DETECTOR DEVELOPMENTS

Practical Wireless

3D.

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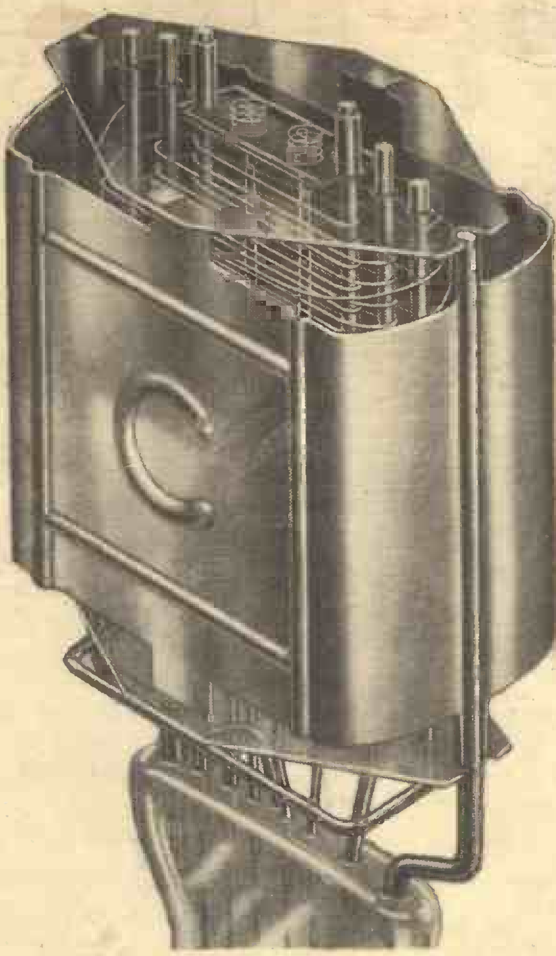
Also in this issue

- Making a Speaker
- An All-Wave Receiver
- Picnic Aerials
- Making Short-Wave Chokes, etc., etc.

UNIFORMITY EFFICIENCY LONG LIFE

BETTER RADIO RECEPTION



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WAIT FOR OUR TELEVISOR!—

Practical Wireless

EDITOR:
Vol. II. No. 41 || F. J. CAMM || July 1st, 1933
Technical Staff:
H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.M.I.E.E.
W. J. Delaney, Frank Preston, F.R.A., W. B. Richardson

ROUND *the* WORLD *of* WIRELESS

Still Forging Ahead

THE number of receiving licences in force in Great Britain at the end of May, 1933, was 5,576,500 owing to an increase of 289,400 during that month. The six million mark should be reached very soon and the Radio Exhibition in August, no doubt, will give us a good start towards the seventh million. Great Britain is "well away" at the top of the list of European broadcasting systems.

National Broadcast of a German Trial

IN one of the Berlin Law Courts the Ministry of Propaganda, similar to the custom prevailing in Russia, has installed microphones in order that the proceedings may be recorded and later, at a more convenient hour, broadcast through the transmitters.

Tuning by Light

ACCORDING to the *New York Times*, Paul MacGahan, an engineer of the Westinghouse Electric and Manufacturing Company of America, has invented a "shadow" meter which greatly facilitates the accurate tuning of a wireless receiver. The gadget consists of a small rectangle of transparent material in the front of the cabinet, over which a shadow travels, as the station is tuned in. At the outset the darkened line is a broad one which gradually narrows as the set is tuned close to the desired frequency. The meter itself is formed by a small aluminium vane which is mounted on a moving coil and in front of which a small shutter has been secured which masks the rays cast by a small lamp. In its normal position, namely, between stations, the shutter blocks out the light rays and thus provides a wide shadow. As the condenser dial is turned and the set tuned, the small vane revolves until at the moment sharp tuning has been reached; the shutter is almost parallel to the rays of the lamp thus casting the narrowest shadow or hair-line on the meter dial.

Teaching Americans the Technique of Speaking

AT Georgetown University, Washington (D.C.), special classes have been formed for training students in the technique of speaking before the microphone. In this way, it is believed, public speakers may be trained, as for radio talks slovenliness in speech must be completely avoided.

Linking Up Swiss Radio

THE Swiss broadcasting system, with the recent addition of Monte Ceneri, has now permitted the interlinking of Beromünster, Sottens and Radio Lugano not only with the principal Swiss centres but also with cities in neighbouring countries. Special pupinized cables through Geneva and Lausanne will allow concerts from Paris, Lyons, or Marseilles to be broadcast through Sottens; Basle feeding Beromünster, connects Switzerland with Strasbourg or Frankfurt-am-Main; Zurich with Stuttgart and Berlin, or through St. Gall with Vienna, and Monte Ceneri through Lugano can transmit programmes emanating from Milan and Rome. In addition, the Post Office authorities have organized a service which will allow 300,000 telephone subscribers to listen to these radio entertainments.

THE STANDARD—

"Practical Wireless" on September 24th last created an entirely new standard in radio journalism. *It guarantees* receivers described in its pages to function in the manner claimed, and to give *free advice* to every reader!

THE STYLE—

It is naturally a source of extreme satisfaction to us to observe that so many of our features have been copied, thus paying tribute to our originality and enterprise.

—AND THE PACE

"Practical Wireless" always publishes first-hand information on the latest developments *immediately they are available to the public—not before!* An inspection of our pages to date will show that we faithfully observe our duty to the reader in providing accurate and up-to-date information—in a phrase, *real, reliable, and unrivalled reader service!* We shall continue to watch and to safeguard the interests of the home constructor!

Monte Carlo on the Air

OWNERS of wireless sets capable of receiving distant and low-powered stations should tune into Nice-Juan-les-Pins (249.5 m.) on the evening of July 8th, when the studio will relay a concert from the Terrace of the *Monte Carlo Kursaal*. The station proposes to carry out a series of similar relays during the season.

German Interval Signals

ALTHOUGH, for the majority of its broadcasts, Nürnberg relies on the mother station, Munich, for its programmes, the two studios have different interval signals. Nürnberg has adopted a five-note phrase from *The Mastersingers*, and Munich a short theme from Wagner's *Parsifal*. Both are given in the form of bells.

Tuning in the Brewery!

SEVERAL of the Milwaukee and St. Louis breweries have installed wireless transmitters at Headquarters for the purpose of direct communication with their motor lorries. In this manner, cars fitted with receivers can receive immediate instructions regarding the delivery of beer. In some instances, these motors possess apparatus allowing them to remain in constant touch with the brewery.

Radio Tessin's Interval Signal

THE Monte Ceneri transmitter now testing temporarily on 1,145 m., as an interval signal has adopted the chimes of the bells of the *Campane di Pazzalino*, an old church in its immediate neighbourhood.

Through Strasbourg to Verdun

THE Strasbourg studio is widening its sphere of action and promises during the summer a series of interesting relays of celebrations taking place at Metz and also at Verdun. Unfortunately, France, generally, is badly supplied with cables suitable for the transmission of music, and until special pupinized lines have been laid, overhead cables must be used for these relays.

ROUND *the* WORLD *of* WIRELESS *(Continued)*

French High-power Station

WORK has already been started on the 120-kilowatt PTT transmitter to be installed at Thourie, some 40 miles to the North of Nantes, and it is expected that the station will be working towards the end of the year. If the French papers are to be believed the number of wavelengths available in the new Lucerne Plan for France will not permit the inclusion of special channels for the privately-owned transmitters, and on this assumption, with the bringing into operation of Thourie, such stations as Radio Normandie (Fécamp), Radio Lyons, etc., may be compelled to close down. It is further reported that the sum of two million francs has been voted for the reconstruction of the Pontoise *Poste Colonial* short-wave transmitter, and that the power is to be increased from 15 to 50 kilowatts.

Belgian Railway Radio

THE great success obtained by the installation of a wireless receiver and loud-speakers in one of the Belgian expresses has induced the authorities to consider a similar equipment of a large number of trains running on the Arlon-Brussels-Ostende route, and between Liége-Charleroy-Mons and Paris. The carriages will also be supplied with headphones for the use of travellers.

Jamming the Russians

APPARENTLY Soviet propaganda broadcasts can no longer be heard by German listeners, as on evenings when special transmissions are given for their benefit, the Nazi authorities jam the wavelengths used by Moscow and Leningrad. French radio fans complain that when the Radio Strasbourg news bulletins contain references to German political matters, the broadcasts are also subject to interference. If this is the case, all the heterodyning on the broadcast band is not necessarily accidental!

Spain's High-power Station

THE original plan for the reorganization of the Spanish broadcasting system is making progress, inasmuch as the government has officially stated that the sum of four million pesetas has been earmarked for the construction of a 100 kilowatt transmitter at Madrid; it will, however, be entirely under State control. Economic conditions may not permit the installation of big stations at Barcelona, Valencia, and San Sebastian, but a promise has been made to increase their power to 20 kilowatts.

Radio Toulouse

ALTHOUGH on various occasions it has been stated that the French State had definitely refused to authorize the working of the new St. Agnan high-power transmitter, it is now rumoured in Paris that the Minister of Posts and Telegraphs has unofficially declared that a permit may be granted to the new station within the next few weeks.

INTERESTING and TOPICAL PARAGRAPHS

French Broadcasting Bill

NOTWITHSTANDING considerable opposition the French Government has succeeded in passing the new bill concerning radio receiver licences and taxes on valves, which is to provide an income for the transmitters to whom authority to broadcast wireless programmes is granted. The French listener, who so far has received such entertainments without payment, must now pay a fee of roughly 8s. (at par) per annum for a valve set and the equivalent of 2s. 6d. for a crystal receiver. In addition, a tax is levied on valves; it varies according to the value from 6d. to 10d. per unit. In order to encourage educational institutions to listen to lectures and talks provided by the State studios, public schools will not be required to pay these taxes.

THE KING'S RECORD PRESSED.

A few late workers at the H.M.V. factories at Hayes looking at the first pressing of a record of The King's Economic Conference Speech, which was made by "His Master's Voice" and broadcast the same evening by the B.B.C.

SOLVE THIS!

Problem No. 41.

Hepworth had a two-valve Det.-L.F. transformer-coupled set which gave good reception. Wishing to increase the volume, however, he converted the set into a three-valver with two L.F. stages. The first of these was R.C. coupled and the second, transformer-coupled. After the set had been altered Hepworth found that it would not oscillate at all on the long waves, and only over a few degrees of the dial on medium waves, unless a higher voltage than previously was applied to the detector high-tension positive tapping. Why was this?

SOLUTION TO PROBLEM No. 40.

When fitting the grid-bias plugs to the flexible leads, Smith had inadvertently fitted the negative plug to the positive lead, and *vice versa*. Reversal of the plugs enabled the receiver to function satisfactorily.

The following reader received a book in connection with Problem No. 39. His was the only correct solution received.

T. Pilkington, 1 Law Street, Accrington, Lancs.

Lucerne Wave Plan

WHATEVER decisions are taken at the Conference in respect of the new allocation of broadcasting channels, it is hardly likely that the amended plan will be brought into force before January, 1934. Listeners, generally, in most continental countries will be given six months' notice before the date on which their stations change over to the allotted wavelengths. In the meantime, there is no doubt that considerable testing and experimenting, after broadcasting hours, will be carried out by individual transmitters, but it is evident that the actual "general post" must take place on one and the same date if chaos in the ether is to be avoided.

Holland's 570,000 Listeners

ACCORDING to recent statistics there were 280,610 owners of wireless apparatus in Holland in April, 1933, and a further 291,628 subscribers to the radio distribution network. The proportion of listeners to population is high, working out at roughly 7 per cent. No registration is in force in Holland, and figures relating to the number of wireless enthusiasts are based on the membership of broadcasting associations; it is therefore estimated that Holland must possess at least another hundred thousand or more "free lances."

Switzerland and the Lucerne Plan

ALTHOUGH definite wavelengths have not yet been allotted, there is a likelihood that some alteration will be made in the channels allocated to the Swiss transmitters. Beromünster, however, will probably work on about 539 metres, and Sottens will take over the frequency now used by that station. On the other hand, although Monte Ceneri has carried out tests on 1,145 metres, there is every possibility that it may have to work on the lower part of the broadcast band.

Vienna Retains its Position

LITTLE change is expected in the wavelength of the new Bisamberg transmitter; it is probable that it may be told to transmit on 515 m. as against 518.1 m., to which, up to the present, it has been tuned.

School of Accountancy: Change of Address

WE are informed that the School of Accountancy has removed its headquarters for England and Wales to Bush House, London, W.C.2, which is one of the most modern office buildings in Europe and, in its new headquarters, the school has installed a highly efficient organization, which must prove of great advantage to its many students at home and abroad.

H.M.V. Move

AS from June 1st, the new address of the Gramophone Co., Ltd., is 98-108, Clerkenwell Road, London, E.C.1.

IRON CORE COILS

by HANS VOGT

IMPROVEMENTS IN THE NEW TUNING COILS EXPLAINED BY THE INVENTOR

"Practical Wireless" always gives first-hand information!

INVENTING, it is true, is an art, and any new development of fundamental importance, based on a good and sound new idea, is what we call an "invention." Yet, important as it is, the good idea is only the initial step, and sometimes more spirit and work is involved in turning an invention into practice, and adapting it to the technical requirements, than in the initial inventive idea.

So, after having found the principle of the new iron cored coils satisfactory further work meanwhile has been done to adapt the new principle to the practical requirements of radio technique, and to utilize the chances it offers to the utmost possible extent.

Before describing the latest improvements thus achieved in Ferrocart coils, the fundamental considerations which induced me to create the new coils may briefly be outlined.

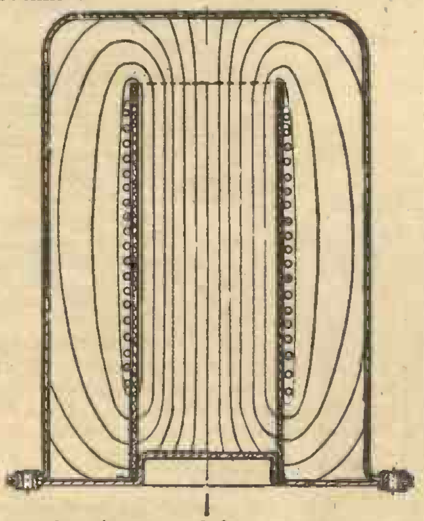


Fig. 1.—An air coil has a weak magnetic field, the lines of force are strayed out and many turns of wire are required to attain a certain amount of inductance.

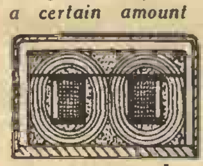


Fig. 2.—By introducing an iron core the field is greatly intensified and concentrated, therefore much less turns of wire are required to obtain the same amount of inductance.

Physical Considerations

From a physical standpoint it is a very simple fact that the dimensions of a coil can be considerably reduced by winding it on a magnetic core, while the efficiency is increased simultaneously by the core. Fig. 2 will demonstrate this. The air coil

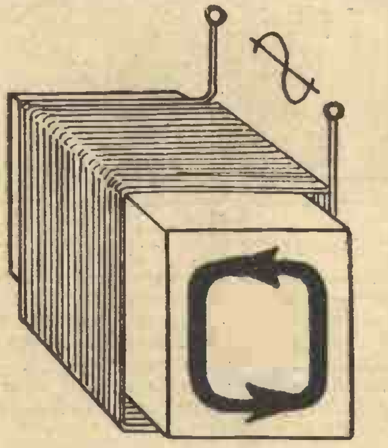


Fig. 3.—In a solid iron core, considerable eddy current losses are induced by the alternating magnetic field.

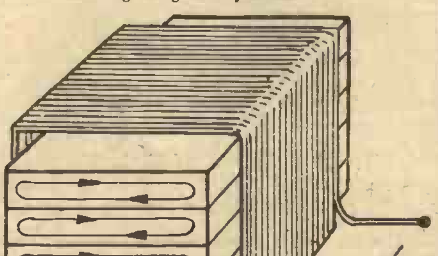


Fig. 4.—In the case of low frequency, these eddy current losses can effectively be avoided by building up the core of many sheet iron laminations. As the eddy current losses are increasing with the square of the frequency this method cannot be transferred to high frequency.

on the left, (Fig. 1.) although being large, has a very weak magnetic field, and a great deal of the lines of force are strayed out. By introducing an iron core (coil on the left) the lines of force are concentrated and intensified; therefore, much less turns of wire are required to obtain the same amount of inductance. By reducing the length of wire required, the ohmic resistance of the coil, of course, is greatly reduced, and, due to the concentration of the magnetic field and avoiding of leakage field, any screening cover may be arranged very closely to the coil, and no additional losses will be produced in it by the leakage field.

Practical Difficulties

Accordingly, you might think it a very simple matter to make a small and highly efficient high-frequency coil by simply winding it on a magnetic core. Practically, however, it is not possible to do so; on the contrary, a simple test will show that the losses of a H.F. coil are advanced enormously by introducing a piece of iron into its interior space. This is because very considerable eddy current losses are induced in a solid core (Fig. 3). To prevent these eddy current losses, the core of low-frequency transformers and chokes is built up of a plurality of thin sheet iron plates with intermediate insulating layers (see Fig. 4). However, as I ascertained by tests in my laboratory, even this method cannot be applied in case of high frequency, for the eddy currents are increasing with the square of the frequency, and so they are one million times higher at a frequency of 1,000 *kilo*cycles than at a frequency of 1,000 cycles. I, therefore, tried to build up the core of insulated iron powder as per Fig. 5, but as it is very difficult to safely insulate the particles from each other and to prevent capacitive coupling between the particles, no definite success could be obtained even by this method.

A New Idea

Having found out that neither the finest lamination nor subdivision into pulverous material is sufficient alone, I tried to combine both methods, arranging very small

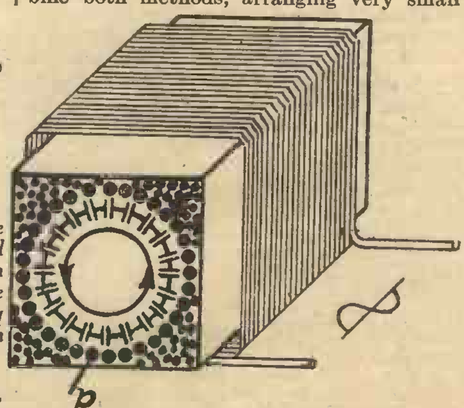


Fig. 5.—A core made of iron particles mixed with insulating material. It is impossible absolutely to insulate the particles and prevent eddy current losses in this way, as there are forming dielectric displacement currents due to capacitive coupling between the particles.

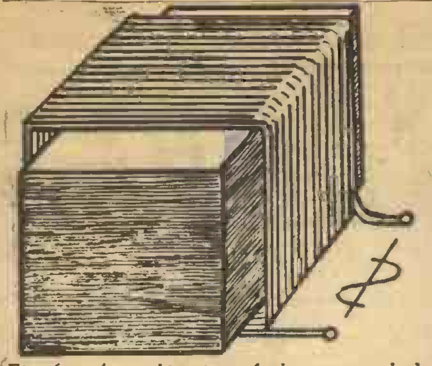


Fig. 6.—A combination of the two methods, arranging a mixture of iron particles and insulating material in very thin layers on an insulating material.

insulated magnetic particles in very thin layers separated from each other by intermediate insulating layers. Already the first tests in this line proved this method to be very effective, and after further improvements as regards insulating methods, size of particles, etc., the Ferrocart in its present form resulted, the structure of which is shown by Fig. 6.

Coil Development

It is one thing to make a new invention, and another to make it practically applicable. So, having developed the suitable magnetic material, the matter was not finished, as considerable work still remained to be done, consisting in creating coils of suitable construction of the new material. Figs. 8 to 10 shows the progress made along this line in the last months, and the great progress of the new coil types as compared with the first toroid coil will be obvious. Special attention has been devoted to convenient construction so as to make the adjusting and fitting as simple as possible, and to create a compact self-contained inductance element. Fig. 8 is a toroid coil of obsolete type. It is difficult to wind, and matching has to be effected by inclining the two halves against each other, putting the coil into a box and filling up the box with a filling mass to solidify the whole. Subsequent matching is not possible. Also the quantity of Ferrocart material required is very considerable.

Fig. 9 is a modern so-called pot-coil. A very small cylindrical coil is automatically wound on a coil-former of insulating material, and is perfectly enclosed in Ferrocart material. Between the Ferrocart pot and the Ferrocart cover there is arranged an air gap, and by screwing down the centre screw this air gap is varied and the inductance varied accordingly. Matching can thus be effected very easily, and re-adjusting is always possible. The shell coil, shown in Fig. 10, is built after the principles of the shell type transformers; the core is stamped out of Ferrocart plates without any wastage in stamping. Fig. 11 is an inductance element embodying coils of this type. The coil in Fig. 11, looking like a little accumulator, is fitted in a transparent cover of insulating material. By a special device the magnetic bridge which is to close the magnetic path of the core can be moved to and fro to vary the air gap. The terminals are arranged in the cover. This little inductance element can be fitted very easily, little holes being arranged in the bottom and cover for this purpose. Also several elements can be arranged in the form of a coil block as per Fig. 12, to form a band-pass filter unit or a short long-wave set.

As is well known, in modern multi-stage receivers with one knob control, it is very important to have accurately matched inductances. In case of air coils, matching has to be made when winding the coils, by removing some of the windings. Subsequent matching of the screened coils fitted in the receiver cannot be realized with air coils, though this would be the ideal way of trimming the set. With the latest construction of Ferrocart coils, on the contrary, this ideal method can easily be applied, and I consider this a very appreciable additional advantage of the new coils over air coils, being of greatest importance from a practical point of view. Comparing the latest types of coils with the first toroid coil, it will be evident that a further important step forward has been done by creating these new types of coils, augmenting considerably the superiority of the new principle of coil construction. The primary advantage of the new coils, of course, consists in their low losses. As you know well, decreased losses mean reduced damping, and so improved selectivity, which is the most important property of a modern receiver.

In conclusion I may point out I always was convinced that, in spite of the rapid progress already realized in the last decade in radio technique, there remained still a wide field open for improvements in the components of radio receivers. Starting from this contemplation, I developed the Ferrocart coils, and I feel sure further progress will follow.

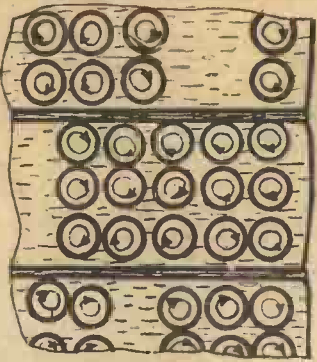


Fig. 7.—The small local eddy currents forming in the compound mass due to insufficient insulation and capacitive coupling, are locked up by the intermediate insulating layers.

Fig. 8.—The first type of coils with Ferrocart core. The coils of this kind are inconvenient to be wound and matched, and although by far superior to air coils they are still relatively clumsy. Subsequent matching is not possible as they must be made stable by putting them into the screening box and filling up the box by a filling mass.

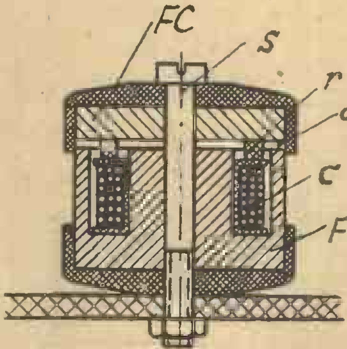


Fig. 9.—A pot coil. The wire coil (C) is completely enclosed in Ferrocart material (F). By handling the centre screw (S) the Ferrocart cover (FC) is approached to the core (F) and the airgap (a) is varied accordingly by pressing together the rubber ring (r). The inductance easily can be matched after the coil is fitted in the receiver, which is a further important advantage of the new coils over air coils and the old Ferrocart coils.

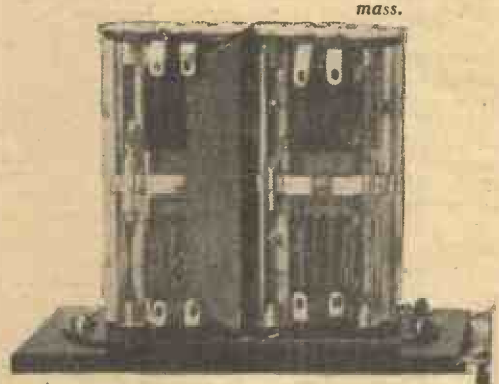


Fig. 12.—Several of the coils of Fig. 11 can be combined in form of a coil block to form a band pass filter unit or a short long-wave set.

Fig. 10.—A shell coil which is very useful from a practical point of view. The thimble gives a comparison of the size.

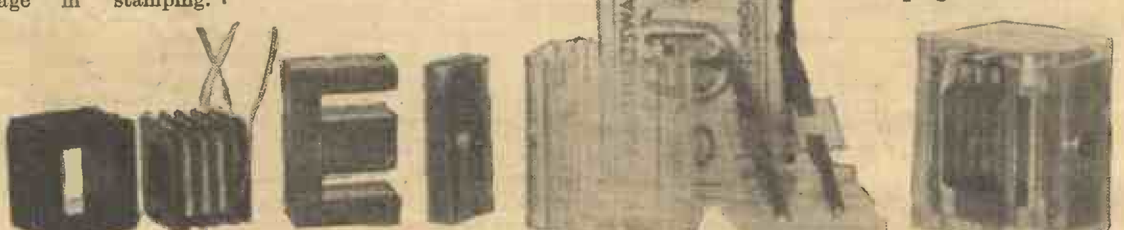


Fig. 11.—An inductance element consisting of a shell type core (a), the wire coil (b), the magnet bridge (c), the transparent casing of insulating material (d), and the transparent cover of insulating material (e). The complete element is shown at (f).

Making an ALL-WAVE RECEIVER

Designed by Togni

In this Article the author tells you how to make a tuner for long, medium, and short waves, and also how to make a "universal" H.F. Choke

As short-wave broadcasting continues to increase in popularity, there is a rapidly-growing demand for all-wave receivers, that is, receivers which will tune, not only to the medium and long-wave bands, but also to the short and ultra-short waves. Innumerable difficulties present themselves when an attempt is made to design sets of that type, but there is no doubt that they will have to be solved in the very near future, if broadcasting is to continue at its present rate of progress.

Of course, it is a simple matter to receive short-wave stations on a standard long-wave set by using an adaptor or converter, but this is not sufficient; the system is clumsy and inconvenient. I have for some time been interested in the problem of all-wave receiver design, and have experimented with a number of different arrangements with varying degrees of success. It is at once evident that an all-wave receiver must be in the nature of a compromise, since the circuit requirements on wavelengths below, say, 100 metres are somewhat different to those higher up the wavelength scale. At the same time, I have found it quite possible to make an instrument which shows a high degree of efficiency on the longer waves, and yet which will give good reception of the more powerful short-wave stations. I am quite convinced that at present it is impossible to design a reasonably priced set for home construction that is equally efficient on all wavelengths between 15 and 2,000 metres, but I think that if the advantage of fairly good S.W. reception can be combined with very good reception on higher wavelengths, without appreciable extra cost, it is worth having.

Quite naturally, the most important components in an all-wave set are the tuning coils, but the high-frequency chokes must also be designed specially for the work they have to do. I have therefore worked out a fairly simple form of construction both for a tuning coil and for a choke, and it is proposed to describe these components so that you can try them for yourself.

The Tuning Circuit

Before dealing with the constructional work, it will be best to explain the general features of the tuner by referring to the circuit diagram of Fig. 1, which shows it connected up in a Det.-L.F. circuit. There are three tuned windings, short-wave, medium-wave, and long-wave, and these cover wavelength ranges of about 20 to 50 metres, 250 to 550 metres and 900 to 2,000 metres respectively, when tuned by a good (low minimum capacity) .0005 mfd. condenser.

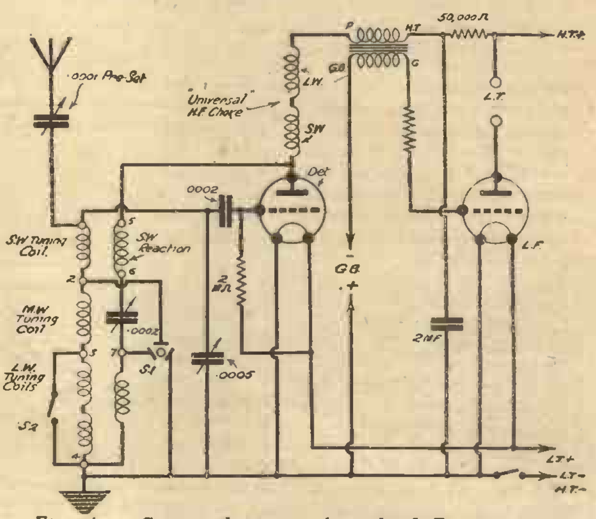


Fig. 1.—Circuit diagram of a det-L.F. receiver using the all-wave tuner and H.F. choke described.

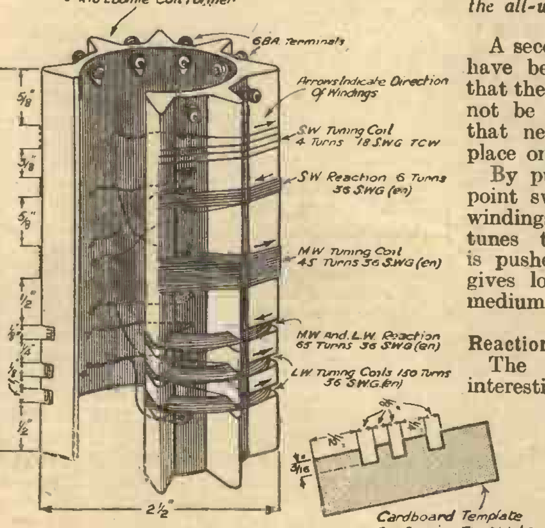


Fig. 2.—Winding data for the all-wave tuner.

A second short-wave tuning range could have been added, but it was considered that the extra complications involved would not be worth while in view of the fact that nearly all S.W. broadcasting takes place on wavelengths below 50 metres.

By pulling out the knob of the three-point switch marked S1, the two larger windings are short-circuited and the set tunes to the short-waves. When S1 is pushed in, the single-pole switch S2 gives long waves (knob pushed in) and medium waves (pulled out).

Reaction

The reaction circuit is unusual and interesting, since two separate windings are joined in series "through" a .0002 mfd. variable condenser. Thus, when the tuner is set to short-waves, one reaction winding is short-circuited by switch S1, and the moving plates of the reaction condenser are connected to earth. By using this arrangement the switching system is simplified and hand capacity troubles are avoided. To ensure that reaction control shall be equally effective on every waveband a "universal" H.F. choke is employed. This really consists of a long and short-wave winding connected in series, but no switching is required because the S.W. winding is ineffective on long waves, whilst on short-waves the H.F. currents are kept well in check by the S.W. winding.

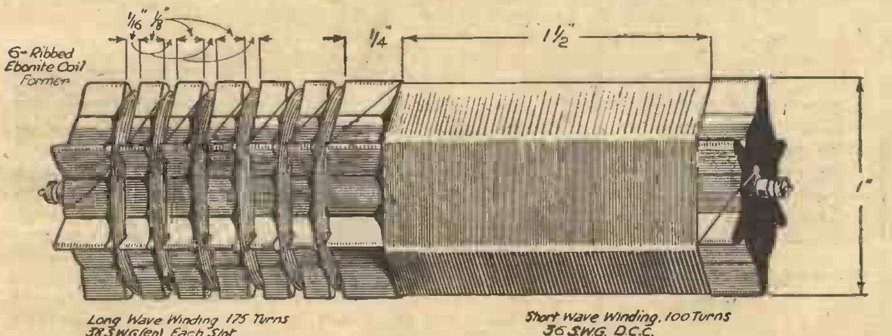


Fig. 3.—This sketch gives details of the "universal" long and short-wave H.F. choke.

Making An All-wave Tuner

The form of construction employed for the all-wave tuner is perfectly simple and straightforward, as can be seen from

(Continued overleaf)

(Continued from previous page)

Fig. 2, and differs only from that of the usual dual-range tuner in so far as two extra windings are added.

The materials required are :—

One 4in. length of No. 12 " Becol " 8-ribbed Ebonite Coil Former 2½in. (outside) diameter.

Seven 6 B.A. Terminals, with soldering tags.

1oz. 36 s.w.g. Enamelled Wire.

One Short Length 18 s.w.g. Tinned Copper Wire.

First of all the ebonite former must be prepared by making three sets of notches in the ribs at the positions indicated in Fig. 2. These are each ¼in. wide and $\frac{3}{16}$in. deep, and can easily be made with a small file, unless a lathe is available, in which case the task will, of course, be still further simplified. When doing the work by hand, it will be found that it can be carried out most accurately by making a small cardboard template like that shown as a detail to Fig. 2. This can be laid against the edge of each rib in turn, while the notches are filed out. Next, seven ⅛in. holes must be made round the upper end of the former to receive the 6 B.A. terminals.

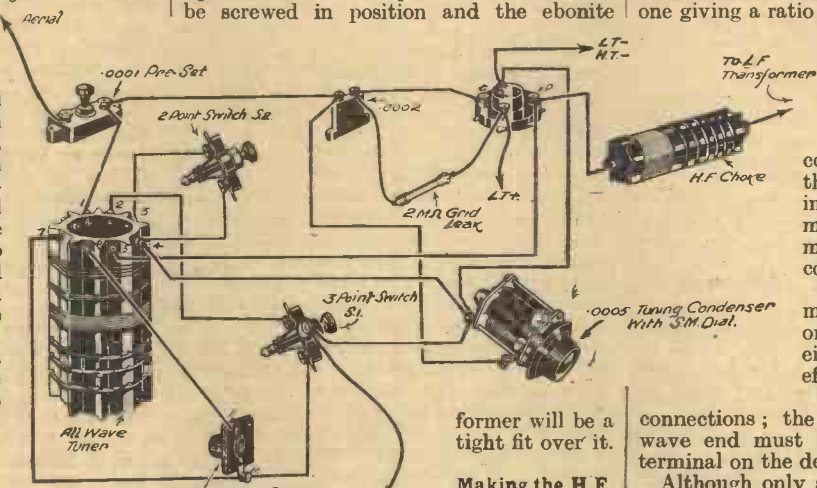


Fig. 4. Pictorial wiring plan for the Tuner and H.F. Choke described.

Winding the Tuner

Having prepared the former, winding can be commenced. Start by making two very small holes near one of the lowest notches, anchor the end of the 36 gauge enamelled wire in these, and leave a length of about six inches on the inside of the tube. Now wind 75 turns in the bottom set of notches, pass over the second set and put on another 75 turns. This completes the long-wave tuning coil, so two more small holes must be made and the wire anchored in these. The combined long- and medium-wave reaction coil comes next and is wound in the third set of notches. This winding must go in the *opposite direction* to that of the tuning coil and consists of 65 turns of the 36 gauge wire ; the ends can be anchored as before. The medium-wave tuning coil is wound as a single layer on top of the ribs and starts ⅛in. away from the reaction winding. Forty-five turns are put on in the same direction as the long-wave tuning coil, the ends being secured in just the same way as those of the other windings.

We next come to the short-wave reaction coil, which has six turns of 36 gauge wire wound in the same direction as those of the other reaction coil (that is, opposite to those of the tuning coils). Lastly, the short-wave tuning coil is wound. Only four turns of 18 gauge tinned copper wire are used for this, and they are taken in the same direction as the turns of the other two tuning coils. They are wound over the ribs, but instead of being touching each other, a space of about ⅛in. is allowed between them. The wire should be kept quite tight while winding, and, to prevent subsequent slipping of the turns, it is well to melt a spot of sealing-wax over them where they touch the edges of the ribs.

And now the ends of the various windings can be soldered to their respective terminals. To avoid confusion it is best to do this job systematically, starting at the bottom of the former and working upwards. Pull each wire so it is just taut and then cut it off to such a length that it will comfortably reach the terminal ; scrape off the insulation and apply a spot of solder after lightly smearing with flux. It will be noticed that two wires go to each of terminals 2, 3 and 4 ; the ends of these can conveniently be twisted together before soldering.

