who are satisfied with nothing less than a five-valve set. Probably the most popular circuit at the present day is a three-valve arrangement consisting of S.G. detector and pentode valves. This is certainly a good arrangement, and is capable of a really fine performance, but three valves are deemed by some to be insufficient. Whilst the pentode can give quite a good output, there is a preference by some of our readers for two L.F. stages, and in order to have a receiver with range-getting capabilities they demand a four-valve circuit, and will be satisfied with nothing less. It is in answer to this demand that our technical department has produced the "SONOTONE."

Details, wiring diagram, etc., will be given next week, and it will be seen to be a really remarkable little receiver. An ordinary type of screen-grid valve is employed for the H.F. stage, and this is coupled to the detector valve by a tuned-grid circuit. The latter is ganged with the aerial circuit, so giving "one-knob" control. The two L.F. stages are very efficiently arranged, the first utilising an ordinary type of intervalve transformer, and the output valve being fed by a modern form of coupling. This is the popular Benjamin Transfeeda, which, as most of our readers are by now aware, consists of an ordinary L.F. transformer, a coupling condenser, and a wire-wound resistance, the three components being housed in a small metal case, and wired to give what is known as a "parallel-fed transformer" arrangement. The anode resistance is of very generous proportions, and will dissipate 3 watts, and in addition is tapped so that it may be more accurately matched.

Detector decoupling is employed in addition to a screen-grid decoupler, and with the further refinement of an output filter the receiver is perfectly stable.

To ensure that overloading will not take place anywhere in the set two volume controls are fitted, one of the pre-detector type and one of the post-detector type. The former is in the form of a control of the potential applied to the filament of the screen-grid valve, whilst the latter is arranged across the first L.F. coupling. With a generous valve in the output stage, only a moving-coil loud-speaker will do justice to the quality of the output, and the particular model specified for this set is Igranic. It can be fitted into a beautifully finished oak cabinet which has been specially selected for the receiver, and which is made by a well-known firm of cabinet makers (Camco). Tests of this set have satisfied us that in practically any part of the country a great number of stations should be received at really good strength.

LIST OF COMPONENTS FOR "SONOTONE" FOUR

- Lissen Shielded Two Coil Ganged Unit.
- Utility Two Gang Variable Condenser Type W. 135. .0005 mfd.
- Sovereign Pre-set Variable Condenser .0003.
- Ready Radio Reaction Condenser .0005.
- Slekton Standard H.F. Choke.
- Bulgin Screened H.F. Choke (Standard Type).
- Ready Radio L.F. Transformer Ratio 3-1.
- Benjamin Transfeeda.
- R.I. Output Choke (Type DY 20).
- T.C.C. Three Terminal Type .0002 fixed Condenser.
- T.C.C. .0001 Fixed Condenser.
- Dubilier Grid Leak 2 meg.
- 4 Lotus Valve Holders, 4-pin Type.
- 1 Microfuse (100 m/A).
- 2 Lewcos Spaghettis—600 Ohms, and 10,000 Ohms.
- 3 Belling Lee Terminal Blocks.
- 6 Belling Lee Terminals (Aerial, Earth, LS.—, LS.+, and 2 Pick-up).
- 3,—2 MFD. Fixed Condensers—T.C.C.
- Belling Lee Battery Cord, 5 way.
- Panel 14 ins. x 7 ins. British Hard Rubber Co.
- 2 Coils Glazite.
- 25 Ohms Filament resistance—Colvern.
- 500,000 Ohms Volume Control—Sovereign.
- Pertrix Batteries, 120 Volt and 9 Volt Grid Bias.
- Mazda Valves—S.G.215, H.L. 210, L.2, and P.220A. (S.G.215 and H.L.210 are metallised).
- Camco Ambassador Cabinet.
- Earth: 1 Tin Filt. for earth.
- L.T. Battery.
- Loud-speaker—Igranic Type D.9.

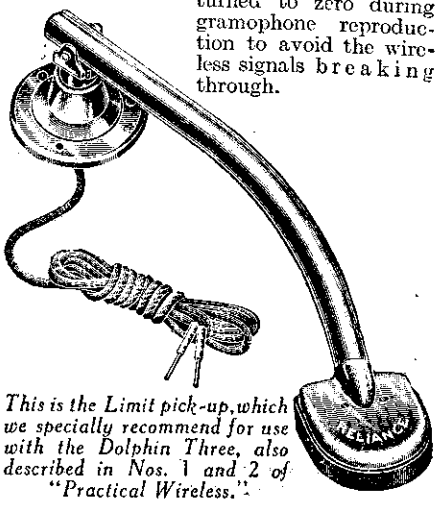
ADDING A PICK-UP TO THE DOLPHIN AND THE LONG-DISTANCE EXPRESS

This is the Clarion pick-up which works splendidly with the Long-distance Express described in Nos. 1 and 2 of "Practical Wireless."

THE Long-Range Express Three, and the Dolphin Three may both be used for the reproduction of gramophone records. For the Long-Range Express a Clarion Pick-up is recommended, and this should be mounted on the motor-board, making use of the template supplied with the Pick-up so that the instrument will track correctly. In addition, it will be necessary to fit two terminals to the rear part of the chassis. One terminal must be joined to the grid of the Detector valve, and to avoid any instability this lead should be of the metal-shrouded variety. The remaining Pick-up terminal must be provided with a lead so that it may be plugged into the Grid-Bias battery. The Detector valve is acting now as an L.F. valve, so that the value of the Bias must be adjusted to ensure that the valve works on the correct part of the curve. For the valve specified in the article 1.5 volts will be sufficient. It is essential for a volume control to be fitted across the Pick-up. This should be mounted on the motor-board as near to the Pick-up as possible. If it is considered worth while, a switch may be incorporated in the receiver to switch over from radio to gramophone. A single-pole-change-over switch will be needed, the grid of the valve being connected to the arm of the switch, the Grid Bias and Condenser then being joined to the terminal on one side of the switch, and the Pick-up to the other side.

The Dolphin is already provided with terminals for the Pick-up connections, and therefore no alterations will have to be carried out before this set may be used with a Pick-up. For this receiver we recommend the Limit Pick-up. The remarks in the first part of this article relative to a volume control will also apply to this receiver. Although in this instance an L.F. valve is employed, the grid swing is still rather small, and records of the very loud kind will be inclined to overload. The above remarks relative to the installation of a switch are also relevant to this receiver.

With both sets, the tuning dials must be turned to zero during gramophone reproduction to avoid the wireless signals breaking through.



This is the Limit pick-up, which we specially recommend for use with the Dolphin Three, also described in Nos. 1 and 2 of "Practical Wireless."

THE LATEST KITS REVIEWED

NEXT WEEK!
THE LOTUS LANDMARK 3

THE OSRAM THIRTY-THREE MUSIC MAGNET

THE Music Magnet range of home-constructors' kits which have been produced by the G.E.C. has been still further improved by the addition of the Thirty-Three. This is a most interesting kit, comprising a three-valve set, loud-speaker and cabinet. The latter is of moulded bakelite, possessing quite pleasing lines and finish, and, unlike the majority of cabinets, the loud-speaker opening is quite plain, no fancy cut-outs being fitted. The opening is covered by an old-gold fabric which tones very well with the cabinet.

All the separate components are enclosed in clearly identified envelopes, and a most comprehensive instruction chart is supplied, on which, in addition to the step-by-step instructions, a 13in. scale is provided. The cutting of the various wires is thus greatly simplified.

Three controls only are fitted to the receiver, one for tuning, one for volume, and one for wave-change. The tuning coils, of which two are employed, are of original design, wound on square, instead of the more usual circular formers. The short-wave winding is carried on a former inside the long-wave former, the two windings being arranged at right angles. The coils, and the two variable condensers are screened and ganged, and the entire receiver is enclosed in a metal chassis. A separate compartment is fitted to house the batteries.

There are several novel features incorporated in the circuit, foremost of which is the employment of a screen-grid valve in the detector stage. This, in conjunction with the S.G. H.F. valve, results, as might be expected, in a very good long-distance performance. A fuse is included in the battery leads to avoid risks of destroyed valves through short-circuits, or wrong connections, and adequate decoupling is incorporated in each stage. The tuning dial is calibrated direct in metres, instead of degrees, and this is of great assistance in tuning-in long-distance stations. In order that the receiver may be used for gramophone reproduction, pick-up terminals are fitted.

On test, as was to be expected from a study of the circuit arrangements, the receiver proved to be both powerful and selective. Local high-powered stations came in with a real punch, and it was possible to pass them if the control was turned too rapidly. The volume control acts as a form of reaction control, in addition to reducing the potential applied to the filament of the H.F. valve, and with the aid of this control it was possible to hear quite a number of stations at good loud-speaker strength. The power valve which is fitted did not suffer from overloading, and quite a pleasing tone was produced by the speaker. The back of the cabinet is open, so that there was no cabinet resonance, although there was quite sufficient bass. The instruction chart contains a table giving the principal European stations, with wavelength and power, so that it is quite simple to pick out the stations with the calibrated dial. The chief features of the set are reproduced herewith :—

1.—A complete table model receiver with built-in loud-speaker.

2.—Batteries housed inside cabinet—no external battery connections.

3.—Two metallized Osram screen-grid valves and latest type Osram power output valve.

4.—Screen-grid detector gives great sensitivity.

5.—Tuning by one knob only.

6.—Single tuning dial calibrated in wavelengths.

7.—Combined radio volume and reaction control for smooth operation.

8.—Wavelength change by rotary switch with definite positions.

9.—New magnetic loud-speaker chassis with floating cone ensures highest quality reproduction.

10.—First-class components—de luxe finish throughout.

11.—All metal chassis construction, and efficient screening for perfect stability.

12.—Unit assemblies make home construction the essence of simplicity.

13.—Valve holder panel ready assembled—strip wiring gives reliability.

14.—Dual gang tuning condenser of new design accurately balanced for extreme selectivity.

15.—Separate circuit trimmers for long and short wave-bands.

16.—Connections for gramophone pick-up.

17.—Latest Osram valves (battery type) with the Wembley filament.

18.—Low H.T. current consumption using standard Osram valve combination.

19.—Handsome one-piece cabinet in moulded bakelite—walnut graining.

And as an indication of the concise way in which the instructions are printed we quote Step No. 5 :—

"At this juncture the chassis should be subjected to careful inspection. Every thumb nut, with the exception of the three fitted to terminals with identification labels, viz., 'Pick-up,' 'Aerial' and 'Earth,' should have a wire securely clamped beneath it. No terminals other than those mentioned should be free of wires; if this is not found to be the case, re-check workmanship from the beginning of Step 3. It is essential that in all cases the terminals be securely fastened. The above points having been checked, the chassis wiring is complete."