That completes the constructional work and the all-wave tuner is now ready for use. The easiest way to attach it to the baseboard is by means of a wooden disc 1¾in. diameter and ¼in. thick. This can be screwed in position and the ebonite former will be a tight fit over it.

Making the H.F. Choke

In regard to the " universal " H.F. choke; the materials required are :—

One 3in. length of No. 2 " Becol " 6-ribbed Ebonite Coil Former 1in. (outside) diameter.

1 oz. 38 s.w.g. Enamelled Wire.

One Short Length 36 s.w.g. d.c.c. wire.

Two 4 B.A. Terminals, with soldering tags.

The arrangement of the windings is illustrated in Fig. 3, from which it can be seen that the long-wave portion is divided into six sections, each of which is placed in a notch $\frac{1}{16}$in. wide by $\frac{3}{16}$in. deep ; the short-wave portion consists of a single layer wound in a $\frac{1}{16}$in. deep groove 1¼in. long. First of all, then, the notches can be made with a saw, again using a template as a guide, and the grooves are taken out with a flat file. The terminals are next fitted into the ends of the former, which has a ⅛in. hole running through it. If a 4 B.A. tap is available, the ends of this hole may be threaded by that means, but alternatively, the terminals will make their own thread if a little force is used.

Solder the end of the 38 gauge enamelled wire to the terminal nearest the slots and then wind on 1,050 turns, putting 175 in each slot. After filling the last slot, solder the end of the 38 gauge wire to one end of the 36 gauge (double cotton covered) wire and put a single layer winding of the latter in the 1¼in. long groove. If the turns are kept close together, it will be found that just about 100 can be fitted in the space provided. Finally, cut off the wire and solder it to the second terminal.

Tuner and Choke Connections

All connections for the tuner and choke can be followed by making reference to Fig. 1, but to assist those few readers who still fight shy of circuit diagrams a pictorial wiring plan showing the detector valve only is given in Fig. 4.

The .0001 mfd. pre-set condenser in series with the aerial lead is absolutely essential since, without it, the set would probably fail to oscillate on the short-wave band. It is also of particular importance that the .0005 mfd. tuning condenser should be a really good one designed on " low-loss " principles and having a low minimum capacity. A bakelite dielectric condenser, though it might be perfectly satisfactory on wavelengths above 300 metres, is quite useless for short-wave work. A good slow-motion, or vernier, dial must be used with the condenser, and one giving a ratio of about 100 to 1 is to be preferred. As an alternative to the vernier dial, a .00005 mfd. variable condenser might be connected in parallel with the normal tuning condenser, and this can then be used for " searching " on short waves, after making a rough adjustment on the .0005 mfd. component.

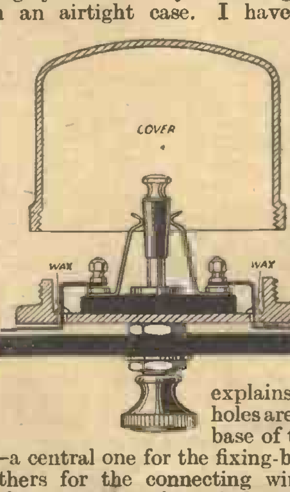
The reaction condenser may be of either the air- or solid-dielectric pattern, either kind being equally effective.

Notice the H.F. choke connections ; the terminal at the short-wave end must be joined to the plate terminal on the detector valve holder.

Although only a Detector-L.F. circuit is given, it would not be a difficult matter to arrange two similar tuners in an S.G. circuit and in that case the reaction windings of the aerial tuner would not be used. Ganged tuning is quite out of the question for short-wave reception.

A SWITCH IMPROVEMENT

PUSH-PULL switches often give trouble after a time owing to faulty contact between the springy metal strips and the plunger. This deterioration can be very largely avoided by enclosing the switch in an airtight case. I have found that certain kinds of shaving-soap containers (made of bakelite or some similar material) form excellent cases for this purpose. The method of adaptation is shown in the sketch which almost explains itself. Three holes are drilled in the base of the container—a central one for the fixing-bush, and two others for the connecting wires to enter. After mounting the switch and connecting up the wires, the holes through which they pass are sealed up airtight with a little melted wax. The cover is then screwed on, making the whole switch assembly completely dustproof and damp-proof.—N. HURST (Wimbledon).



Picnic Aerials

Some Useful Hints on Outdoor Reception.

By A. V. D. HORT.

MOST interesting results can often be obtained by taking a receiver away from its normal surroundings. If you live in a big town, you will almost certainly find that the performance of your receiver is far better when you take it away from the confines of houses and streets. Modern flats, in particular, contain steelwork in their structure which is definitely inimical to long-distance reception with anything but the most powerful set.

Apart from these considerations, a great deal of enjoyment can be obtained from listening to the programmes under out-of-doors conditions. Take your receiver with you when you go off in the car, and you will have a pleasant companion to provide you with entertainment when more active occupations begin to flag.

When you pack up the receiver, do not forget that you must take an aerial-earth system for it as well. If you go by car, you will almost certainly use the car batteries for power supply, so that you need not worry about weighty accumulators. But an aerial you must have, and a last-moment makeshift with odd bits of wire is rarely satisfactory. Even the receiver with a built-in frame aerial will have a wider range, and will give improved signal strength with the addition of a short external aerial, and an earth connection. For the receiver which has no frame aerial you must provide an adequate overhead aerial to replace the one at home, or you will be disappointed.

There is no need to take out with you a coil of the usual 7-22 aerial wire, nor to be equipped with an elaborate mast. This wire is awkward to handle, owing to its stiffness and its liability to kink, and it calls for insulators. The handiest wire for the picnic aerial is the stranded rubber-covered flexible cable, which is commonly used for leading in from the overhead aerial to the house.

Equipment Necessary

Here, then, is the whole equipment, which does not really need any preparation before you start: A 50ft. or even 100ft. length of the rubber-covered cable, a broomstick or stake, 5ft. to 6ft. long, pointed at one end, 3 or 4yds. of stout string, two wooden pegs, and a large clasp-knife. If you cannot lay your hand on the last-named item, a large meat skewer, or similar metal spike, will serve. This list provides for every emergency. In practice you will be able to dispense with one or more of the components, according to the conditions in the places where you have your picnics.

Fig. 1 shows you how to arrange your aerial and earth, using all the parts mentioned. In this way you can put up an excellent temporary aerial in open country, when there are no trees or posts handy for your purpose. Proceed as follows to erect the aerial. Choose the spot for the receiver, and put a peg in the ground close to it. Attach to this peg one end of the cable, using a "clove hitch" to secure it (Fig. 2), and leaving a spare foot or two of the cable to go to the aerial terminal. Run out the cable to its full length, secure the free end to the stake—again with a clove hitch—push the pointed end of the stake into the ground, knock in the second peg in a dead straight line with the aerial, and guy the stake to it with the string. No extra insulators are required, as the rubber covering of the cable is quite adequate for a temporary aerial of this sort. So long as the staying peg is truly in line with aerial, it will hold up the "mast" quite safely without extra pegs at the sides, unless, of course, there is a very strong side wind.

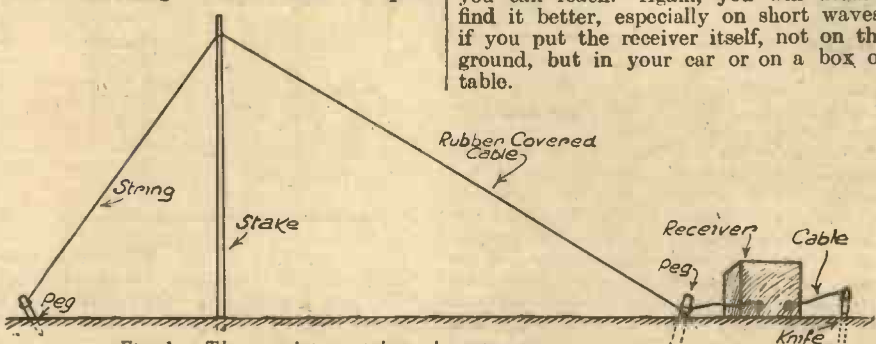


Fig. 1.—The complete aerial-earth equipment.

Aerial and Earth "Hook-ups"

The earth lead is a yard of the same cable. Bare both ends of this lead, and connect one end to the earth terminal of the receiver. Open the smaller blade of the clasp-knife, wind the other bared end round it and close the blade on the wire. The large blade pushed well into the ground will give you an earth connection which, under most conditions, will prove quite satisfactory. In very dry weather, damp the soil round the knife, if you have the water to spare!

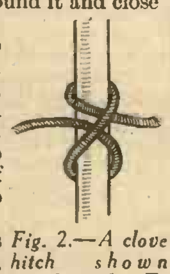


Fig. 2.—A clove hitch shown loosely tied. To finish, press the two loops together and pull the free ends.

A long, low aerial of this kind is, to a certain extent, directional. To get the best results from a given station, arrange the aerial so that it points directly away from the station. You will hardly be able to find the accurate direction without a map and compass, but even an approximation will help. Similarly, if interference is bad from one station, place the aerial at right angles to an imaginary line between your position and the station, as indicated in Fig. 3. Of course, if the wanted and unwanted stations lie in the same direction or in opposite directions, you must simply do the best you can by careful tuning.

The aerial system illustrated in Fig. 1 need only be used in its entirety in an open situation. You can do much better than this with the same equipment, if conditions are favourable. You can raise the far end of the aerial by fixing to a convenient tree. Tie the string to the cable, and one of the pegs to the end of the string, and sling it up over the highest branch that you can reach. Again, you will usually find it better, especially on short waves, if you put the receiver itself, not on the ground, but in your car or on a box or table.

The stranded cable gives you an aerial wire which should continue to give good service for a long time. In a real emergency, if you have nothing else, you can use ordinary cotton-covered wire, about 18 s.w.g. Wire as fine as 26 s.w.g. will do, with the added convenience that you can easily put a coil in your pocket; but handle this fine wire cautiously, and do not try to pull up your aerial too tight.

The Earth

There are many possible variations for the earth connection. On sandy soil, where it is difficult to make a good connection with a short spike in the ground, driving the knife, with the lead attached, into the trunk of a tree will often help; the roots of the tree spread out over a wide area, and the sap is a sufficiently good conductor for the purpose in hand.

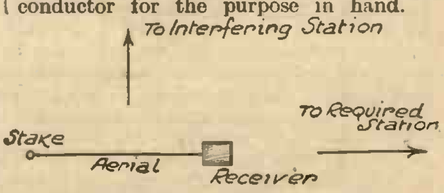
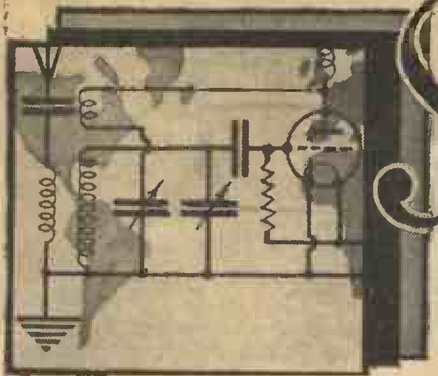


Fig. 3.—How to arrange the aerial to avoid interference.



Short-Wave Circuits

The Author Here Describes the Hartley and Armstrong Super-Regenerative Circuits. By FRANK PRESTON, F.R.A.

OF all the short-wave receivers in use to-day (and there must be many thousands) it is more than probable that something like eighty per cent. of them employ the same circuit arrangement. The reason is, no doubt, that the Reinartz circuit, shown in Fig. 1, has become so popular that no one thinks of trying to improve upon it. But despite the undisputed efficiency of the Reinartz circuit there are others which are better in many respects, and with which every short-wave enthusiast should experiment.

The Hartley Circuit

The first of these which comes to my mind as a real old favourite is the Hartley circuit, shown in Fig. 2. This was actually developed before the days of broadcasting, and was intended for transmitting purposes. It is, nevertheless, a particularly good arrangement for a short-wave receiver, principally on account of the ease of reaction control which it provides, but also because of its simplicity and adaptability for experimental use. You can see from Fig. 2 that a single winding acts as combined aerial, grid and reaction coils. The whole winding is tuned by the usual .00015 mfd. condenser, but only one half is connected between grid and filament of the detector valve. The "top" end of the coil is connected to the anode through a .0001 mfd. pre-set condenser, which provides the necessary feed-back or reaction. As a matter of fact, an ordinary variable condenser could be used in this position, when it would serve as a reaction control. But it is found better to employ a condenser connected between the anode and earth (marked C.3) for the latter purpose. This gives what is known as "throttle" control due to the fact that as its capacity is increased, reaction is "throttled" down, since part of the amplified H.F. currents appearing in the anode circuit of the valve are allowed to leak away to earth instead of passing back into the grid circuit. It can thus be seen that the reaction control works in the opposite direction to the more usual one, the degree of feed-back being increased by reducing the condenser's capacity.

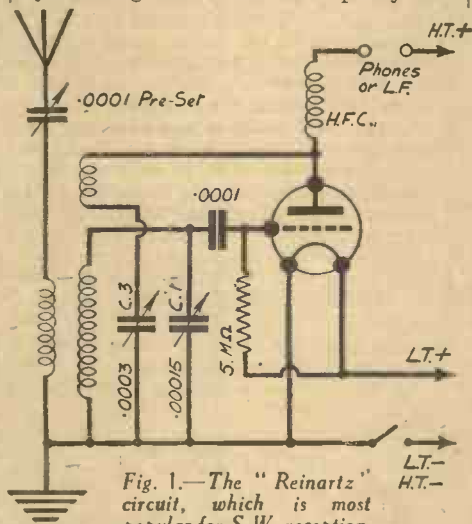


Fig. 1.—The "Reinartz" circuit, which is most popular for S.W. reception.

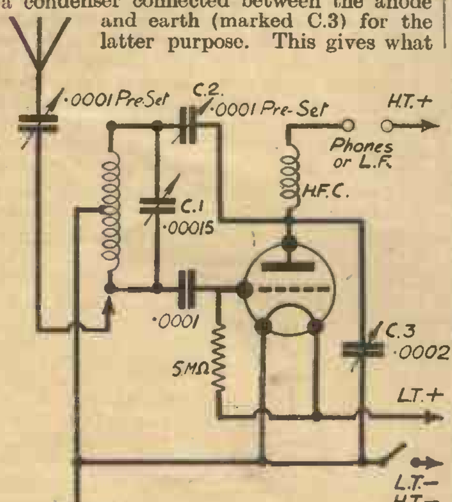


Fig. 2.—The "Hartley" circuit, referred to on this page as an excellent and simple arrangement.

Making "Hartley" Coils

Almost any type of S.W. coil can be used in the Hartley circuit, but it must, of course, have a centre tapping. For experimental purposes, however, it is much better to make up a few coils like that shown in Fig. 3. Bare 16-gauge wire is employed, and this is first wound round a 2in. diameter former, which may consist of a bottle or cardboard tube. After winding, the coil is removed, when it will expand to about 2 ins. diameter, due to the springy nature of the wire. The turns are then rigidly fastened together by means of four strips of ebonite, as shown. All connections may be made by means of crocodile clips, or terminals can be soldered to the wire if desired. Instead of joining the aerial lead directly to the grid end of the winding as shown in Fig. 2, it can be tried in various positions along the coil.

A coil consisting of 4 turns will cover a wavelength range of approximately 15 to 30 metres, whilst one having 8 turns will tune from about 28 to 60 metres. Others to tune up to 100 metres or so could be made by using proportionately larger numbers of turns, but these will not generally be required since most of the more powerful stations work on wavelengths below, roughly, 50 metres.

Preventing Hand Capacity

Perhaps the greatest objection to the "Hartley" circuit is that the tuning condenser is "in the air" (not connected to earth), and this is liable to cause hand capacity unless precautions are taken. The difficulty can best be avoided by operating the condenser through the medium of an extension spindle, and using a vernier dial provided with a metal screening plate which can be earthed. On completing the receiver, condenser C.2 should first be adjusted to its most suitable position. This is done by setting both the reaction condenser C.3 and the tuning condenser C.1 to 90 degrees and screwing down the knob of C.2 until oscillation just commences. After this, C.3 will provide full control over the whole waveband.

Another particularly interesting circuit is that known as the Armstrong Super-Regenerative. This also was first "invented" before the days of broadcasting by an American engineer named Major Armstrong. The Super-Regenerative circuit met with a fair measure of success as a medium-wave receiver some ten years ago, but although it was extremely sensitive it suffered from the serious objection that it was "noisy." That is, in addition to the signals which it brought in, there was a continuous "hiss" forming a more or less strong background (sometimes even a foreground). Besides this, the set was rather tricky to adjust and was very prone to cause strong interference with other receivers operating within a comparatively wide area. It is interesting to observe in passing, however, that the last-named objection was almost entirely removed by working on a small frame aerial; and, most amazing of all, reception of American medium-wave stations in this country was often accomplished by means of the single valve Armstrong when used on the small frame.

(To be continued.)

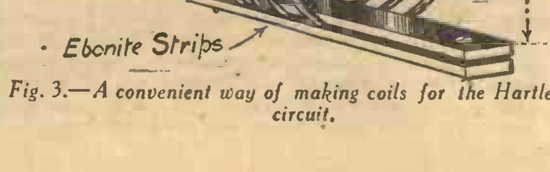
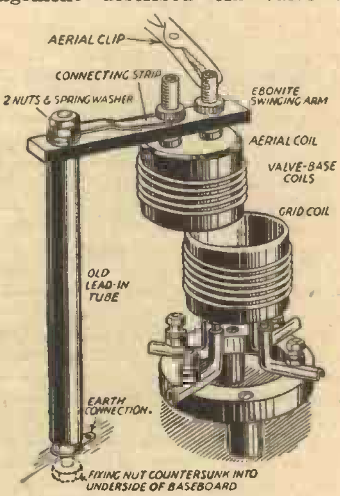


Fig. 3.—A convenient way of making coils for the Hartley circuit.

The READERS' HALF-GUINEA WRINKLES Page

Inductive Coupling for Aerial Coil

NO doubt a large number of short-wave listeners use coils wound on the bases of old valves, and have hitherto used capacitive coupling of the aerial, but would like to try out inductive coupling. In the arrangement described old valve bases



An efficient inductive coupling device.

are also used for the variably coupled aerial coil, and in this case two of the pins in the base are removed and the coil plugged into two suitably spaced sockets screwed into a narrow strip of ebonite. The ebonite strip is mounted on a portion of old lead-in tube of the requisite length. The rod passing through the centre of the tube is fixed to the baseboard by means of two hexagon nuts, the one on the lower side being in a hole countersunk in the under surface of the baseboard, whilst the upper one holds down a soldering tag. The strip carrying the coil sockets is secured to the top of the tube by two hexagon nuts and a spring washer, whilst a soldering tag is also fitted here. The pressure on the spring washer is adjusted until the ebonite arm can be swivelled, but the whole is free from vibration, then the two hexagon nuts are locked to prevent them working loose. The soldering tag at the bottom of the pillar is connected to the nearest earthed point, whilst the tag at the top is connected to one of the two sockets on the ebonite arm. The aerial is connected to the other socket by means of a crocodile clip, and the degree of coupling can be varied by swivelling the aerial coil. In practice, two aerial coils are used, one having twenty turns, and the other five turns, and the variation of coupling will be found of great assistance in removing blind spots in the tuning.—P. TAYLOR (Penzance).

A Wristlet Voltmeter

WHEN using the popular small double range voltmeter many builders of sets must have found some difficulty in noting the reading of the meter when testing the internal circuits of their sets, especially when their heads are well into

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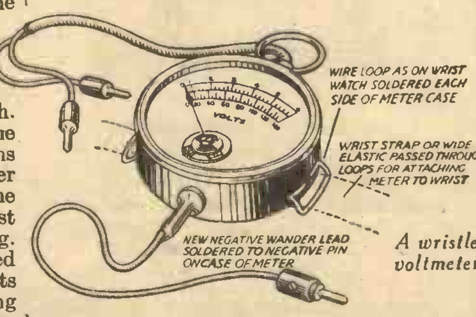
the cabinet, where there is usually no room to stand the meter.

The idea I suggest is a simple one.

Solder two small pieces of fairly rigid wire, previously bent to shape, on the side of the voltmeter case as on an ordinary wristlet watch. A leather band to fit the wrist may be purchased for a small sum from any jeweller or watchmaker, but for the purpose of economy and ease in placing on, or removing from the wrist, a length of ordinary cotton covered elastic is suggested.

Another benefit of this fitting is that it allows for both hands to be free.

As the average two-range voltmeter has



A wristlet voltmeter.

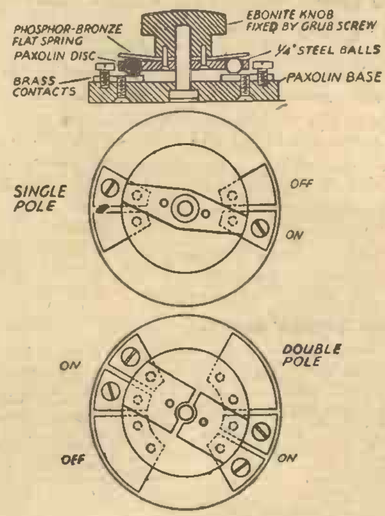
the common negative to the pin at the base of the meter, an extra lead can be soldered to this pin, as shown in the sketch, to facilitate use when the meter is attached to the wrist.

If there is real or fancied danger of shock, a piece of thin rubber sheeting may be stuck to the back of the case.—T. A. COOKSLEY (London).

A Simple Switch

THE accompanying sketches show the construction of a simple and very reliable switch. The contacts consist of ¼in. or 5-16in. steel balls inserted in holes in a paxolin disc and held down by a flat phosphor bronze spring, or springs, as the case may be.

The brass segments on the base have small countersinks drilled in them in the "on and off" positions and the balls drop into these and so locate the switch in the required position, and also ensuring a better contact. The lower sketch (knob removed) shows the arrangement for a double-pole switch, which type will be found very reliable for wavelength selectors, "on and off," and many other purposes where a small current is passed. As the movement of the balls is a combined rolling and



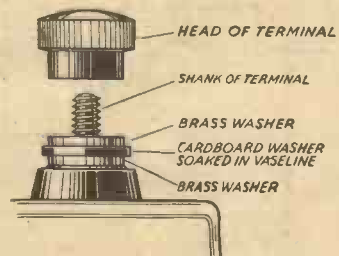
A switch with ball contacts.

slipping one, they are always kept clean. I have used these switches successfully on 200-volt work for small current purposes.—D. TANGUY (Portsmouth).

Curing Corroded Accumulator Terminals

WHEN creeping once commences up the brass parts of accumulator terminals it is very difficult to arrest. I had similar trouble with one which corroded very badly in a month or so, and the screw shank was commencing to deteriorate. After trying many methods of cleaning, painting, and coating thickly with vaseline, the dodge shown in the accompanying sketch effected a complete cure. A cardboard washer, thoroughly soaked in hot vaseline, is clamped between two screwed brass discs. The cardboard washer is also screwed on tightly, and should be slightly larger than the brass clamps to isolate the metal parts, and so prevent future creeping. The terminal shank should be well cleaned and coated with vaseline before the parts are fitted.—W. BLACK (Coventry).

(Continued overleaf)



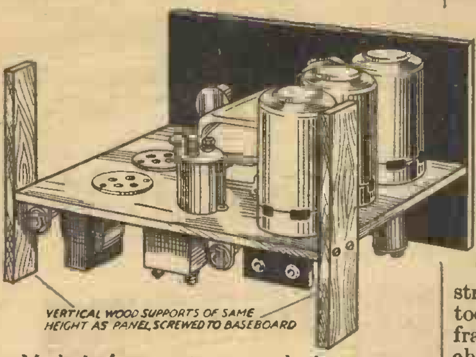
An anti-corrosion dodge.

RADIO WRINKLES

(Continued from previous page)

Supporting a Panel When Wiring

A DIFFICULTY often experienced by constructors who favour fixing certain components "under-baseboard" is that



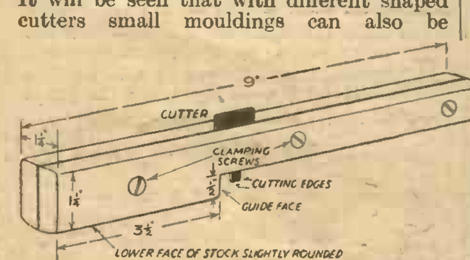
Method of supporting a panel when wiring.

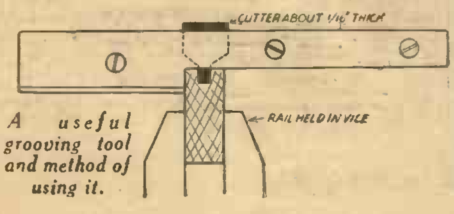
of holding the baseboard and panel firmly in a suitable manner to facilitate reversal of the assembly, and so ease and quicken the job of wiring. When the area of one or the two sides of the board are filled to capacity with components, propping-up the job on books is invariably out of the question—and so is holding the work with one hand, and with the other trying to perform actions which obviously can only be done with both hands. The accompanying sketch shows an extremely easy method of overcoming this drawback.

The legs (length according to height of panel and components underneath) should be screwed or nailed in position, and it must be remembered that two nails or screws in the centre of each leg will be necessary.—W. W. (Leicester).

A Useful Grooving Tool

TO those who like constructing their own radio or speaker cabinets the accompanying details of a home-made grooving tool may be of interest. The cutter is made from a piece of an old band saw, or similar steel, the actual cutting edges being filed square. The stock is made of hardwood such as beech. This is cut along the middle, and three screws inserted so that the cutter is securely clamped between the two halves of the stock. The depth of the groove, etc., can be easily adjusted when clamping the cutter in position. The tool is used the same as a spokeshave, care being taken that the guide edge is always kept pressed close to the piece of wood being grooved. It will be seen that with different shaped cutters small mouldings can also be scratched along rails, etc.—H. F. COLLINS (High Wycombe).



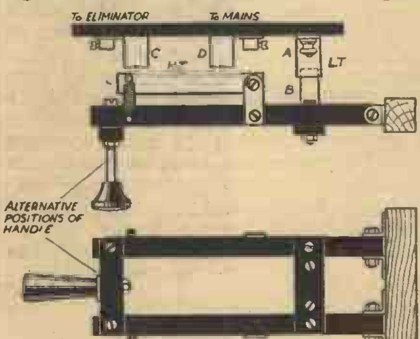


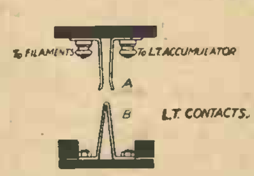
A useful grooving tool and method of using it.

A Combined H.T. and L.T. Switch

MOST readers who possess a set which derives its H.T. from an eliminator, and its L.T. from an accumulator, realize the desirability of ensuring that the L.T. is switched on before the H.T., in order to avoid the strain on components caused by the peak voltage of an unloaded eliminator. Many employ two separate switches, and make a habit of operating the L.T. first, but the gadget described combines the two, and so ensures that even if the set is operated by an unenlightened member of the household, the H.T. cannot be applied before the L.T.

The switch is not at all difficult to construct, to anyone who possesses the usual tools found in a constructor's kit. The framework is built up of four strips of ebonite, fixed together by brass screws and nuts, and pivoted on four angles cut from sheet brass. The four H.T. contacts—the switch is double-pole—are of the type found in aerial earthing switches, and are mounted on a strip of ebonite fixed on edge to a wooden baseboard. The two blades are also of sheet brass—or copper if preferred—pivoted at one end to brass angles while at the other end is a spiral



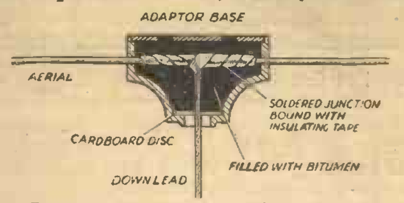


A combined H.T. and L.T. knife switch and details of contacts.

spring to give a quick break action. The L.T. portion of the switch has contacts of sheet brass, bent into the usual form—as in push-pull switches—the blade also being of sheet brass, bent to the shape shown, and fixed to the ebonite cross-bar by screws and nuts. Its length must be such that contact is made between A. and B. before the H.T. blades touch their respective contacts. When completed, the switch should be enclosed in a wooden box, in one end of which a slot has been cut to accommodate the operating handle—which may be in either of the two positions shown—and the whole mounted on the side of the cabinet, in the case of a radiogram or large set, or in any other convenient position. To make the switch still more effective, a fuse should be inserted in each pole of the H.T. supply on the mains side. These may be fixed to the baseboard, making the whole unit self-contained. In my case I have added a pilot light on the side of the box, wired in the filament circuit which gives a visual indication as to whether the set is on or not.—A. J. P. MORLING (Norwich).

A Weatherproof Aerial Joint

IN the majority of cases amateur's aerials consist of horizontally-suspended wires and lead-ins of the T or inverted L type. Often the lead-in is joined to the aerial in a haphazard manner, and is just twisted



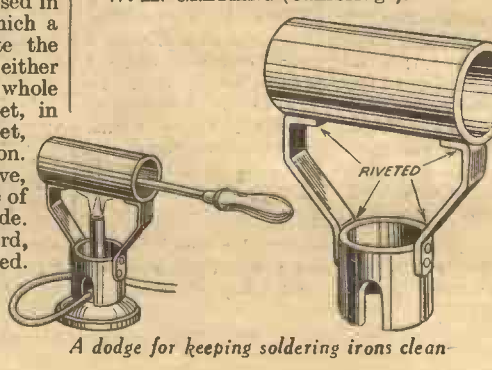
Section of a weatherproof aerial joint.

round a few times and left. Here is a good method of making a weather-proof joint box to protect the joint after it has been well connected up. Insulated aerial wire should be used for ensuring a trouble-free aerial. Procure an electric light plug adaptor, and in the bakelite top drill two small holes opposite each other about ⅜in. below the rim, and just large enough to take the aerial wire, which is threaded through; afterwards sliding the top along the wire to wherever the joint is required. Thread a bared end of the lead-in through the flex hole of the plug top, and twist round the aerial wire, after the latter has been bored just inside the plug top. Solder the connection and bind with insulating tape, afterwards pushing the joint down in the plug top, and filling the top with bitumen, taking care the joint is covered entirely with it. Remove the contacts from the plug base and screw on in the ordinary way, sealing the contact holes with more bitumen. Make sure the wire insulation enters both drilled holes and flex holes, otherwise corrosion will set in.

The cardboard, indicated in the sketch, is to prevent the bitumen running out of flex hole when filling.—JOSEPH A. WILSON (Gidea Park).

Keeping Soldering Irons Clean

THE simple apparatus shown in the sketch can be made up from iron tubing and strip iron combined. Two pieces of tubing are required, and two pieces of strip. A slot is cut in the lower piece of tubing to clear the tube on the bunsen burner. The strips are riveted to the tubing, and if light irons are used the arrangement will remain steady. If too heavy irons are used an extra support must be fixed. The arrangement prevents the flame from reaching the iron. In this way the iron is kept clean, and will keep so much longer than when used in the bare flame. Copper tubing can be used if obtainable, as it holds the heat longer. —W. H. GRAYLING (Cambridge).



A dodge for keeping soldering irons clean

choke would be less efficient. In practice it is impossible to eliminate capacity entirely, due to the proximity of adjacent turns, but we can cut it down to reasonably low limits by dividing the winding up into sections and arranging the terminals fairly well apart. The constructional part of the work will be considered later.

Preventing Feed-back

There is another point to consider because a choke, like a tuning coil, has a certain magnetic "field," and therefore if it is placed near to a coil or another choke the fields of the two will link together and cause feed-back, or unwanted reaction. This difficulty can be minimized in three ways. One is to arrange the two components with their axes at right angles, another is to make the choke of binocular form (see Fig. 2), when the fields of the two halves will neutralize each other, and the third is to fit the choke with a screening box. The third method is best, but certain precautions must be taken in using it. Since a metal screen lowers the inductance, the choke must have a greater number of turns than otherwise; the screen must not be placed too near the windings, and it must be made of some metal such as aluminium, copper or silver which will not "absorb" any power from the choke.

S.G. Chokes

In addition to the "reaction" choke already referred to, there is another kind which is connected in the anode circuit of an S.G. valve and is used in conjunction with a tuned-grid coil for high-frequency coupling purposes. The connections are shown in Fig. 3. It is not generally realized that this choke must have quite different characteristics to that used for reaction purposes. It must match the anode impedance of the S.G. valve, having an impedance about twice as great at the lowest frequency (highest wavelength) to which the set will tune. As the average impedance of modern S.G. valves is 300,000 ohms the choke must approximate to 600,000 ohms. This means that its inductance should be about 500,000 microhenries. Besides having a high inductance, however, the choke must have a very low self-capacity or else it will be inefficient at the higher frequencies.

Special Uses for H.F. Chokes

Other uses for H.F. chokes are represented in the skeleton circuit diagram of Fig. 4. The component marked Choke 1 is a by-pass for the B.-P. coupling condenser, and its purpose is to feed the grid-bias supply to the V.-M. valve; an ordinary "reaction" choke may be used here. It is more usual to employ a resistance in this position, but the choke is often better when certain forms of low-frequency interference are experienced. Choke 2 really supplements the reaction choke and serves to prevent the leakage of H.F. into the low-frequency stages. Here again, a fixed resistance is generally employed, but a choke is sometimes better; one of the "reaction" kind is quite suitable. The two mains chokes, marked Choke 3 and Choke 4 are often helpful with any mains receiver (either D.C. or A.C.) since they prevent interference due to H.F. currents which are sometimes superimposed on the mains supply. A suitable inductance for these chokes is about 100,000 microhenries, and they must be able to carry the total current drawn from the mains, generally up to .5 amp. or so.

Fig. 4 shows yet another choke marked Choke 5—and this is generally referred to as an "anti-break-through" choke, its purpose being to prevent interference from a nearby medium-wave Regional station when listening on the long waves. To be effective it is clear that this choke must have a fairly high impedance at about 300 metres, and a much lower one at 2,000 metres. An inductance of about 1,500 microhenries is a good average value.

Short-wave Chokes

Short-wave chokes are, theoretically, just the same as those used for the longer wavelengths, and in fact many of the "broadcast" chokes available will work satisfactorily down to so low as 10 metres. At the same time, it is generally better to employ special S.W. chokes designed so as to have a very low self-capacity, since this is of increasingly greater importance as we move down the wavelength scale. To cut down capacity means reducing the number of turns, but this can be done quite safely because the impedance for any given number of turns becomes greater as the wavelength is reduced. For example, a 1,000-microhenry choke has an impedance of something like 40,000 ohms at 6,000,000 cycles (50 metres), and of only 50 ohms at 8,000 cycles; a component of that value would therefore be perfectly suitable for a receiver working on wavelengths between 10 and 50 metres. I have quoted 10 metres as the lowest wavelength limit, since for still shorter waves a choke of but a few microhenries, and having an almost negligible self-capacity, is better.

FROM THE FLASHLAMP

By Photon

DESIGNING A LOUDSPEAKER HORN

IT is generally considered that the correct shape of a horn, whether it be for a gramophone or for a speaker, is that given by the logarithmic curve or "exponential" law. Although the logarithmic law gives a good form of horn, the mouth or termination of the horn ceases to be logarithmic—at the mouth there is a sudden change whatever the theoretical form or contour of the horn may be. If it were not for this question concerning the mouth of the horn, there would be nothing amiss with an ordinary cone, because the conditions in a cone are precisely the same as those which obtain when sound radiates from a source in three-dimensional space. The point is that, whatever the basis of design may be, the mouth itself should be "flared" in order to slur over the change where the horn opens into the world at large.

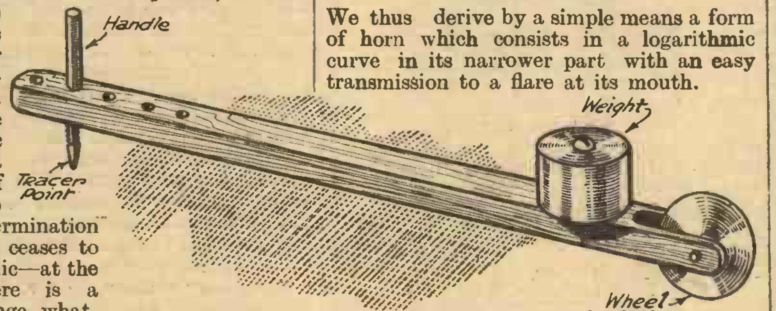


Fig. 2.—Trammel with tracer point and wheel.

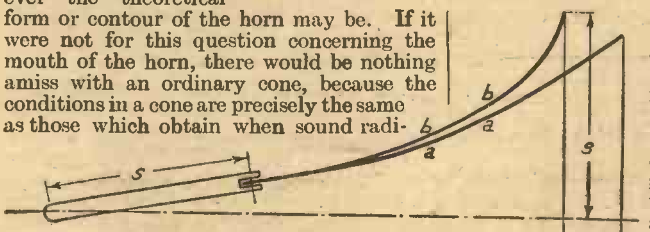


Fig. 3.—Illustrating the use of trammel for laying out horn contour b, b, also departure from true log from a, a.

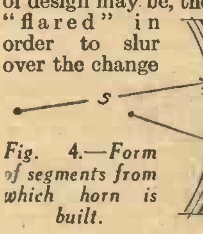


Fig. 4.—Form of segments from which horn is built.

A well-known property of the logarithmic curve is illustrated in Fig. 1; a tangent to the curve at any point p meets the base line (which may be taken as the axis of the horn) at a definite distance r, measured along the axis from a perpendicular from the point of contact p. If a trammel be constructed (Fig. 2) consisting of a bar carrying a tracer wheel at one end, and a pointer at the other, the distance from the pointer to the centre of the tracer wheel being called s, then, if the pointer be moved along the horn axis or base line of Fig. 1, the tracer will follow a logarithmic curve so long as its angle to the base line is small. When this condition no longer applies, as when the angle of the trammel increases, the projection of the length s on the base line (or horn axis) diminishes and the r of Fig. 1 is no longer constant.

If we continue to develop the traction curve laid off by the tracer wheel outwards, we find that the departure from the logarithmic curve is as shown in Fig. 3, and the diameter of the mouth of the horn, where the trammel has become vertical, is equal to $2s$.

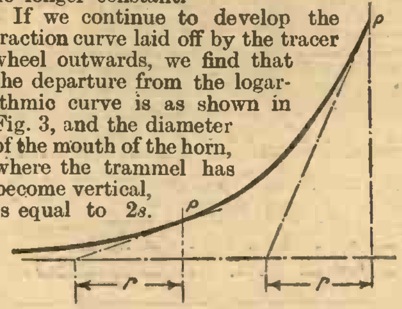


Fig. 1.—Illustrating a property of the logarithmic curve.

We thus derive by a simple means a form of horn which consists in a logarithmic curve in its narrower part with an easy transmission to a flare at its mouth.

There is a beautifully simple method of constructing a horn of the form given which is within reach of anyone whose resources include a pair of scissors and a gluepot. From the fact that the length of the arm s is constant, it follows that if we consider the horn as made up of a number of circumferential strips, all the strips when developed on the flat have the same radius of curvature. Hence, in order to build up the horn we have only to cut up a quantity of paper segments as in Fig. 4, whose mean radius = s, and build these up one on the other as in Fig. 5. The foundation can be made from stout cartridge paper or Bristol board. When that is dry, and set, the necessary thickness of *papier maché* can be built up by pasting on layer upon layer of newspaper or "lining paper." Every piece of paper is cut to the same segmental form and pasted circumferentially round the horn, each layer breaking joint with that previously laid.

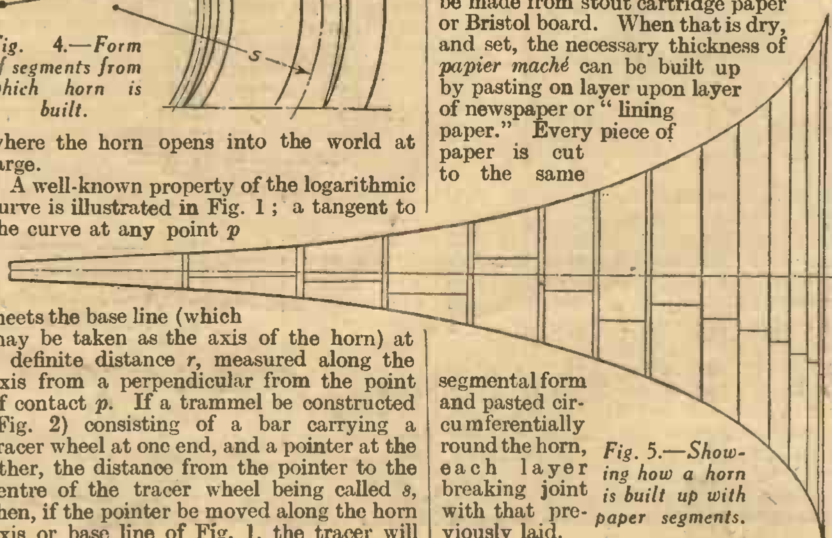


Fig. 5.—Showing how a horn is built up with paper segments.

DETECTOR DEVELOPMENT

A Brief Résumé of the Evolution of Detectors from Pre-Broadcasting Days to the Present Time

By L. A. HODGES

DETECTORS are common to all wireless receiving sets; the first set had one, and the latest designed Class "B" Ferrocart receiver has one. Any device used for the reception of wireless signals is really a detector of the small alternating currents set up in the receiving aerial. Since wireless waves were first produced by Hertz in 1868 many types of detectors have been employed before reaching the advanced and efficient methods of to-day.

It is interesting to see just what form and principle of operation these various detectors had, from the earliest type to the most modern type.

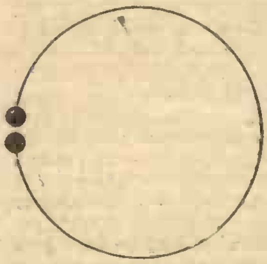


Fig. 1.—A Hertz detector or resonator.

The First Detector.

Hertz's receiver took various forms, the usual type of which was simply a certain size of wire ring with two spark balls separated by a small air gap, the size of the ring being adjusted until the best effects were obtained, employing the principle of resonance. The impact of the wireless waves cause induced charges to surge backwards and forwards within the ring, these surgings manifesting themselves as minute sparks at the air gap. Such a device, although of no practical use, constituted the first wave detector. The detector is illustrated in Fig. 1 and is sometimes called a resonator.

The Coherer.

Probably the earliest form of detector to be used was the improved form of coherer. This is based upon a peculiar microphonic behaviour of loose metal contacts to electric waves. This was first brought into prominence by Professor Branley in 1890, and afterwards more thoroughly investigated by Sir Oliver Lodge, to whom the term "coherer" is due.

It was found that the impact of electric waves upon a glass tube filled with nickel and silver filings would cause them to cohere, making them conductive to a direct current which could flow through it. The coherer, in its simplest form, was not reliable, and it was much improved by Marconi. His pattern consisted of an evacuated narrow glass tube containing accurately fitting silver terminals (Fig. 2), separated by a small gap, between which are the metal filings. Connections to the plugs were made by means of wires sealed in the glass, and the complete coherer placed in a circuit with a cell and some form of relay or recording instrument. The potential applied to the coherer, by means of the cell, was adjusted until just insufficient to cause the metallic filings to cohere without the additional potential of an incoming wave. To the coherer was added an automatic tapper to "decohere" after each signal. Although this necessitated a slow rate of signalling, this delicate receiver of electric waves made wireless telegraphy practicable. The coherer constitutes the first detector to give an audible signal produced by, or rather resulting from, electric waves. It was with this improved form of coherer that Marconi, in 1899, established communication by wireless across the English Channel.

The Magnetic Detector.

Following this Marconi, in 1902, made another important step forward by developing a more sensitive detector known as the magnetic detector, as the result of which signals could be heard in the telephone.

Fig. 2.—A Marconi coherer.

Referring to Fig. 3, the magnetic detector consists of two magnets A, A, with like poles placed together so as to magnetize an endless band of stranded iron wire B, continuously moving through coil C. The hysteresis lag causes the field to be carried on by the wire a little beyond the central point, and when oscillatory currents flow through coil C the residual lagging flux is annulled, and the magnetism may be said to jump to the central position. This slight though rapid shifting of flux induces a current in the coil D, so that a click is heard in the telephone E, for each spark transmitted, and received by the circuit. Thus a dot is rendered by a short crackle, and a dash by a buzz. The sounds are not very loud but the action is regular. The magnetic detector constitutes a current-operated device, and is inserted directly between aerial and earth. Before coming to the introduction of the valve detector, it is necessary briefly to describe rectification.

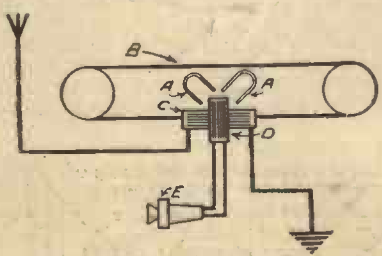


Fig. 3.—Magnetic detector of 1902.

Rectification.

The high-frequency alternating currents used in wireless broadcasting consist of two components, the high-frequency carrier current, and, superimposed on it, the low frequency, or microphonic current. The high-frequency current is useless in itself as far as the diaphragms of the telephones are concerned, its variations are so rapid that no diaphragm could possibly follow them. It is the low-frequency component that matters to the receiver, and the work that the detector has to do is to separate the low-frequency component from the high-frequency one. In doing this, a current is obtained which is varying in accordance with the variations of sound in the studio at the transmitting end, and is capable of making the diaphragms of the telephones or loud-speaker responsive. This work of the detector is known as rectification.

Whilst it is true to say that the above devices described were detectors of wireless signals, they could not do what the detectors of to-day accomplish, *i.e.*, rectify the high-frequency currents set up in the receiving aerial. There are two kinds of detectors to do this, the crystal detector and the valve detector.

Crystal Detectors

The discovery by General Dunwoody of the rectifying property of carborundum was made in 1906, it being subsequently found that certain other crystals of mineral alloys were excellent rectifiers. A popular form of detector is shown in Fig. 4. The detecting property of the crystal lies apparently in its varying conductivity of electrical currents in different directions. A crystal that rectifies may be described as a conductor of electricity in one direction only. The advantages of crystal detectors lie chiefly in the fact that they are cheap, simple, and compact. They cost nothing to maintain, and for these reasons they had a good general run of popularity for several years, and passed the advent of broadcasting, until rivalled strongly by the valve.

Crystals, however, rectify only; there is no amplification. Their range is short, selectivity rather difficult, and they are unable to handle strong impulses, so it was left to the valve to overcome this.

The Valve Rectifier

The introduction of the vacuum valve as a rectifying detector was made in 1904 by Professor Fleming. We all know that after an ordinary electric lamp has been in use for some time

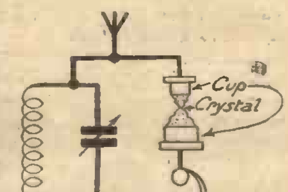


Fig. 4.—Simple circuit using a crystal detector.

(Continued on page 522)

THIRD ARTICLE

CHANGING FASHIONS *in* SET DESIGN

A Brief Survey of the Development of Wireless Receivers from the Inception of British Broadcasting to the Present Day

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

As we have seen, up to the end of 1926, quite large sets, including five-valvers with two high-frequency stages, employed general purpose valves throughout. Even in the early months of 1927 the same state of affairs persisted, but then, quite suddenly, the result of months of patient experiment, and the outcome of several years' accumulated experience were showered upon us in a flood of new valve types which greatly modified set design.

Early among the new arrivals were special high amplification valves for use in resistance capacity coupled stages. R.C.C. had become popular on the score of good reproduction—chiefly because low-frequency transformer design often left much to be desired. Because of the low stage gain possible with general purpose valves coupled in this way, however, it was often necessary to employ as many as three low-frequency stages. With the new high magnification valves the gain per stage was greatly increased, and two low frequency stages became the rule.

More New Valves

Swiftly following the R.C.C. valves came power and super-power output valves of the dull emitter type, permitting the advantages of greater output and better reproduction to be enjoyed by listeners who were restricted to comparatively small low-tension batteries. The power valves gave reasonable output, and certainly better quality than the old general purpose valves, while the super power type, with its much greater grid acceptance, resulted in enormous improvements in reproduction with the popular sets of the day with their multiplicity of low-frequency stages.

I have just been looking at a description of a constructional set published in the early summer of 1927 and typical of large numbers of sets produced about that time. It comprises a detector valve and three resistance-capacity-coupled low-frequency stages, the output valve being of the power type. With such a set, volume control naturally assumed considerable importance, because although the full amplification available would be necessary on weak signals, serious overloading might be experienced with the local programme. Accordingly we find that in addition to the reaction control, there is a complicated system of jacks, by means of which either one or two valves can be cut out as required, while further control is possible by means of filament rheostats.

Tetrode

But valve development did not end with the introduction of the new output valves. For some time past, interest had been shown in the tetrode or four electrode valve. This valve, possessing two grids, was employed mainly as a means of reducing the anode voltage required for receiving valves. The reason why high tension voltages of 50 to 150 volts were necessary is that the electrons—minute negative charges, emitted by the filament—mutually repel each other. Unless the H.T. voltage is high enough to overcome these forces, an undue number of electrons will be forced back to the filament while many others still hover in the space between the filament and the control grid, forming the so-called "space charge," in which position they tend to "blanket" further emission.

In the early tetrode an auxiliary grid, maintained at a fairly low positive potential, was situated between the control grid and the filament. Its duty was to neutralize the space charge and, by its attractive force, give the electrons emitted by the filament such a high velocity that a large proportion of them passed through the auxiliary grid into the influence of the true, or control grid, and thence on to the anode. The device was very successful in that satisfactory results could be obtained with anode voltages as low as 15 volts. But somehow the idea did not take on as well as it deserved—probably because the newer types of dull emitter valve had such generous emission that the tetrode scheme did not seem worth while. Out of the four-electrode principle, however, came an entirely new valve form which cleared away immediately several problems that had been worrying set designers, and marked the commencement of a new era in radio.

Neutralizing and Selectivity

The problems in question were these. First, the neutralized high-frequency circuit, although representing a great improvement in radio frequency amplification, was not entirely satisfactory. As the neutralizing effect depended upon the reactance of a condenser, a quantity which varied according to the frequency of the signal being received, one setting of the condenser only gave *perfect* neutralization for one particular frequency (wavelength). It was, of course, impracticable to re-neutralize the set for every station, so that a compromise had to be effected, with the result that the H.F. stages operated only at maximum efficiency at one point on the tuning range.

The second problem, which was bound up in the first, was that with the increasing number of stations on the air, greater and ever greater selectivity was necessary. Most of the methods of improving selectivity had also the effect of cutting down signal strength, so that the maximum amount of amplification possible was necessary to give good performance, and even the best neutralized triode could scarcely be termed satisfactory in this direction.

The solution was forthcoming in an entirely new type of tetrode—the screened grid valve, which first appeared in commercial form during the early summer of 1927, and, by the autumn, was shown by all the leading valve manufacturers.

Screened grid valves are so well known, and so universally applied to-day, that it is unnecessary to say more than that this type of valve was one in which the inter-electrode capacity, and its effects, were reduced to an almost negligible quantity. In the first place, the electrodes themselves were spaced well apart, especially as regards the grid and anode, the connections to which were at opposite ends of the bulb. Then the fourth electrode, or screening grid, is situated between the control-grid and the anode, and is maintained at a positive voltage approximately equal to half the anode voltage. As a result, although the screen is positively charged, it is, so far as radio frequency is concerned, effectively earthed through the high-tension supply. It therefore acts as an electrostatic screen between the grid and

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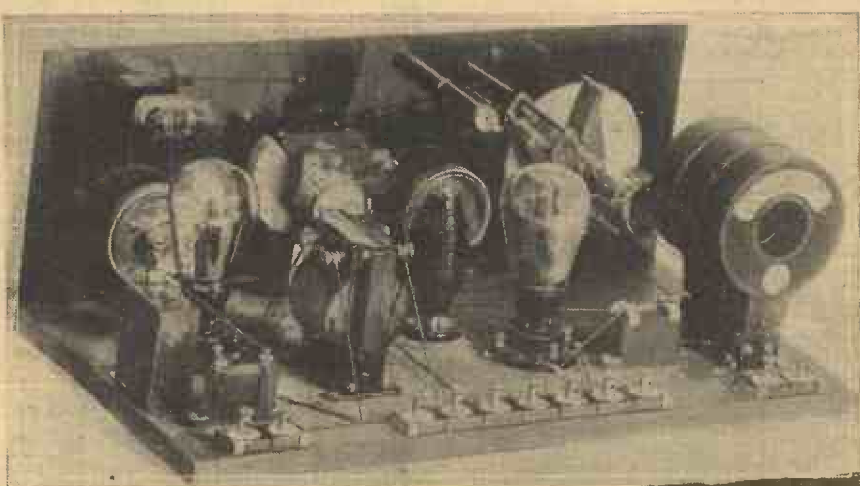

A set which savours of past experiences (about 1927). Note the filament rheostats, plug-in coils and neutralizing condenser.

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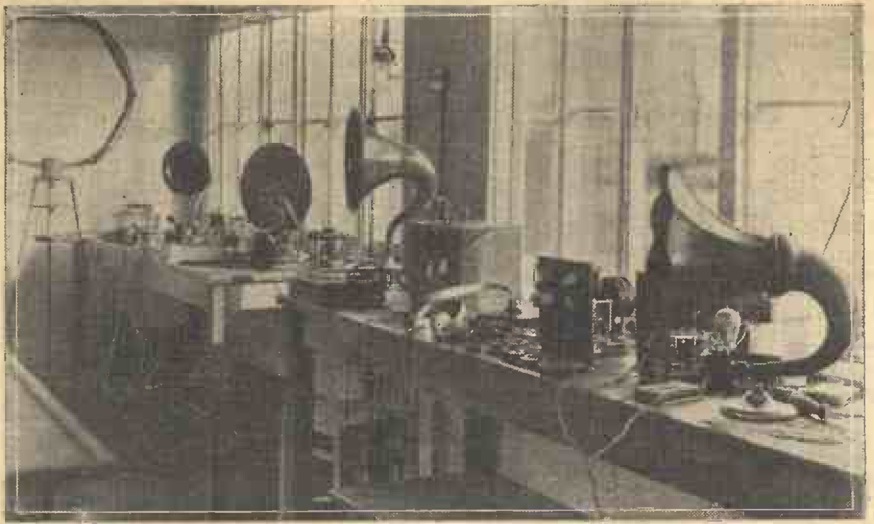
the anode, and prevents feed back between the two circuits.

The necessity for neutralizing coils and condensers was at once done away with, and the circuit connections immediately considerably simplified. The very high amplification factors of these valves also made possible greater stage gains, but in this connection it should be noted that, although the amplification factors of these early screened-grid valves was from 150 to 200 or more, the anode impedances were also very high, so that the full advantage of high-stage gain could be reaped only when correspondingly high-impedance couplings were employed. The most efficient coupling is a tuned circuit, so the tuned anode or choke fed tuned-grid coupling became standardized. Designers endeavoured by all the means at their disposal to decrease the losses in coils and condensers, while accuracy of tuning was further improved by the production of variable condensers the vanes of which were modified in shape to give more open settings on the tuning scale. Great improvements were also made in the design of slow-motion devices for fine and accurate tuning.



Different types of horn loud-speakers, a cone speaker, a range of plug-in coils, slow-motion dials, etc., characterize this laboratory equipment.

Another change in set design which was brought about by the screened-grid valve, was the form and extent of screening between stages. The effects of inter-electrode capacity had been minimized, and any unwanted reaction effects could generally be tracked down to stray couplings between components and wiring. As a result, in order to achieve stability in sets employing screened-grid valves, very complete metallic screening between anode and grid circuits of high-frequency stages was necessary. Usually, this took the form of metal plates attached to the metal panel. A hole, just large enough for the valve to project through, had to be made in the screens, and the valves had either to be fitted horizontally, when they took up a deal of space, or vertically when the design of the screening was intricate, and the wiring of the various stages was difficult and very inaccessible. Very much later, screening cans for valves, and still later the modern metallized valve simplified the mechanical problems of screening, but on the sets of 1927 and 1928, the constructor had to be something of a structural engineer and juggler to erect the complicated screening partitions.

The screened-grid valve had done this for radio, however, it had rendered receivers much more sensitive and much more stable, so that a four-valve set incorporating one high-frequency stage, detector valve, and two low-frequency valves gave range and selectivity equal to, if not greater than, that previously obtainable with two high-frequency stages, and this, too, with increased stability and ease of operation. With the addition of really efficient power output valves, quality too had improved out of all recognition. The use of proper output valves gave an additional fillip to the production of better loud-speakers, and although horn type instruments were still largely used, their acoustic design was on sounder lines, and electrically they were also superior than any that had gone before.

Using the Mains

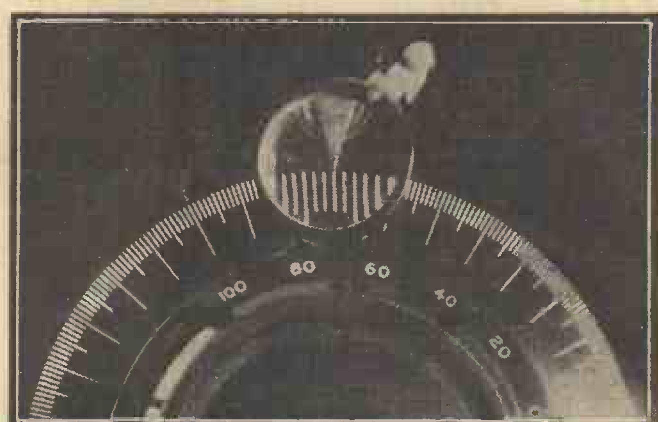
Battery eliminators had also made their appearance, and generous high-tension was, therefore, within the reach of all who could afford the somewhat high initial cost of this apparatus. Towards the end of 1927, the first indirectly heated A.C. mains valves were placed on the market. These were of the general purpose type, and were available in H.F. and L.F. forms. For the output stage, ordinary directly heated super-power valves of the four-volt type were recommended.

Although very efficient from the point of view of characteristics, these valves were somewhat slow in achieving popularity, chiefly because the associated apparatus, filament transformers, and H.T. units were high in price, and partly because the listening public had not been educated up to mains radio at the time. Later on, the production of A.C. mains apparatus was to be undertaken on a larger scale, prices were to become cheaper, and listeners were to become "mains minded," but for the moment the full range of battery valves, including screened-grid types, provided as much technical food as the average listener could assimulate, and entailed more cost than he could usually afford. In the following year, still further technical achievements were to be recorded, but a full two years were to pass before even the screened grid valve could be said to have passed into universal acceptance.

AN AID TO DIAL LOGGING

With so many high-powered broadcasting stations on the air it is becoming a problem of great importance to log the dial readings accurately when you have tuned in the various stations correctly on your wireless set. Not only is it desirable to have slow-motion dials on the condensers, but in some cases it becomes necessary to add some simple device which will enable the proper condenser markings to be noted.

One simple method for this to be carried into effect is shown in the accompanying illustration. First of all procure a small vest pocket type magnifying glass and remove the cover. These glasses are really quite powerful and have a focal length of anything up to two inches. Take a short strip of thin brass and fix one end to the glass frame with a 8BA screw. Drill a hole in the ebonite panel of the wireless set, slightly to the right and above the top of the condenser scale as shown and, bending the brass strip at right-angles at each end, attach it to the panel with a 6BA screw and nut. The lens can be held away from the panel a distance just sufficient to give correct focussing and can be swung in and out of use as desired. As the photograph shows, the dial divisions are magnified, and in this way it is possible to log more accurately the particular settings for different stations.



Showing how a small pocket magnifying glass can be mounted to ensure accuracy in logging condenser dial readings.

Are YOU interested in 5-METRE WORK? Then see Next Week's Issue

RADIO RAMBLINGS

By JACE

Jottings from my Notebook

The Best Position for an Indoor Aerial

I RECALL a somewhat odd experience I had a short time ago. A friend had bought a rather unselective two-valve set and asked my advice in regard to the most suitable type of aerial. A short inside one was suggested and this was duly erected as an insulated wire running along two sides of the room and loosely tacked to the picture moulding. Results? Practically nil, for even the local station was barely audible. Investigation showed that the wire was running almost parallel with an electric conduit pipe, which was (as is always the case) earth connected.

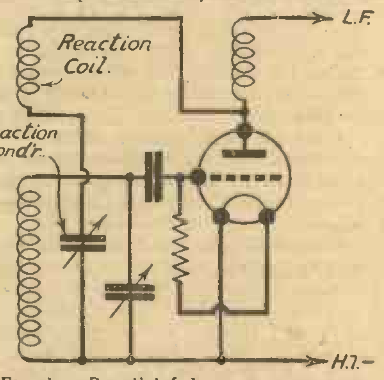


Fig. 1.—Parallel-fed reaction circuit.

By moving the aerial to the two opposite walls, all was well. Apparently the earthed conduit had been acting as an efficient, though unwanted, screen.

The moral is, if you employ an inside aerial, try it in different positions until the best one is found.

Instability with Class "B"

A DIFFICULTY which is occasionally experienced with a class "B" output stage is that there is a certain amount of parasitic oscillation due to slight variations in the two halves of the class "B" valve, or to other causes. This is generally evidenced by a faint, high-pitched whistle or by a peculiar form of distortion on certain high notes.

A satisfactory cure can nearly always be effected by connecting a condenser of about .005 mfd. across each half of the primary winding of the output transformer. The condensers also have a tendency to reduce the high-note emphasis which is always produced by class "B" valves, but they are not usually quite sufficient, in themselves, for this purpose. A more complete measure of tone correction may be secured by joining a .02 mfd. fixed condenser between the ends of the secondary winding of the "driver" transformer.

Another point to watch in a class "B" set is that there should be no leakage of H.F. current from the detector anode circuit into the amplifier, because this is liable to be magnified and to cause serious low-frequency instability and distortion. The usual expedient, of inserting a .25 megohm resistance in the grid lead of the first L.F. (or "driver") valve, is usually sufficient but occasionally a better effect is produced by wiring a 50,000 ohm resistance in shunt with the primary winding of the first L.F. transformer.

The Screening Grid Potential

WITH present-day receivers it has become the usual practice to have only one H.T. positive tapping, the various valves being fed through suitable voltage-dropping resistances. This system is all very well so far as the anode voltages are concerned, but things are rather different in respect to the screening grid supply to S.G. or V.-M. valves. A voltage equal to about two-thirds that applied to the anode is required, but as the current is so very small an ordinary fixed resistance is practically useless for reducing the voltage to a correct figure. In mains sets the difficulty is overcome by using a potentiometer (connected between high-tension positive and high-tension negative) for supplying the screening grid potential, and although the same idea may be applied to a battery set it is not very economical, since the potentiometer causes a constant waste of H.T. current.

Aerials and Interference

BECAUSE a short indoor aerial generally gives more selectivity than the usual elevated wire there seems to be a good many people who think that it is also better for eliminating *electrical* interference. This may or may not be the case—it all depends on the circumstances. If the interference is definitely due to an outside source the indoor aerial will probably prove helpful. But if it is coming into the house *via* the electric lighting mains its

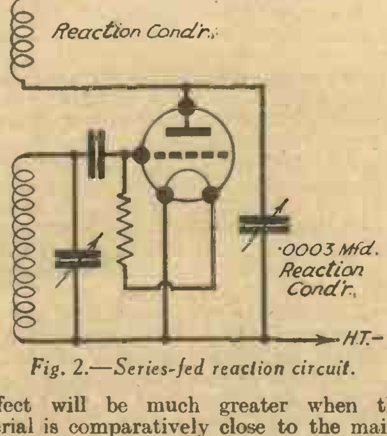


Fig. 2.—Series-fed reaction circuit.

effect will be much greater when the aerial is comparatively close to the mains leads. Where interference is experienced, then, and its source is unknown, the best thing is to try both kinds of aerial and

(*Continued overleaf*)

RADIO RAMBLINGS

(Continued from previous page)

find out for yourself which best suits your own case.

Series and Parallel-fed Reaction

ALTHOUGH the Reinartz, or parallel-fed reaction, arrangement (Fig. 1) is almost universal, there is much to be said in favour of the series-fed reaction circuit shown in Fig. 2.

As a matter of fact, the latter circuit is practically the same as was used a few years ago with plug-in coils, except that reaction is controlled by a .0003 mfd. variable condenser instead of by "swinging" one of the coils. This throttle control, as it is called, works more smoothly than the swinging coil and is less liable to produce instability than is the Reinartz method. In addition, it saves the necessity for a high-frequency choke. It will be clear that the reaction condenser operates "left-handed"—that is, the amount of feed-back is increased as the condenser's capacity is reduced. When the capacity is increased, H.F. currents appearing in the detector anode circuit are allowed to leak away to earth, and therefore there is a reduction in the amount of reaction obtained.

The parallel-fed reaction arrangement is applicable to any type of set using either plug-in coils or the more usual dual-range tuner, but it is of particular value on the shorter wavelengths.

The Latest From Lucerne

ALTHOUGH "long" wavelengths at the time of writing have not yet been definitely allocated, it is easy to foresee that considerable alterations will have to be made in the dials of receivers bearing the names of stations. The latest proposal places some well-known transmitters in the following order. Kalundborg (1,153 m.); Huizen (1,195 m.); Oslo (1,239.7 m.); Madrid, Ankara, Kaunas (1,282 m.); Motala (1,327.4 m.); Warsaw (1,388.9 m.); Daventry National (1,522.8 m.); Königs Wusterhausen (1,604.3 m.); Radio-Paris (1,694 m.); Bucarest, Reykjavik and Porto (1,775.1. m); Lahti (1,863.3 m.); Moscow (1,973 m.). It will be noticed that no provision has been made for Eiffel Tower and that France may thus lose one long channel. If allocated in this manner the list does not take into consideration a number of transmitters already working in the band, and some of the wavelengths may still be shared.

DETECTOR DEVELOPMENTS

(Continued from page 518)

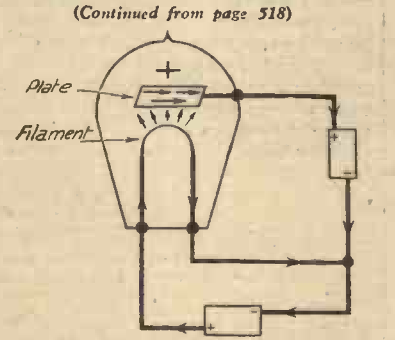


Fig. 5.—This diagram explains the principle of the two-electrode valve.

there is a tendency for a black deposit to form on the inside of the glass wall of the bulb. It was from the investigation of this phenomenon by Professor Fleming that the first valve rectifier was evolved. He introduced a second electrode into the vacuum in the form of a small metal plate and connected up as shown in Fig. 5.

When switching on the current to the filament, the plate being connected to the positive terminal of another battery, a small current flowed in the plate circuit, although there was no metallic connection between the plate and the filament. He further found that, when changing over the wires so that the plate was negative, no current flowed in the plate circuit.

As this device permits electrical currents to pass through in one direction only (as in the case of the crystal), it was soon adopted as a rectifier of oscillatory currents of electricity, and was known as the two electrode valve. Following this discovery, De Forest added a third electrode to the valve, between the filament and the plate, known as the grid. The current in the plate circuit could be controlled according to the manner in which the grid was charged. The result of this was that the valve was made to act as an amplifier of wireless signals as well as a rectifier.

After manufacturers had mastered the art of maintaining a vacuum in producing these valves, crystals gradually took a back seat. The progress of the three-electrode valve (Fig. 6) since broadcasting commenced is well known. Developments from bright emitters to dull emitters, the introduction of mains valves, their applications as leaky grid or anode band detectors, the introduction of more electrodes, as in the screened grid detector, etc., all seemed to point that valves would be the last line of detectors.

And now comes the new cold valve.

The Westector

This, the Westector, is the latest development in detectors. This new cold valve (Fig. 7) consists of a number of discs of copper and copper oxide plates, an electronic action taking place between

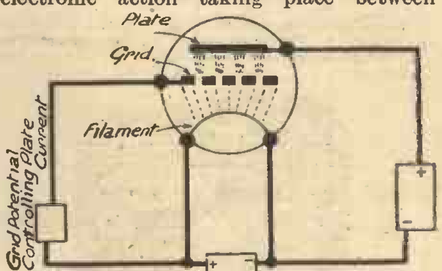


Fig. 6.—Illustrating the function of the three-electrode valve.

these permanent junctions. The Westector will handle large inputs, but it only rectifies—it will not amplify—a particular advantage being that no heater or anode currents are necessary for its operation. As they are particularly suitable to sets of superhet design they can certainly be classed as a possible rival to the valve

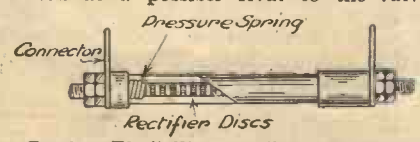


Fig. 7.—The "Westector," or cold valve.

rectifier. However, in comparison with early detectors, we have to-day reached such a stage of efficiency in detection that it will be difficult to revolutionize these methods by any new means of detection.

Facts and Figures

Components Tested in our Laboratory

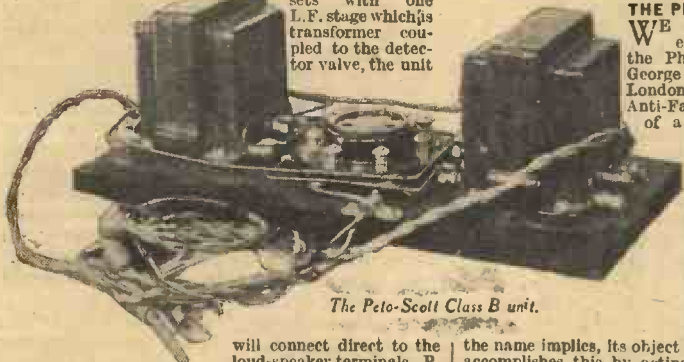
BY THE PRACTICAL WIRELESS TECHNICAL STAFF

PILOT CLASS "B" CONVERSION KIT

THE illustration shows the Peto-Scott "Pilot" Class B Conversion Unit, which retails at 37s. 6d.

The unit should be wired as Blue Print supplied, care being taken to ensure that the seven pin valve-holder is wired exactly as in the sketch, terminal No. 6 being left blank.

This Unit will operate on the majority of sets without any alteration to the existing receiver. In operation the existing Power valve acts as the driver valve, and must be a Triode, the normal small power being satisfactory. Under test we found it to be extremely efficient.



The Peto-Scott Class B unit.

In the case of sets with one L.F. stage which is transformer coupled to the detector valve, the unit will connect direct to the loud-speaker terminals, P. and H.T. on transformer being connected to LS— and LS+ respectively.

If a choke output circuit or output transformer is fitted between output valve and loud-speaker terminals, it should be removed and the P. and H.T. terminals on driver transformer connected to plate of output valve and H.T.+ respectively.

The filament connections should be made to a 2-volt accumulator. The loud-speaker is now connected to the terminals on the output choke. There are two ratios, viz. :—

The Plew Anti-fading Unit which gave excellent results under test.

1—1. Connect speaker between terminals marked 2 and 2.

1.5—1. Connect speaker between terminals marked 3 and 3.

If the first stage of your existing receiver is resistance coupled, it would be advisable to cut it out.

This should be done as follows :—

The feed resistance which is connected between H.T.+ and the anode terminals of detector valve must be removed. The connection from anode terminal to reaction condenser and H.F. choke remains. The wire from the "A" or "P" terminal of existing L.F. transformer must be transferred from the first L.F. valve holder to the anode of detector valve holder.

If an H.F. choke is used, the wire from transformer should connect to the H.T. side of choke; that is the side from which the anode resistance has been taken off. The first L.F. valve can be taken out of set to save filament current, as it is no longer used.