The General Electric Company are to be congratulated once again on getting down to the problem of the home constructor. Too many so-called kits are just a mere collection of odd components with very meagre instructions on connecting up and operating. The care which has obviously been expended on the design of the Thirty Three, and the method of presenting all the instructions to the constructor, are points which are well reflected in the finished receiver, as there is none of the "home-made" appearance anywhere visible. The results, too, are a credit to a three-valve receiver, and we have no hesitation in recommending this Music Magnet to our readers.

DO YOU KNOW?

—That where an outside aerial cannot be erected, a mains aerial will often give better results than the orthodox indoor aerial.

—That cabinet resonance can be removed by leaving the back of a cabinet type loud speaker open, or filling the cabinet with absorbent wool.

—That where high values of G.B. are employed valves can be destroyed through a short circuit. A fuse in the G.B. lead will prevent this.

—That an unscreened H.F. choke can cause instability, due to its external field. Vary its position in such cases to find a position where no coupling exists.

—That long waves are not used on the other side of the Atlantic.

—That the L.F. transformers—where more than one is employed, can interact,—resulting in instability and distortion. Therefore, it is advisable to arrange transformers at right-angles unless earthed metal cases are employed for these components.

—That the aerial lead should not be permitted to pass near the output end of a receiver, as H.F. in the L.F. side of a set results in distortion and instability.

KIT:
Osram Thirty-Three Music Magnet.

MAKERS:
General Electric Co. Ltd.

SPECIFICATION:
Metal chassis, bakelite cabinet, S.G. H.F. and detector valves, and super power valve, ganged tuning condensers, dial calibrated in wavelengths.

PRICE:
£9 9s. 0d. with valves;
£10 11s. 0d. with batteries.

THE WHY AND THE WHEREFORE—3

The Third of a Series of Weekly Articles Describing in Non-technical Language the Function of the Various Components in a Wireless Receiver. By JACE

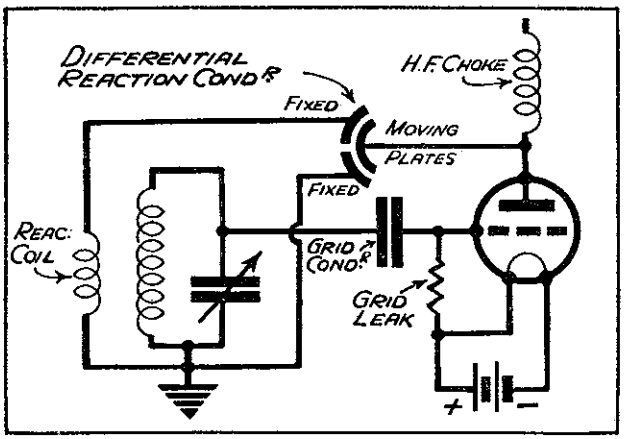
AS I pointed out last week, before the received oscillations will operate the headphones or loud-speaker, it is necessary that they shall be "detected"—or more correctly, rectified. There are in common use, two ways of carrying out this process, one being known as the anode bend method, and the other the grid leak and condenser arrangement. In addition to these, there are one or two other schemes with which we need not trouble ourselves here.

Anode Bend Rectification

You will remember that inside the valve there is a stream of electrons from the cathode to the anode, passing via the grid. The anode is provided, by means of the H.T. battery, with a positive potential, and therefore the electron stream will consist of negative electrons. It follows, therefore, that if the grid is made negative it will assist, or add to, the electron stream, whilst if the grid is made positive it will retard or decrease the stream. Now to explain fully the process of rectification we should have to study the characteristic curves of the valve, and this would lead us into a rather lengthy technical explanation which would no doubt confuse the majority of our readers. We shall therefore content ourselves by stating that, for the anode bend method of detection the grid of the valve has to be provided with a negative potential of such a value that only the application of positive impulses will affect the steady electron flow. It follows, therefore, that the received signal, consisting as it does of oscillations which are alternatively positive and negative, will arrive at the grid, but by virtue of the applied negative bias, only the positive variations will be reproduced in the anode circuit.

Leaky Grid Rectification

With the grid leak and condenser method, a small fixed condenser is inserted between the grid and the tuned grid circuit (or the anode of the preceding H.F. valve). The oscillations applied to the condenser cause an accumulation of negative electrons on the side of the condenser which is connected to the grid, and in order that this accumulation may not get so large as to stop the electron flow inside the valve, a resistance is joined from the grid to the positive side of the filament. This also applies a slight positive bias to the grid, and the combination of this positive potential and the charge on the condenser cause the same effect as is described above under the anode bend method—namely, one half only of the oscillations are reproduced in the anode circuit. It will be obvious that with both these methods, there will be correct values for the various potentials and components if the rectified impulses in the anode circuit (which will now be of low frequency) are to be faithful reproductions of those originally induced into the microphone circuit.



The complete detector circuit, showing the method of joining up the reaction condenser and coils.

Reaction

We must now regard the variations in the anode circuit of the detector valve as a slow one-way current of varying strength, changing now so slowly that the diaphragm of a telephone receiver may be caused to follow the variations. There is, however, a certain proportion of high frequency current present, and although we must not allow this to get into the L.F. side of the receiver, we can turn it to good account here by using it to strengthen the signals in the grid circuit. This is carried out by inserting a coil in the anode circuit and then placing this anode coil in close proximity to the grid coil. This enables the H.F. impulses of the anode circuit to "react" on the H.F. impulses in the grid circuit and reinforce them—a process well-known to listeners as "reaction." In order to ensure that all the anode circuit H.F. currents be utilized in this way, and that none may pass to earth via the battery circuit, it is necessary to insert a barrier to H.F. currents, and you will remember that in last week's discussion we described such a barrier as an H.F. choke. In this present case, however, the choke need only have sufficient inductance to prevent the passage of the H.F. currents.

Controlling Reaction

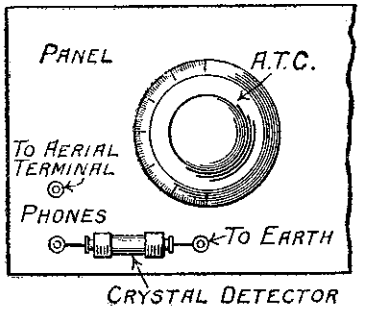
The degree of the reaction may be controlled by either varying the distance separating the anode and grid coils, or by arranging the coils close together to get the maximum coupling, and then providing an alternative path for the currents to earth instead of through the anode coil. This latter method is the most usual to-day, and the illustration shows the complete detector circuit so far described. In this circuit arrangement the alternative path is provided by a component known as a "Differential Reaction Condenser," which consists of two sets of fixed plates, and one set of moving plates. The moving plates are joined to the anode, and one set of fixed plates is joined to the anode coil. This provides the path through the coil giving the reaction effect, the actual strength being dependent upon the size of the condenser formed by these two sets of plates—the smaller the condenser the less the effect. The alternative path is provided by the remaining set of fixed plates which is joined direct to earth, and therefore the adjustment of the moving plates transfers the H.F. impulses through either path.

We can now either pass the rectified signal through a pair of headphones, or carry out a process of L.F. amplification in order to make the signal sufficiently strong to operate a loud-speaker, and we shall deal with this process next week.

A Stand-By Crystal Detector

In cases where only one accumulator is available, it is a good plan to have a crystal set handy so that an important broadcast item need not be missed when the accumulator runs down. A useful alternative arrangement is to adapt the main set so that it can be used as a crystal receiver in an emergency.

The tuning part of the circuit is common to both sets, and all that is required is a crystal, preferably of the permanent type, and a pair of 'phones. To connect up, attach one end of the 'phones to the grid condenser (that side joined to tuning condenser), and the other end to one end of the crystal detector. The other end of the detector has now to be attached to the earth terminal. That is all.



The crystal detector, together with two telephone terminals, can be mounted permanently on the panel, as shown in the sketch, one terminal being connected to the aerial terminal of the set, and the other to one end of the crystal detector. The other side of the crystal detector is connected to the earth terminal.

When the accumulator runs down, or is sent away for re-charging, just connect up a pair of 'phones and tune-in with the aerial tuning condenser in the ordinary way. For this emergency hook-up the reaction condenser will, of course, be inoperative.

If thought necessary, a switch may be fitted so that the 'phones and crystal are "cut-out" when the main set is in use.

The "Arithmetic" of Wireless—1

A Simple Explanation of some of the Everyday Calculations met with in Wireless Practice.

By G. V. COLLE.

DO not assume from the title of this article that we are about to delve into the *mathematics* of wireless. They are somewhat complicated, and wireless has become such a popular and general hobby that, quite rightly, it is not thought necessary for the dabbler, or even the enthusiast, to worry about them. The *arithmetic* of wireless, however, is a subject that everyone must know something about, and it is the purpose of this article to explain some of it in simple terms. One can call to mind innumerable questions that spring from a lack of knowledge of wireless "arithmetic": Why do I want a .0005 condenser particularly? What resistance shall I have to use there? What H.T. voltage will that valve need? How about that aerial coupling condenser? and so on *ad infinitum*.

Ohm's Law

The first piece of arithmetic that anyone interested in wireless must allow to sink in is Ohm's Law. The first form in which it is met is this: "Current equals Voltage divided by Resistance." Current is measured in amperes, voltage in volts, and resistance in ohms for this purpose. Put in its simplest form, this statement tells us that if we have a current of one ampere flowing through a resistance of one ohm, the voltage producing it must be one volt. If the resistance has a value of two ohms, the voltage must be two volts, and so on. Child's-play, no doubt, but it is surprising how many people who ought to know better are still baffled by Ohm's Law. Simply remember $C = \frac{V}{R}$, and you will never go wrong.

It would be as well to make it clear here that it follows from this that a doubling of the voltage we are concerned with will result in a doubling of the current, assuming, of course, that the resistance remains the same. Now for a practical application; we want to find, for some reason, the resistance of the filament of a valve of the "2-volt, .1-ampere" type. Two volts through 2 ohms would produce a current of 1 amp.; therefore the figure we want is obviously 20 ohms. This has taught us something else. If we want to run one of those valves from a 4-volt accumulator, we must interpose the right amount of resistance to "absorb" 2 volts, and 20 ohms is the value for it. The resistance and the valve will each have two volts across them. More complicated examples of the use of Ohm's Law will follow later, but the "A B C" of the subject has obviously got to be cleared up first, for the benefit of new readers who are in the "tyro" stage.

Law Relating to Resistances and Condensers

Before one can make much use of Ohm's Law, of course, one has to know the law concerning resistances—that two connected in series possess a total resistance equal to the sum of the two. This is an excellent example of another perfectly obvious fact that remains unknown to a vast number of home constructors. A "spaghetti" of 50,000 ohms can be made up simply by connecting a 20,000 and a 30,000 in series. The law governing resistances connected "in parallel" is more complicated, and will find its place in a later article.