The Unit should be connected to the loud-speaker terminals as previously described.

The operation of your set is exactly as before. The Grid Bias to the driver valve should be increased somewhat, so as to economise in H.T. current. The bias increase should not be such as to cause distortion.

It should be noted that the Class "B" Valve is switched off by simply disconnecting one of the accumulator leads.

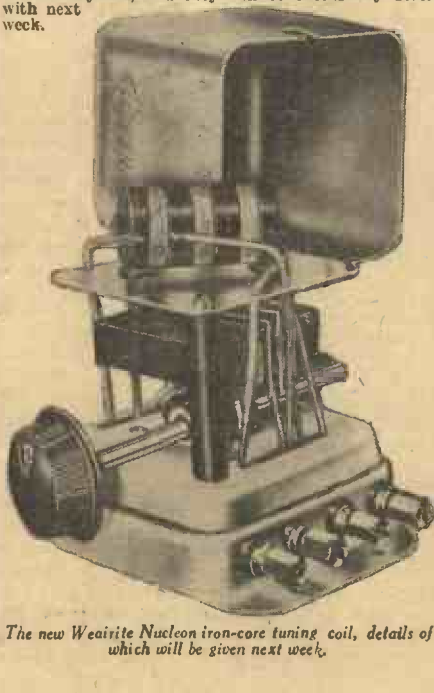
Should a special Class "B" Speaker be used, the output choke can be dispensed with and the connections made to anodes and H.T.+.

THE PLEW ANTI-FADING UNIT

WE have just received an excellent little device from the Phasodyne Radio Co., 22, George Street, Hanover Square, London, W.1, called the Plew Anti-Fading Unit. This consists of a small moulded bakelite case fitted with four terminals which are marked "P," "O," "H.T." and "S" respectively. The unit is connected in the anode circuit of the detector valve and is made to vary the screening grid potential applied to the preceding S.G. stage. The component is very ingenious and works well. As the name implies, its object is to prevent fading, and it accomplishes this by acting as a form of automatic volume control device. The makers are very modest in their claims and we were pleasantly surprised to find how efficiently the unit operated; stations such as Fecamp, which normally fade badly, were receivable at practically constant strength during the whole of a fairly long test. Complete with a sheet of wiring diagrams and full instructions for use, the unit retails at the attractive price of 10s.

THE WRIGHT AND WEAIRE "NUCLEON" COILS

THE illustration below shews the ingenious design of the new "Nucleon" Coils manufactured by Wright and Weaire, Ltd. Originality and low price is their keynote, and they will be extensively dealt with next week.



The new Weairite Nucleon iron-core tuning coil, details of which will be given next week.

IMPRESSIONS ON THE WAX

A REVIEW OF THE LATEST DISCS

By E. REID-WARR

THERE is still a shortage of the more important orchestral works on records, most of the lists being made up of the more ephemeral type of music.

We will begin with the songs which still top the lists. Another Caruso record has been rejuvenated—*Celeste Aida* and *Je Crois Entendre Encore* (*Pearl Fishers*), *H.M.V. DB*1875. In this record you hear Caruso's voice when tendencies towards baritonal quality were developing—a not unusual occurrence in the career of tenors—and it is interesting to compare it with earlier ones. The two arias are admirably chosen—one grandiloquent, the other tuneful, haunting in charming simplicity. John Hendrik, that very good German tenor, has made another excellent record in *Parlophone R*1517. He sings two Lehar songs in German—*Gipsy Love* and *The Czarevitch*—which are a very delightful pair. This young man is so very good that it is difficult to believe that he was working as a clerk less than four years ago. Now he is well on the way to fame. Another cheering example for amateurs!

Talking of amateurs, have you heard the Hon. W. Brownlow? Here is a baritone who is a very fine artist from every standpoint. The entire rewards of his efforts benefit charity, hence his amateur status. His last record contains two light trifles, *This Lovely Rose* and *When I Think of You*, on *Columbia DB*1126. A vocal record which has much to commend it is Robert Burnett's *Edward* and *Wee Willie Winkie* and *Jenny Wi' the Lang Pock* on *Parlophone E*11236. This Scottish baritone has a rare dramatic gift. His singing of that gruesome poem of Dalrymple's is positively eerie. You'll need much Scotch (the language) to follow the other two. Stuart Robertson has two martial ditties well worth hearing in *Vimy Ridge* and *Light of Foot*, on *H.M.V. B*4416, and the new show, "*Music In The Air*," is most artistically and generously ensampled by the Light Opera Company on *H.M.V. C*2568.

I liked Brahms' best two, *Hungarian Dances* 5 *and* 6, as they are played by the San Francisco Symphony Orchestra on *H.M.V. E*607. Almost everybody knows them well; the gaiety of spirit they express is most infectious. A record to come back to at any time. A strange offering comes from *Brunswick* (119). This is *Lament For The Living*, with the subtitle "Suite in G Flat." The name leaves one guessing, but the four parts or movements, "Lament," "Searching," "Phantoms" and "Why?" begin to enlighten one. If you can imagine an allegorical film round such a lachrymose subject, this music would fit in admirably. It is tuneful, modern, but not hair-raising. I think I rather like it.

Bird of Love Divine and *I Hear You Calling Me* are bound to be popular as they are played by so fine an orchestra as the London Palladium. Here you have a symphonic arrangement quite in the grand manner and yet the melody stands out delightfully. Two old favourites in very fine raiment. On *H.M.V. C*2563.

Medleys that are different are the two Scenas, *Venetian Nights* and *A Vision of Spring*, played by the New Mayfair Orchestra. Vocals for colouring such pieces as Come, Lassies and Lads and Offenbach's Barcarolle help to make two quite attractive pictures on *H.M.V. C*2565.

Another *Lilac Time!* The Commodore Orchestra (and Organ) play it on *Broadcast* 3309. It is competent—the Commodore always is—but they should have locked the organ and mislaid the key for *Lilac Time*. Now for a really brilliant bit of playing. This is *The Enchanted Forest* by Ilja Livschakoff's Orchestra on *Decca F*3565. Every modern trick and instrument is used, and the result is uncommonly attractive. *The Little Company* backs it up. Because the orchestral qualities are predominant, I mention here with pleasure *The Black Gipsy* and *The First Flowers in May*—two tangos by the Dajos Bela Dance Orchestra. These are *Parlophone R*1510.

I like Mark Hambourg's playing of Beethoven's *Sonata in C Sharp Minor* (*The Moonlight*) better than anything by him for a long time, not, perhaps, so much from the actual execution, but from the artistic interpretation, which is very satisfying. Hear *H.M.V. C*2551-2 with the fourth side containing a positively enchanting fragment—Beethoven's *Nel Cor Piu Variations*.

In a very different world is John Hunt's introduction of the "Neo-Bechstein" piano *via* Chopin's *Prelude in C Minor, Op.* 28, *No.* 2, and *Mazurka in A Minor, Op.* 68, *No.* 2, and *Clair de Lune* (Debussy). The chief interest lies in this new instrument which has no hammers, but electro-magnets and a loud-speaker! The result is a kind of cinema organ effect with amazing swell effects. John Hunt plays these pieces delightfully, and has great skill with this new invention. Definitely a record to have—*H.M.V. C*2567.

The best humorous record comes from Ronald Frankau, who gives pungently *The Preparatory School*, *The Public School and The Varsity*, on *Parlophone R*1515. The other side is *Let's Go Mad*. That loving couple (!), Billy Caryll and Hilda Munday exchange more amenities on *Broadcast* 3311 (*Home Chat*). Then two funny men with excellent voices sing of *Eucalyptus* and *The Golden Shores of Wigan* on *Sterno* 1193. You doubtless heard Duke Ellington's broadcast and formed your own views! I will but say that he hurt me far less on *Hot Feet* and *The Blues I Love to Sing*, on *H.M.V. B*6343. I feel that we should have understood it all better, had we lived in either 6000 B.C. or A.D.!

Practical Letters from Readers.

The Editor does not necessarily agree with opinions expressed by his correspondents.

Class "B" and H.T. Eliminators

SIR,—I have read in PRACTICAL WIRELESS recently quite a lot about Class B Amplification, and I would very much like to adopt this form of amplification. I understand, however, that it is practically impossible to work Class B off an average type H.T. eliminator. What about the thousands of experimenters, myself included, who have either bought or made H.T. units? Have we to scrap them and buy new ones? I know of only one such unit on the market at present designed specially for Class B, *but* it is rather expensive. Here is a splendid chance for the technicians of PRACTICAL WIRELESS to lead the way once again, by telling us how to adopt out present units to suit. Wishing PRACTICAL WIRELESS every success.—R. E. ATKINS (Horden).

[*Provided that the eliminator delivers sufficient current for the maximum requirements of the amplifier, the Neon Stabiliser may, of course, be used in place of the smoothing condenser in the unit to keep the voltage constant. The subject is, however, receiving our attention.—Ed.*]

I.N.R. and His Majesty's Speech

SIR,—I happened to tune in Brussels on the afternoon of June 12th, and heard someone speaking. After a while, I knew it was King George, and I listened to the end. Afterwards there was a very pleasing incident, which I wish to report. *The announcer told us in Flemish, that that was the end of His Majesty's speech, and said, "We will now put on a gramophone disc and play 'God save the King.'* We will then proceed with our concert."

As a regular reader of your splendid paper, and being a Britisher, I thought this jot of news may interest you, and be worth publishing, just to let Englishmen know what the officials of the I.N.R., which is the Broadcasting Company of Belgium, think and feel when they relay a speech by our King. Best wishes for the future of PRACTICAL WIRELESS.—F. J. WHALLEY (Antwerp).

A Ceylon Reader's Views

SIR,—Being on leave in London when PRACTICAL WIRELESS began publication I took it in from No. 1 and have continued doing so after my return to Ceylon. Like the many thousands of other readers I can say I have not met its equal for giving good value, both as regards the practical as well as the theoretical side of wireless. Every subject, however abstruse, is dealt with in such clear and simple language that one *has* to understand it. I must also thank you for the Wireless Constructor's Encyclopædia which I have found most useful. As you welcome criticism may I make a suggestion.

Most of the circuits given in PRACTICAL WIRELESS need special coils which are more often than not unobtainable in Ceylon (I should think this applies to other parts of the Empire, too) and, therefore, their construction is either not possible or has to await receipt of the necessary coils, etc., from the manufacturers. Another point that has struck me is: Why is it considered a *sine qua non* of a set that a wave-change switch must be included in the circuit? We, in the Colonies, do not in the least mind coil changing, and, as our receivers, to be of any use, have to tune in all wavelengths from 12 or 15 m., to 1,000 m. we generally build them so that it is merely a question of changing coils for each waveband.

The ideal circuit for us is one with S.G., det., and 2 L.F., as with this and the necessary coils the world is within our reach. On such a set the Empire S.W. station comes in at full L.S. strength often when we cannot hear our local (Colombo) owing to atmospherics. Now, sir, if you can describe a set using such a circuit (the last stage might with advantage be Q.P.-P., or Class B amplification), giving details for making the necessary coils, you would be conferring a boon on all readers outside England.—R. G. LEEMBRUGGEN (Matara, Ceylon).

(*Continued on page 526*)

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT if signal strength is not reduced when the earth is removed the earth connection is inefficient.

—THAT a mains A.C. receiver can always be used on mains of higher frequency than that for which the set was designed, but should not be used on mains of lower frequency.

—THAT in making a portable set it is always best to screen the loudspeaker leads, to prevent instability.

—THAT when calculating the value of bias resistance for an A.C. pentode the anode and screening grid currents must be added together.

—THAT good reception can often be obtained by dispensing with an aerial and connecting the earth lead to the aerial terminal.

—THAT fitting new valves to an old set often causes instability.

—THAT for power grid detection the detector anode voltage must not be less than 120.

—THAT the wiring of an electric bell often makes a good indoor aerial.

—THAT when decoupling is provided there is no harm in wiring a new high-tension battery in series with a partly exhausted one.

NOTICE.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

ROUND *the* WORLD *of* WIRELESS *(Continued)*

INTERESTING and TOPICAL PARAGRAPHS

Relays from North American Continent

NEW working arrangements have been concluded between the B.B.C. and the Canadian Broadcasting Commission, National Broadcasting Company and Columbia System, whereby in future there will be an increased exchange of programmes between the North American Continent and Great Britain. One of the most notable events in the history of broadcasting will also take place when Sir John Reith personally opens the new *Radio City* in New York next November.

Reopening of Münster Transmitter

THE 1 kilowatt broadcasting station at Münster (Westphalia), which was closed down after the opening of the Langenberg transmitter, is to be overhauled and again brought into operation. It will take part of its programmes from Cologne, but broadcasts will also be made from its own studio.

Broadcasts of Criminal Trials

GERMAN stations recently caused some sensation by transmitting gramophone records of proceedings in a Berlin Court. As the experiment was a successful one it is proposed to include such broadcasts as a special feature in the programmes when occasion arises.

Friendly Neighbours

AN Austrian listener, whose neighbour was in the habit of broadcasting dance music from the adjacent flat until the local station closed down at midnight, sent his son to borrow the wireless receiver which was the cause of the uproar. In answer to the boy's polite request, he was asked whether his father still wanted to dance at that hour. "No," was the reply, "he does not actually want to listen to *hot jazz*, but he wants *to go to sleep!*"

New 300-watt Austrian Relay Station

THE Ravag has passed an order to the Western Electric Company for the installation of a 300-watt relay transmitter to be installed at Bregenz, on the borders of Lake Constance. As the plant is ready it is expected that the station will be completed by August.

French Wireless Tax

SIMILARLY to the principle adopted in Germany, the French Posts and Telegraphs Department will collect the new wireless tax from possessors of radio receivers through postmen on their rounds. The tax may be paid in monthly instalments if desired.

An American Idea!

IN order to avoid certain restrictions imposed by the United States Federal Commission a group of Los Angeles (California) business men propose to build a floating broadcasting station in the open sea, beyond the ten-mile coastal limit. The power of the transmitter has not yet been definitely fixed but may reach 25 kilowatts. The station would be registered with a Central American republic to which free publicity would be granted. Its principal activity, however, would consist of sponsored programmes for the advertising of commodities and products forbidden, at present, to American studios. It is the same law which induced the owner of a Texas station to remove his transmitter across the Mexican border.

A PIANO WITH MICROPHONES

H.M.V. gramophone records recently issued have introduced a new musical instrument to England. Here John Hunt is seen recording a Chopin Prelude on the Neo-Bechstein piano. The sounds from the strings of this instrument are amplified by means of microphones and valves and reproduced through a loud-speaker. Extraordinary effects can be gained and reproduction is similar, in many characteristics, to that of an organ. This is the first change that has taken place in pianoforte design for a hundred years. The piano was erected in the "His Master's Voice" studios at Abbey Road for the making of gramophone records.

Popularising Radio

NOT only has the German Reichsfunk designed and placed on sale a popular wireless receiver to be sold compulsorily by dealers at a very low price, but to encourage the reception of educational talks in schools it has reduced the tax to these institutions from 2 marks per month to the equivalent of roughly ninepence for that period. At the reduced fees—only certain transmissions may be tuned in during school hours, but exceptions will be made on special occasions.

B.B.C. Thriller

THE B.B.C. has decided to revive the German radio play *Flags on the Matterhorn* on July 6th (Regional) and 7th (National). It was first broadcast in Great Britain a year ago to celebrate the sixty-fifth anniversary of the conquest of the mountain. The tremendous realism of the microphone story of the Englishman's victory over the Italian guide makes *Flags on the Matterhorn* one of the outstanding plays of ten years of broadcasting.

West National Transmitter

ALTHOUGH the West Regional station has been radiating a full service since May 28th, the bringing into operation of the National transmitter is a matter which requires extensive preparation. The alternative programme for Wales will be broadcast on 261.6 m., a channel shared with London National. The working of two high-power transmitters on the same wavelength is a new departure, and it is possible that the introduction of the full twin programme service from West Regional may not begin before July.

Radio Lisbon

WORK on the Portuguese high-power station in the neighbourhood of the capital is well under way, and it is hoped that the transmitter may be ready for tests towards the beginning of October.

Why Vienna Broadcasts are Weak

ALTHOUGH this station is working on 100 kilowatts and should provide strong signals, results, so far, have been disappointing to listeners in the British Isles. The reason for which the broadcasts are not heard at a strength commensurate with the power used is because the reflector aerial mast has not yet been brought into operation. The transmissions are not destined to the capital, but to the Western districts of Austria and it is for this reason a "beam" effect is desirable.

Munich to Increase its Range

ALTERATIONS are to be made to the new Munich 60-kilowatt station with a view to increasing its power. Work is to be started at once in order to permit the transmitter to radiate 100 kilowatts (aerial).

SOLVE THIS!

Problem No. 42

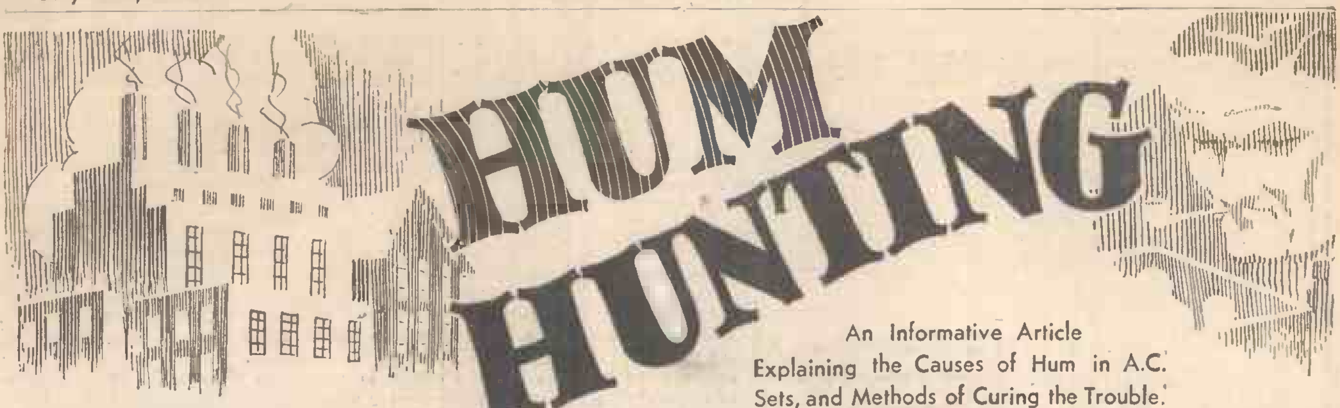
Binks made up a three-valve S.G.-D.-Pen. receiver which was provided with band-pass aerial tuning and a tuned grid inter-valve circuit. A three-gang-coil unit, with self-contained switches, and a gang tuning condenser were employed. It was soon found, however, that although the set functioned quite satisfactorily at some times, signals were very faint at others. Binks also noticed that when signal strength was poor, selectivity was also much below its usual standard. Suspecting bad contacts, he examined all the wiring, tried different valves, and tested all the components for continuity of circuit, insulation, etc., but without finding anything wrong. What was the cause of Binks' trouble?

SOLUTION TO PROBLEM No. 41

The anode resistance in the R.C. unit caused a greater voltage drop than did the transformer primary previously connected in the detector anode circuit. In consequence the anode voltage applied to the detector was too low to allow the valve to oscillate.

The following three readers received books in connection with Problem No. 40:—

J. H. Burnett, 7, Grange Avenue, Scunthorpe, Lincs.; E. Basilio, 2, Glastonbury Road, West Hove, Sussex; B. L. Suart, Brinnington Hall Lodge, Brinnington, Stockport.



HUM HUNTING

An Informative Article Explaining the Causes of Hum in A.C. Sets, and Methods of Curing the Trouble.

By A RADIO ENGINEER

THERE are few things more annoying than to find that after having finished building a brand new A.C. mains set, its performance is almost drowned by a loud and continuous hum. Some may consider it a greater nuisance when the hum, either in a new set or in a receiver, which hitherto has been beyond reproach, is not sufficient to spoil the programme entirely, but is, nevertheless, distinctly audible.

In the first case you are painfully aware that something has gone radically wrong, and generally it is not a very difficult matter to track down the cause. In the case of a less severe hum, however, the cause usually is more obscure, and the possible reasons so many, that hum hunting may take up quite a large part of your leisure time for several days.

It is easy to introduce hum into a receiver, and even with the greatest care in design there is always a risk of some unwanted coupling with a source of hum, so a few notes on the causes and cures for hum may be helpful.

Three Points to Consider

There are, generally speaking, three points at which hum may be introduced into a set: first, through the mains connection, *via* the high tension supply unit; second, *via* the aerial-earth system; and third, by pick-up within the receiver itself, due to unwanted coupling between some part of the circuit and the power pack circuits.

Hum directly due to the A.C. mains, and not caused by internal or external couplings, is usually the result of faulty smoothing of the high-tension supply. Although the mains are supposed to be of a standard frequency—usually 50 cycles per second, the wave form is seldom a perfect 50-cycle sine wave, but carries ripples corresponding to higher harmonics of the 50-cycle fundamental. The H.T. supply, after it has left the rectifier, is not a steady direct current, but a uni-directional pulsating current, the pulsations being at twice the frequency of the A.C. supply, and bearing, in addition, any ripple present in the original mains voltage.

It is the duty of the smoothing circuit to filter out these ripples. The common explanation of smoothing is that the choke passes the direct current portion of the supply, but "chokes back" the ripple which is by-passed through the smoothing condensers. This is not a complete explanation, because the condensers act more as buffers, absorbing power during the peaks of the ripples and giving out power during the troughs. Insufficient smoothing, due either to a choke of too low an impedance, or to reservoir condensers of too small a capacity, results in a certain amount of ripple remaining in the H.T. supply forming the anode current to the various valves—and that hum will be amplified in the successive stages of the set, so that in the output stage it assumes annoying or even serious dimensions.

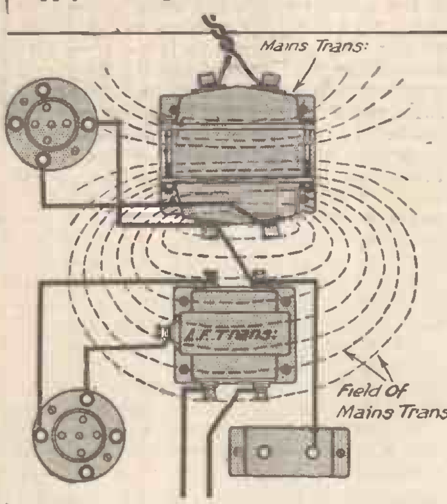


Fig. 1.—An L.F. transformer located within the field of a mains transformer induces hum.

L.T. Wiring

Pick-up of mains hum within the set is not caused by defective smoothing. It is the result of coupling—either magnetic, or capacitative—between parts of the receiving circuit and the circuits carrying "raw" alternating current. For example, in a very badly designed set, in which the intervalve transformers are located within the magnetic field of the mains transformer, hum might be very bad indeed. On this point, it is worth noting that certain cheap mains transformers of the "manufacturers'" type have very powerful magnetic leakage fields. If it is necessary to employ a transformer of this kind, care must be taken that the power pack is kept right away from the receiver proper, or, at any rate, the pack must be well shielded.

Another fertile source of hum is badly designed low-tension wiring. The heater wiring carrying a fairly heavy raw A.C. current has of necessity to pass fairly close to the grid pin of each valve holder, but the runs should be so located that coupling with the grid circuits is a minimum, thus reducing the risk of pick-up to the lowest possible.

When hum is introduced through the aerial-earth system it may, or it may not, be serious. If the set employs one or more high-frequency amplifying stages, and these high-frequency amplifiers are correctly designed and are not overloaded, any mains ripple picked up by the aerial will not be reproduced in the set—unless by poor design some coupling within the receiver transfers the ripple to the detector or low-frequency stages when, of course, it will be amplified and very noticeable.

If, however, the H.F. valve is overloaded, that is to say, if it is allowed to partially rectify incoming signals, then, when the set is tuned in to a signal, the incoming carrier will be modulated by the hum, rectified by the H.F. valve, and you will hear all about it by the time the signal gets to the loud-speaker.

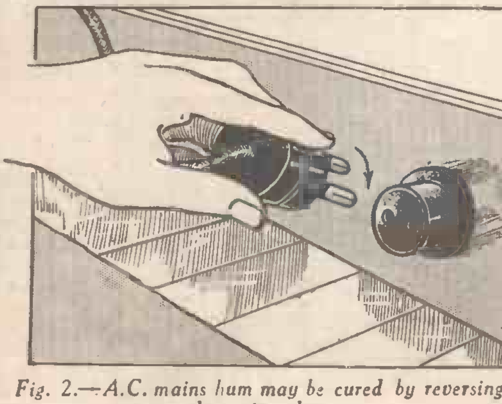


Fig. 2.—A.C. mains hum may be cured by reversing the mains plug.

Getting on the Track

Now, suppose an A.C. set develops a bad hum; what are the best steps to take in order to track it down and put matters right? Well, in the first place, the simple operation of reversing the mains plug and thus changing over the side of your power transformer which is connected to earth may be tried. Next, ascertain whether the earth connection is good. A high-resistance connection here will develop a comparatively large hum voltage across it if there is any inductive coupling between the earth lead and any part of the house wiring. Have a good look, too, at the run of wires between the aerial and the set, and ascertain that it does not pass close to any part of the electric light or power wires. Do not forget, in this connection,

(Continued overleaf)

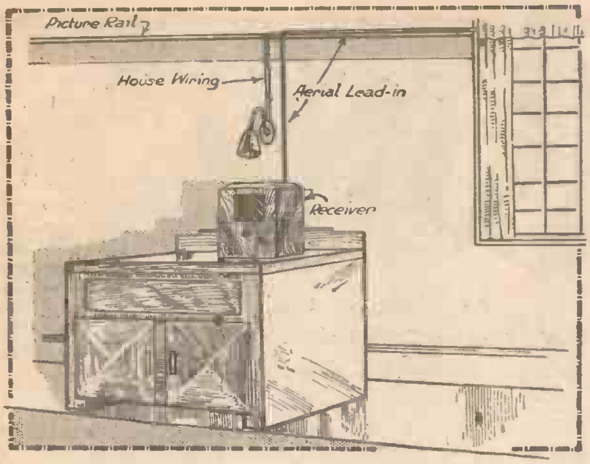


Fig. 3.—Induced hum may be experienced if the aerial lead-in runs near the house wiring.

(*Continued from previous page*)

that there may be wires concealed in walls, ceilings and floors.

If you have eliminated these obvious causes, turn your attention to the power pack. Check up, first of all, the filament of the rectifier valve. If one filament of a full-wave rectifier has failed, or lost its emission, the unit will still operate as a half-wave rectifier, but with greatly increased ripple. A similar effect can be caused if one-half of the H.T. secondary has broken down. Faults in the smoothing condensers may be the trouble—a disconnection to either condenser (internal or external) means a big ripple voltage at the anodes of the receiving valves.

By the way, if after applying all the tests you fail to stop the hum, you may suspect insufficient smoothing, when the remedy is to substitute for the usual 4 mfd. reservoir condensers electrolytic condensers of 8 mfd. or more. I am not explaining in this article how to test each component, as the usual methods for carrying out this side of the work have already been described in recent issues. I am merely endeavouring to indicate where to look for faults and what to look for.

While on the subject of condensers, if the power pack seems in order, you might next examine the by-pass condensers of the various decoupling circuits—detector, H.F. and L.F., and also, the condensers decoupling automatic biasing circuits. If any of these condensers has developed an open circuit there is every likelihood of bad hum materialising. There is almost certain to be a small amount of pick-up in the associated circuits, and if the so-called "decoupling" resistance is not by-passed to earth effectively, the hum frequency voltage developed across the resistances will set up intense hum. In fact, a decoupling resistance without its associated condenser becomes, not a decoupler, but a coupler.

Avoid Bunching

Yet another important point to watch is the way in which the wires connecting the set to the high tension and filament supply unit are run. It is very easy to ruin all the good work of careful design and workmanship by bunching together H.T., L.T., and even grid bias leads between the set proper and the mains unit. On more than one occasion I have cured a set completely from terrific hum merely by sorting out the bundle of connecting leads and spacing them well apart. On a few occasions it has also been necessary to use metal sheathed wiring for leads carrying raw A.C. In other cases, it has been sufficient to alter the aerial and earth leads from close proximity to mains connections.

Sometimes queer and apparently contradictory hum symptoms make their appearance. For example, I remember one case where a big radiogram was perfectly free from hum when used as a wireless receiver, but was appalling when the gramophone pick-up was in use. The solution was found eventually when the set was partially dismantled. There was a bad connection in the switch used for changing over from radio to gramophone, resulting in a high resistance contact in the grid circuit of a detector valve when the gramophone was being played. In consequence, A.C. mains ripple, picked up in the lead joining the gramophone pick-up to the switch, and passing fairly near the electric gramophone motor, caused a voltage drop across the high-resistance contact, which A.C. voltage was impressed upon the grid of the detector valve in its normal functioning of being the first L.F. valve.

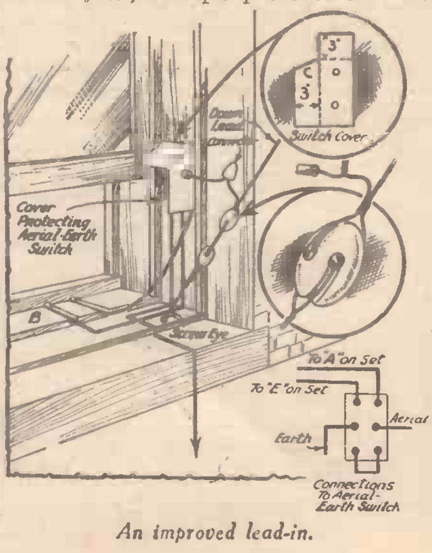
It is notoriously difficult to keep the heater wires far away from the grid circuits of the different valves, but every effort should be made to do so as far as possible. One of the best methods of achieving that end is to make the grid leads short and to use under baseboard wiring for the heater leads. Finally, bear this in mind. Barring a few obvious types of failure which should be discovered within the first five minutes of your hum hunt, practically all hum can be tracked down usually to poor high-resistance contacts, or badly spaced components and wires.

Fig. 4.—Look to the earth connection.

AN IMPROVED LEAD-IN

THE method described is much easier made than the soldered joint, gives good contact, and does not corrode. The first thing is to fix the down-lead. Fix a screw-eye in the woodwork on the window-sill (as sketch), then prepare two insulators with a 3in. length of wire between them, and a 12in. length at one end. Put the 12in. length through the screw-eye, and give it a loose twist on itself. Thread the down-lead through the free end of the insulator, pull it just tight, and bending it back on itself, lash together with a strand of aerial wire or other thin wire. Leave an end of about 2½in. and cut off the odd wire (illustrated). Make the down-lead taut by tightening up the wire through the screw-eye. Bare the end of the lead-in wire about ¾in. and twist it round an equal amount of the end of the down-lead, as shown in the sketch. Procure a connector, as used by electricians, screw this on the twisted ends and you have a perfect joint. Turn the connector so that it sheds the rain.

To take the lead-in through the window, drill two ¼in. holes, about 2in. apart, through the window-frame from the inside, at a point just below the level where the sash rests (illustrated). Now take a wood chisel and cut a ¼in. groove across B, at each hole. The lead-in is led along one of these grooves, and through the hole, a little slack being left to keep any strain off the joint, a staple put over the wire at the outside end of the groove ensures that the wire stays in the groove, and that no pull comes on the joint. The other hole is used for the earth wire. This method allows the window to open and shut without injuring the wire. A piece of ebonite may be taken and holes bored in it, the same distance apart as the holes in the window-frame, and two sockets fitted. Fix the lead-in and earth wires to these sockets. Place this over the entry holes and secure close to the woodwork by means of two small wood-screws in opposite corners. (To make a neat job of this you must be very exact about the distance between the holes, and the entry holes may need to be enlarged a little at that end to take the sockets.) Two leads fitted with plugs must be provided.



An improved lead-in.

If possible, it is advisable to use an outside earth, and take both lead-in and earth to an outside D.P. D.T. switch before going through the entry holes. The switch is easily protected from the weather by a piece of zinc shaped as in sketch. Place the switch on the zinc and screw to the woodwork at side of window, taking care that you have the flap "C" at the proper side, *i.e.*, farthest from the glass. Bend the flap in at right angles and the top down to meet it and the result is a neat, trouble-free job.—JAMES PETTIGREW (Edinburgh).

DISTORTION! —It's Causes and Cure!

Some Random Remarks on an Important Subject.
By BERNARD DUNN

A DIFFICULTY which confronts the designer, and even the user, of any receiver is that of obtaining good "quality" reproduction. "Perfect" reproduction will perhaps never be possible, but we have already approached very near to that ideal. The transmissions sent out by the B.B.C. are the envy of the whole world for their excellent purity, or, in other words, for their extremely close resemblance to the original sounds produced in the studio, but it is probably no exaggeration to say that 80 per cent. of our receivers do not do justice to them. Of course, the whole question of "quality," "purity of production," "fidelity," "good tone"—call it what you will—is very involved. Not only have the receiver and loud-speaker to act their parts, but the room in which they are to be used and, more important still, our *ears* have to "play up" to them. Rather fortunately, the ear is a very tolerant organ in some respects, and is quite prepared to "overlook" many of the shortcomings of our reproducing system. At the same time it has to be satisfied in certain ways before it can pass on to our minds a feeling of enjoyment.

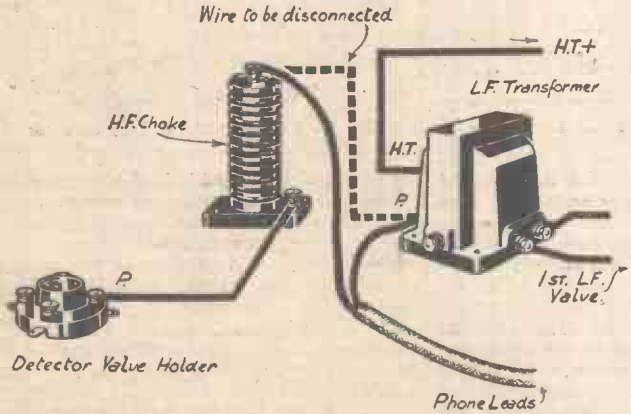


Fig. 1.—Method of cutting out the L.F. amplifying valves when tracing the source of distortion.

Judging "Quality"

It is rather a pity, in some respects, that our ears are so very accommodating, because we are often inclined to take the kind of reproduction to which they become accustomed as a standard by which others may be judged. What is meant is this; we become so used to listening to one particular set and speaker that our ears tell us that the reproduction is "good," whether it really is or not. For this reason any person who is in search of perfect quality can scarcely hope ever to attain it by experimenting with one set and one speaker to the exclusion of all others. He should endeavour to hear as many instruments as possible, and, with a perfectly open mind—or should we say "ear"?—try to appreciate the good and bad points of each. By this means he will soon begin to understand what is possible and what can be expected. Perhaps you will say that all this is of no importance to one who has not a musical "ear." Don't believe it; anyone can develop a reasonably good judgment by doing as suggested above, and carefully listening to as many sets as possible.

What is Distortion?

But it is not the purpose of this article to dwell on the physiological and psychological side of the business, but to tackle this question of distortion from a practical point of view. First of all, what is meant by distortion? A dictionary says that to distort is "to twist or turn from the natural shape of a figure; pervert from the true meaning; misrepresent." Well, then, if our loud-speaker does not give a true representation of the sounds being made in the broadcasting studio, distortion is taking place somewhere. When confronted with the problem it is all very well to say that the fault is at the "other end," meaning at the transmitting station, but, as mentioned before, the transmissions sent out by stations in this country, at any rate, are so near to perfection that we can safely take them as our ideal.

Old valves are a common source of L.F. distortion, since, due to their reduced filament emission, they become overloaded on even comparatively weak signals. Defficient valves can generally be traced by the fact that volume is very poor unless the grid-bias voltage is cut down to zero or a very low figure. Besides, when this fault is present the tone of reproduction is usually "thin" and "screechy." The only cure is to fit new valves.