The rule about condensers is the reverse. To make an emergency condenser of .0005 capacity we have to use one of .0002 and one of .0003 *in parallel*. Two other valves adding up to .0005 would, of course, have the same effect. Condensers in series follow the same law as resistances in parallel, and for that reason will be left alone for the time being. It may as well be mentioned here, however, that the total capacity of two *equal* condensers in series is half that of each separate condenser. Thus an "emergency" .00025 may be made from two .0005's in series. To deal with our first imaginary query about the choice of condenser, it is sufficient to say here that a .0005 condenser is almost invariably used for tuning, on the long and medium broadcast waves, simply for the reason that with the conventional size of inductance coil it just covers the necessary width of band.

Tuning Coils and Condensers

Our usual "50" coil and .0005 covers roughly 220-550 metres in the average receiver. Were we to use a 75 coil a much smaller condenser would serve to cover the same range; one could probably cover 230-560 metres with a 75 coil and a .0003, simply because the condenser was across a greater number of turns. A .0005 condenser seems to be accepted, however, as the size that is most convenient for modern use as far as broadcast reception on the usual waves is concerned and .0005 it is, in most cases.

For short-wave work a much smaller tuning condenser is required, and as a rule it is inadvisable ever to use anything larger than .0001. Here again the point is simply to choose a condenser that matches a convenient size of coil for covering a convenient wave-length-range. These somewhat trivial points are mentioned chiefly to show the newcomer to wireless that these things *do* have definite reasons behind them, and that one cannot play "fast and loose" with accepted conventions.

Wavelength and Frequency

Another simple piece of arithmetic that *must* be absorbed concerns the relation between wavelength and frequency. These are tied together by the rule "wavelength in metres multiplied by frequency in kilocycles equals 300,000." Thus 150 metres corresponds to 2,000 kc/s, 30 metres to 10,000 kc/s, and so on. The number of stations that can be occupied without interference between any two wavelengths cannot be told at sight from the wavelengths only, but from the frequencies it can, assuming that there must be a clear separation of 10 kc/s between the stations (the European regulations at present allow only for 9 kc/s, hence the interference prevailing).

Between 200 metres (1,500 kc/s) and 300 metres (1,000 kc/s) we obviously have room for fifty stations. And yet between 25 metres (12,000 kc/s) and 30 metres (10,000 kc/s) we have room for *two hundred* stations! From this example of accommodating 200 stations in a "wave-band" of 5 metres while another "wave-band" of 100 metres will only hold 50, one can see how useless it is to get into the habit of thinking in wavelengths.

INTERACTION: ITS CAUSES—AND EFFECTS

A Few of the Causes of Instability are Discussed, and Methods of Prevention Suggested by FRANK PRESTON, F.R.A.

IF one compares the average home-constructed receiver with a commercial product of similar size, both for appearance and performance, one will find many differences. On the grounds of appearance, the usual contrast between the two sets is that while the "home" product looks "scrappy" the commercial receiver is usually a model of neatness and compact design. Under these conditions the performance is very often equal. When the home-made set is compressed a little, however, and made to look neat, it very seldom works as well. The one word "interaction" goes a long way to explain this phenomenon. While almost anyone with a little knowledge of radio principles can make an untidy set work well, it takes more of an expert to design the same set in such a way that it still works when it is "tidied up." It has been a standing joke amongst the "old hands" in radio for years that the efficiency of a home-made set varies in inverse proportion to the tidiness thereof. The fact of the matter is that one cannot take liberties with the placing of the separate components of a set until one knows one's job inside out. Certain components *must* be close up to others; certain components, on the other hand, must be deliberately separated from others.

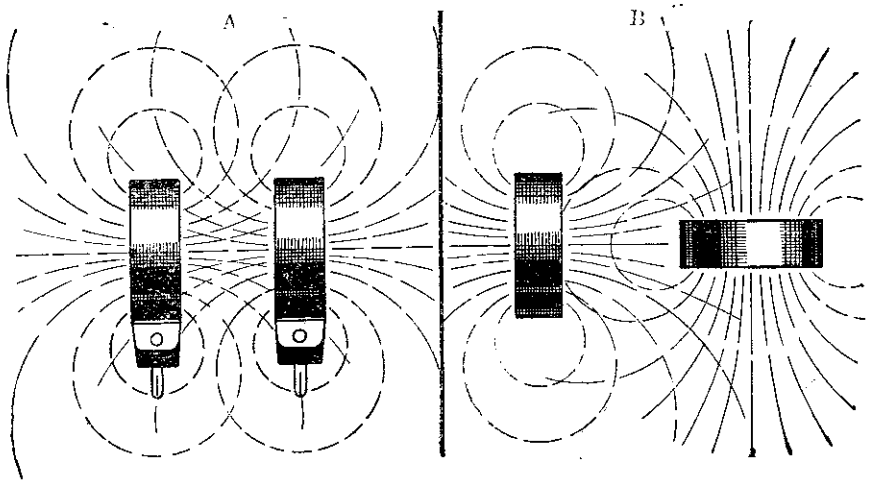


Fig. 1.—Showing the shape of the electro-magnetic field of coils of the usual plug-in type.

Conventional Layouts

From this reasoning, to make things easier for the home-constructor, have sprung certain accepted, conventional "layouts," with which one cannot go far wrong. We have in mind the universal "detector and two-note-mags" type of set, with the signals entering *via* the aerial terminal, on the extreme left, passing through the tuned circuit to the detector, out to the note-magnifiers, and "exit right" at the loud-speaker terminals. While this standardisation process undoubtedly makes the lot of the amateur a happy one, it rather tends to prevent him from finding out things for himself in the very useful school of experience.

A few suggestions about layouts and interaction may perhaps prove helpful to those readers who are possessed of an inquiring turn of mind. The main thing to be avoided is interaction between *two tuned circuits*. When a set uses a stage of H.F. amplification the grid circuit of the H.F. valve and the grid circuit of the detector (or the anode circuit of the H.F. valve—really the same thing) will be tuned to the same wavelength.

Any possibility of interaction between these two circuits must be carefully guarded against. Fig. 1 shows roughly the shape of the electro-magnetic field of coils of the usual plug-in type, and it will be readily seen that the "A" arrangement is unsatisfactory; while the "B" is considerably better.

Screening

Screened coils and screening-boxes for complete H.F. stages make things fairly easy for us nowadays, but if we do build a set with plug-in or home-made coils, it is important that the two circuits should be arranged at right-angles, as in Fig. 1b, and that a screen should be arranged between them. A small piece of metal, moreover, is not sufficient. A screen of sensible size is well worth any trouble involved in the construction of the set.

Since a tuned circuit consists of a coil and a condenser, it is obviously no great gain to screen the coils from one another while the condensers lie side by side on the front panel. This is one good reason for using a screen of the same depth as the baseboard, and "partitioning off" the H.F. stage altogether (Fig. 2). A metal or metal-backed panel, and a baseboard covered on the underside with copper foil, also help things considerably.

The screened-grid valve was invented to do away with the anomaly that, while it was possible to screen the grid and anode *circuits* of a valve from each other, the grid and anode were still fairly closely coupled together inside the valve. A meshed screen was therefore introduced between them, and the anode lead brought out at the opposite end of the valve from the others.

If we are to make the most of the possibilities of a screened-grid valve, we must "back up the designers" and see that the grid and anode really are still screened from one another. The easiest way of doing this is to use a layout similar to that in Fig. 2, mounting the valve horizontally through the vertical screen, so that its anode goes through into the detector compartment, the rest of it being left behind where it belongs, with the input side of the H.F. stage. One can see the screening-grid in most modern valves of this type, and the valve should be arranged through the hole in the screen in such a way that the screen is level with the "continuation" of the screening-grid (Fig. 3). As a matter of fact, it is almost useless to attempt to use a valve of this type nowadays without screening it in this way, thanks to the high efficiency of modern valves and components, which have made interaction a much greater problem than it used to be.

Interaction Between Transformers

The same rules apply to the L.F. end of the receiver. Interaction between two

(*Continued on page 154.*)

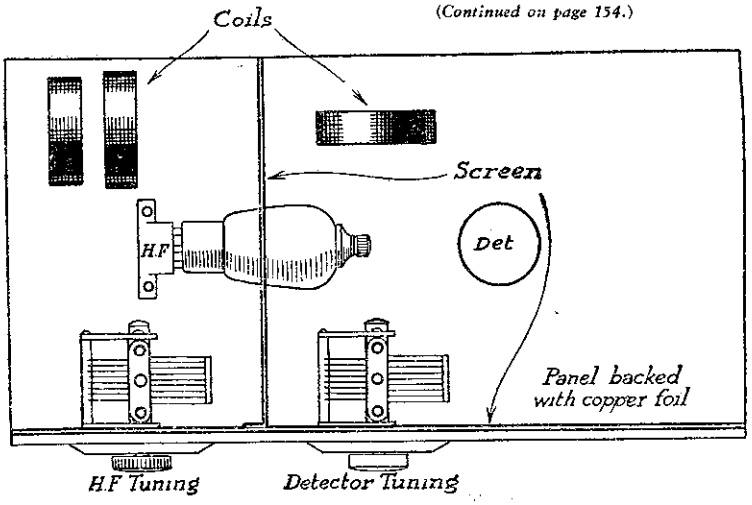


Fig. 2.—A screen the same depth as the baseboard is used for "partitioning off" the H.F. stage.

(Continued from page 152.)

L.F. transformers can produce the most dire effects. If it does not result in audible oscillation, to the accompaniment of anything between a " fog-horn " note and a high-pitched whistle, it may easily produce a parasitic oscillation above the audible range of frequencies, which will only betray its presence by spoiling the quality of reproduction completely.

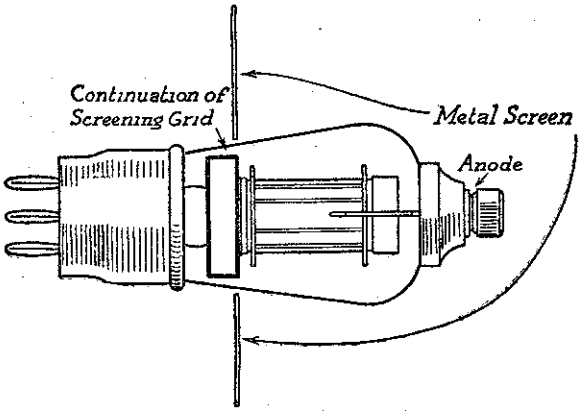


Fig. 3.—The screen should be level with the screening grid of the valve.

Fortunately, most modern L.F. transformers are efficiently screened, but even then it is folly to mount two of them too closely together. The cores should be arranged at right-angles, and the distance should be as great as can conveniently be arranged. Incidentally, aluminium or copper screening is not the slightest use for L.F. work! Heavy iron is necessary to do the job at all well. The average home constructor, however, will not be concerned with amplifiers of such dimensions that screening is necessary. We are not finished with interaction, by any means, when we have discussed these few points. Bad wiring alone is often sufficient to cause the ruination of a good circuit arrangement.

Points about Wiring

It may be taken as a general rule, for instance, that any wires leading from the grid and anode of the same valve should not be taken nearer to each other than necessary. Even more important is it that the grid wiring of an early valve in the set should not go near the anode wiring of a later valve. It needs only a very small capacity to start a " vicious circle " resulting in instability and generally bad performance.

The " standard layout " we have already mentioned goes a long way towards the prevention of mistakes of this kind; but in a more compact receiver it is not always convenient to adhere to this, and careful screening is necessary.

Yet another point to watch is the screening of the H.F. side of a set from the L.F. side. If, to make the size of the set convenient, the " doubling-back " type of layout is used (Fig. 4), it will be seen that the input and output ends of the receiver come close together. Screening, as indicated, is therefore necessary.

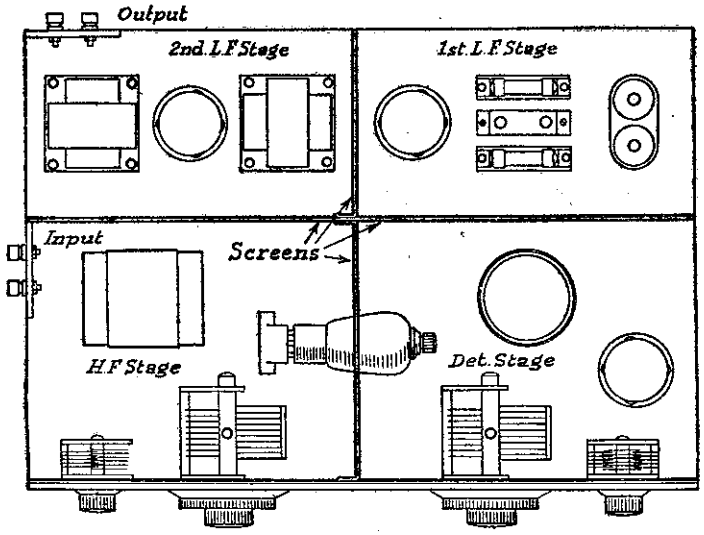


Fig. 4.—When the input and output ends of the receiver come close together the set should be screened as shown.

Much more could be written on this subject, but probably the foregoing remarks, aided by the use of common-sense by the reader, will be sufficient to put him on the right path.

Making Good Soldered Connections

By W. H. D.

THE chief factor governing successful soldering is a well-tinned soldering iron. An electric iron is easy to keep in this condition, but we all know how a slight overheating of the other variety causes the tinning to disappear. A good way to restore this easily is to dip the point of the heated iron into a tin containing a small quantity of soldering fluid and bringing it into contact with the solder. By the way, don't use fluid flux of this description for wireless work.

Make sure that you really do make a soldered joint and not a blob of solder with a wire stuck in. If your completed joints appear as in Fig. 1, you may rest assured that they are not good. The solder should be in the form of a small fillet joining the wire to the tag as shown in Fig 2. Wherever possible do the soldering off the set, but where this is not practicable a piece of stout paper placed underneath the operation, as shown in the photograph, Fig. 3, will collect any excess flux or tiny beads of solder which might later cause trouble.

Should the soldering faces or point of the copper bit have become pitted, restore the original smooth faces by filing them up. There is no doubt that for wireless work a soldering iron with a fine square point is handiest. After a time owing to repeated filing, the end of the bit becomes snub-nosed, and in order that its range of usefulness will not be curtailed it will be necessary to fine the point down. But don't do this by filing, as it is very important not to reduce the weight of the iron by a lot, it being only natural that the heavier the copper the longer will it remain heated.

To repoint an iron without reducing it in weight, heat it up to a dull red and hammer the point alternately on adjacent sides, using a heavy piece of iron as an anvil. Hold the handle of the soldering iron so that the underside of the copper bit lays on the anvil at the angle required on the new point. The hammer blows should be applied from the back end of the taper, keeping the face of the hammer at the point of impact, square with the face being formed, and gradually working the blows towards the point. Having obtained the desired result, plunge the bit into water

(Continued on page 161.)

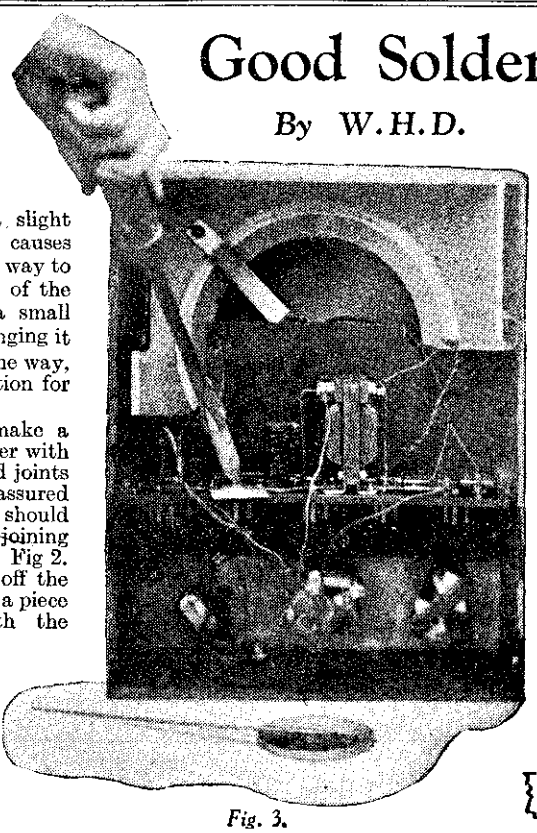


Fig. 3.

Fig. 1.

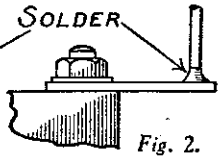
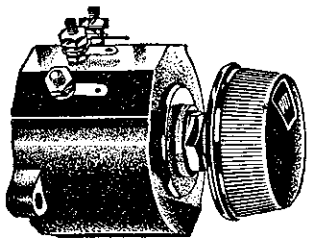


Fig. 2.

A CHAT ABOUT THE LATEST COMPONENTS

AN EFFICIENT WIRELESS VOLUME CONTROL

THE 25,000 ohms potentiometer primarily designed for wireless volume control is typical of a new range of volume controls made by the well-known firm of Wright and Weaire under the trade name of Wearite, from 600 ohms to 100,000 ohms. The great advantage of these volume controls is that they are extra silent in use, due to a special roller bearing contact; each has a square law resistance element, thus assuring even control over the entire range. The wiring is space wound, thus allowing free dissipation of heat and enabling it to carry heavy current. The element is enclosed in a transparent, fireproof, protective cover. An insulating bush is provided ensuring easy fitting to metal panels. Lug-brackets are also employed for baseboard mountings and for ganging. They cost 4s. 6d. for 600 to 50,000 ohms, and 5s. 6d. for 50,000 to 100,000 ohms. Wright and Weaire, 740, High Road, N.17.



One of the new Wearite variable potentiometers or volume controls.

THE MULTITONE TRANSFORMER

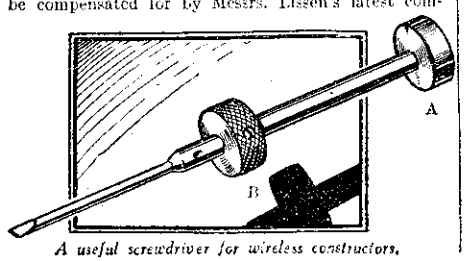
THE modern tendency of tone control has resulted in many devices to make the scheme simple. The Multitone Transformer is a compensated L.F. transformer designed for use in conjunction with a high resistance potentiometer—a value of 4 megohms being actually used. The primary of the transformer has an inductance of 54 henries with no D.C.—which drops to 26 henries at 6 m/A. The mean ratio is 4 to 1. Unlike some types of tone control, this combination provides what might be termed "two-way control," in other words, predominance can be given to the bass, with a variation through the entire scale up to a predominance of the highest notes in the scale. An interesting booklet, "True Tone Control," can be obtained from the manufacturers of this component, Multitone Electric Co., Ltd., 95-98, White Lion Street, London, N.1, in which details of the control and circuit diagrams are given.

A SCREWDRIVER FOR WIRELESS CONSTRUCTORS

THE accompanying illustration shows a screwdriver of a type which undoubtedly will appeal to the wireless enthusiast. It is an all-metal tool, the length over all being about 6in., the blade approximately ⅛in. wide. In use the end A is held stationary in the palm of the hand and the driver turned by means of the chequered portion, B. Simple to use and handy in size, it has many advantages over an ordinary screwdriver for small work, as an even pressure can be maintained upon the screw, thereby minimising the likelihood of the blade "jumping" the screw cut. These screwdrivers are sold at most popular stores at 6d. each.

LISSEN TONE COMPENSATOR

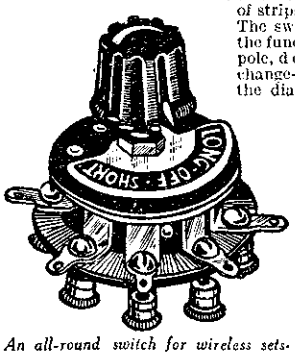
WITH the present congestion in the ether, heterodyne whistles are to be heard all round the tuning dials; modern sharply-tuned circuits result in side-band cut-off, or loss of high notes. These and many other imperfections in reproduction can all be compensated for by Messrs. Lissen's latest components sold under the above name. Two separate items comprise the complete control—a potentiometer, and a small bakelite base of the same dimensions as the base of the Hypernik Transformer. Seven terminals are provided, four of which are fitted with metal strips which link the Hypernik to the base, when the latter is placed beneath it. The remaining three terminals are joined to the potentiometer An interesting pamphlet accompanies the compensator and the full instructions state how the various faults above-mentioned may be remedied. The price is 10s.



A useful screwdriver for wireless constructors.

AN ALL-ROUND WIRELESS SWITCH

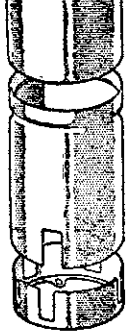
THE multi-purpose wireless switch shown in the sketch below is rotary in action, and has two balls in the extremities of the bakelite arm. The balls snick securely into the spaces between the contact strips, making low-resistance contacts between two pairs of strips simultaneously. The switch performs all the functions of a double pole, double-throw, change-over switch. In the diagram one of the ball contacts is seen making a firm connection between adjacent strips. A special feature of this switch is the terminal, which will hold several wires simultaneously in a vice-like grip. It is obtainable for 3s. 6d. complete with terminals from The Benjamin Electric Limited, Tarriff Road, Tottenham, N.17.