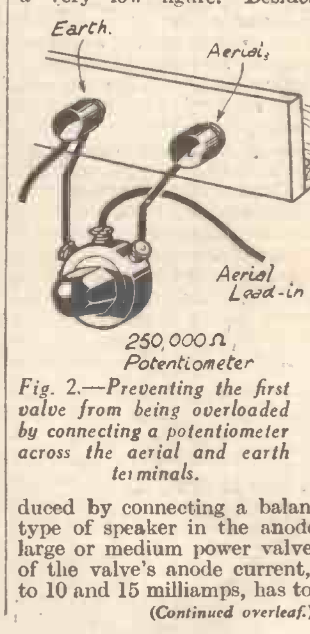


Fig. 2.—Preventing the first valve from being overloaded by connecting a potentiometer across the aerial and earth terminals.

Loud-speaker Feed

Another cause of distortion which occurs, whether the signals are loud or soft, is that produced by connecting a balanced armature type of speaker in the anode circuit of a large or medium power valve. The whole of the valve's anode current, probably up to 10 and 15 milliamps, has to pass through

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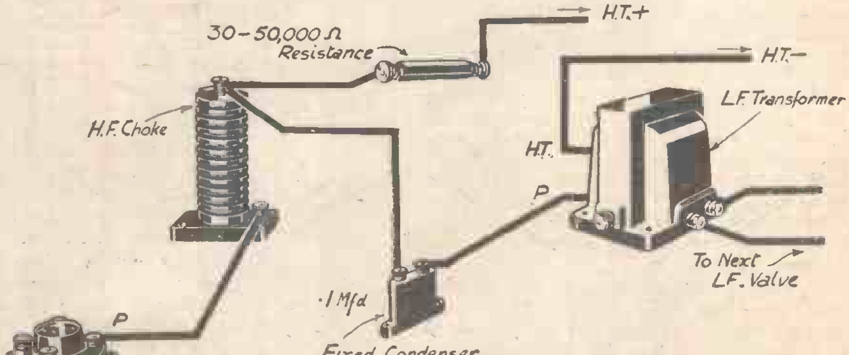


Fig. 3.—Overloading of the L.F. transformer can generally be cured by using the resistance-feed connections shown above.

(Continued from previous page.)

the speaker windings, and this has the effect of "saturating" the magnets. As a result they cannot respond to the rapidly varying signal currents, and music becomes "blurred" or "harsh." A simple remedy is to feed the speaker through a suitable output transformer or to connect it on the choke-capacity principle.

Tone Correction

In addition to the very noticeable kind of distortion dealt with above there is another which is by no means so "obvious" to the untrained ear, that which causes the high and low notes to be reproduced disproportionately; certain parts of the musical scale are heard much more loudly than the others. This really brings us to the question of tone correction which was dealt with on page 1223 of PRACTICAL WIRELESS, No. 26.

Automatic Tone Compensation

Whilst the response of a set can almost invariably be "levelled out" by means of a separate tone control, this system is often objected to on the score of its involving the use of an additional knob on the receiver panel. It is not difficult to design a set which will give good quality at a certain setting of the controls, but unfortunately the tone is often changed quite appreciably by adjusting the reaction condenser or altering the volume some other way. It is well known by now that as reaction is increased there is a corresponding reduction in high-note response. Various methods of compensating for this have been devised, but what is really required is a device which is perfectly automatic. One method is to use a special L.F. transformer which gives extra emphasis to the high frequencies and so to arrange the reaction condenser that it switches a fixed condenser into circuit in parallel with the transformer primary, when set to its "minimum" position. This is fairly satisfactory but has the disadvantage of being rather "sudden" in its action. A much better way is that to be given later where two variable resistances are ganged together to act as a combined reaction and tone control. As the knob is turned anti-clockwise reaction is increased and the response of the L.F. transformer to low notes is reduced. This is brought about by connecting one resistance in the reaction circuit and using the other in conjunction with a small choke as a tone control on the L.F. transformer. After the normal reaction condenser (R.C.) has been set to an optimum value and the most suitable tapping on the choke has been found, almost perfect reaction compensation is provided over the whole range of adjustment. The construction of a tone control choke suitable for this arrangement was described in the article referred to above.

Volume Control Compensation

Every kind of volume control has an effect on the tone *as recognized by our ears*. It is not that the control actually alters the tone, in fact any properly designed one does not, but to our ears it seems to do so. If you are in any doubt as regards the veracity of this statement just try the following experiment and listen carefully to the results. Turn the volume control of your receiver "full on" and then quickly reduce it to, say, the "half-on" position. What do you notice? At the first setting the "quality" was "rich" and "full" (I now assume the set to be a good one), but at the second there was a lack of bass, and perhaps also to a lesser degree, of treble. Why? Well, although the proportionate response of the set to high and low notes was probably just the same in both cases, the ear is less sensitive to frequencies below about 500 cycles and above some 2,000 cycles, especially at low volume levels.

Thus if the volume control is to fulfil its proper purpose and at the same time to have no apparent effect on the tone it must be fitted with some kind of compensating device. In most cases compensation can be effected very easily and at little expense. A simple arrangement for an "acoustically compensated volume control" (as the device is known in U.S.A.) will be dealt with later. In addition to the usual V.C. potentiometer, which is connected across the secondary winding of an L.F. transformer or across the pick-up terminals, there are two fixed condensers marked C1 and C2; C1 is for increasing the bass and C2 looks after the treble. The idea of the system is that C1 offers a fairly high impedance to the lower frequencies (bass), but practically none to the high frequencies.

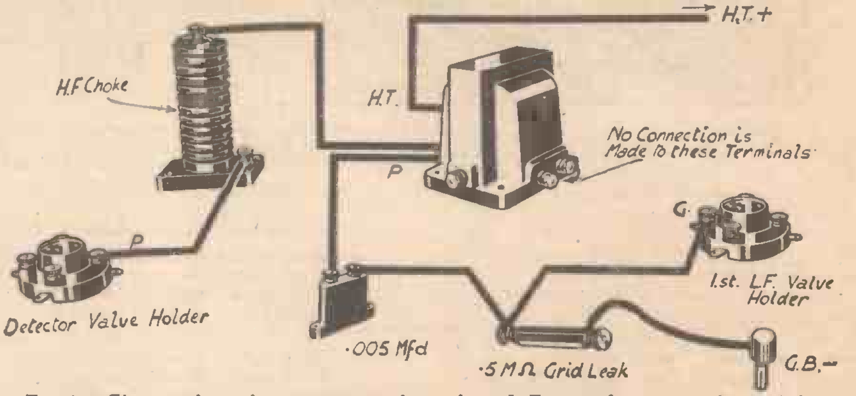


Fig. 4.—Showing how the primary winding of an L.F. transformer can be used for choke-capacity coupling.

(To be continued.)

A HANDY CLAMP

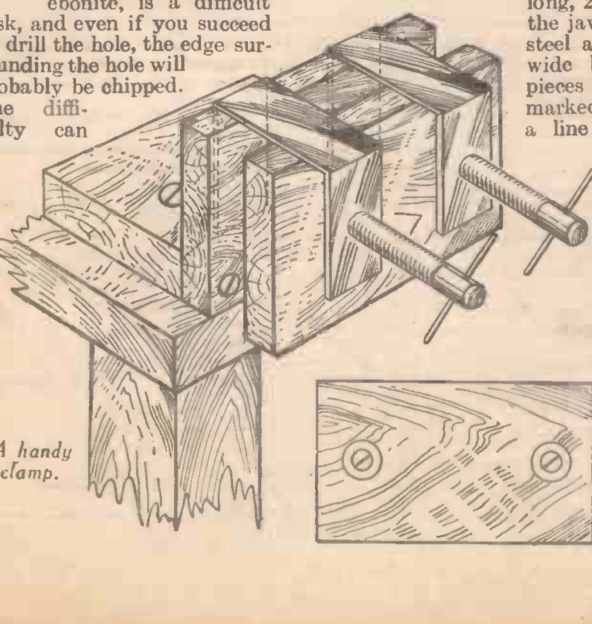
By T. PHIPPS

TO drill a hole in the edge of a panel, whether this be made of wood or ebonite, is a difficult task, and even if you succeed to drill the hole, the edge surrounding the hole will probably be chipped. The difficulty can be overcome quite easily with the aid of this useful device, which will be found handy for a variety of uses.

The sizes given are not critical, so that they can be increased if desired. Two pieces of hardwood are cut to measure 4in. long, 2in. deep and ⅜in. thick for the jaws. Two pieces of iron or steel are next cut, 3½in. by ⅜in. wide by ⅛in. thick. The two pieces of steel or iron should be marked with a sharp-pointed tool, a line being made across each piece 1in. from each end. Two small holes are drilled in one end of each, and at the other ends a hole should be drilled in the centre and tapped to take a 3/16in. screw. After heating the U-shaped clamp clips can be bent on the scribed lines.

Now cut a piece of 5-ply wood or other thick wood and make this the same length as the two pieces of hardwood and about 2in. wide. This part secures the clamp to the edge of the bench or table. Screw the clamp to the baseboard, and fit two 3/16in. key screws in the two U-pieces.

Just a hint on using; the panel or board of which the edge is to be drilled, should be fitted between the jaws, and the key screws tightened up, a pilot drill being used first as a guide.



A handy clamp.

NEW COSSOR PRODUCTS.

IN addition to two new Cossor valves, details are now available regarding the new Cossor "Class B" Console Receiver. The latter is of the small type of receiver, measuring actually 14in. wide by 35in. high, and having a depth of only 11in. It stands on a small four-legged stand, but this may be dispensed with and the receiver employed as a table model. The circuit consists of a screen-grid H.F. stage, detector, driver and Class B output valve, and provision is made for a gramophone pick-up. Single dial tuning is employed, and a permanent magnet moving-coil loud-speaker is fitted. With the exception of the cabinet and the ivorine scale, every part is made in the Cossor factory, and it is a tribute to the enterprise of this firm that the entire apparatus sells for the low figure of £9 19s., which includes royalties. Of the new valves, the 220 VS. is a variable-mu screen-grid having an impedance of 400,000 ohms and a slope of 1.6. At zero grid volts the amplification is 640, and if employed in a suitable circuit, with, for instance, an efficient iron-core coil, a stage gain of at least 500 should be obtainable. Stability is ensured by the low grid-anode capacity, which is only .001 $\mu\mu$F (a record which the Cossor people claim is unbeaten). The anode current is only 3.6 mA at zero grid volts, and the valve is thus an extremely useful one. The Class B valve has already been commented upon in previous pages, and very slight alterations have been made to this valve. The output load should be 12,000 ohms (plate to plate) and the D.C. resistance in the anode circuit should be not greater than 400 ohms total.

PAGE MISSING

PAGE MISSING

An Inexpensive D.C. Mains Unit

Full Details are given here of a Compact and Highly Efficient Battery Eliminator. It is fitted with a Variable Control, making it suitable for all Sets requiring from 10 to 30 Milliamps of H.T. Current

By W. B. RICHARDSON

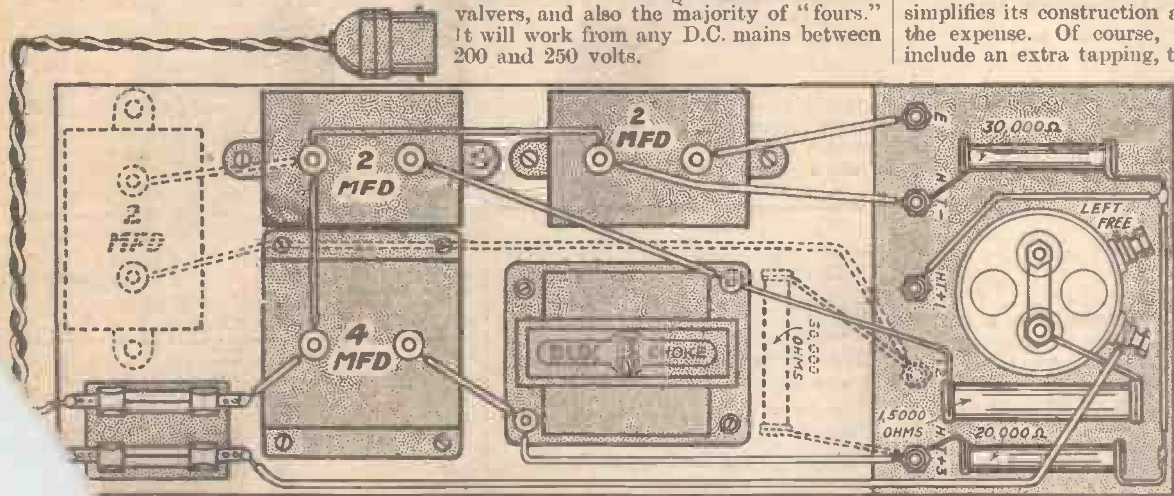


Fig. 2.—Wiring diagram. Dotted outlines indicate extra components needed for an additional tapping.

...are still quite a number of ...n various parts of the ... have access to direct- ... who run their sets ...tteries. Apparently the ... for this is that they would ...ike to convert to "all-mains," ... care to go to the trouble and ...n they know that all ... supplies will even- ...averted to the A.C. ...ertheless, in many ... conversion may not ...r several years, and ...antime the cost of ...s going to mount up. ..., there is no reason why ...te the high-tension cur- ...ld not be drawn from the ...D.C. supply.

...e a complete conversion to ...ains," this can be carried ...sily and cheaply and will not only ... cost of H.T. batteries but give ...er to the receiver.

...ost of Two H.T. Batteries

...few constructors would hesitate ...o make use of the D.C. mains ... that a compact and highly- ...T. eliminator could be con- ...an hour or so for the modest ...t 30s.; that is, for the price ...dard H.T. batteries. And yet ...hat the little instrument illus- ...costs to build.

...ned to meet the need for ...e but thoroughly reliable ...ch can be slipped inside ...n place of the usual 120 ...battery. It has a simple ...bles the voltage to be ...orrect figure with re- ...ything from 10 to 30 ... is a wide range and embraces the average two- and three-valvers, and also the majority of "fours." It will work from any D.C. mains between 200 and 250 volts.

No Unnecessary Frills

It is common practice nowadays to include decoupling resistances inside receivers, and this is always advisable when working from the mains. Incidentally, if the proper values are chosen they act as voltage-dropping resistances as well, and there is then no need to have more than

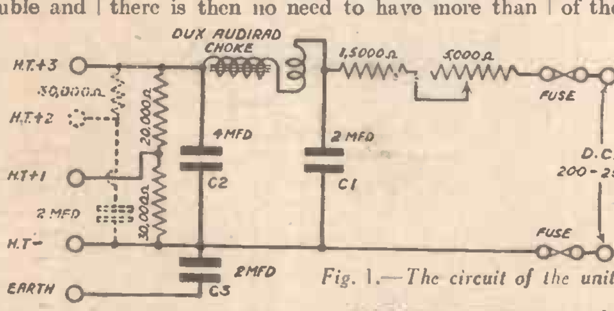


Fig. 1.—The circuit of the unit.

one H.T. positive tapping. This is why the eliminator described here is not embellished with a multiplicity of tappings as are many commercial instruments. This naturally simplifies its construction and keeps down the expense. Of course, if you wish to include an extra tapping, this can be very easily arranged by the addition of a fixed resistance and condenser, as will be described later. However, there is no point in including these if your set is already provided with all necessary voltage-dropping resistances.

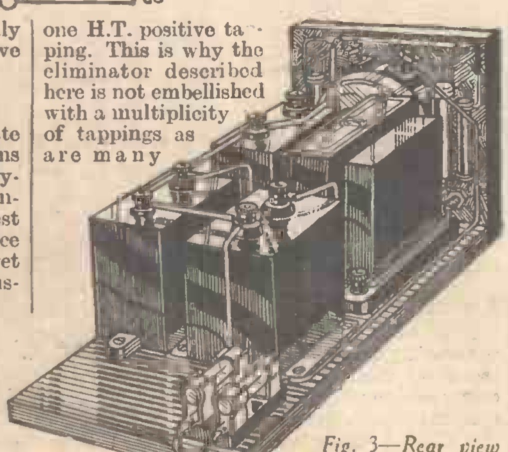


Fig. 3—Rear view of the complete unit.

In this connection it is a good plan if the receiver has several H.T. tappings to determine before making up the eliminator whether these are all really necessary. If not, you can save the trouble of including extra tappings on the unit. Try connecting all the various leads, with one exception, to the 120 or 150-volt socket of the H.T. battery. The exception is the lead from the screening grid of the S.G. valve, which is usually marked "H.T.+1." This must remain in the 60 to 80-volt socket in which it is usually placed.

Apart from this, all the L.F. and output valves, the detector and the screen-grid valves should all take the full 120 to 150 volts on their anodes. Admittedly, in many sets the detector valve seems to give smoother reaction if plugged in at 80 or 100 volts instead of the full 150, but as there should be a decoupling resistance in the anode circuit of this valve, that should suffice to give the necessary drop. Of course, this resistance may be lacking, in which case one should be incorporated together with the usual 1 mfd. or 2 mfd. condenser; for, as already stated, it is always advisable to provide decoupling when working from a mains unit. If, on the other hand, the set already has this device and the valve will still not stand the full voltage, then the resistance should be increased. For instance, if its value is 30,000 ohms, then replace it by one of, say, 50,000 ohms. This alteration will appeal to most constructors as being cheaper than providing another tapping on the mains unit.

Suits Small or Large Receivers

The circuit of the unit is shown in Fig. 1 as you see, it is quite simple. The

(Continued overleaf)

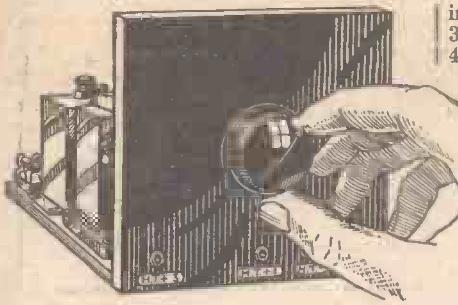


Fig. 5.—The variable control enables the current voltage to be obtained with any receiver.

(*Continued from previous page*)

full mains voltage is first reduced to a suitable figure by means of the 5,000 ohms variable resistance, the 1,500 ohms fixed resistance, and the resistance of the L.F. choke (which is 850 ohms). The reason why the variable resistance or potentiometer is included is because the voltage dropped depends on the current which passes through these resistances. In other words, on the current taken by the set. For instance, to supply a voltage of 150 from 220-volt mains requires a drop of 70 volts. If the set only takes 10 milliamps, then a total resistance of 7,000 ohms will be required. On the other hand, if the set takes 20 milliamps, then only 3,500 ohms will be required to give the same voltage drop. By means of the potentiometer the total resistance can be varied from 1,350 ohms to 7,350 ohms, a refinement which is not found in the majority of D.C. units. Thus by adjustment of the control the eliminator will give the correct working voltage with sets of widely differing characteristics.

The smoothing arrangements are taken care of by the L.F. choke and the two condensers C1 and C2. The choke is the R.I "Dux" Audirad, which contains also a special H.F. choke for the elimination of any interference caused by H.F. impulses coming down the mains.

The condenser C3 is used to provide the earth connection for the set. It is most important to note that *with receivers operated from the D.C. mains the earth wire must not be directly connected to the set,* but must be insulated with a good quality condenser. It is usual to incorporate this condenser in the mains unit, as is done here.

A Tapping for S.G. Valves

The two resistances connected across the output form a potentiometer, which supplies the screen of the screen-grid valve. The values chosen are those which will give about 80 volts with the average valve. If two S.G. valves are used, then the voltage will be slightly lower than with one valve. It can be increased, however, by using a 15,000 ohm resistance for the upper one instead of the 20,000 ohm one shown. Of course, if there are no screen-grid valves in the set then there will be no need for the extra tapping, and the resistances need not be included. Incidentally, this tapping is quite suitable to supply the detector if desired, although it should not be used for both the detector *and* the screen of the S.G. valve.

The Construction

The lay-out and wiring of the eliminator is quite clearly shown by the various illustrations given here. There is, therefore, no need to go into lengthy details. It will be seen that the overall dimensions, including the control-knob, are only 9½in. × 3½in. × 4¼in., the baseboard being 8½in. × 4¼in. × ⅜in., and the panel 3½in. × 4¼in. × ¼in.

The quickest way to proceed with the construction is to mount all the components on the baseboard and wire them up as far as possible. Then mount the potentiometer and sockets on the panel. After this, cut all the necessary lengths of connecting wire for joining the components on the panel to those on the baseboard and fix them to the potentiometer and sockets on the panel so that when the latter is placed in position the other ends of the wires only have to be slipped over the terminals the components on the baseboard and tightened up. You will notice, from Fig. 2, that one terminal of the potentiometer is left free. This is, of course, quite in order, since the instrument is used as a variable resistance and not as a potentiometer.

Just a word about the components.

LIST OF COMPONENTS FOR THE D.C. MAINS UNIT.

One Lewcos Potentiometer, 5,000 ohms.

Two 1-watt type Erie Resistors, 15,000 and 20,000 ohms.

One 2-watt type Erie Resistor, 1,500 ohms.

Four Plugs and Sockets, Belling-Lee.

Glazite connecting wire.

Ebonite Panel, 4¼in. × 3½in. × ¼in.

Baseboard, 8½in. × 4¼in. × ⅜in.

One R.I. "Dux" Audirad Choke (25 henries, 50 mA.).

One 4 mfd. T.C.C. Condenser, type 80/81.

Two 2 mfd. Sovereign Condensers, 750 volt test.

One Bulgin Fuseholder, type F16.

Two Bulgin Fuses, type V.

These are all chosen with due regard for the high voltage of the mains and the comparatively large current they have to handle; therefore, no departure should be made from the specification.

The condensers, in particular, should not be rated at less than 250 working volts, while the main fixed resistor, and the potentiometer, should not be of lower rating than those specified. If an extra tapping is desired on the unit as previously mentioned, then the following extra components will be needed:

1 30,000 Erie resistor (1 watt type).
1 2mfd. Sovereign condenser (750 volt test).
1 plug and socket.

These are connected as shown by the dotted outline in Fig. 2, and also in the circuit diagram.

Operating Notes

The first thing to do when connecting up is to detach the earth wire from the receiver and to plug it into the extreme right-hand socket of the eliminator. There must be no earth connection to the receiver itself at all. Next connect the H.T. wander-plugs in the appropriate sockets. H.T. + 1 gives about 80 volts, H.T.+ 2 (if you have included it) gives about 100 volts, and H.T.+3 about 150 volts. Turn the control-knob on the unit as far as it will go in an anti-clockwis direction, switch on the filament curre and plug in to the mains. The set shoul immediately work. If it does not, reverse the plug in the mains socket. There is, of course, a right way and a wrong way round for the plug. If joined the wrong way, the negative side of the mains connects to the plates of the valves instead of the positive, and so the set will not work. Removing the plug, giving it half a complete turn, and reinserting it will immediately put matters right.

If your set is a two-valver, taking about 10 milliamps, then the variable control will most probably need no alteration; but if the set is a three-valver, taking, say, 15 or 20 milliamps, then about half a turn in a clockwise direction will be required to give the full voltage. A set taking 30 milliamps will need the control right over in a clockwise direction. Remember that an anti-clockwise rotation *decreases* and a clockwise *increases* the voltage to all tappings.

UNSTABLE PORTABLES

INSTABILITY in a portable receiver m often be traced to interaction betv leads, either battery leads or the leads used to connect the variou ponents together. A very commor overcoming such interaction is t screening cable of the kind e H.F. anode leads or gran leads. The covering to nected to earth. It must however, that this material sh used indiscriminately. When it is for screening the grid lead of valve serious losses are liable to the result will be great loss of sign Anode leads in general may b as also may the loud-speaker l wire linking two or more together runs parallel with the w the frame aerial, great care should to ensure that the space separatn wires is adequate. The wire should so that it forms an angle with the winding.

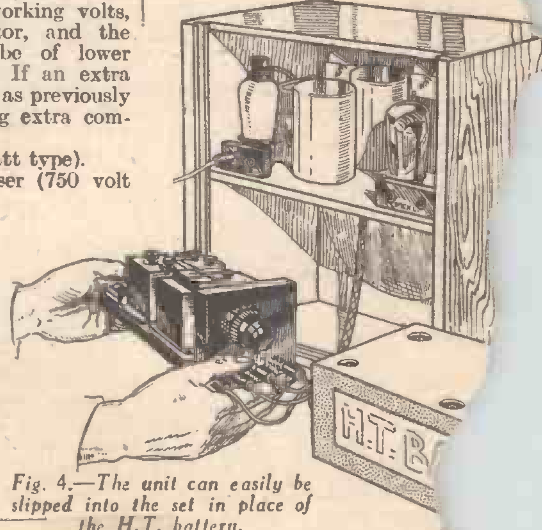


Fig. 4.—The unit can easily be slipped into the set in place of the H.T. battery.

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RADIO RAMBLINGS

By JACE

Jottings from my Notebook

A PROPOS my note (on page 521 of our issue dated July 1st), which dealt with methods of providing screening-grid potentials.

A much better way is illustrated in the skeleton circuit of Fig. 1, where the detector valve and its anode feed resistance (R) act as two "arms" of a "natural" potentiometer. Actually, of course, the transformer primary is also in circuit, but as its resistance is comparatively small it makes no difference. In most cases, the correct screening grid potential will be obtained by making R of 30,000 ohms, but the best value can always be found by using a variable resistance of 50,000 ohms maximum. To prevent back-coupling it is best to include a 1,000 ohms resistance (marked R 1) in series with the screening-grid lead.

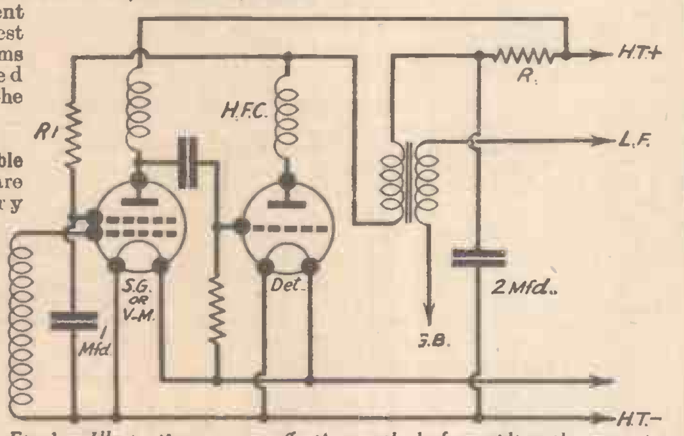


Fig. 1.—Illustrating a very effective method of providing the screening-grid potentials for an S.G. or V.-M. valve. The detector valve and its anode feed resistance form two "arms" of a potentiometer.

A Short-wave Portable

PORTABLE sets are becoming very popular this year and look like being more numerous than ever before. But I wonder how many readers have thought of making a *short-wave* portable. Personally, I find that such a set provides no end of fun, and since only one, or possibly two, valves are required, it can be made up in truly light-weight form. Practically any standard circuit arrangement is suitable, but I am all in favour of the Armstrong Super Regenerative. This can be used with a few feet of wire as aerial, or the tuning and reaction coils can be wound as a small frame aerial, which will fit into the lid of a convenient attache-case. A certain amount of screening is generally desirable, since the usual earth connection will probably be dispensed with. Perhaps the best way is to build the set in an aluminium containing box, which will act as an efficient counterpoise. I can recommend you to try a set built along the lines suggested.

West National

I AM rather anxiously awaiting the forthcoming tests from the West National transmitter. As you will have read in previous issues of PRACTICAL WIRELESS, this station is to share the 261.5 metre wavelength with London National. Presumably, both transmitters will give the same programme, but nevertheless, the slightest wavelength "slip" at either station will result in an enormous amount of interference over a wide area. This danger is being guarded against as far as possible by the employment of tuning-fork control, and it is hoped that by that means perfect synchronization will be obtained. The whole problem is different from any other which has previously confronted the B.B.C., and the responsible engineers regard it as an important "test case." The closest parallel is that of the Scottish National and Bournemouth, which share the 288.3 metre wavelength. But whereas the latter stations are some 400 miles apart, and one of them uses a power of only 1 kilowatt, London National and West National are separated by only 150 miles, and both will work on 50 kilowatts.

H.T. for the Car Radio

IT has previously been mentioned in these notes that wireless sets are supplied as standard equipment on a number of American cars. Until fairly recently the chief difficulty with this type of set has been in respect to high-tension supply, and in the majority of cases dry batteries have been used for this purpose. Motor converters, working from the 6 volt lighting battery, have been tried, but are both cumbersome and rather expensive, and now a much simpler system is coming into use. It is not by any means new, for it is almost identical with the ordinary ignition equipment, the idea being that a spark coil with make-and-break is driven from the 6-volt accumulator and gives a secondary voltage of 300 or so. This is A.C., and is therefore rectified by a filamentless gas-type rectifier, and then smoothed by being passed through a normal type of choke-condenser filter. The price of a complete eliminator of the kind briefly described is equivalent to about £5 at par, and I understand that the unit is finding a ready sale. When car radio is introduced into this country the same kind of H.T. eliminator will probably be made over here.

An Ode Without Odium.

PRACTICAL WIRELESS has sure come to stay;
The readers on Wednesdays all shout "Hip hooray!"
Poor Pa grabs the Data Sheet—that's all he'll see
Of the tip-top three penn'orth till he gets his tea!

In the calm of the evening he turns up the page
Whereon he will find latest circuits displayed;
He studies them carefully, looks at his set—
An ancient two-valver, and he wants a "sup. het."

He reads of the powers of Camm's "Fury Four,"
Which guarantees programmes from stations galore;
He turns up the adverts to work out its cost,
Then grabs hat and coat and for an hour he is lost!

Soon he gets back with his arms full of bits,
And settles to work without taxing his wits.
To find what goes where—is it here, or just there?
For the diagrams show the posish to a hair!

The youngsters, like foremen, all gaze at his work,
They know just what's what and they won't let him shirk.
They tell him he's wrong, and he finds that they're right;
He fixes a wire and—then out goes the light!

He searches around for the kids' money box
(It's Wednesday, and now he is right on the rocks);
He puts in the coppers and up goes the light,
And then his eyes rest on a wonderful sight.

The youngsters have finished the set in the dark,
And grin, full of glee, till young Billy says, "Hark!
I think I've got Berlin—Oh, gee! That's the stuff!
Why, tuning's quite simple, and not a bit rough."

The moral of this is quite plain, don't you see?
PRAC. WIRELESS is written for you and for me;
Its wording is simple, its diagrams neat,
Even youngsters can follow instructions "tout suite!"

* * *

To the tune of "The Mountains of Mourne."

(But you need never mourn if you use a PRACTICAL WIRELESS *diagram for your new set, whether you run down to the sea or remain for ever in a blind area.*—ED.)

FROM THE FLASHLAMP

By Photon

THE energy in the field of a magnet, such as used in a moving-coil speaker, is not by any means wholly in the gap; in fact, however careful the designer, at least half the energy external to the magnet assemblage is in the leakage field, that is to say, in the lines of force that find their way from pole to pole by paths external to the gap. The greater part of this leakage is in the "fringes," that is in the region close to the edges of the gap proper.

So far as the energy in the gap itself is concerned its calculation is a matter of simple arithmetic if the field density B is known. In air (and, therefore, in the gap) B is the measure of H, hence the expression, $\frac{B \times H}{25 \times 10^7}$ becomes $\frac{B^2}{25 \times 10^7}$; thus, supposing that in a certain speaker the gap has a volume=1 c.c. and the desired B is 7100 lines per cm.^{2}, the energy will be:—

$$\frac{7100^2}{25 \times 10^7} = 0.2 \text{ joule.}$$

As a matter of general experience, with good straight-forward design, the leakage field is 1.5 times the gap energy, or we have to multiply 0.2 by 2.5, giving 0.5 joule. Moreover, the iron parts of the magnetic circuit exercise a tax on the total in the region of 20 per cent., and we have therefore to supply 0.6 joule as the energy value of the magnet itself. Referring to the previous article, and adopting 15 per cent. cobalt steel, we find that the weight of the magnet will be .6/.36=4.4 lbs. And the cost .6×15s. 4d.=9s. 2d.

It is convenient thus to be able to explore the possibilities of any given specification without actually laying out a design; this preparatory computation enables the designer to predict approximately the cost before embarking on the actual preparation of drawings. The next step is to determine the length of the magnetic path. It is evident that the mere determination of the weight of magnet steel required tells us nothing of the shape or proportions required. Now the properties of a magnet steel are defined by a graph which is actually a part of the hysteresis curve for the steel in question (Fig. 1). The only fact required beyond this graph is the "length" of the gap, that is the length the magnetic flux has to bridge. We will take this to be 1.25 mm. (or .125 cm.). The B having been taken as 7,100, this is also the value of H in the gap, and if the gap were one cm. wide we should require 7,100 gilberts, for a gap .125 cm. wide we need therefore .125×7,100=900 gilberts (approx.). With the addition of 20 per cent. for the reluctance of the iron and junctions in the magnetic circuit we take 1,100 as the gilberts to be supplied by the magnet. Now, referring to the graph, we see that at B×H max. the value of H may be taken as 120 gauss. Dividing 1,100 by 120 we have 9.2 cm. as the correct length of the magnet, that is to say, the length of path in the magnet steel through which the flux passes.

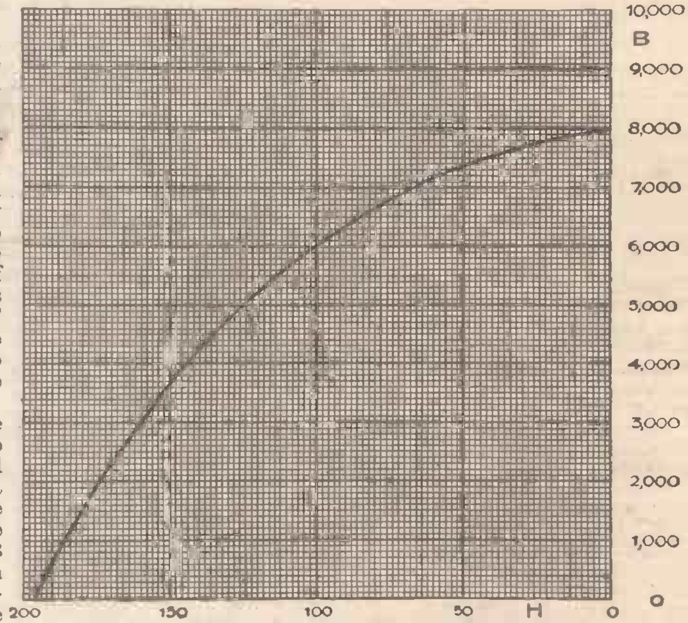


Fig. 1.—The curve showing field density and the measure H referred to in this article.

The Arcady Portable Three

(Continued from page 545)

ments of this the set can be made to work efficiently with any type or length of aerial.

The screened grid valve is coupled to the detector on the tuned anode principle by means of one of the new iron-cored coils, actually the Igranic "Igranicor." This form of coupling gives a good degree of stability. Moreover, it simplifies the construction of the set

Ample decoupling is provided in the anode circuit of the detector valve and all form of motor-boating or L.F. instability is entirely avoided. In order that the high impedance of the detector driver may accurately be matched to the Class B valve, the driver transformer is parallel fed, a 50,000 ohm resistance and 1 mfd. condenser being used.

It was mentioned before that a moving-coil speaker was employed, but it might be added here that this is of a special type supplied complete with transformer.

Wait for the full constructional details which will be given next week.

MODULATION

By E. G. ROWE, B.Sc.(Eng.), A.C.G.I.

THE problem confronting us in getting speech and music from one place to another may be divided into four sections. First we have the conversion of sounds of comparatively low frequency into electrical waves; then the trans-

Fig. 1.—The constant current which forms the "carrier-wave."

mitting of these waves over the required distance; thirdly, the successful reception of these signals, and finally their reconversion into sound. In this article we are going to discuss the first two sections.