An all-round switch for wireless sets.

GANGED CONDENSER TUNING CONTROL UNIT

THE home-constructor's path is being made lighter every day. The latest product from the Lissen factory bears the above rather elaborate title, and it is certainly a novelty. Two ganged condensers, of the solid dielectric type, are mounted on two stout pillars behind a handsome bakelite dial of the usual slow-motion appearance. The rear condenser has a small metal screen to avoid unwanted couplings, and if the moving vanes of the condensers are earthed this plate also is earthed. At the rear of the bakelite fixing plate are three terminals which have bases of the contact-stud type. A rotatable brass fitment bridges these terminals, the controlling end being brought out at the lower end of the dial. Three positions are engraved for this control—Off, Short and Long. A concentric knob on the dial enables one set of moving vanes to be moved through a small arc to compensate for slight discrepancies in ganged tuning circuits. At a cost of 14s. 6d. this three-in-one component will be found very useful to the home-constructor.



A neat wireless valve screen and base.

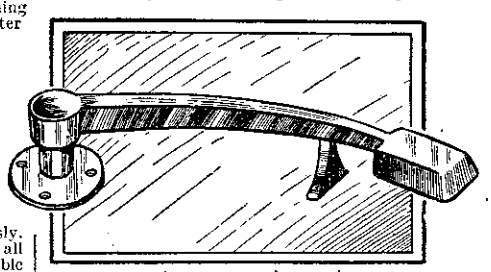
ALUMINIUM WIRELESS VALVE SCREEN AND BASE

THE popularity of the screen-grid valve has created a demand for a valve screen and base. That shown in the centre of this page has a telescopic adjustment enabling it to be used in conjunction with all types of screen-grid valves. It will also accommodate the majority of valve-holders. It is 3/16in. in diameter and costs 2s. 9d. Colvern, Ltd., 1, Mawneys Road, Romford, Essex.

A NEAT GRAMOPHONE PICK-UP

IT is now generally recognised that electrically-recorded gramophone records can only be heard at their best when an electrical reproducing device is used. The ordinary soundbox, even of good quality, has serious drawbacks.

The neat tone-arm here combines also a pick-up enabling the record to be amplified by the wireless set and reproduced through the loud-speaker. I



A neat gramophone pick-up.

is moulded as one complete unit in fabrolite, and the leads are carried through. It costs 27s. 6d. B.T.H. Co., Ltd., Crown House, Aldwych, W.C.2.

AN INGENIOUS SCREWDRIVER FOR THE WIRELESS CONSTRUCTOR

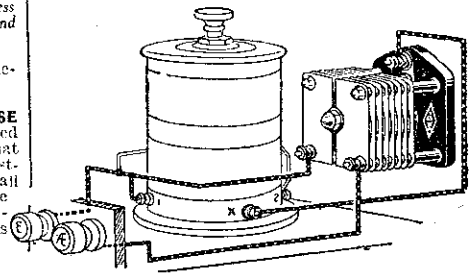
EVERY home constructor is aware of the difficulty of inserting small screws in awkward places, where the fingers cannot easily hold the screw in place. The screw usually drops into an inaccessible corner from which it cannot be retrieved. Many devices have been marketed to facilitate the operation, not the least ingenious of which is the nips-it screwdriver. The blade portion of the screwdriver is split, and the split is opened to form a sort of leaf spring. By closing the two parts of the blade it will be perceived that, when these are inserted into the slot of the screw they will spring open and grip it so that with one hand the screw may be inserted and started. The long blade enables the hand to be kept well clear of the work. R. E. Collingwood and Son, Ltd., Rochdale.

A WIRELESS VOLUME CONTROL

IT is not generally realised that volume can be controlled at the input end of a wireless receiver as well as the output. A well-tried method of doing this is by using a differential condenser between the aerial and the tuning coil. The diagram at the foot of this page shows the connections, using a well-known make of air dielectric condenser for the purpose. You merely have to connect the previous aerial terminals of the coil to the moving plates of the condenser. Connect the aerial to one set of fixed plates and the earthed end of the coil to the other set of fixed plates. This will give very smooth control of volume. A. & F. Bulgin, Ltd., Abbey Road, Barking.

CLIX TERMINALS

MESSRS. LECTRO-LINX are producing new plugs under the name Master Plugs, as well as sockets of a new design. The chassis mounting valve-holder has also been modified, and now can be obtained with terminals for connections. A further item, which will be of interest to the home constructor, is the reduction in the price of the panel terminal (No. 1A), which is now only 2½d.



Method of controlling the volume from the input side of a wireless circuit.

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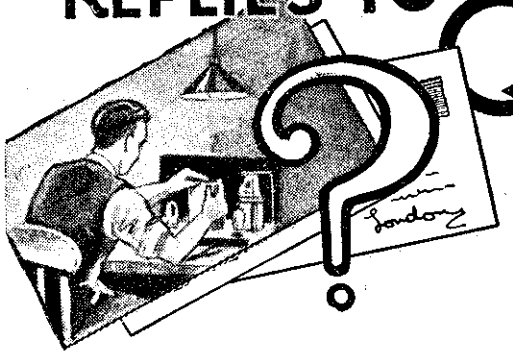

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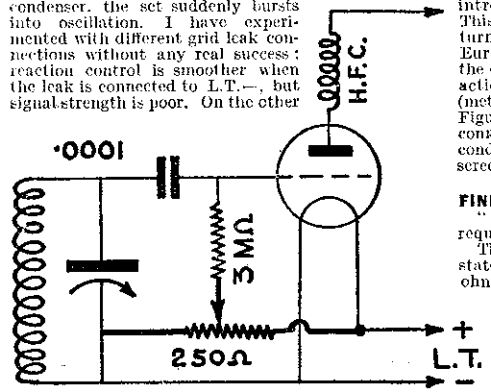
If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query must bear the name and address of the sender. Send your queries to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2.

UNSTABLE REACTION CONTROL

"Some time ago I made up a short-wave set from a number of components which I had on hand. Although I am able to receive a fair number of stations, tuning is difficult on account of reaction overlap. When attempting to increase the strength with the reaction condenser, the set suddenly bursts into oscillation. I have experimented with different grid leak connections without any real success: reaction control is smoother when the leak is connected to L.T.—, but signal-strength is poor. On the other hand, connecting the leak to L.T.+ produces an increase in volume, but reaction is difficult to handle. Can you suggest where the trouble lies?"



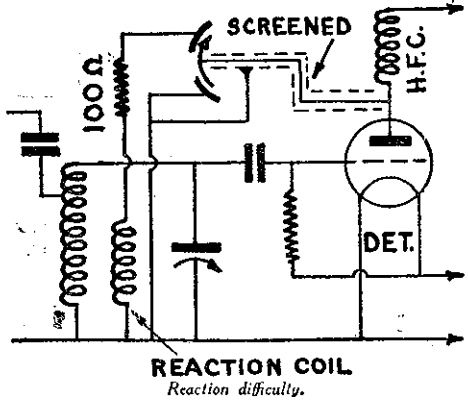
Curing unstable reaction control.

There is no doubt that the cause is centred round the grid leak connection, although it is probable that a different detector valve or lower high-tension voltage would help to improve matters. Since positive and negative grid leak connections give extreme results, it is logical to expect that the "happy medium" should be found somewhere between the extreme values. This happy medium can be obtained by connecting the grid leak to a slider of a 250-ohm potentiometer wired in parallel with the L.T. leads as shown in above. By operating the potentiometer control it will be possible to find a position at which reaction control is quite smooth and volume at a maximum. As a matter of fact this method of connecting the grid leak is well worth a trial on any sensitive receiver where reaction control is very critical. The potentiometer can be used as a "vernier" reaction adjustment.

ANOTHER REACTION DIFFICULTY

"My S.G.-Det.L.F. receiver is very similar to a design issued by a well-known firm of manufacturers and works quite well in all but one respect. Oscillation can be obtained over most of the tuning dial with only a small capacity of reaction condenser, but in one place the set cannot be made to oscillate at all, even though the reaction condenser be turned to its maximum setting. I should like to know the cause of this fault."

The "dead-spot" is caused by a form of parasitic oscillation which more or less chokes the detector valve. It might be cured by altering the size of the reaction winding, but a more certain remedy is to introduce a resistance into the reaction circuit. This might be done by removing the reaction turns and rewinding with 36 gauge silk-covered Eureka resistance wire. Another method is to break the connection between the reaction winding and reaction condenser, and insert a 100 ohm non-inductive (metallised is most convenient) resistance as shown in Figure 5. It is also often advisable to make the connection between the detector anode and reaction condenser in screened wire, connecting the metal screen to earth.



Reaction difficulty.

FINDING THE VALUE OF RESISTANCES

"How does one calculate the value of resistance required for reducing the voltage of an eliminator?"

The calculation is based on Ohm's Law, which states that the value of the necessary resistance (in ohms, is equal to the voltage to be "dropped" or absorbed divided by the current consumption (in amperes). As, however, the current is usually in milliamperes and the resistance in thousands of ohms, the equation can be simplified to read:—Resistance (in thousands of ohms) equals voltage to be dropped divided by the current (in milliamps). By way of example suppose a voltage of 80 is required for the detector tapping and the eliminator gives a maximum of 200 volts. We must first of all ascertain the current consumption of the valve at 80 v. This is found by referring to the makers' Instruction Sheet or Characteristic Curve for the valve in use. Assuming this current to be 2 milliamps, the necessary resistance must have a value (in thousands of ohms) of 120 divided by 2, or 60,000 ohms.

The same calculation applies when finding the value of resistance required for providing "automatic" grid bias when connected in the cathode lead of an indirectly-heated valve.

DATA SHEET No. 3.

COPPER WIRE DATA (Continued).

D.C.C.		S.S.C.		D.S.C.	
Turns per inch.	Yds. per lb.	Turns per inch.	Yds. per lb.	Turns per inch.	Yds. per lb.
13.3	25.6	15.9	26.4	14.7	26.1
17.3	45.4	20.0	46.8	19.6	46.3
21.7	79.4	26.3	83.3	25.6	82.5
26.3	129	33.3	137	32.2	134
32.3	203	42.5	222	40.0	218
37	294	51.8	332	48.8	325
42	422	62.1	488	57.8	478
47	587	73.0	695	67.1	675
50.5	755	82.6	912	75.2	887
55	1,024	95.2	1,250	85.5	1,220
64	1,477	112	1,815	90.1	1,750
71.5	2,287	137	2,871	118	3,760
78	3,456	164	4,406	137	4,128

D.C.C.—Double Cotton Covered.
S.S.C.—Single Silk.
D.S.C.—Double Silk Covered.

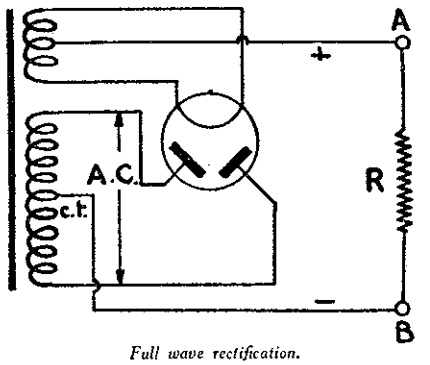
FULL WAVE RECTIFICATION

"How, in view of the fact that electrons flow in one direction only, can both the positive and negative half-waves be rectified by a full-wave valve?"

On the face of things this does appear to be rather a teaser, but let us consider the rectifying circuit illustrated. This is a normal full-wave rectifier arrangement where the two ends of a transformer secondary are connected to the two anodes of the rectifying valve, a negative connection being obtained from the centre tapping.

For every instance that one end of the secondary winding is positive the other is negative, and *vice versa*. In consequence there is always a flow of current between the filament and *one of the anodes*. As the centre tapping has a potential half way between the two ends of the winding it is always negative in respect to the positive end. Thus there is a constant flow of current around the circuit A.B. which represents the "load" (receiver, accumulators on charge, etc.).

It will be seen from the above explanation that both halves of the wave are rectified, although the resulting voltage is only equal to that developed between the centre tap and one end of the winding, or in other words, half the voltage developed across the whole winding.



Full wave rectification.

EXTERNAL VOLUME CONTROL

"I have a commercial receiver which, owing to my close proximity to one of the Regional Stations, is severely overloaded. I do not wish to tamper with the inside of it, but think that a volume control would be very valuable. Can I fix one outside the receiver?"

The best form of external control in your particular case (as we do not know the aerial tuning arrangements) would be made up from a Differential Reaction Condenser, the most suitable value being .0003 mfds. Remove the aerial from the aerial terminal of your set, and join the aerial to the moving vanes of the differential condenser. One set of fixed plates is then connected to the aerial terminal of the set, whilst the other set of fixed plates is joined to the earth terminal. The condenser can be either fitted to a small piece of wood or to the cabinet.

BEST ARRANGEMENT FOR AERIAL

"Having removed to a house in the busy part of the town I am rather cramped for space to erect an aerial. The greatest horizontal length which I can possibly obtain is 20 feet, so, to make the best use of this, I propose to employ a "sausage" aerial consisting of six strands arranged round two strong hoops. Before going to the expense of purchasing the necessary parts, however, I would like to have your opinion and any suggestions you might offer."

For general reception purposes there is nothing to be gained by using more than a single aerial wire unless the strands can be kept at least 5 feet apart. Even then the improvement over a single wire is very slight. You are advised to use a single wire and elevate it as much as possible, for *height* is the main consideration. It might be added that enamelled wire is best for use in towns, where smoke and fumes are more prevalent, because it resists corrosion and oxidation to a much greater extent than does bare copper. As regards the gauge of wire, you cannot do better than the old-fashioned stranded 7-22's.

FREE ADVICE BUREAU COUPON

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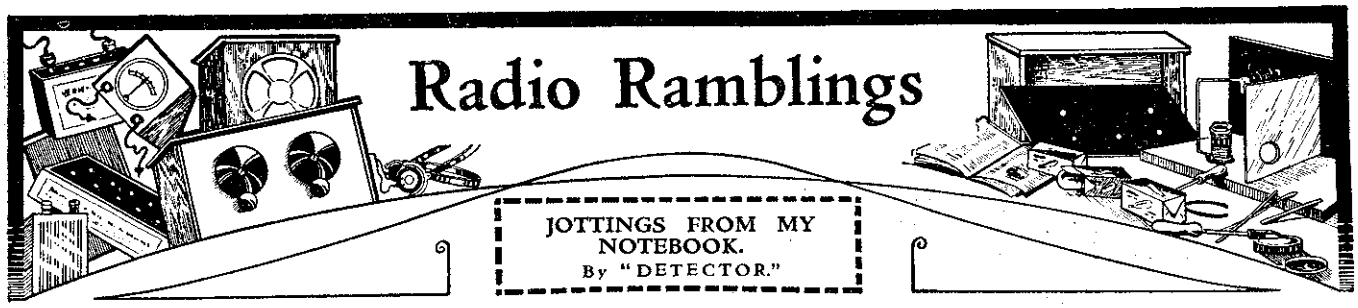
PRACTICAL WIRELESS, 8 10/32



Radio Ramblings

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

A Cure

SHORT waves breaking through on the long waves may be overcome by inserting a suitable choke in series with the aerial lead. The choke should offer a high impedance to signals on the 200-600 metre waveband, but not to those on wavelengths above 1,000 metres or so. In addition, the choke should be of small dimensions to avoid magnetic coupling with other components. A suitable "stopper" choke, as it is called, can be made roughly by winding 300 turns of 40 gauge enamelled or silk-covered wire round a short end of pencil. There is no need to keep the turns even; indeed, it is better to pile them up so as to reduce the length of the winding. A neater job can be made by putting the windings in a couple of slots turned in an ebonite rod. Use $\frac{1}{4}$in. diameter rod and make two slots $\frac{1}{4}$in. deep, $\frac{1}{16}$in. wide and $\frac{1}{10}$in. apart. The choke must be short-circuited for medium-wave reception, so this will in some cases involve the fitting of a two-pole switch in place of the normal single-pole one used for wave-changing. In other cases it might be possible to modify the wiring to the existing switch to make it serve both purposes.

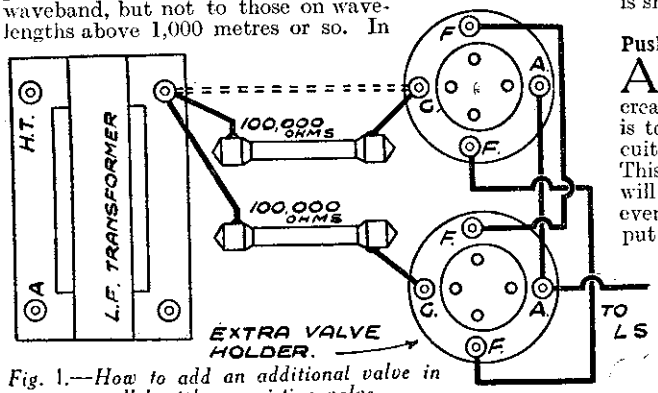


Fig. 1.—How to add an additional valve in parallel with an existing valve.

Power Valves in Parallel

DO you want more volume and power from your set? If so there are two ways of obtaining it provided that the output from the detector valve is adequate. You can tell whether the detector output is adequate by noticing if distortion occurs when the speaker is delivering maximum volume. Distortion points to the fact that the last valve is being overloaded. One way of increasing volume and at the same time preventing distortion is to substitute a larger power valve for that already in use, and another is to connect a second valve in parallel with it. These are well-known methods, but before adopting either of them make sure that the H.T. and L.T. supplies are adequate for the new conditions. Also, if the speaker is connected directly in the anode circuit remember that the current passing through its windings will be increased. When two valves are to be connected in parallel they should be of exactly similar types, whilst it is a great advantage to de-couple them by putting a stopping resistance of from 50,000 to 100,000 ohms in each grid circuit. The method of connecting the resistances is shown in Fig. 2.

Push-pull Amplification

A BETTER but more expensive way of increasing the output volume is to use the push-pull circuit for the output stage. This form of amplification will give increased volume even when the detector output is only of moderate magnitude. It is particularly useful when the available H.T. voltage is too low for one of the larger power valves. The circuit is shown in Fig. 3, where it will be seen that a pair of special transformers (one input and one output) are required. The secondary winding of the input transformer is centre-tapped, the tapping being connected to grid bias negative. Each end of the winding is connected, preferably through a decoupling resistance to prevent instability, to the grid of one of the output valves.

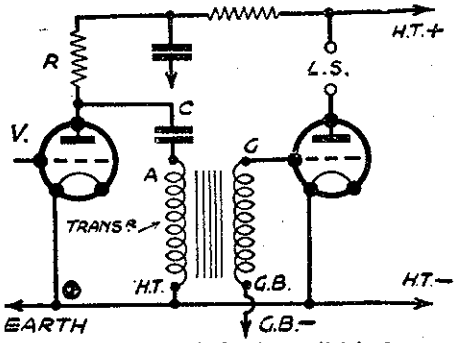


Fig. 2.—The method of parallel-feeding a transformer.

During reception the positive half cycle of each wave is applied to the grid of one valve and the negative half to the other. Positive and negative potentials are reversed for each wave so that the valves are each receiving positive and negative charges alternately. It is on account of this that the system receives its name, one valve "pushing" while the other "pulls," as it were. The output from both valves is "collected" with a centre-tapped transformer or choke and passed on to the speaker. For push-pull, as for parallel connection, both valves should have reasonably similar characteristics. Manufacturers will supply a matched pair of valves for this purpose without making extra charge.

Power-grid Detection

WHILST talking about methods of increasing the output volume, one's thoughts naturally turn to the use of power-grid detection. Many wrong impressions are current in regard to this form of detection, so I would like to correct some of them here. The circuit of a power-grid detector is the same as that of a grid leak detector, but the values of grid condenser and leak are usually lower; about .0001 mfd. and .25 megohms respectively are average ones. Because of this a number of amateurs, and even self-styled experts as well, have used the lower values of components and fondly imagined that they have created a power-grid detector. They have been quite wrong, of course, because the principal thing about a valve acting as a power-grid detector is that it operates on a different part of its characteristic curve. To do so it is absolutely essential that it should receive an anode voltage of at least 120, and usually a good deal more.

The next common fallacy is that a power-grid detector gives greater amplification, and hence more volume. This is untrue; it will *handle* more volume without distortion, but to do so it must receive a larger input from the S.G. amplifier or aerial. It will be clear from this that no advantages are conferred by its use unless it is preceded by a high-gain S.G. amplifier or the set is connected to an aerial situated only a few miles from a powerful transmitter.

Metallised Valves

WHEN making a battery set it is usual to assume that it does not matter to which filament terminals of the valve-holder the positive and negative L.T. connections are made. This assumption is correct when ordinary valves are employed, but not when metallized ones are in use. The reason is that the metal coating is

(*Continued on page 160.*)

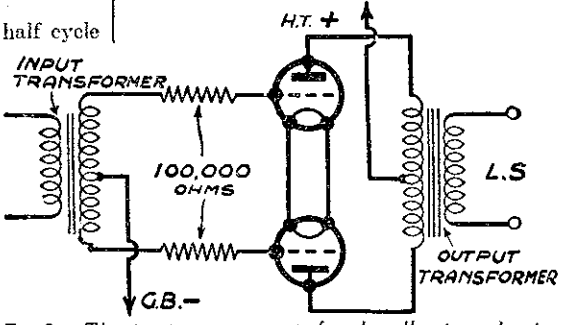


Fig. 3.—The circuit arrangement of push-pull valves, showing the resistances arranged for ensuring stability.