To start with, why is it that we use high frequencies for wireless work? Well, it can be proved that to radiate any appreciable power from an aerial the currents flowing in it must be of a much higher frequency than that possessed by sound. The range of audio-frequencies is from, say, 20 to 20,000 cycles per second, while for the production of electro-magnetic waves without using excessive power we require frequencies of the order of one million per second. Thus North National has a frequency of 995,000 cycles per second, while at opposite ends of the scale are Hilversum on 160,000 cycles and the B.B.C. ultra-short-

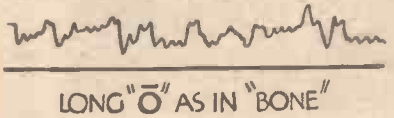


Fig. 2.—The complicated variations produced by a sound.

wave work on a frequency of about sixty million cycles.

A second reason for using high frequencies is the fact that each station of necessity must appropriate a band of frequencies at least 10,000 cycles in width, and thus in order that any great number of stations shall operate the working frequencies must be high. Thus a high-frequency current is used and on it is imposed the low-frequency current due to sound. The high-frequency current may be represented as in Fig. 1—a constant frequency, constant amplitude wave—and is known as the "carrier wave."

Now the currents set up due to speech

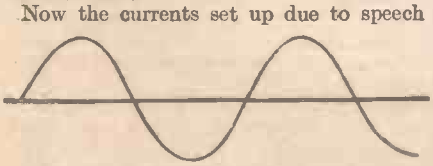


Fig. 3.—A simpler form of variation.

have a very complicated wave form something like Fig. 2, but they may be split up into a number of simpler waves, known as "sine" waves (Fig. 3). Each of these acts in the same way and may be considered to do so independently of the others, so that for clarity and simplicity we will see what happens when we use one sine wave. This, by the way, represents the tone we should get from a tuning fork.

Fig. 4 shows the low-frequency wave superimposed on the "carrier wave." This is then known as the "modulated wave." Thus a modulated wave is a high-frequency wave whose amplitude varies in exact accordance with the waveform representing the audible note it is required to transmit. The "depth of modulation" is the maximum amount by which the amplitude of the high-frequency oscillations varies above and below the normal amplitude when there is no modulation. This is usually expressed as a percentage, a 50 per cent. modulated wave being one whose amplitude varies from $\frac{1}{2}$ to $1\frac{1}{2}$ times the "carrier" amplitude.

It can be shown mathematically that this complex "modulated" wave may be considered as three high-frequency waves—

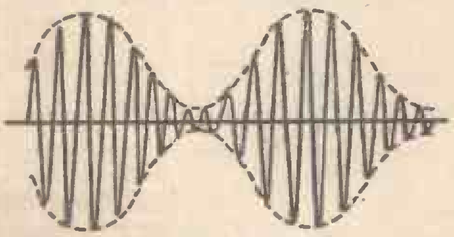


Fig. 4.—The variations of Fig. 3, superimposed on the constant current of Fig. 1.

one is the carrier frequency and the other two have frequencies equal to (carrier frequency + speech frequency) and (carrier frequency — speech frequency) respectively. These last two waves are the well-known "side-bands," and it is evident that as the speech frequency varies so these side-band frequencies are continually varying.

Transmitting L.F. Currents

The simplest way in which a high-frequency wave may be modulated is shown in Fig. 5. This is a crude arrangement and long ago superseded, but it serves to show as a method. A carbon microphone is placed in series in the aerial circuit, which is supplied with high

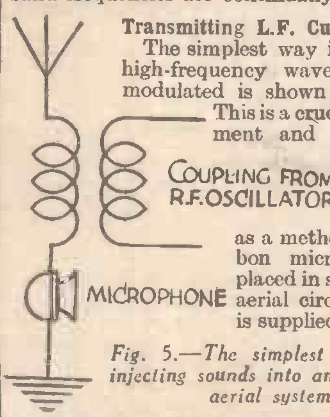


Fig. 5.—The simplest method of injecting sounds into an oscillating aerial system.

frequency from a radio-frequency oscillator. A carbon microphone is simply a box full of carbon granules and closed by a thin flexible metal diaphragm. As the sound waves due to, say, someone speaking impinge on this diaphragm, so the carbon granules are compressed and released with the frequency of the sound. This varies the resistance of the carbon, and thus the total resistance of the circuit. Therefore the amplitude of the current flowing will also alter.

Finally, it may be of interest to state that it is not necessary for both side-bands to be sent out from a broadcasting station for successful communication. In fact single side-band working is suggested as a means of accommodating more stations, and reducing the interference between stations.

Facts and Figures

Components Tested in our Laboratory

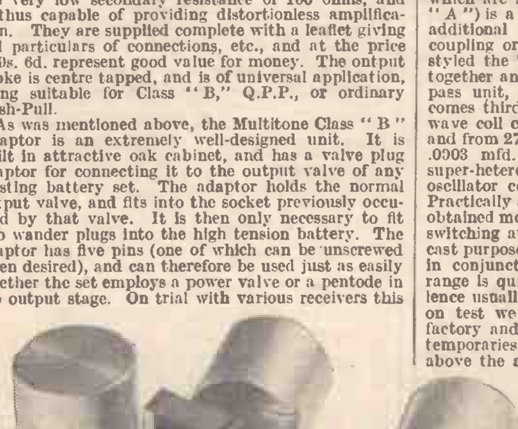
BY THE PRACTICAL WIRELESS TECHNICAL STAFF

MULTITONE CLASS "B" COMPONENTS

THE Multitone Electric Co., Ltd., well known as the pioneers of tone control transformers, have sent to us samples of their latest Class "B" components, as well as a very cleverly-designed Class "B" adaptor. Dealing first with the components, which consist of a variety of driver transformers and an output choke. There are three types of driver transformers, each of which has a ratio specially suited to a particular make of valve. For example, the first has a ratio of 1-1, and is suitable for use with the Cossor 240B or the Marconi B21; a second one of 1.5-1 ratio correctly matches the Mullard PM2B, whilst a component of 2-1 ratio is intended for use in special cases where a fairly high impedance valve is used in the driver stage. Every one of these transformers has the very low secondary resistance of 100 ohms, and is thus capable of providing distortionless amplification. They are supplied complete with a leaflet giving full particulars of connections, etc., and at the price of 9s. 6d. represent good value for money. The output choke is centre tapped, and is of universal application, being suitable for Class "B," Q.P.P., or ordinary Push-Pull.

Multitone Class "B" Adaptor.

As was mentioned above, the Multitone Class "B" Adaptor is an extremely well-designed unit. It is built in attractive oak cabinet, and has a valve plug adaptor for connecting it to the output valve of any existing battery set. The adaptor holds the normal output valve, and fits into the socket previously occupied by that valve. It is then only necessary to fit two wander plugs into the high tension battery. The adaptor has five pins (one of which can be unscrewed when desired), and can therefore be used just as easily whether the set employs a power valve or a pentode in the output stage. On trial with various receivers this



Class "B" Adaptor gave very satisfactory results, and we have no hesitation in giving it our warm recommendation. The price is very moderate, being only 37s. 6d.

IGRANIC IGRANICOR COILS

THE Igranic Electric Co., Ltd., Bedford, was undoubtedly one of the very first firms to make tuning coils for the home constructor, and many readers will still have recollections of the early types of Igranic honeycomb plug-in coils. It would be impossible to give better testimony to these early coils than to mention that hundreds of amateurs are still using them and rigidly refuse to adopt the more usual dual range tuners. But Messrs. Igranic always keep their components up to date, and the latest range of iron-cored tuners is in keeping with this principle. The mode of construction of the tuners is somewhat different from that generally adopted for iron-core coils in that the ferrous core is not solid, but is built up from thin laminations in the same manner as the core of a low frequency transformer. The laminations do not consist of ordinary iron, of course, but are composed of finely divided iron mixed with other materials which insulate the particles from one another. A thorough system of mixing is employed, and finally a resinous powder is added. It is then moulded under heat and great pressure. The result is a very hard lamination of "T" or "I" shape. The windings themselves are put on a slotted ebonite bobbin, and the whole assembly is attached to a substantial ebonite base by means of two brass straps. A wavechange switch is included in the base, and this is worthy of special mention in so far as it is (unlike most coil switches) a really sound mechanical job which should give satisfactory service for an indefinite period. The Igranicor coils are made in five different types, all of which are similar in design. The first (Type "A") is a dual range aerial tuner, having an additional winding which may be used for coupling or reaction purposes; the second is styled the Type "H.F.," and is for coupling together an S.G. and detector valve; a band-pass unit, giving a 9-kilocycle band width, comes third; the fourth is a dual range short-wave coil covering the ranges of 14.8 to 27.5 and from 27.2 to 78 metres when tuned by a .0003 mfd. condenser; lastly, there is the super-heterodyne equipment consisting of an oscillator coil and an intermediate band pass unit. Practically any combination of the above coils can be obtained mounted on a common base and with a ganged switching arrangement. All coils intended for broadcast purposes are accurately matched, and may be used in conjunction with a gang condenser. This latest range is quite in keeping with the standard of excellence usually associated with Igranic components, and on test we have found the coils particularly satisfactory and at least as efficient as any of their contemporaries, whilst their sound construction is well above the average.

Igranic Igranicor coils.

GRAHAM FARISH AIR DIELECTRIC CONDENSER

IN the past Messrs. Graham Farish, Masons Hill, Bromley, Kent, have confined their attention in regard to variable condensers to components of the bakelite dielectric type, but they have recently produced an excellent air dielectric component. This is designed on distinctly low-loss principles, and is of particularly rigid construction. By the use of steel end-plates, protected from rust or corrosion by a suitable finish, together with three-point suspension of the frame the assembly is entirely free from distortion or warping. The precision metal work ensures perfect matching of parts, and accurate spacing by machine production gives uniformity of characteristics when the components are mass produced. Two-point fixing to the centre spindle is provided, ensuring that the spindle is in proper alignment with the moving vane assembly, while the absence of spacing washers makes for absolute reliability over a long period. By the use of a minimum amount of insulating material in the electrostatic field the high frequency losses of the component are reduced to negligible proportions. Large terminals are fitted in an accessible position, and as the driving shaft is independent of the condenser and easily removable, any number of condensers can easily be ganged together by choosing a shaft of appropriate length. At the time of writing the price has not definitely been fixed, but we understand that it will be either 4s. 6d. or 5s.

Graham Farish variable condenser.

Ferranti electric alarm clock.

FERRANTI ELECTRIC ALARM CLOCK

THIS is the latest addition to the range of clocks made by Messrs. Ferranti and the accompanying photograph shows that it is of attractive appearance. The clock is of the synchronous type, and is very economical in its electricity consumption, consuming approximately two units in three months. It is fully automatic, and the alarm is arranged on the twenty-four-hour basis, so that it can be set to go off at night or in the morning, but it only goes off once in the twenty-four hours. The alarm itself is of the buzzer type, giving a gentle but compelling sound. The alarm may be stopped merely by depressing the knob at the top of the clock, and will go off again the following day without being re-set. If it is required to stop the alarm from working at any time, it is only necessary to depress the knob and lock it by giving it a half turn. The price of the clock is 25s., and it is made in a bakelite case finished in red, mahogany, walnut, or blue enamel.

The Ferranti clock is a reliable and well designed timepiece which we have no hesitation in thoroughly recommending.

Practical Letters from Readers.

The Editor does not necessarily agree with opinions expressed by his correspondents.

From an Operator in the Royal Navy

SIR,—May I express my appreciation and thanks for your excellent Encyclopædia, which I received a short time ago.

It really is an extraordinarily good book, packed with plenty of useful information, and though I happen to be a wireless operator in the Royal Navy, it has already taught me lots of things which I had previously not known.

My only complaint is about the scarcity of details of *all*-mains sets and indirectly-heated valves in the book, although I admit they *are* mentioned.

I am glad you are supporting television in PRACTICAL WIRELESS. I certainly think it is assured of ultimate success; and then, won't the critics be pleased? Would it be possible for you to include an article or two on the subject of talking films? As an amplifier is necessary for "talkies," the subject is in a measure akin to wireless.

Wishing the paper every success.—EDWARD J. DUFFY (Manchester).

Another Bouquet

SIR,—I feel I must write and thank you for the excellent binding of Vol. No. 1 of PRACTICAL WIRELESS. I am more than pleased with the job, and it makes me feel quite proud to be in possession of it, together with the data sheets and binder and, last but by no means least, the wonderful Encyclopædia. Where is there, I ask, another wireless periodical which caters for its readers to such an extent as this? Carry on with the good work, and may your wonderful efforts meet *always* with the success they well deserve.—FREDERICK WILLDAY (Burton-on-Trent).

The Fury Four

SIR,—I should like to congratulate you on your fine paper, PRACTICAL WIRELESS, of which I have been a reader since No. 1. I have just completed the Fury Four, and am very pleased with its remarkable performance. I must confess it is the best set I have yet built, and I am now about to add a pick-up for gramophone reproduction.—W. R. CHURCHILL (Taunton).

The "Pyramid Two"

SIR,—I should like to congratulate you on the "Pyramid Two," described in June 3rd issue. I have made up the screen-grid circuit and find it gives amazing results, and is economical on both L.T. and H.T.—R. A. F. WINSLOE (Godalming).

Thanks: and a Suggestion

SIR,—I have just received my Volume 1 of PRACTICAL WIRELESS, in the blue cover, from the bookbinders, and must say that they have made a splendid job of it. I also thank you for placing at the disposal of your readers a genuine bargain in book-binding.

Whilst having no fault or criticism, may I offer a small suggestion? It is with reference to the layout of the paper. Would it be possible to place all the advertisements at the back and the front of your paper so that they do not interfere with the articles? It would also make for a smaller book when the copies were being bound. An approximate calculation shows that fifty per cent. of the advertisements in the paper are obsolete or nearly so in six months, and the other fifty per cent. can always be found in the current numbers.

There is one other small item. Could all coupons or vouchers, or inquiry forms back on to the advertisements, so that these also would not ruin the valuable articles. If you can see your way to this ideal, I am sure you will be making a big step towards a perfect "practical" wireless weekly.—H. A. OKLEY (Streatham).

An Appreciation of Volume One

SIR,—I have just received my bound Volume One of PRACTICAL WIRELESS and, thanks to your excellent cover, and index, it is one of the best wireless reference books I have ever seen. Wishing your wonderful paper every success in the future.—D. R. PEART (Wicklow).

(*Continued overleaf*)

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT the Radio Exhibition opens at Olympia on August 15th.

—THAT you can tell when your set is properly tuned in to a station by connecting a milliampmeter in the detector anode circuit.

—THAT the cause of instability in a receiver can often be traced by placing a screen over each component in turn.

—THAT when using a D.C. eliminator it is best to connect a fixed condenser in series with both the aerial and earth leads.

—THAT special H.T. generators are now made for motor-car wireless sets.

—THAT the double-diode triode does the work of three valves by acting as detector, automatic volume control, and low-frequency amplifier.

—THAT a double-diode pentode valve will shortly be put on the market.

—THAT L.F. instability can often be prevented by using a choke-condenser output filter.

NOTICE.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor;* PRACTICAL WIRELESS, *Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

PRACTICAL LETTERS

(Continued from previous page)

From British Columbia

SIR,—Some time ago I received my copy of "The Wireless Constructor's Encyclopædia." Its contents are appreciably concise, easily followed, and not too technical for the amateur radio fan.

In fact, it is a book that we, the far-distant readers who have not such ready access to reading matter—always pick up at an odd moment, and find something instructive and practical that we can work out and experiment with.—H. TWIDLE (Valdez Island, British Columbia).

An Uncommon Short

SIR,—Recently I had an interesting experience which I think is worth relating for the benefit of other readers.

I am making up several 3-valve all-mains A.C. sets, and when trying one in particular nothing happened. The wiring, etc., was correct, and I was at a loss to know what was preventing the set working. I removed the coil cans and found some loose bronze metal, with which I had sprayed the cans, chassis, electro-condenser and cover of the condenser, had got between the coil wires and thus entirely prevented any reception. This experience has taught me the lesson to see that the coils, if made of bare wire, are absolutely clean.—F. S. HIGGINS (Stevenage).

From a South African Reader

SIR,—Having been a subscriber to PRACTICAL WIRELESS from No. 1, I should like to express my appreciation of your paper. As an electrical engineer I appreciate the thoroughly practical way in which the information it contains is given.

At present I am busy on a 5-valve receiver (A.C. S.G. det. L.F. and push-pull), which I hope to have working soon. Could you not give us a short-wave and broadcast band set as the long wave is of little value here. All good wishes to your practical publication.—JOHN MURRAY (Wynberg, S. Africa).

[*We hope to publish a design for a short and medium-wave receiver in an early issue.*—ED.]

RADIO CLUBS & SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

SLADE RADIO

A very interesting lecture on Class B amplification was given by Mr. B. Poliakoff at a recent meeting of the above club. After pointing out that the efficiency of the output stage is a quantity which is often overlooked in judging the performance of a set, he went on to give the comparative figures for triode and Class B. Efficiency of speakers, fidelity of reproduction, and the question of output stage for battery users were dealt with. The usage of H.T., the driver valve, input and output transformers followed, also the difference between Class B and Q.P.P. was explained. Rating of transformers, batteries and amount of current used, stability and decoupling came next, after which followed a demonstration. The results were very pleasing, a special point being made of the use of the tone control. Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

INTERNATIONAL SHORT-WAVE CLUB (LONDON CHAPTER)

The R.A.C.S. Hall, Wandsworth Road, S.W.8. was well filled on Friday evening, 23rd June, when a demonstration on Real Radio Reproduction was given. The apparatus used consisted of a receiver and amplifier, R.K.-A.C. speaker mounted in a "Howe" box baffle, identical with that used by the B.B.C. This was followed by a lecture on the latest 5-metre experiments by Mr. P. G. H. Macfarlane, London Chapter Technical Advisor, who spoke of the interest being shown in the ultra-short waves at the present time, the possibilities of these low waves, and the construction of 5-metre receivers. His talk was well illustrated by circuit drawings on the blackboard. A. E. Bear, Secretary, London Chapter, 10, St. Mary's Place, Rotherhithe, London, S.E.16.

SPECIAL PROGRAMME FROM YV1BC

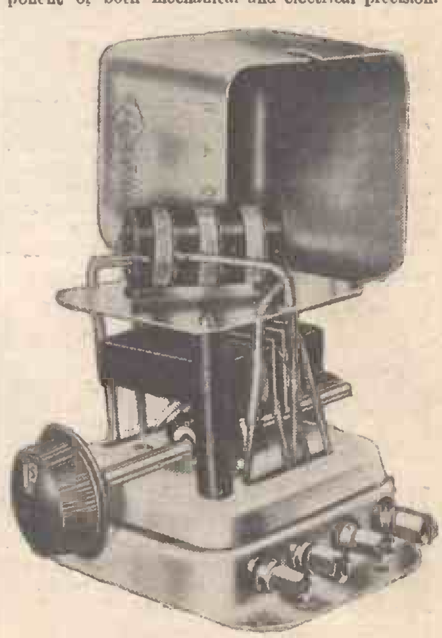
On July 9, from 6.15 to 7.15 p.m., Caracas time, Station YV1BC of Caracas, Venezuela, will broadcast a special programme dedicated to the "Anglo-American Radio and Television Society." The programme will be broadcast simultaneously in 960 kc/s, 312.3 metres, and 6,112 kc/s, 49.08 metres. Typical Venezuelan music and songs will be featured, and all the announcements will be made in English. Reports of reception will be welcomed, and should be addressed to Broadcasting Caracas, or the Anglo-American Radio and Television Society, 11, Hawthorn Drive, Willowbank, Uxbridge, England.

WEARITE NUCLEON COILS

THE well-known radio firm of Messrs. Wright and Weaire, 740, High Road, Tottenham, N.17, following their principle of always being abreast of the latest developments, have not been slow to recognize the advantages of ferrous cored tuning coils, and have, after a considerable amount of experimental work, produced a new series of tuning coils having a core of the new iron dust material known as Nucleon. The advantage of using an iron core lies, of course, in the fact that by increasing the effective permeability of the core at any given inductance, the numerical value can be increased. It is also known that by employing a completely "closed" iron core circuit with negligible leakage it is possible to obtain extremely high values of inductance without undue losses. Theoretically, it would be quite easy to increase the permeability of the iron core up to almost any limits, so producing a coil of extreme efficiency. But Messrs. Wearite have found that if the permeability is increased beyond certain limits difficulties of matching a number of specimens immediately arise. They have, therefore, devised a core of medium permeability, which shows a marked advance over the usual air core, and yet at the same time permits of the construction of any number of coils each of which shows identical characteristics. Thus the amateur set builder can use a set of these coils in conjunction with a gang condenser of normal type without running up against the difficulties of balancing the several tuned circuits.

In the Nucleon range there is a series of both Junior and Senior coils, and in both types the grid winding is in two halves, a connection being made to the centre tapping. As a result, alternative coupling ratios can be provided between any two valves and optimum operating conditions can thereby be provided for any combination. Messrs. Wearite have also paid very great attention to the arrangement of reaction and aerial windings, since they have found that when these sections are put on more or less haphazardly, as is sometimes done with air core coils, ganging is seriously upset.

This latest coil, an illustration of which is reproduced below, is an extremely well made component of both mechanical and electrical precision.



The new Wearite Nucleon iron-core tuning coil.

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A Sensible INVESTMENT for everyone in the Wireless business.

One of the many valuable action illustrations in this work.

Lifting out the Diaphragm and Coil of a Magnavox Speaker. This enables the speech coil to be examined if short circuited or broken windings are suspected.

NEWNES'
COMPLETE WIRELESS

This fully illustrated new work deals with the whole theory of wireless from the very simplest principles up to the most advanced stage. It shows you the most up-to-date practice as exemplified in the fine commercial sets which have been placed on the market recently. It shows you the possibilities of short-wave work, and contains numerous useful designs.

Another splendid illustration showing the fitting of a New Cord to the Drum of the Marconiphone 42 Receiver.

A MODERN REFERENCE WORK

THE progress in wireless practice during the past few years has been enormous. The Screened-Grid, the Pentode, the Bigrid, and the Variable-Mu Valves have made their appearance in rapid succession. Band Pass Tuning, Push-Pull Amplification, the Stenode, the Autotone, the Dual Speaker, are other items which were unknown to the wireless industry a few years ago.

This fully illustrated work is designed to bring every reader of "P. W." right up-to-date on the theory, design, and construction.

To feel at home amongst such a variety of electrical appliances the modern wireless man must have a thorough grounding in electrical theory. This point has been kept well in mind in the compilation of the present work. No effort has been spared to make the theoretical treatment complete.

Included in this work are many proved circuits and designs, together with full details of the methods of construction and wiring, and many articles devoted to the servicing of high-class receivers and radio-grams.

We are convinced that the wealth of information which has been brought together in this work will be of real use to the enthusiastic wireless amateur and absolutely essential to the man to whom "wireless" is bread and butter.

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Practical Wireless

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A Novel AERIAL MAST

By RAYMOND ELLIS.

Rigid Construction, Without Guy Ropes, and Easy Erection are Features of This Unusual Mast, Which Can Be Placed Right Against the Bottom Fence of Your Garden.

THE accompanying sketches show a new type of aerial mast which should appeal particularly to those whose garden or "back-yard" is short, and who desire to get the utmost length out of the space at their disposal. It is, moreover, easily taken down and re-erected without calling for more than one pair of hands.

A glance at Fig. 1 will show that the general design is rather reminiscent of the Eiffel Tower, and the mast's stability is based on the sound principle of applied triangles. By simply removing the locking bolt, the supporting prop may be raised and, as the operator moves backwards, the whole structure will swing down to lie flat on the ground. The prop gives ample leverage to enable the weight of the mast to be handled easily. To build the mast you will require the following materials:—

- Two 18ft. lengths of timber 3in. by 1in.
- One 18ft. length of timber, 3in. by 2in.
- One 18ft. length of timber 2in. by 2in.
- One 5ft. length of timber 3in. by 2in.
- One 3½ft. length of timber 3in. by 2in.
- One 2ft. length of timber 3in. by 2in.
- Four pieces each 2ft., 3in. by 1in.
- Six ½in. bolts each 5in. clear of head, with nuts.
- One ⅝in. bolt 8in. clear of head, with nut.
- Twelve iron washers ½in. hole.
- Two pieces of iron pipe each 1in. in length and ⅝in. bore.
- Six iron washers ⅝in. hole.

The cost of the whole material at average retail prices should not exceed 9s.

Constructional Details

Having got the material, the first step is to lay the 18ft. pieces of 3in. by 2in. on the ground with the two long pieces of 3in. by 1in. extending one on each side beyond it so that they overlap one end of the thickest piece by 3ft., making a total length of 33ft., and in the manner shown in Fig. 2.

With a pencil mark the overlapping portion into four sections of 9in. each and at the three pencil marks made, drill ½in. holes right through the three pieces of wood so that they may be securely bolted together. It may be found easier to make a good job of this if the pieces are roughly nailed together first.

Having made the holes, insert three of the ½in. bolts, being sure to slip a ½in. washer over each of the protruding ends, and attach the nuts, drawing them up good and tight.

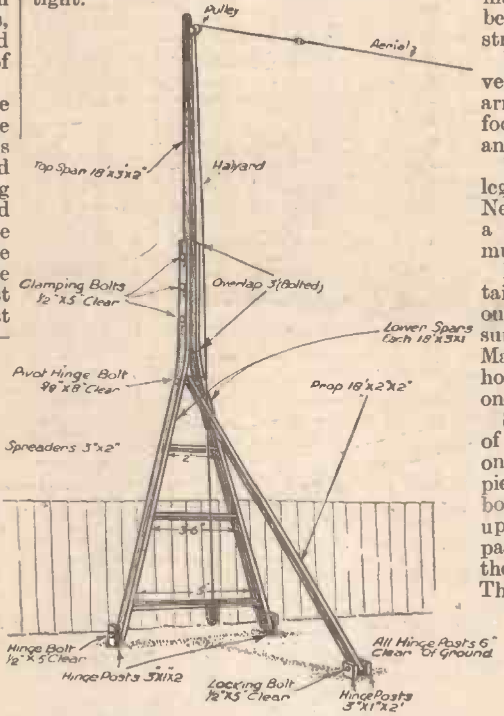

Fig. 1.—Showing constructional details of the mast and how it can be placed close to fence or wall in short garden.

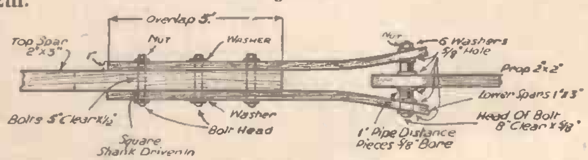

Fig. 2.—Details of the bolted overlap and pivot joint of prop.

Now take your 5ft. piece of 3in. by 2in. timber and, spreading out the ends of the two "legs" you have just bolted on, drive this "stretcher" between them till the ends of the legs are about 6ft. apart. If a slight bevel is made on the ends of the stretcher pieces, this will greatly facilitate the job and make a better fit. Two stout screws at each end will make the stretcher a permanent job. Now, between the expanded "legs" fix the 3½ft. stretcher, and the 2ft. one in the same way.

Your mast should now look like the vertical part of Fig. 1 and when you have arranged holes for the hinge bolts at the foot of the legs, you can attach the prop, and its pivot hinge bolt.

Make a ½in. hole through the foot of each leg, and about 4in. from the extreme end. Next take the 2in. by 2in. prop and make a similar hole through each end, but one must be ½in. bore and the other ⅝in.

Now return to the mast itself and ascertain, where the legs commence spreading out, just about what point their inner surfaces are approximately 5ins. apart. Mark this point on each leg and drill a ⅝in. hole through each side and in line with one another.

Slip a washer of correct size on to the head of the 8in. bolt and pass the end through one of these holes. Next pass a washer, one piece of pipe, and another washer on to the bolt protruding through the first leg. Bring up the end of the prop with the ⅝in. hole and pass the bolt through this. Add a washer, the second piece of pipe and another washer. This should about fill the space between the legs if you have measured correctly. Now drive the end of the bolt through the hole in the opposite leg, add the last of the ⅝in. washers and affix the nut, but, while it must be safely on, don't draw it *too* tight.

You are now almost ready to erect your mast, but, before going any

(*Continued on page 576*)

Fig. 3.—Mast lying on ground ready for erection.

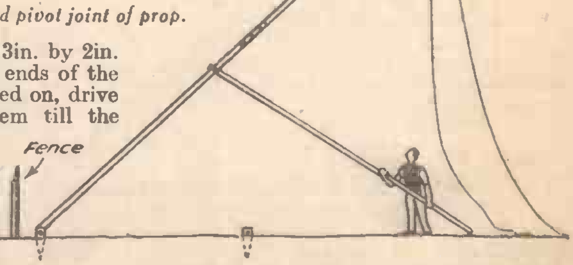

Fig. 4.—As operator walks forward with prop, the mast is raised.

MAKING A RADIO ROBÔT

This Little Figure will Dance in Time to Music issuing from a Loud-speaker.

By S. T. FISHER.

AN ingenious little figure which will dance and pirouette in time to dance music issuing from the loud-speaker can easily be made from parts which are almost certain to be found in any "junk" box.

An application of the principle of the electro-magnet is used, operated by a relay which is fed from the output of any wireless set, in conjunction with the loud-speaker.

The parts required are: One telephone ear-piece, without cap and diaphragm; old electric bell; one fixed condenser of 1 or 2 mfd. capacity; one fixed condenser of .05 mfd. capacity; one cigar box 8in. by 5in.; 4 terminals; Leclanché cell or some form of battery to deliver three or four volts.

Detailed measurements are not given, as these will vary in each case, depending on the size of the telephone ear-piece and make of electric bell.

With the aid of a fretsaw remove a part of the bottom of the cigar-box, as shown in Fig. 1. The electric bell is dismantled and one of the coils forming the electro magnet dispensed with, leaving the other coil fixed to the support, which is screwed inside the box above the aperture. Where the holes for these screws are bored slots should be cut, so that the position of the coil may be raised or lowered. The construction of the relay calls for some care, as the mechanism is essentially very delicate.

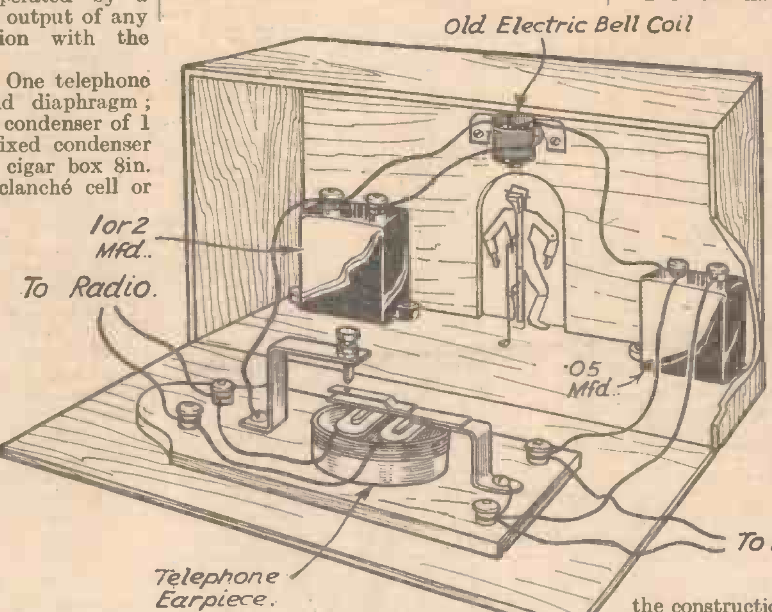

Fig. 1.—The general arrangement of the device.

The Base of the Electric Bell

This is used to accommodate the relay, and the telephone ear-piece is screwed down to this firmly in the centre. Next, take the armature of the bell and cut off the clapper portion, which is of no use. The armature is then mounted on the base by means of a piece of brass or strong tin, bent into such a position that the armature just clears the top of the ear-piece. The armature, of course, must be parallel with the magnets of the ear-piece.

The remaining piece of the bell, the long strip of metal which held the contact screw or "make and break" is now bent into position, and screwed down to the base at the opposite end of the armature mounting. It is very important to have this part fitting correctly, as the success of the gadget depends on the adjustment which can later be made by the contact screw. The contact screw should occupy its original position and touch the silver contact of the spring riveted to the armature. If you have gauged everything correctly the result should be as shown in Fig. 2.

The terminals are now mounted two at each end of the base. Connections are taken from the ear-piece to one pair of terminals, marked "radio." The other pair should be marked "low tension."

The Relay

The completed relay should now be screwed to the inside of the cigar box lid. The fixed condensers are placed in the corners of the box and connections made as follows:—

One end of magnet coil to large capacity fixed condenser and contact screw; other side of condenser to terminal "low-tension." From this terminal to .05 mfd. fixed condenser and other end of magnet coil. Other side of .05 mfd. condenser to armature mounting and second L.T. terminal.

There now remains the construction of the little jointed figure, which presents no difficulties (see Fig. 4). The essential point to bear in mind is that the completed figure must be very light in

(Contd. on page 562)

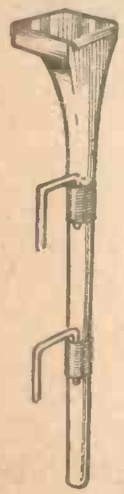

Fig. 3.—The support for the figure.

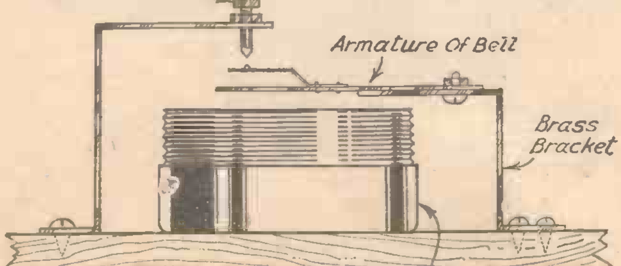

Fig. 2.—The relay.

Fig. 5.—The wire support for the pillar.

Fig. 4.—Details of the figure.

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Building the D.C. ACE

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

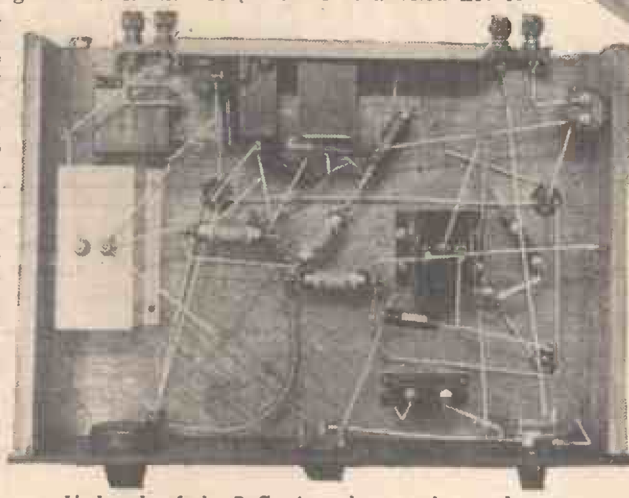
LAST week's short introduction to the design of this receiver did little more than outline barely the salient features, but it was felt unnecessary to devote a lot of space to describing all its advantages—the set will speak for itself in no uncertain tones when the constructor has finished his task of building it to the design given this week.

First of all it is assumed that the reader has now collected all the necessary components. They are, however, given again here to ensure there is no mistake. Do not forget that the Polar twin-gang condenser has the two sets of moving vanes insulated from one another, a feature to which I drew attention last week. Then there is the new Lewcos filament and smoothing choke, together with the 250 ohms, and 3 ohm Wearite resistances, all of which have been made specially for this D.C. set.