Radio Ramblings

(Continued from page 158.)

intended to act as a screen and to do so it must be connected to earth. In the valve itself the screen is connected to one filament pin, so the wiring must be so arranged that that pin is earthed. As L.T. — and H.T. — leads are almost invariably joined together and to earth they should be connected to the same valve pin as is the metallised screen. The valve-holder terminal corresponding to the "screen" pin is shown in Fig. 4. Even if ordinary valves are employed it is advisable to make the connections as described because when a valve requires to be replaced it might be an advantage to choose a metallised one. These metallised valves nearly always give slightly better results than plain ones, because the screening makes them more stable in operation. They are particularly useful in a portable set where stability is often difficult of attainment.

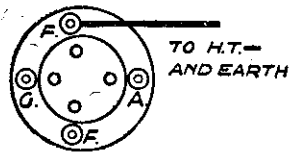


Fig. 4.—Always earth the filament terminal shown so that valves of the metallised type may be interchanged.

Calibrating a Receiver

IT is a great advantage to be able to find any desired transmission in a few seconds, just as it is to be able to identify any station that might be received. But can you do this? You can if you care to spend an hour or so calibrating your receiver. All that is needed is a piece of graph paper and a little patience. First draw two heavy lines parallel to two adjacent edges of the paper and divide each into equal distances. Mark off the horizontal one from 0 to 100 or 0 to 180 according to the number of divisions on the tuning dial, and on the vertical line mark off wavelengths according to the tuning range covered. Next tune in a few of the more powerful stations and take a note of the dial reading for each. Make a small cross corresponding to each station and draw an even line to pass through the middle of each cross. A separate graph can be made for medium and long waves if desired, or a single one can be made to serve for both by making a second wavelength scale.

(Continued on page 161.)

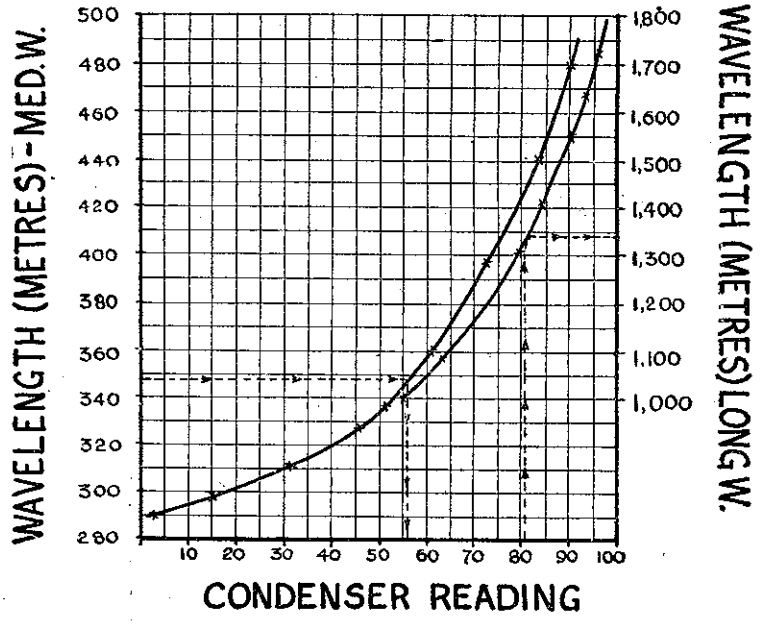


Fig. 5.—How to draw a calibration chart.

Radio Ramblings (*continued from page 160*)

Two curves will then be drawn on the same chart. The method outlined is illustrated by Fig. 5, which shows a calibration chart for a three-valve receiver.

Using a Calibration Chart

NOW let us take examples of the use of our chart. Suppose we wish to listen to Barcelona, for instance, the wavelength of which is 348.8 metres. We find the wavelength on the left-hand scale, draw a horizontal line to meet the curve and from the point of intersection draw a vertical line to meet that scale showing "Condenser Reading." This gives the position on the dial as 56 degrees. On the other hand, suppose a station was received at 81 degrees on the long waveband and we wished to establish its identity. We should draw a vertical line from 81 degrees to meet the curve and then take a horizontal one across to the wavelength scale. This shows the wavelength to be about 1,340 metres, and by making comparison with any published list of stations, it is not difficult to identify the station as Motala on 1,348 metres. Both examples are shown by broken lines on the chart illustrated.

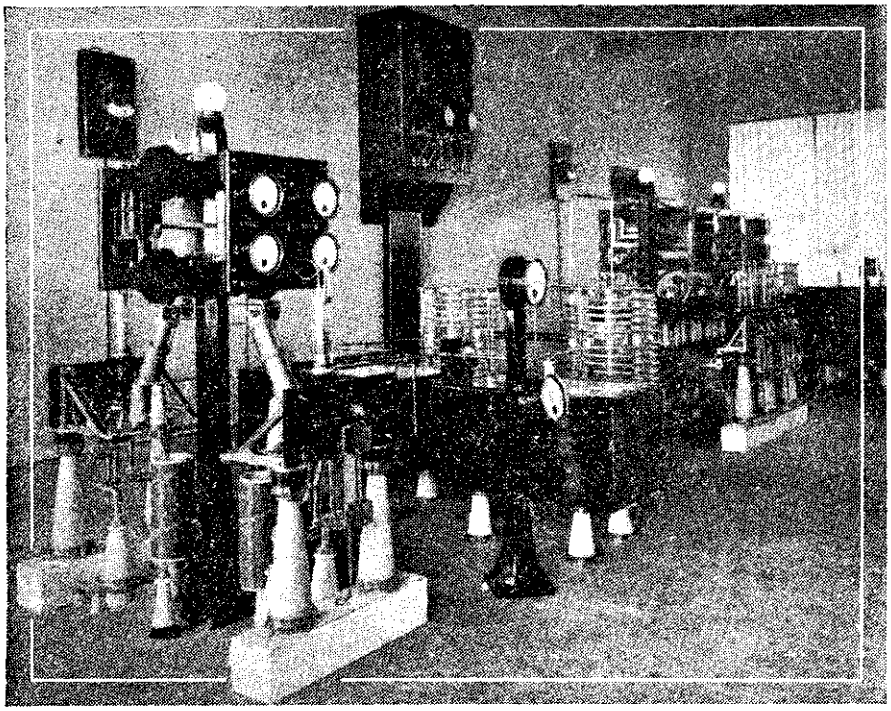
MAKING GOOD SOLDERED CONNECTIONS (*continued from page 154*)

and clean up with a file on the faces, subsequently tinning as described.

Always scrape the surface of a plated part where it is to be soldered.

Lightly tin the piece to be soldered and the end of the wire or part to be attached. Make the joint by picking up a bead of solder with a heated iron. Never apply the solder direct.

PRAGUE'S GIANT BROADCASTER. NEW 200 kW. RADIO STATION



The new radio station is situated in the geographical centre of Europe, some 35 kilometres east of Prague, in the vicinity of the small town of Cesky-Brod. This new high-power broadcasting station is rated at 200 kilowatts (C.C.I.R.), and is the most powerful broadcaster operating in the medium wave broadcast band. The illustration shows: The power amplifier from the front, looking right, at the new Prague broadcasting station.

Coupling and De-coupling.

(Continued from page 139)

have to use double these couplings, as shown at Fig. 6.

Returning to the question of actual values, it has been indicated what the two decoupling components should total, and it would appear at first sight that the cheapest method would be to use 400,000 ohms with 1 mfd., but unfortunately such a value of resistance will often throw away too much of the high-tension voltage. The amount of voltage lost over the resistance is extremely simple to arrive at, it merely being necessary to multiply the resistance by the number of milliamps passing and knock off three noughts. For example, if the anode resistance were only 30,000 ohms, and the current 3 milliamps, multiply these two together and the result is 90,000; knock off three noughts and it will be seen that the loss of voltage would be 90. Thus the matter has to be approached in the following manner. Decide first of all what voltage it is desired to apply to the detector stage and subtract this from the H.T. battery voltage, which will leave the amount that may be sacrificed in the interests of decoupling. Say 80 volts is required on the detector, and the battery voltage is 120, then 40 volts can be spared. Now reference to the valve curve or the use of a milliammeter will show what current the valve is taking. Suppose it is taking 3 milliamps; it is now desired to find what resistance will drop 40 volts when 3 milliamps is flowing. This is arrived at by dividing the milliamps into the voltage, when the answer will be the number of thousands of ohms required.

Continuing with our example, if we divide the 3 milliamps into the 40 volts, this goes approximately 13 times, and as the answer is in thousands of ohms, the resistance will be 13,000 ohms. The nearest value obtainable will be 15,000 ohms, which will have to be associated with a 4 mfd. condenser in order to reach the 40,000 which we have indicated as being a general figure for safety.

This is a little complicated to work out, but Table No. 2 indicates a number of values from which it will be simple to arrive at any intermediate figure.

When decoupling a first L.F. stage, the result of multiplying the resistance and condenser can usually be lowered to 30,000, which is fortunate, as otherwise the relatively large anode current, which results in small values of resistance, would result in the use of large and expensive condensers.

In conclusion, when working out the decoupling resistance for a detector valve that is resistance-coupled to the next valve, the decoupling resistance can usually be half the value of the anode resistance, associated with the necessary condenser to give a combined value of 60,000, as already explained.

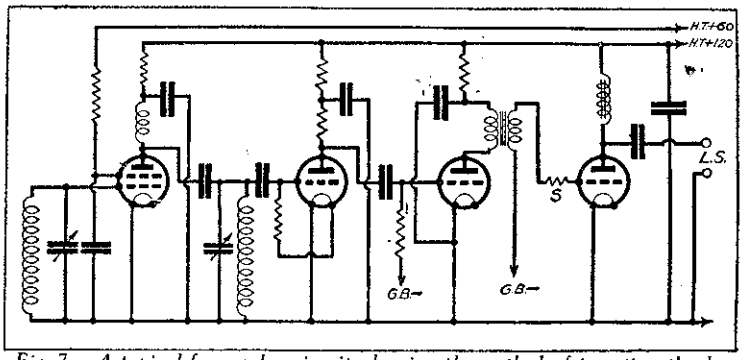


Fig. 7.—A typical four-valve circuit showing the method of inserting the decoupling resistances.