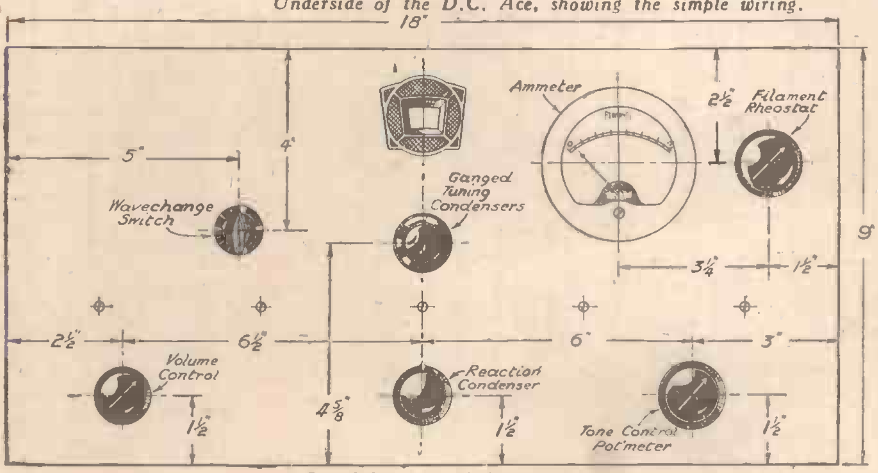
Naturally a start must be made first of all with the baseboard. This is built up of wood ⅝in. thick, the actual size being 18in. by 12in. As the set is rather a heavy one the thickness suggested is the most satisfactory and constructors are advised to adhere to this dimension. There are two side battens 12in. by 3in. by ½in. secured to the underside by screws passing right through the baseboard, thus raising the underside three inches to allow the necessary components to be mounted underneath. In addition, screwed centrally in place along the back edge is another wooden batten, 9in. by 3in by ½in., and this will be seen clearly in the photographs.

The positioning of the components on the baseboard is a relatively straightforward task, but, as the final positions were decided upon only after considerable experiment and alteration the constructor is advised not to deviate at all from the layout shown. Although two accompanying diagrams show the layout in miniature everyone is strongly urged to obtain a full sized blueprint.

The neat appearance of the receiver may be seen from this illustration.



Underside of the D.C. Ace, showing the simple wiring.



Panel layout and dimensions.

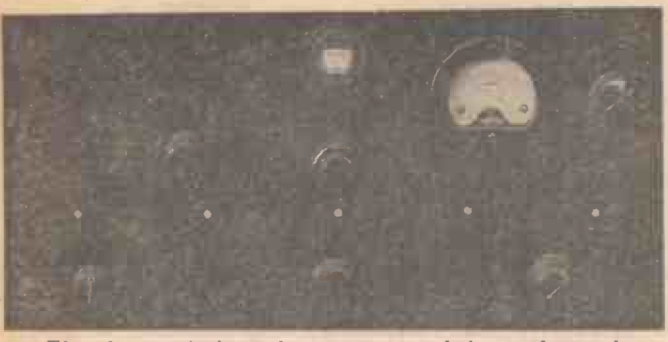
The cost involved is out of all proportion to the value secured as component positions can be measured up accurately and for the purpose of this description I am going to assume that the reader has obtained a blueprint.

Component Positioning

First of all mark out carefully the positions of the three valveholders and drill the three 1in. holes to accommodate them. Note the socket positions relative to the front of the baseboard before finally screwing down the holders. Next comes the twin gang condenser, dead central in the baseboard and mounted clear of the baseboard edge to allow for the escutcheon held on the panel. Do not make a *final* fixture of this to the baseboard until the panel has been prepared.

The pair of Colvern coils have no doubt been supplied already ganged with the switch rod passing right through them. If so, see that, when screwing them to the baseboard, the KTF coil is the one nearest to the panel and the KGR remote from the panel. It will be quite a simple matter to mount the remaining components on the top of the baseboard if the blueprint is followed carefully. Note that the 50,000 ohm Varley tag resistance is held in place by the bottom terminal at the back of the Polar condenser.

When this part of the work is completed satisfactorily turn the baseboard over and position the nine condensers as shown on the blueprint and also the two pairs of terminals in their mounts. There are also nine resistances on this side of the



This photograph shows the arrangement of the panel controls.

baseboard, but none of them is screwed to the baseboard. They are either held in place by the run of the wiring or alternatively in the case of the tag resistances and the heavy duty Bulgin grid bias resistance one end is "anchored" to a condenser terminal, to hold it securely. This reduces the length of the wiring and does away with the necessity for holders which not only take up valuable space, but also (perhaps more important) add to the total cost of the set. The resistances, therefore, that are held by condensers can be mounted in position, but the others must wait until the wiring side of the set is undertaken.

The Panel.

We now come to the next stage of the work, namely, the drilling of the panel. The appearance of the panel will be gathered by a reference to one of the photographs, and the reader will notice that it is unsymmetrical. This was due primarily to the necessity for including an ammeter to measure the filament current, but even so there is quite a good balance.

Dimensions for marking out and drilling the panel are given in a separate diagram and it must be remembered that these dimensions are front of panel measurements. When marking out all the scribed lines are made on the back of the panel, so be careful to allow for this back and front marking, a factor which does not enter into account when there is perfect symmetry.

Complete instructions, together with a template, are furnished for fitting the Polar condenser escutcheon, and make sure to allow for the full height of the top of the baseboard from the bottom panel edge. With the escutcheon fixed, it will be possible to fix accurately the position of the gang condenser on the baseboard by placing the panel against the baseboard edge and allowing a small clearance between the engraved scale and the back of the escutcheon. If you have not an expanding bit for drilling the escutcheon and ammeter holes it will be necessary to adopt the old dodge of drilling a number of small holes as near the wide edge as possible and then finishing off with a large half-round file. When the panel components are mounted in their respective positions lay the panel on one side and prepare for the last task of all, that is the wiring.

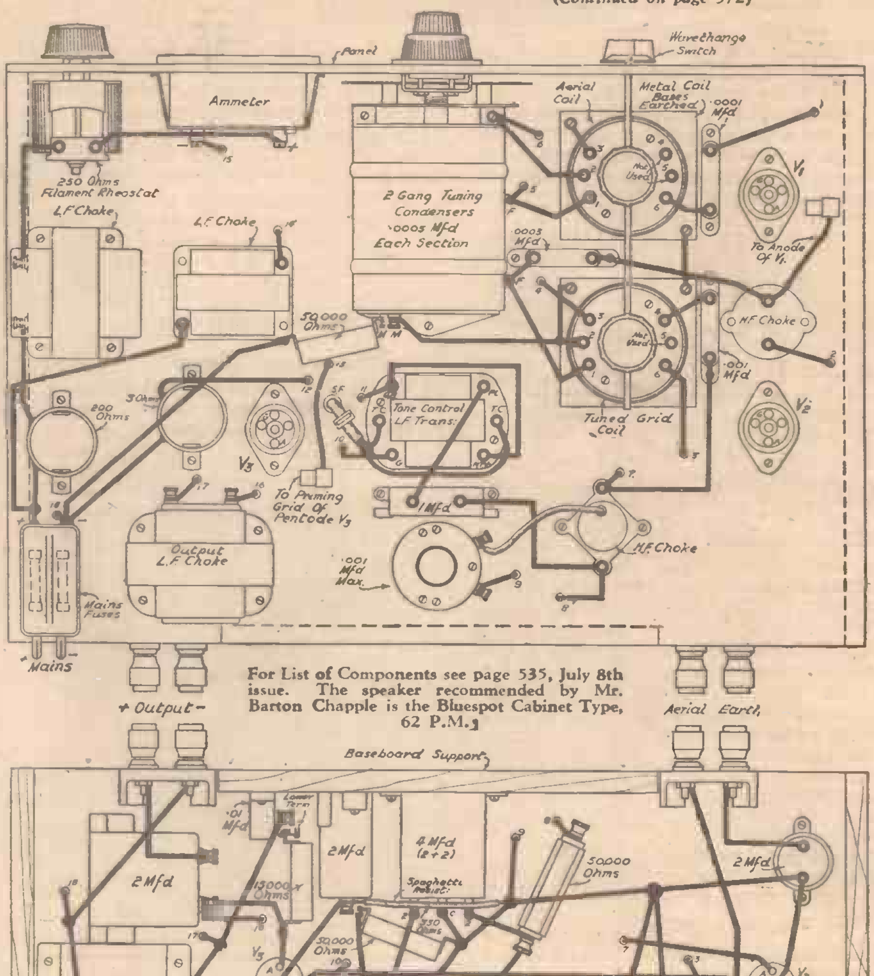
The Wiring

I always prefer to undertake this work with No. 16 gauge yellow Glazite. The wire is nice and rigid and even with long runs fixed only at the ends, there is no tendency to sag, and the finished job always looks neat. In addition, my personal view is that there is nothing to beat a good soldered joint and this has been followed on the present set. With a handy electric soldering iron, all the tags are soon tinned and an electrically and mechanically sound joint effected. To those not an adept with the iron I would merely say persevere and you will be well rewarded for your efforts.

As quite a number of the wires pass right through the baseboard it will be necessary to first of all drill holes for that purpose. This should be done first, and if all the component positioning has been undertaken according to the blueprint the holes will be clear of components, but, in any case, just make sure that your drill does not foul anything.

Now there is rather a lot of wiring or, at least, the constructor is apt to assume this when studying the blueprint, but if it is carried out in easy stages no difficulty will be experienced. Carry out the filament wires first in direct straight runs, remembering that with D.C. mains valves the filaments are in series. Turn the baseboard up the right way (the panel of course is

(Continued on page 572)



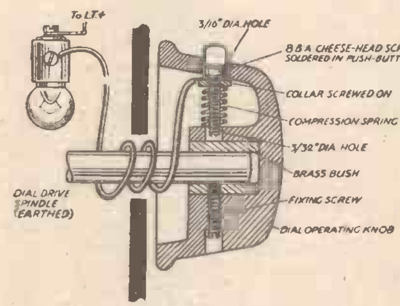
For List of Components see page 535, July 8th issue. The speaker recommended by Mr. Barton Chapple is the Bluespot Cabinet Type, 62 P.M.

Wiring diagram of the D.C. Ace.

The READERS' HALF-GUINEA WRINKLES Page

A Novel Dial-Light Switch

NOT wishing to incorporate an additional switch on the panel of my set for switching off the dial light, I devised the following scheme as shown by the accompanying sketch. The light is switched



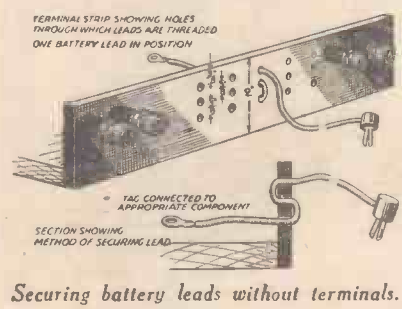
A novel dial-light switch.

on whilst tuning by slightly depressing a small push-button actually fitted in the tuning knob, and is automatically switched off when tuning is completed. The button and spring, both of which were slightly shortened, were taken from an old electric light socket and the screw and collar (or thin nut) from a terminal. The head of the screw was soldered into the button and assembled, as shown. The insulated lead is soldered to the collar, and is loosely wound round the spindle to allow the knob to turn freely. This device works perfectly, and can be made and fitted in a very short time to any hollow knob such as are now in common use. It saves an appreciable amount of current, as will readily be understood.—F. L. TAGG (Edmonton).

Securing Battery Leads

HERE is a simple method of securing battery leads which prevents them being pulled apart from any of the components, and also dispenses with terminals and battery cords.

In a suitable length of plywood or ebonite, 2in. wide, drill a series of holes, as shown in Fig. 1, then screw the strip on the back edge of the baseboard in the ordinary way. Drill as many sets of holes as you have leads. Now get some red and black twisted rubber-covered flex, untwist it, and cut off pieces the length required. These are laced through, as shown in Fig. 2



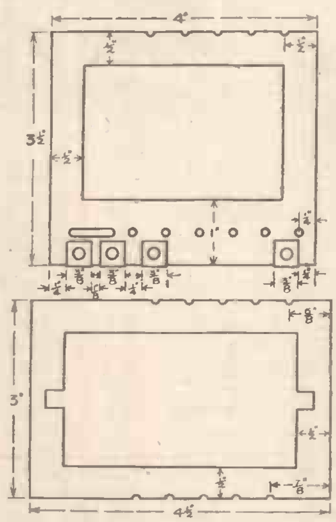
Securing battery leads without terminals.

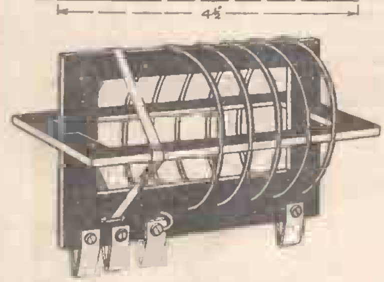
> **THAT DODGE OF YOURS!**
>
> Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best wrinkle submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be *original*. Mark envelopes "Radio Wrinkles." Do NOT enclose Queries with your Wrinkle.

and pulled tight. To make a good connection to the components of the set, get some soldering tags and solder one to the end of each lead, a wander plug being attached to each of the other ends.—J. W. ROOF (Rugby).

An Efficient Coil Former

THE accompanying description of an efficient former for short-wave coils will no doubt be of interest to other readers.



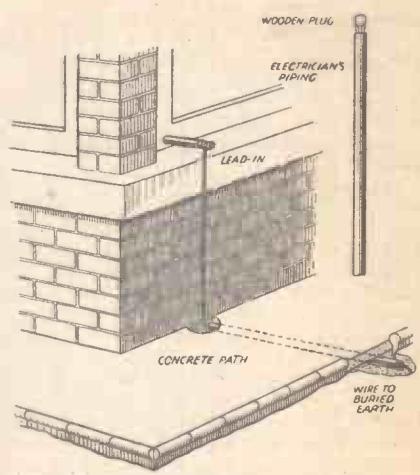


Making a short-wave coil-former.

One advantage is that there are only two pieces to cut from ⅛in. scrap ebonite; if the joint is carefully cut a tight fit no other fixing is required. This part of the work can be done with a fretsaw. The wire used for the grid coil was 16 gauge tinned wire which was first strained round a tin of about 2in. diameter to form the shape. This has to be turned through the row of holes in the bottom of the former and soldered to the copper tags which are 1in. by ⅜in. The reaction coil being of finer d.s.c. wire takes on a square shape. I slotted the bottom instead of drilling a hole so that the degree of coupling could be varied slightly before the ends were soldered to their respective tags. I used four grips from an old D.P.D.T. knife switch, screwed the corresponding distance apart on an ebonite base, to plug the former in. For a ten turn coil I reduced the spacing between turns from ½in. to ¼in. and so on. The sketches show clearly the constructional details and a finished coil.—W. H. WOODS (Gt. Yarmouth).

An Improved Earth Lead

WHEN a concrete path runs underneath a window it is very difficult to obtain a good earth lead, as people will constantly



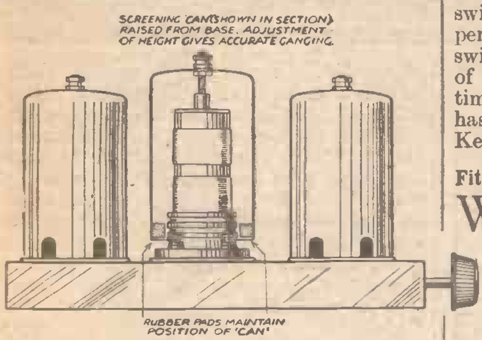
Method of installing an earth lead.

tread on the wire, if it is laid over the path. To fix the wire underneath the path, obtain a piece of electrician's piping the same length as the breadth of the path. Fix a piece of wedge-shaped wood into one end, dig a hole at the edge of the path below the concrete, and dig another hole in the path underneath the window, a piece of concrete will have to be removed in this operation. Then with a hammer knock the piping underneath the path from the first hole towards the second hole. If this is done carefully no difficulty will be experienced, but the surplus earth must be removed from the hole near the window. When the pipe is in position, turn it round several times and gently draw out. Then remove the wooden wedge and place the pipe back into the hole already formed. Thread the lead in wire through the pipe and so underneath the path to the desired earthing position, as shown in the accompanying sketch.—H. DEARDEN (Sale, Cheshire).

RADIO WRINKLES

Ganging Screened Coils.

AFTER various tests to get my dials in good condition, and to keep the set steady on all wavelengths, I experimented with the screening cans. The accompanying sketch illustrates how I got the set stable by keeping the can of No. 2 coil



A simple dodge for ganging screened coils.

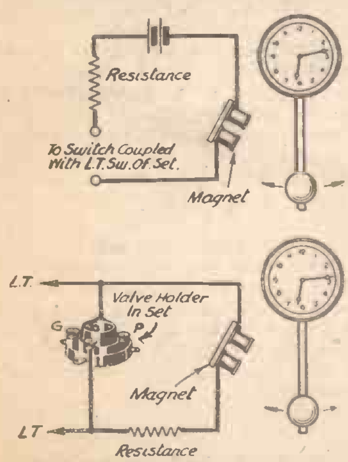
up about ⅜in. from bottom. By fixing small rubber pads inside the can, as shown, contact with the coil winding is prevented. —H. H. WARWICK (Harrow).

A Time Meter for Radio.

THE majority of wireless enthusiasts do not bother to keep a record of the number of hours their sets are in use, even though the information gained is of value. How long are your valves lasting? This is a question that very few could answer. Again, what about batteries? You cannot possibly tell which kind lasts the longest unless you know the exact number of hours each one is used. There are various ways by which you can ascertain the number of hours your set is working. Perhaps the simplest method is as described below.

The apparatus required consists of a cheap pendulum clock and an electro-magnet. The clock should preferably have an iron or steel pendulum, if this is not the case a piece of soft iron must be fixed to it in a suitable position. A disused electric bell will furnish the magnet which should be fixed opposite the soft iron on the pendulum. It must be arranged so that it just clears the pendulum when the clock is working in the ordinary way.

The electro-magnet is connected in series with a battery and switch. The switch should be coupled to the "on and off" switch of the set. A different arrangement

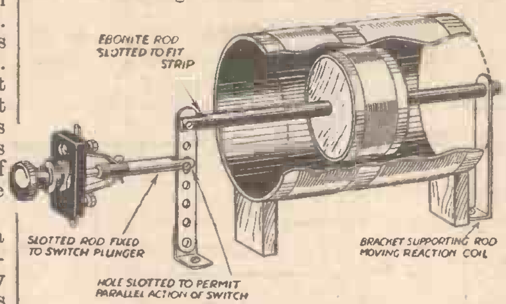


A novel time meter for radio.

is to make use of the L.T. accumulator. To do this a pair of wires are connected one to each wire that is connected to the L.T. valve sockets. It is advisable to connect a resistance in series with the magnet to limit the current to a minimum. To check the number of hours a set is in use, the clock is adjusted to the correct time and set going. Whenever the set is switched on the magnet will attract the pendulum and hold it until the set is switched off. Obviously, then, the number of hours the clock is behind the correct time equals the number of hours the set has been in use.—J. R. HICKMOTT (West Kensington).

Fitting an Adjustable Reaction Coil.

WHEN I built my set I made my own coil by putting the required number of turns on a former. The design was simple enough, just a divided coil allowing a wavechange by switching out the long-wave part. I was, however, troubled with the reaction. On the lower part of the medium wave band reaction was unduly fierce, while right at the bottom of the dial the set oscillated with the reaction condenser at minimum capacity. On the other hand, at the top of the long wave band, it was nearly impossible to reach oscillation point. I therefore devised the following dodge to alter the coupling of the reaction coil. The actual contact of the wavechange switch is screwed into



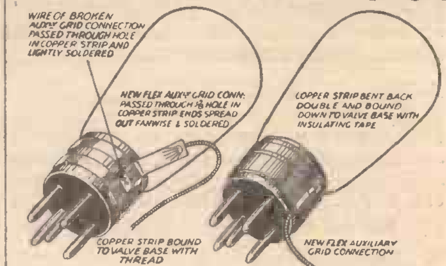
Fitting an adjustable reaction coil.

the ebonite end of the rod, and in place of this I screwed a rod with a drilled end. This end I loosely bolted to a 2½in. perforated metal strip which was fitted to a small angle piece screwed to the baseboard, as indicated in the accompanying sketch. The reaction coil was firmly fixed to an ebonite rod, and the rod fitted to the lever at one end, and another piece of metal strip was used as a bearing at the other. I found the correct number of turns by trial and found that the coil, when pushed farther into the long wave winding, was very effective in bringing the oscillation point within the range of the condenser, without causing the medium wave reaction to be unduly fierce.—R. H. W. BURKETT (Oxford).

Repairing a Pentode Valve

ABOUT a year ago I built a three-valve all-mains set, employing, in the output stage, a five-pin pentode valve with side terminal. When tried out the set worked perfectly, but when placing it in the cabinet an unfortunate mishap broke the side terminal completely away from the valve base. As the valve had cost 25s., dismay hardly described my feelings.

A close examination showed that the end of the fine wire that made the connection with the interior of the valve could just be seen, and with a hooked wire I succeeded in bringing it to the hole in the valve base. With a pair of fine-nosed pliers I then bent 1/16 in. of the end outwardly, at right angles. A piece of thread round the valve held it from springing



Repairing a pentode valve.

inwards again. Taking a strip of copper foil 1½in. by ⅜in., with a needle I made a small hole ⅜in. from one end, and at the same distance from the other end made a hole ⅛in. diameter. With the copper strip parallel to the long axis of the valve it was held so that the wire end projected through the small hole, and a tiny quantity of solder, applied quickly at the right heat, secured it in position. With strong thread the strip was then lashed just above and below the joint, to the valve base, the portion between the lashings being left bare. It was then bent over on itself at the middle and the valve inserted in the set. Next, the 20 s.w.g. systoflexed connection to the terminal was replaced with a length of single insulated flex, which was bared at the valve end, passed through the ⅛in. hole, and the ends spread. The strip (now doubled, with the flex ends between) was bound tightly to the valve base with insulating tape, the set coupled up and the power switched on. It worked without a falter, and has done so ever since. Need I add that such a repair demands careful handling, but as I had had no previous experience of wireless work, it should not deter anyone with patience and reasonable skill.—G. E. BRIDDON (Barnsley).

Metal Bar Connectors.

HERE is an idea for reducing wiring to a minimum. Two strips of metal are run across the back of a receiver, as shown in the accompanying sketch, one bar being connected to H.T. positive, and the other to H.T. and L.T. negative and earth. By this method the two bars make convenient tapping places all through the set. The decoupling arrangement as shown in the diagram will make the system clear. If valve-holders can be mounted close to the negative bar, the negative of the filament terminals can be connected to it, thus eliminating one side of the L.T. circuit. —GEORGE WREN (New Cross).

Using metal strips for reducing wiring connections.

TELE-TALKIE TOPICS

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

HAVING settled what always ranks as a controversial point as far as the scanning disc is concerned, namely, the size and shape of the exploring holes to conform to given transmission standards, let me give a few brief hints on making up the disc proper.

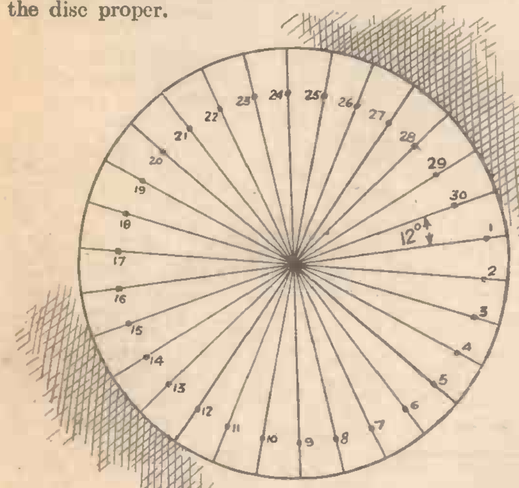


Fig. 1.—Marking out the holes in the scanning disc.

When you have decided on the diameter of the disc required, the table given in the June 24th issue of PRACTICAL WIRELESS will settle straight away the size of the hole necessary. Obtain a sheet of No. 32 S.W.G. aluminium and mark out a circle to the chosen diameter. This is best carried out with trammels, but if you do not possess such a tool a simple substitute can be made up from a strip of wood slightly longer than the disc radius. Measure off a line of length equal to the radius and make two *small* holes at the line extremities. Pin one end of the wood strip to the disc centre and with your scriber point in the other hole, run the scriber round lightly over the aluminium sheet.

Marking Out the Holes

Then cut out the circular disc carefully, and with a large protractor mark off thirty radial lines at angles of twelve degrees between each, somewhat as shown in Fig. 1. Take great pains to ensure that these radii do really subtend angles of twelve degrees at the centre, as in this way you will reduce the possibility of errors of angulation being evident in the completed disc, as I will explain later.

Now take a piece of stiff paper and mark off along its edge a distance equal to half an inch less than the disc radius. This is the distance "x" of Fig. 2, the distance "y" of the same diagram being the picture width found in the previous table referred to. Divide this distance "y" *very accurately* into thirty equal divisions. If any difficulty is experienced in this part of the work owing to the small and generally very awkward hole sizes, follow this simple plan. Let AB be the distance "y" of Fig. 2. Draw a line AC at any convenient angle with AB, as shown in Fig. 3. Measure off along AC (starting from the point A) thirty equal and convenient distances, say ¼in. each, with an ordinary ruler. Now join the last division on this line with a line to the end B, and from each of the marked divisions along AC draw other lines *parallel* to BC. Where they intersect AB will be the disc hole divisions required.

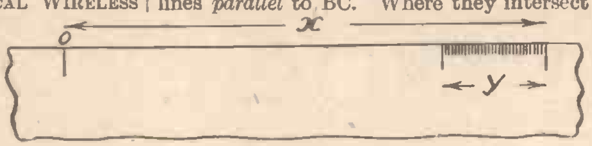


Fig. 2.—Scale for determining the exact position of the holes.

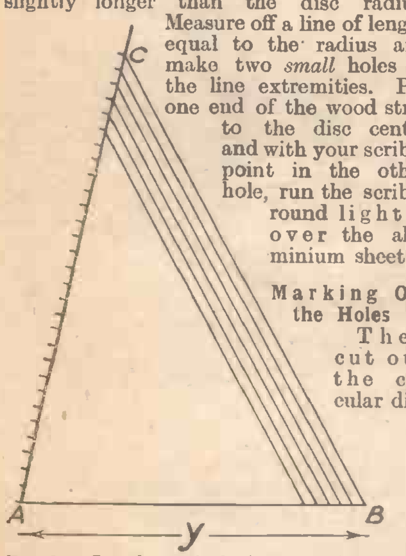


Fig. 3.—Simple method of accurately spacing the holes.

Hole Punching

Now place your paper strip of Fig. 2 along any one radius, and with the mark O against the disc centre, mark off the position of No. 1 hole, that is, immediately opposite the outer division of the divided portion "y." Move the paper strip round in a *clockwise* direction until it coincides with the next radial line, and mark off No. 2 hole one division in. Repeat for Nos. 3, 4, and so on (as shown in Fig. 1) until you have marked off the single turn spiral of holes Nos. 1 to 30.

We now reach the punching operation and for this we need a square punch made from silver steel rod, perfectly flat on all four sides with sharp corners and ground to size, so that it corresponds to the hole dimension. This punch, hardened and tempered, can be made by the home constructor himself, or by an instrument maker as desired. A length of about 1in. only is required, as the punch is best accommodated in a brass holder, as shown in Fig. 4, approximately ¼in. protruding from the holder.

Obtain a hard wood block and lay the disc flat on it. (If soft wood is used, the thin aluminium sheet will get drawn down with each hole punched, and in consequence, holes of incorrect dimensions will be the result.) Position the punch so that one edge just lies along a radial line and the *outer* edge of the punch is touching the mark made for the hole position. With the punch held vertically, strike the brass holder with a hammer so as to drive it through the metal. This operation must be repeated for each hole in turn, exercising the greatest care in aligning the punch.

To lighten the disc, and enable it to whip out flat, cut away large sectors of the aluminium so that say, four spokes, a rim, and a hub are left, as indicated in the photograph of Fig. 5. Then add a brass boss at the disc hub, the hole in the boss being such that it will fit the shaft of the motor selected to drive the disc at its prescribed speed of 750 r.p.m.

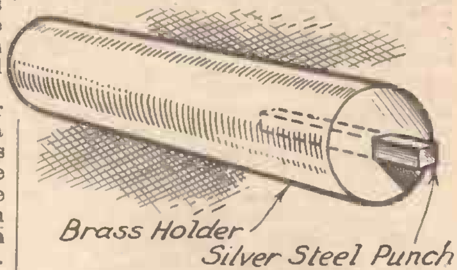


Fig. 4.—Punch for making the holes.

Fig. 5.—Photograph of the finished disc, with spokes, rim and boss.

DISTORTION! -It's Causes and Cure!

(*Continued from July 8th issue, page 533.*)

Some Random Remarks on an Important Subject.

By BERNARD DUNN

THUS the ratio, the impedance between points S and B and A and B, is always greater for low than for high frequencies. As a consequence, the more the average volume is reduced, the less is the proportionate reduction of low frequencies.

As to the condenser C2. When volume is cut down, by moving the slider S towards the end B, the resistance between points A and S is increased, but C2 (which has a low impedance to high frequencies) is in parallel with resistance A—B and therefore the proportionate reduction of high frequencies is less than that of those towards the middle of the audible range. In order fully to understand the above explanation some knowledge of condenser impedances is necessary, but if you prefer not to go into technicalities there is no need, since you can try the system yourself if I give you the capacities for C1 and C2. As a matter of fact their values depend chiefly upon the resistance of the volume control potentiometer. If the latter is of .5 megohm (a usual value) C1 should be about .1 mfd. and C2, about .0005 mfd. When using a 50,000 ohm component C1 and C2 should have values of .5 mfd. and .002 mfd. respectively. Between these two extremes approximately "*pro rata*" capacities will be suitable. In any case the optimum values will depend to a certain extent upon the characteristics of the receiver or pick-up, so they are best determined by experiment.

Any readers who insist upon good quality and who do not like great volume are recommended to try the method of V.C. just described; it removes a great drawback to low-volume listening.

Where Distortion Might Occur

There are thus only four places in which distortion can occur: (1) In the intervening ether between transmitting and receiving aerials. (2) In the receiver itself. (3) In the loud-speaker, and (4) In the room in which our speaker is situated.

In regard to (1), this source is most unlikely, unless the two aerials are a few hundred miles apart. The problems surrounding loud-speakers and their positions in the room have adequately been dealt with in these columns before, so they will not be referred to again. We are thus left with one possible source of distortion—the receiver—and we can, therefore, consider this on its own merits. Incidentally, it might be added that practically the whole of the distortion and poor reproduction which is experienced does undoubtedly originate in the set. I have known people spend money on expensive new loud-speakers and no end of time making and arranging baffles,

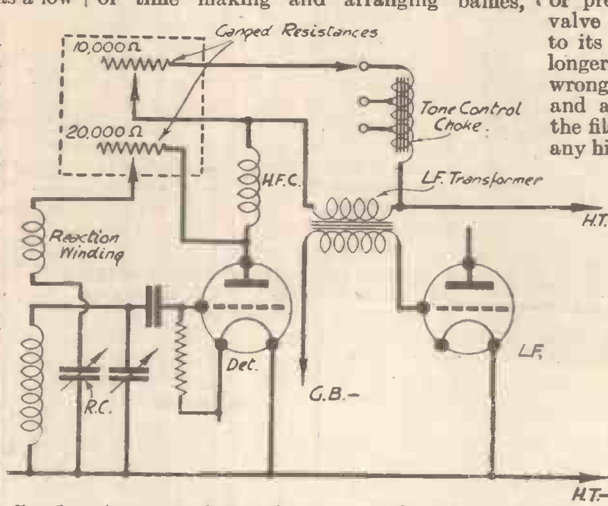


Fig. 5.—A very good way of automatically compensating for the attenuation of high notes brought about by increasing reaction.

only to find that the fault lay entirely with the receiver.

Two Kinds of Distortion

Distortion is of two distinct kinds, one of which is particularly annoying (and very easily recognised) and the other is frequently ignored, due to its not being detected except by the more critical of listeners. The first kind is that which manifests itself by a "rattling" or "jarring" noise on music, or by the impression that a speaker has the proverbial "hot potato" in his mouth.

Tracing the Source

Just as this kind of trouble is most easily detected (in fact, it cannot possibly be missed) so is the cause not difficult to trace. Almost invariably it is due to "overloading" in some part of the set. When the latter form of distortion is experienced the first thing is to make sure that the H.T. supply is of sufficient voltage—not less than 100 volts—and that the grid bias tappings are properly adjusted; this sounds very simple, but it is no less important. If everything is right in this respect the next step is to find whether distortion is taking place before or after the detector valve. As a check, the L.F. amplifying stages should be "cut out" by connecting a pair of 'phones in the detector anode circuit. The method is to join the 'phone leads in series with the first L.F. transformer or anode resistance (where R.C.C. is used) as shown in Fig. 1. If distortion is still present it must be due to the detector or preceding valves. Eliminate the S.G. valve by connecting the aerial lead-in to its anode terminal, and if the fault no longer remains the S.G. stage is obviously wrong. Try varying the screening grid and anode voltages, and make sure that the filament connections are sound, because any high-resistance contact would obviously prevent the valve from functioning correctly.

It might be that the valve is fairly old, in which case its filament emission will probably be weak; the best test is to replace the valve with a new one. Alternatively, the S.G. valve might be overloaded, due to its receiving too great a signal voltage from the aerial. If it is, a cure can be effected by connecting a .0001 mfd. pre-set condenser in the aerial lead, or by taking the aerial to the centre terminal of a 250,000 ohm potentiometer joined across the aerial and earth terminals as shown in Fig. 2.

Detector Distortion

When the trouble is confined to the detector valve it will probably be found that the grid leak is faulty or at too high a resistance, or that the grid condenser is deficient. On the other hand, the valve itself might be overloading, when a higher H.T. voltage or one of the aerial-input limiting devices mentioned above will set matters right. Obviously an old or faulty valve could cause the difficulty, and again, replacement would verify this point. Where R.C. coupling is used it might be that the anode resistance is of so high a value that the detector valve is receiving insufficient H.T. voltage. It will not be difficult to replace the resistance or,

(*Continued on page 576.*)

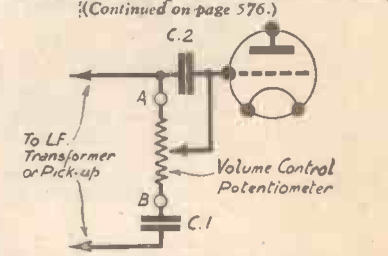


Fig. 6.—A simple method of automatic tone compensation as applied to a volume control.

WIRING DIAGRAM IS GIVEN OVERLEAF

Buildi[ng the] "ARCADY" PO[RTABLE]

A New, Simple and Inexpensive Portable Receiver, having a Number of Novel and Up-to-date Features, Including a Pentode Detector-Driver.

Designed by OUR TECHNICAL STAFF.

LAST week you were given preliminary details of our new three-valve portable receiver, so now it is proposed to describe its construction. At the outset it should be made clear that the work involved is by no means difficult and can satisfactorily be attempted by any amateur of reasonable ability. The cabinet specified is sold complete with aerial frame, baseboard and ebonite panel, all of which fit exactly in their appropriate positions. First of all the panel and baseboard should be removed so that they can be marked out and suitably drilled. Start with the panel and mark it out as shown in Fig. 1. There are nine holes in it altogether, three of which are only ⅛in. diameter, for the baseboard holding screws; of the others,

The finished Arcady in the attractive Peto-Scott cabinet.

those two for the tuning condensers are 9-16in., the remaining four having a diameter of 5-16in. All except the two largest holes can easily be made with a mechanic's small brace and twist drills, but the large ones will probably have to be bored with a joiner's brace and a centre-bit. Failing the latter tool it is not a difficult matter to make the holes first by drilling them about a quarter of an inch diameter and then enlarging them with an improvised reamer consisting of the tang of a file. Be careful that all panel holes are in exactly the correct positions, because if they are not the operating knobs will not be symmetrically placed in the curved panel opening in the front of the cabinet.