The Mains Express Three

(Continued from page 144)

be attached; the other lead should be attached to the mains terminal which is marked with a voltage that corresponds to the house-lighting voltage. For example, if the voltage is 230 volts, the lead will be attached to the terminal marked 230. Do not in any circumstances remove the other lead from the terminal marked 0. When making these connections be very careful that a loose strand of wire does not escape, as it might touch one of the other terminals. It is advisable to bare a length of flex that is long enough to be twisted into a proper loop for this purpose.

Having made sure that all the connections are correct and that the mains leads are connected to correspond correctly with the house-lighting voltage, the aerial and earth should be connected; in general the former should not exceed 40ft. in length, including down-lead. Next connect the loud-speaker, which should preferably be a moving coil, and insert the mains lead, which will previously have been connected to a bayonet plug or two-pin plug, whichever is convenient.

Trying Out the Set

As the valves are of the indirectly-heated mains type, a few seconds must be allowed for them to warm up, then switch to long or short waves as desired: push in for long and pull out for short, set reaction control to minimum—that is, with moving plates out of mesh with the fixed plates—and turn volume control full on, then explore the ether by means of the tuning condensers. If a station is too loud when picked up reduce it by means of the volume control. If, on the other hand, it is very distant, and consequently weak, bring it up to full volume by means of the reaction condenser. Note that the tuning condensers should be slightly readjusted after resetting the reaction condenser. It is probably necessary again to point out that the reaction control should be used with a great deal of discretion, as the excessive use of this method of increasing signal strength results in very bad distortion. Owing to the way in which reaction sharpens the tuning, a very definite "side-band" cut-off is obtained and this results in a woolly, or muffled tone.

It may be that the required station is being interfered with by another, in which case proceed as follows: Reduce the volume control until the unwanted station has almost disappeared; this will also reduce the volume of the wanted station, but by increasing the reaction and slightly retuning, it will be found that the wanted station will appear without the unwanted one, unless, of course, they are so near each other that no set will separate them.

The tuning of the Variable Mu Three can be thoroughly mastered in a couple of hours, when it will be found that station after station will roll in without difficulty. The volume of this receiver is amazing, while the quality of reproduction that has been obtained by careful design and tone compensation will delight and amply reward the constructor.

It should perhaps be pointed out that the small fuse which is supplied with the special model of the Sound Sales Mains Transformer should be inserted in the appropriate pair of clips. This will prove to be a valuable safeguard against any damage arising from short-circuits.

CATALOGUES RECEIVED

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state, on a postcard, the names of the firms from whom you require catalogues, and address it to "Catalogue," PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8/11, Southampton St., Strand, London, W.C.2.

TUNEWELL COMPONENTS

AMONG the new components shown in the latest folder issued by Tunewell Radio, Ltd., are well-finished sets of screened band-pass coils having a range of 200-2,000 metres. The coils are wound on ribbed ebonite formers and are accurately matched to within one half per cent. They are mounted on bakelite bases containing switches with phosphor bronze springs and ebonite actuating cams.

B.T.H. PICK-UPS AND TONE ARMS

MANY of the cheaper pick-ups available are incapable of reproducing the wide range of frequencies impressed on a modern electrically cut record. To ensure a musical output of the highest quality a high-class pick-up, such as the new B.T.H. "Minor," should be used. This instrument is sensitive over a range from 50 to 5,000 cycles, and gives an output of ½ volt at about 990 cycles, thus ensuring a good volume and a high quality of reproduction. Full particulars of this model, and also the B.T.H. Senior De Luxe Pick-Up and Tone Arm, are given in a neat folder we have just received from the Edison Swan Electric Company, Ltd.

HEAYBERD MAINS APPARATUS

THE well-known firm of Heayberd—manufacturers of practically all types of mains apparatus—have sent us their 1933 catalogue. The home constructor will find this a veritable mine of information, as, instead of being simply a list of their products with prices, this book gives technical tips, and complete circuit diagrams for making up various types of eliminator. With the diagrams is a list of all the components for these eliminators, with prices, enabling any constructor to make up a mains unit to suit both pocket and technical requirements. A pocket attached to the inside of the back cover is intended to hold such leaflets as may be issued by Messrs. Heayberd. This is one of the most informative catalogues we have yet seen, and no constructor should be without one. The address is 10, Finsbury Street, London, E.C.2.

Broadcast Query Corner

UNDER the above title, with the assistance of a recognised authority on foreign broadcasting matters and a regular contributor to wireless publications both at home and abroad, we are inaugurating a special Identification Service, which should prove of great assistance to our readers. When tuning in well-known stations it happens frequently that listeners pick up wireless transmissions of which they fail to recognise the origin. It is to solve these little problems that the *Broadcast Query Service* has been organised.

In order that a careful search may be made it is essential that certain data should be supplied to the best of the inquirer's ability and knowledge. When sending such queries to the Editor the following rules should be followed:—

1. Write *legibly*, in ink. Give your full name and address.
2. State type of receiver used, and whether transmission was heard on headphones or on loud-speaker.
3. State approximate wavelength or frequency to which receiver was tuned, or, alternatively, state *between* which two stations (of which you have the condenser readings) the transmission was picked up.
4. Give date and time when broadcast was heard. Do not forget to add whether *a.m.* or *p.m.*
5. Give details of programme received, and, if you can, some indication regarding the language, if heard.
6. State whether and what call was given and/or kind of interval signal (metronome, musical box, bells, etc.) between items.
7. To facilitate publication of replies, append a *nom-de-plume* to your inquiry.

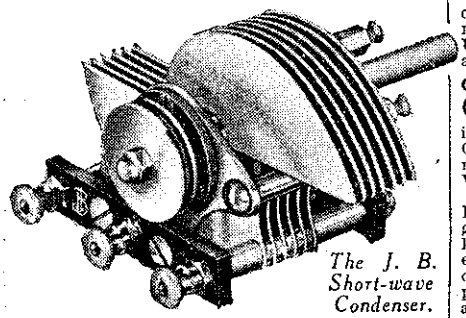
Although the service is mainly applicable to broadcasting stations, wherever possible replies will be given in regard to morse transmitters (commercial stations, fog beacons, etc.) and short-wave broadcasts. For the indentification, however, of stations operating on channels *below* 100 metres it will be evident to inquirers that a closer estimate of wavelength must be submitted than in the case if broadcasts on the medium or long waveband, if successful indentification is to be carried out.

All inquiries should be addressed to *The Editor*, PRACTICAL WIRELESS, 8-11, *Southampton Street, Strand, London, W.C.2*, and the envelope marked *Broadcast Query Service*, in top left-hand corner. Stamped addressed envelope should *not* be enclosed, as replies cannot be sent by post, but will be published in due course in each issue of PRACTICAL WIRELESS.

AROUND THE TRADE

JACKSON BROS., SHORT-WAVE CONDENSER

THIS is a neat little condenser designed in every detail for short-wave working, and has many novel features. No current is carried by the bearings, and a special screened pigtail connection to rotor is used. The minimum capacity is very small and the maximum is true to rating. Such insulating material as is used is carefully placed and proportioned so as to reduce H.F. losses. The frame has been designed



The J. B. Short-wave Condenser.

to avoid, as far as possible, closed loop effects. Obtainable in 5 capacities from .00005 to .00025, the price is 3s. 9d. The overall dimensions of the .00015 size (including sweep of vanes) is 3⅝in. by 2¾in. by 2¼in.

MAGNACORE TRANSFORMER

A NEW development which promises to revolutionize the manufacture of low frequency transformers is announced by Magnacore Limited, of 57, James Street, Camden Town. By the use of a new core metal known as microcetic alloy, it is claimed that transformers of exceptionally high efficiency can be produced at a much lower cost than hitherto. Various types of Magnacore transformers, embodying the new core metal, are now in production as well as a novel combined parallel feed transformer, condenser and resistance, to be known as the Magnacore Passfeeda Unit. Price and other details have not yet been announced.

OSRAM VARIABLE-MU TWO-VOLT VALVE

OWING to the desire which has been expressed in many quarters for a "variable-mu" valve in the 2-volt battery range, the General Electric Company, Ltd., have developed for the market a new valve of this class to be known as the Osram V.S.2.

The Osram V.S.2 is fitted with the Wembley Filament, which has been proved to have a 10 per cent. greater electron emission per watt than any other known filament in production. Owing to this electron efficiency, the high values of mutual conductance, common to Osram 2-volt battery valves, are obtained purely by utilization of the ample electron emission, and not by reduction in electrode clearances.

The characteristic of the Osram V.S.2 is a mutual conductance sufficiently high to provide very good sensitivity when used as a screen-grid single stage H.F. amplifier, but not too high to introduce instability if used in a two stage amplifier, under which condition the principal benefit of the "variable-mu" valve is felt.

The requirements in the way of grid bias are moderate, a 9-volt battery sufficing to reduce the slope to 0.05 ma/volt, while a 15-volt battery will reduce the volume of signals to practically zero. The variable grid bias may conveniently be obtained by the use of a high resistance 50,000 ohm potentiometer connected directly across the grid battery, and open circuited when the set is not in use.

LOTUS

AMONG the many new components introduced this season by Lotus Radio are the following:—

L.F. Transformer No. 1. This is a cheap transformer specially designed for the home constructor. While small in size, specially designed windings and core give high efficiency, good reproduction and an exceptional straight-line amplification curve. It is enclosed in a neat brown bakelite moulding. In ratios of 3 or 5 to 1, the price is 5s. 6d.

DIRECT RADIO ADVERTISEMENT, SEPT. 24th ISSUE.—CORRECTION

We are asked by the Direct Radio Ltd., of 159, Borough High Street, London, S.E.1, to state that an error occurred in their advertisement appearing on page 44 of our issue for September 24th. These are as noted here: *Kit No.* 2. £3 15 9. This should read 7s. down and 11 Monthly Payments of 7s. *Kit No.* 3. 9s. down and 11 Monthly Payments of 9s.

IN QUEST OF QUALITY

(Continued from page 129)

employ loud-speakers with large horns, and they seem to be capable of a very fine performance.

Power

A very important point, apart from the speaker and receiver, is the volume at which the reproduction is required. Where only a very small room is to be used it would obviously be absurd to reproduce say a Guard's band at its original strength, and alternatively the volume to which you would listen in that room would be ridiculous in a large hall. Therefore, there is not the same need for fidelity for the small set user as for the public address man, but there is still the necessity for arranging that the receiver will handle comfortably the entire musical range. The principal considerations are ample H.T., and correct choice of valves for each stage. If you examine the receivers used for public address work, you will find that 500 volts is quite a small value to employ for the high tension supply, and such schemes as valves in parallel or push-pull are adopted to make up for the short comings of the valves. Therefore, it is no use seeking real quality with an antiquated loud-speaker, and a two valver with 60 volts H.T., although, as pointed out in the opening paragraphs, this may satisfy some listeners.

ADVERTISEMENT INDEX

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