After drilling the panel, the components can be attached to it and the baseboard marked out. Commence by setting off the positions of the holes for the valve-holders. These latter can then be bored out with a brace and bit, making two of them 1in. diameter and the other 1½in. The larger sized hole is for the Class B valveholder which is at the right-hand end (as seen from the front). If a sufficiently large bit is not available for the largest hole, the latter can first be made 1in. diameter and then opened out by means of a half-round wood file. The next job is to mount the tuning coil. As can be seen from the photographs, this is raised up from the level of the baseboard by attaching it to two pieces of wood each measuring 1⅞in. wide by 2½in. long by ⅜in. thick. These are necessary to bring the knob of the self-contained coil wave-change switch so high up the panel that it is symmetrical with the other controls. The pieces of wood are attached ⅞in. on each side of the centre of the baseboard, and must be fixed at right-angles to the front edge. They are secured by passing two 1in. screws through the baseboard from the under side into each one. The coil is then fastened on top of them by means of four ⅜in. screws.

The remainder of the assembly process consists of arranging and attaching the other components in positions clearly indicated in the wiring diagram. It need not be mentioned that some of the parts are on the top side of the baseboard and the others underneath, since this point will be evident from the illustrations.

When all the parts have been fixed in place the wiring can be tackled. There are remarkably few connections and what there are follow fairly short and direct paths; all of them can easily be traced by making reference to the wiring diagram. The main wiring is carried out in Glazite, a number of leads being taken through ⅛in. holes from one side to the other of the baseboard. To prevent the possibility of mistake, all the holes are numbered in the wiring diagram so that any wire can be traced from end to end. There is one little point in the wiring that calls for an explanation—one wire, from the 10,000 ohm decoupling resistance, is secured under the head of a wood screw attached to the lower side of the baseboard. The latter forms a terminal point from which two flexible leads, one to the H.T. battery and the other to the loud-speaker, are taken. Battery leads present no difficulty, and are each made from a 15in. length of flex fitted with the appropriate wander-plug or spade terminal. Similar lengths of wire are used for the loud-speaker connections, and two of these are attached to the anode terminals of the Class B valve-holder, the third being fastened to the "H.T.+3" lead by means of the wood screw "terminal."

The Frame Aerial

When the receiver itself has been wired up, attention can be turned to the frame aerial. This consists of two windings for long and medium-wave reception, and these are placed side by side in a sinking specially made for the purpose in the main frame-work. Start at the top of the frame and

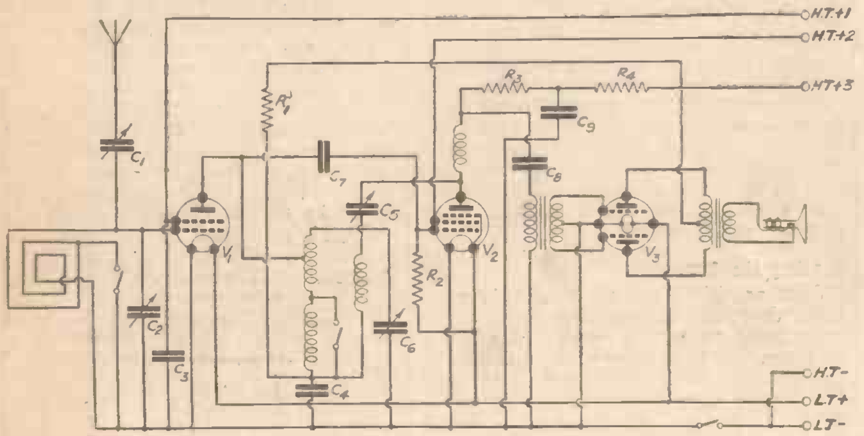


Fig. 3.—Circuit diagram of the Arcady Portable Three. The values of components are as follow:—C1, .0003 mfd. pre-set; C2, .0005 mfd. variable; C3, 1 mfd.; C4, 1 mfd.; C5, .0002 mfd. variable; C6, .0005 mfd. variable; C7, .0002 mfd.; C8, 1 mfd.; C9, 2 mfd.; R1, 2,000 ohms; R2, 2 megohms; R3, 50,000 ohms; R4, 10,000 ohms; V1, 215 S.G.; V2, 220 H.P.T.; V3, 240 B.

LIST OF COMPONENTS FOR TH[E]

- One Peto-Scott Portable Cabinet.
- Two "Utility" Standard .0005 mfd. Condensers with 3in. Dials.
- One Graham Farish .0002 mfd. Litlos Condenser.
- Three T.C.C. type "50" Condensers, 1 mfd.
- One T.C.C. type "50" Condenser, 2 mfd.
- One T.C.C. type "S" Condenser, .0002 mfd.
- One Sovereign .0003 mfd. Pre-set Condenser.
- One Igranic type "H.F." Ingranicor Coil.
- One Graham Farish Grid Leak, 2 megohms.
- One Amplion Binocular H.F. Choke.
- Three Graham Farish Ohmite Resistances—2,000 ohms, 10,000 ohms and 50,000 ohms.
- One Multitone Bepu 2/1 Driver Transformer.

ng the RTABLE THREE

CHEAP AND EFFICIENT

make two small holes near the front edge of the sinking. Pass the end of the 24 gauge wire through these and leave a length of nine inches or so projecting inside the frame. Now wind on thirteen turns, placing them side by side and just touching each other. While winding, a steady tension should be kept on the wire for the whole of the time so as to prevent any looseness. Also take care that the wire is not allowed to kink, because if it does there is a danger of it breaking due to the tension on it. Such a break could easily escape notice due to the cotton covering hiding it, and this might prove a very elusive fault when the time comes to try out the set. After winding the requisite thirteen turns, make two more holes, anchor the wire as at the beginning and again leave a short length projecting inside the frame. And now for the long-wave winding, which is composed of the thinner (34 gauge) wire. Pass the end of this wire through the last pair of holes, leave a space of about half an inch and wind on thirty-five turns in the *same direction* as those of the medium-wave winding, again placing them side by side and touching each other. At the end of the winding make two more small holes, break off the wire to correct length and anchor it. When putting on the long-wave winding avoid putting too much tension on the wire, since it is very thin and liable to stretch, and even to break, if not handled with reasonable care.

Connecting Up

The final task is to put the various parts together in the cabinet. Before doing this the loudspeaker should be screwed to its fret (which should have a 5in. diameter hole in its centre) and the pre-set condenser fastened in the top left-hand corner of the frame. Put the receiver in the frame and connect up the aerial in the following manner: Take the "beginning" end of the medium-wave winding, scrape off a short length of insulation near its centre and connect this bared portion to the "front" terminal of the pre-set; connect the very end of this wire to the top terminal of the aerial tuning condenser; twist together the two adjacent leads from the frame, make a loop at the end and secure this under the terminal of the wave-change switch; connect the lead from the end of the long-wave winding to the moving vanes of the aerial condenser (this is beneath the fixed vanes and on the end-plate nearest the panel).

The frame and set can next be slid into the cabinet and the loudspeaker leads soldered on. Of the three leads, the two coming from the seven-pin valve-holder go to the two end soldering tags, whilst that from the H.T. terminal goes to the centre tag.

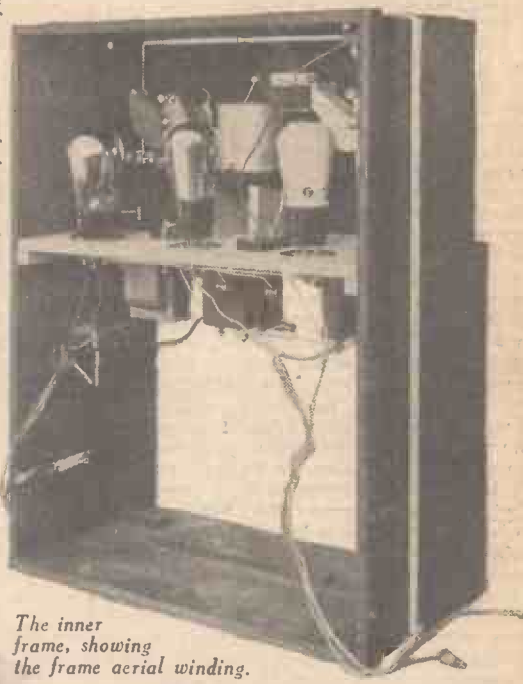
Now fit the H.T. battery and L.T. accumulator in place and connect them up, putting wander-plug "H.T.+1" into the 72-volt socket, that marked "H.T.+2" into the 63-volt socket, and that marked "H.T.+3" into the 120-volt socket. The set is then ready for trying out. The tuning is almost the same as with any S.G.-Det.-L.F. receiver, but for the benefit of less experienced constructors a few notes on this subject will be given next week.

Operating the Set

When first trying out the set it will be found best to connect an outside aerial if possible, so as to make reception somewhat easier and to obviate the need for correct orientation of the frame. The aerial lead is simply connected to the front terminal of the pre-set condenser attached to the top inside corner of the frame. An earth lead also can be used if desired, and this will be joined to the negative accumulator terminal. Next set the wavechange switches to long or medium waves; the frame aerial switch knob should be pushed in for long and pulled out for medium waves; the coil switch knob is turned so that the arrow points straight up for long, and to a horizontal position for medium waves.

The reaction condenser can then be set to its minimum position and the two tuning dials rotated together until the local station is heard. Incidentally, it will be found that the readings on the two dials are almost identical for most stations. After the local has been tuned in it should be brought up to full strength by means of the reaction control, after which the aerial and earth

(*Continued on page 572*)



The inner frame, showing the frame aerial winding.

E ARCADY PORTABLE THREE.

- Two Clix 5-pin Valveholders.
- One Clix 7-pin Valveholder.
- Two Bulgin Junior 2-spring Switches.
- Four Belling Lee Wander Plugs—H.T.+1, H.T.+2, H.T.+3 and H.T.—.
- Two Belling Lee Spade Terminals—L.T.+ and L.T.—.
- Four ounces Lewcos 24 gauge d.c.c. Wire.
- Four ounces Lewcos 34 gauge d.c.c. Wire.
- Two coils Glazite, odd lengths flex, screws, etc.
- One Rola type F5 PM32 Class B Loudspeaker Unit.
- One Cossor 215 S.G. Valve.
- One Cossor 220 H.P.T. Valve.
- One Cossor 240 B. Valve.
- One Siemens 120-volt H.T. Battery.
- One Ediswan 2 v. 20 amp. Accumulator.

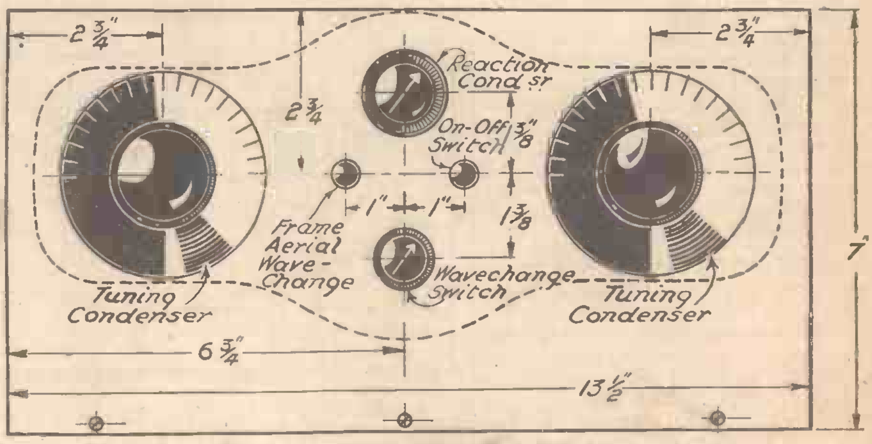


Fig. 1.—This sketch shows the disposition of the panel controls.

THE ARCADY PORTABLE THREE

(Continued from page 571)

may be disconnected and the station again brought up to maximum strength by rotating the complete case until the aerial is in line with the transmitting station. This will necessitate a readjustment of the left-hand (frame) tuning condenser to compensate for the reduced capacity occasioned by the removal of the outside aerial. It might also be found that the set starts to oscillate, due to the reduced damping, and in that case the reaction control must, of course, be slacked off.

The very same method of tuning applies on both wavebands, and it is always easier to get the approximate tuning settings in the first place by making use of the external aerial and earth. It might also be pointed out that, although the set is distinctly portable in construction, it will give much better results when an outside aerial is used. The chief reason for this is that to obtain full benefit from the Class B output valve it must receive a fairly generous input of audio-frequency energy. At the same time there is no need to point out that the set can most certainly be operated on its own aerial with every satisfaction, especially when reception of the nearer stations is all that is required. From these stations a really good volume of undistorted sound can be obtained.

BUILDING THE D.C. ACE

(Continued from page 564)

still on one side until required) and add all the wires that are possible on this top surface. When passing the Glazite into the coils for connecting to the terminals, see that each wire is exactly central in the individual slots and carry the insulation right to the terminal nut. One screw holding down the base of the coil remote from the panel passes right through the baseboard and has a nut on the underside. This is for earthing purposes and makes a convenient common junction for the required leads in that locality.

Next, it will be advisable to add the wires that have to pass through the baseboard itself. The first should be the pair of wires passing from the Multitone transformer to the potentiometer panel control. The wires are run in metal braided cable, as will be seen in the illustration, and can be left just long enough for attaching to the panel control when the panel is finally screwed in place. Having attended to the wires passing through the baseboard, link up all the possible points, as shown in the underneath baseboard wiring diagram.

It is here that you must be careful to include the resistances. Since these have terminals in some cases bend a loop in the wire and after placing it over the terminal shank tighten up hard. With reference to the two Dubilier condenser banks of condensers note carefully that it is the centre tag which is the common one. Another item to watch is the way the wires are led away from the valveholder tags. Keep them as clear as possible, to ensure that there is no likelihood of instability.

Do not omit to have the gang condenser cover screwed on before the panel is added, otherwise you will be unable to get at the front screw. Remember also the two flex leads terminating in insulated connectors which make connection to the terminals on the screened grid and pentode valves.

Before attempting to render the set alive check over each wire very carefully. As each one is seen to be in place crosshatch it lightly in pencil on the wiring diagram. This will ensure that no wire has been omitted and also that no wire has been joined to the wrong terminal point. All is now in readiness for putting the set "through its paces," so next week all the operating details will be given.

The Polar Uniknob Two-gang Condenser

I specially recommend the Bluespot Cabinet No. 62 PM for the D.C. Ace. A final word about the Polar Uniknob Two-gang variable condenser with insulated rotor. This is a special condenser, and is made only to order. The price of this condenser is one guinea (1/6 more than the standard Uniknob, which extra charge is for the insulated rotor.)

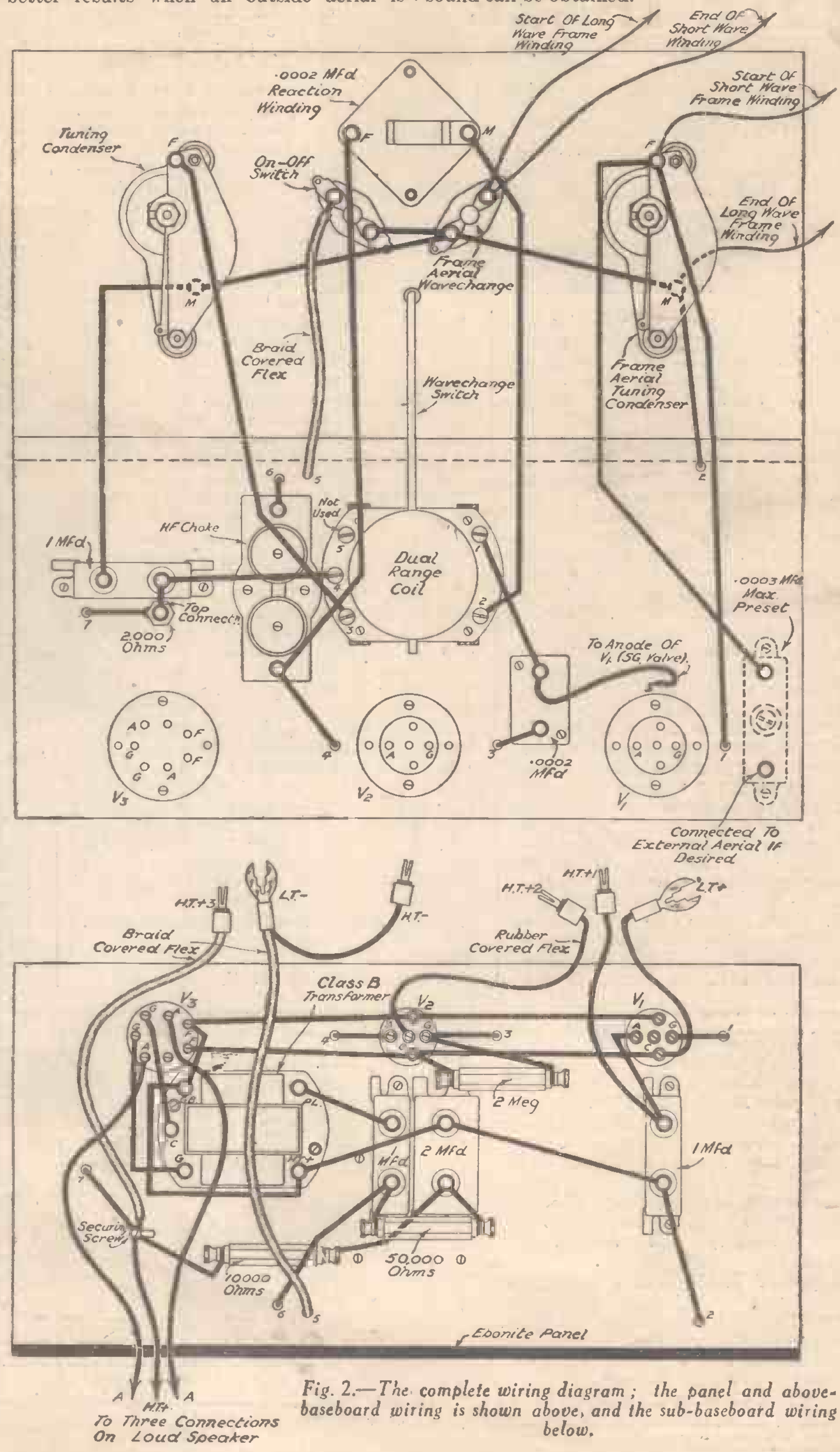


Fig. 2.—The complete wiring diagram; the panel and above-baseboard wiring is shown above, and the sub-baseboard wiring below.

RADIO RAMBLINGS

By GRID LEAK

Jottings from my Notebook

Battery Charging from D.C.

What a difficult question it appears to the uninitiated to find the correct lamp to use in series with the D.C. mains for charging L.T. accumulators. Carbon filament lamps are to be preferred to the usual metal filament type. The reason for this is carbon filaments give approximately 4 watts per candle power, as compared with 2 watts of the other type. Now suppose, for an example, the supply mains give 200 volts and a 50 candle power carbon filament lamp is used. Taking 4 watts per C.P. as a basis, 4 multiplied by 50 equals 200 which is the wattage of the lamp. When the wattage is divided by the voltage the answer is in current. In this case, as you will see, it is 200 watts divided by 200 volts equals 1 amp. By applying this principle to any voltage and wattage it is easy to arrange the correct lamps to use for passing any desired current.

Human Aerials

Reading an article in an evening journal I noticed the correspondent described the receiving station of a friend, this read as follows: "Mr. A—— employs an aerial consisting of two WIVES, *each forty feet long* running North and South, with the lead-in from the Northern end." What is the world coming to? I should have thought it enough that the wife of to-day was amply employed taking care of the house and children without being a pick-up for her husband's signals. I am wondering whether Mr. A—— has been to Utah for his summer holidays.

A Question and an Answer

I am often asked whether it is better to buy a set ready for immediate use, a kit of parts of some well-known manufacturer, or get a blue print and layout of a good circuit, buying the component parts separately. It looks rather a big problem, and each section of the question asked requires a little careful thought on the part of the individual. It is a point which brings to my mind a very marked difference between the Radio Exhibition at Olympia and the one held at the City Hall, Manchester. North countrymen appear to be more keen on hobbies of a technical nature than the Southerner. This revolves itself around the question of environment. The North, being purely a manufacturing area, is peopled by a more technically-minded type of person, while in the South outdoor attractions tend to the spending of leisure hours out of doors. My personal opinion is that the enjoyment and appreciation of the receiver on completion amply compensates anyone who will occupy their mind in this way.

Long-distance Reception

Like myself you are probably finding those elusive long-distance stations now rolling in again and this makes many of you wonder where they go in the summer time. You know, of course, the effects of the sun's rays on different wavelengths, so there is no need to go over old ground. However, although we are now receiving more stations, have you noticed the heterodyne whistles they bring with them? That is the unfortunate snag. The European ether is overcrowded and station wavelength separation not sufficient to enable us to tune in many of these stations without interference from another working on a nearby wavelength. This is exceedingly unfortunate and explains the necessity for selective receivers in order to cope with the difficulty. When a receiver is designed for the utmost selectivity, then perfect reproduction has to go by the board, because you cannot cut the sidebands, which provide the modulation, and expect a true tonal response of the whole of the frequencies transmitted, from the speaker. This instrument cannot give you what the detector does not pass on to the amplifier. So, we have to take the choice of two evils—poor selectivity, or imperfect reproduction. Our circuit designers are to be complimented on the way they steer a middle course to give a fifty-fifty standard. Still it is a great pity, for quite a number of the stations could be dispensed with and closed down. We have examples in this country, in the closing down of relay stations, showing how a high-power station can cover a given area on one wavelength, and the principle could be carried further, thus allowing more freedom in the ether.

Polarity Determination

I was called upon to examine an accumulator the other day. While motoring along the Great West Road I had occasion to call at a wayside garage to fill up with petrol, and while this was being done I strolled into the garage to inspect a new battery charger which had been placed in operation. When the owner became aware of my identity he showed me a bakelite accumulator which had been sent round by a radio fan for charging. It was not marked with a positive or negative terminal, but was one of those which at some time had been painted with red and blue on the respective terminals. He was in a quandary to know which was the right terminal for connecting up. I have known cases where the screw top has been painted only, and owing to carelessness they have been changed round and the battery ruined by charging the wrong way. I explained to him the simplest way out of the difficulty was to dissolve a small amount of salt in a tumbler of water and drop two wire leads into the solution. The wire giving off the most bubbles is the negative. It could, of course, easily have been proved with the voltmeter, but it only goes to show how ignorant one can be in charge of a battery charging station, and many batteries are spoiled by carelessly charging a battery the wrong way round.

THE THERMAL DELAY SWITCH

A Practical Article Describing the Use and Construction of this Ingenious Component

By H. G. SLADE

THERE must be a large number of amateurs who are using mains sets which incorporate H.T. eliminators built by themselves. Most types of rectifier, more especially the metal type, have a volts-milliamps curve with a very steep slope; meaning that at low outputs, the voltage rises to a dangerously high level. It also means that a slight rise or fall in output, causes large fluctuations of the H.T. voltage applied to the set. This is why an ordinary eliminator is useless for Class "B." amplification, unless fitted with some stabilising device, which may take the form of a Neon Tube, or a comparatively low by-pass resistance in parallel with the eliminator output. A glance at Fig. 1 will show how, while the cathodes of the valves are heating up and anode current is very slight, the voltage is well above 500, and does not drop to the correct level until the cathodes have reached their working temperature, and the full anode current is taken. As the valves take about half a minute to get properly into their stride, it means that unless some precaution is taken, this high voltage is applied to the set for this length of time. This is quite a happy state of affairs, provided that all the condensers, smoothing and decoupling, in the set, are rated *to work* slightly above the highest peak voltage likely to be developed, and tested to at least twice this peak voltage.

Decoupling condensers have to be included, because, although apparently safeguarded by a resistance between them and the eliminator, when there is no plate current flowing, there can be no voltage drop across the resistance, and so the full peak voltage is applied to them just the same.

As high test voltage condensers are rather an expensive proposition many amateurs try to make use of any they have on hand, although of nondescript rating, only to be let down, perhaps after quite a long time, when one of them breaks down. This state of affairs is usually the cause of very poor volume, or complete cessation of signals, not to mention the fact that a broken down condenser is one of the last things that occurs to the average amateur when looking for faults, besides taking a long time to locate.

Provided that the condensers are rated to work at, or slightly above, the normal plate voltage of the set, they can be successfully used, if a delay switch of some sort is incorporated in the set or eliminator, which does not come into action until the valves have had time to reach their normal working temperature. Such a switch can easily be made by anyone who can use a few ordinary tools, thus guarding against any further trouble from punctured condensers.

The best type of switch is one that is worked by the application of heat obtained from a small resistance winding fed from the low tension secondary of the mains transformer. One commercial form of this switch is at a first glance somewhat similar to an ordinary valve and consumes usually one ampere at four volts. The switch about to be described will work perfectly whilst using half an ampere, or even less, as the resistance element does not need to attain a red heat, a warmth just too hot to hold in the hand being sufficient. A lighted cigarette held half an inch below the switch very easily works it.

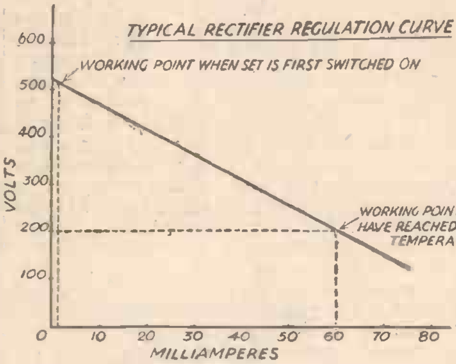
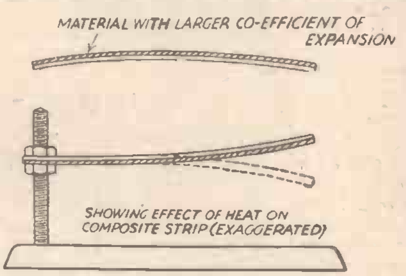


Fig. 1.—Typical rectifier regulation curve

Working Principles

The actual working portion of the switch, and the most important part, is a combination strip of two different materials which are firmly rivetted together so that at ordinary temperatures the strip is quite flat, and, under the influence of heat, the two parts of it expand at widely differing rates, so that one becomes longer than the other. As the two strips are rivetted together the result is that the combined strip shapes itself into an arc, with the material which has expanded the most on the outside as in Fig. 2. If, then, we secure one end of the strip and apply the heat, the free end will move through a certain distance, depending on the coefficients of expansion of the two materials, the length of strip, and the amount of heat applied. (See Fig. 3).



Figs. 2 and 3.—Showing the effect of heat on the composite strip

The time the strip takes to move a certain distance will depend on the proximity of the source of heat to the strip, besides the mass of the strip.

Constructional Details

Before going any further it would be as well to give the material of which the strip is constructed. If one looks through a table which gives comparative expansions of different materials through the same rise in temperature, our old friend ebonite stands distinctly in a class by itself. It has nearly four times the expansion of any other substance for the same increase in temperature, so obviously it becomes one of the components of our strip. For the other we can use almost any metal, because compared with ebonite they are all more or less the same. Quite good results will be obtained if ordinary tinned iron, such as fruit cans are made of, is used. The correct thickness will be obtained if it can just comfortably be cut with a large pair of scissors, and should be about 24.B.W.G. or 25-1,000ths of an inch thick. Brass or copper may be used, but best results will be obtained if ordinary tinned iron, which most people know as tin, is made use of. The ebonite strip should be about 1-32nd thick. If none is available, ⅛th ebonite can easily be filed down to this thickness with a sharp file Both strips are 3in. long and ⅜in. wide, and are drilled in five places along the centre line whilst clamped together, using a 1-16in. drill. Five small brass tacks are then obtained to be used as rivets, and are cut off slightly longer than the combined thicknesses of the strips. These are then rivetted together with the heads of the rivets on the ebonite side, care being taken not to hammer hard enough to split or crack the ebonite. When rivetted the strip can be cleaned up to size, and a clearance hole drilled at one end for a 2 or 4 B.A. rod, whichever is the handiest. A pair of old contacts from a bell or buzzer will be required, and one of these should then be soldered to the metal side of the strip at the opposite end to the hole for the securing rod (See Fig. 4). A piece of 2 or 4 B.A. rod, about 2in. long is then required. The end of this piece of rod should be filed flat, and soldered to a small strip of brass or copper with a hole in one end, so that it can be fixed under a terminal on an ebonite base.

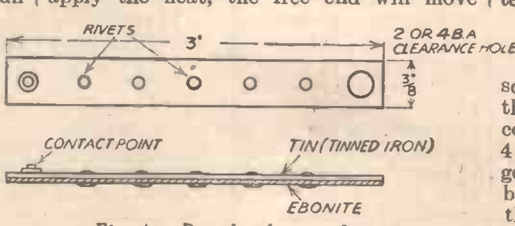


Fig. 4.—Details of expanding strip

The other contact is made from a piece of brass ⅜in. wide by 2¼in. long. A hole is drilled to clear a 4 B.A. screw ¼in. from one end. A 4 B.A. nut is then soldered over this hole and the other contact point is soldered to the point of the 4 B.A. screw. This strip is then drilled to go over the terminal shank on the baseboard and bent as shown in Fig. 5, the 4 B.A. screw being replaced in its

(Continued on page 576)

(Continued from page 574)

nut after a thin checknut is first screwed on to it. The heater or warming element is wound on a piece of 1-32nd mica ⅜in. wide, and 2¼in. long, two small holes for securing it being made in the ends. It is secured to two small wooden blocks which are in turn secured to the base. The winding consists of 43 turns of No. 32 s.w.g. Eureka resistance wire, having a total length of one yard, and a resistance of approximately 8 ohms. If the turns are spaced about 1-32in. apart there will be plenty of room, so the winding should be commenced at about ⅜in. from one end. Larger or smaller gauges of Eureka wire may be used but the length should be varied to keep the resistance at 8 ohms. The necessary lengths may easily be worked out from P.W. Data sheets, as the resistance is known.

The heating effect of this element can be varied by using more or less wire, as it depends solely on the current squared multiplied by the resistance, *i.e.*, if the resistance is reduced the current increases as does the heating effect, and *vice versa*. The base, which does not need describing in detail, can easily be made from Fig. 5. It is made from ¼in. ebonite. When all the parts are assembled on the base, the contact screw A (Fig. 5.) should be run right back, and the nuts securing the expanding strip run up so that the strip comes almost under the bracket B on the opposite side, *i.e.*, in its furthest possible position from the heater, and then tightened up. The screw A should then be adjusted clear of the contact on the strip by about the thickness of a piece of writing paper, and checked tight in that position.

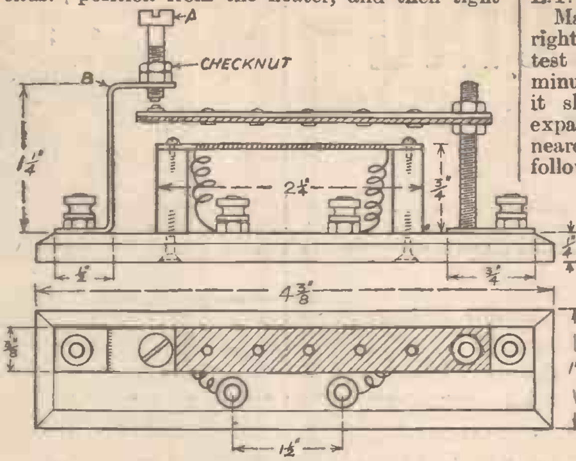


Fig. 5.—Elevation and plan of the complete thermal delay switch

One lead of the H.T. secondary winding of the mains transformer should then be broken, and the two end terminals of the switch wired in series with it. The heater terminals should be wired across the 4 volt L.T. secondary of the transformer.

Make sure that these connections are right before switching on. At the first test the switch may take as much as five minutes before it comes into action, but it should be adjusted by bringing the expanding strip down the screwed rod nearer to the heater, remembering to follow up with the screw A, and resetting it each time.

It will be found that if the expanding strip almost touches the heater the switch will operate in about 10 secs. It should, however, make contact in 30 to 35 secs. to be quite sure that the valves have had time to get properly warm.

As an alternative connection scheme for those whose eliminators are awkward to get at, the heater can be wired across the heater terminals of a valve-holder in the set, and the switch wired between the H.T. input point to the set, and the main H.T. plus lead from the eliminator.

As a final word, do not forget that the switch will give one a nasty kick if touched with the set switched on.

A NOVEL AERIAL MAST

(Continued from page 559)

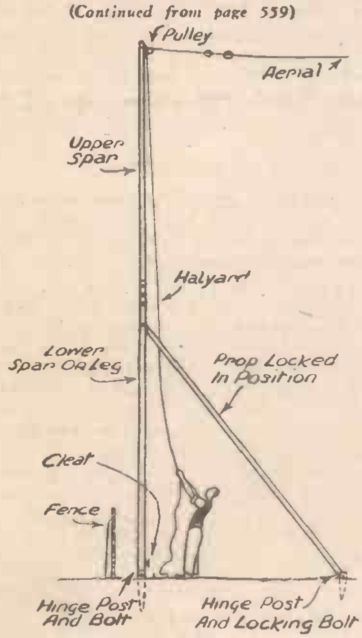


Fig. 5.—Mast now vertical and prop locked in position.

farther, don't forget to fix the usual pulley to the top for your halyard and aerial.

Erecting the Mast

Swing the loose end of the prop over so that it lies alongside the top of the mast, and push the whole thing into position so that the bottom of the legs is at the place where the mast is to stand.

Drill a ½in. hole in one end of each of the four 2ft. pieces of 3in. by 1in. wood about 3in. from the end, and cut the other end to a point to facilitate driving into the ground. Drive one of these pieces into the ground alongside, and close to each of the mast's feet and bolt the ends to the feet, using 5in. bolts, and drawing up not too tightly.

Now go to the other end of the mast as it lies on the ground and raise it as far as possible, then grasp the prop which is trailing on the ground, and walk forward with this in your grasp till the mast is vertical. Place the end of the prop on the ground and drive in the remaining two "pegs" of 3in. by 1in. (previously pointed and drilled exactly like the other two), into the ground close to each side. Pass the last of the 5in. bolts through, not forgetting washers, and lock the three pieces together with the nut. Lastly tighten up the two bolts, holding the feet of the mast, and you will have an anchorage which will stand firmly in all weathers. Affix a cleat or large nail at a suitable height anywhere on the frame, and tie off your halyard.

The whole structure may, of course, be painted to suit individual choice, though the writer finds a good soaking in creosote as good as anything else, for it imparts a decent colour to the wood and definitely protects it from decay. It is a good idea to give all the metal parts a heavy coat of axle grease or tallow before erection as this will prevent rust getting into them.

Should any difficulty be experienced in obtaining the two pieces of iron pipe, as specified in the table of materials, the spacing of the pivot bolt can be made up by using an adequate number of ⅝in. iron iron washers, but the pipe pieces are usually quite easily procurable, and make a better job.

Great Britain Telephones to Central America

A PUBLIC radio telephone service is now available between the United Kingdom and Costa Rica (Guatemala, Nicaragua, Republic of Panama, and the Canal Zone). A three-minute call costs £7 16s. 0d. !

DISTORTION

(Continued from page 569)

if a suitable component is not available, to "short-circuit" it with a piece of moistened paper, which will act as a temporary resistance.

The L.F. Stages

Should the fault definitely be traced to the L.F. amplifier it will most probably occur in the transformer or valve(s). A small low-priced transformer will frequently distort horribly if a current in excess of 1 milliamp or so is passed through its primary winding. The obvious cure for that fault is to buy a better transformer, but a cheaper, and often equally good, remedy is to resistance-feed the transformer in the manner frequently described in PRACTICAL WIRELESS, and illustrated again in Fig. 3.

L.F. Oscillation

When two transformers are used, distortion is very commonly produced by feed-back or low-frequency oscillation. This can be minimized by altering the position of one transformer or by reversing the connections to the secondary terminals. With modern high-efficiency valves, however, it is seldom wise to employ two transformer coupled stages and reproduction can often be improved by changing the first to choke-capacity coupling. It is not necessary to buy a new choke for the purpose since the primary or secondary winding of the transformer can be used instead. (Incidentally, the secondary winding of a burnt-out transformer will serve perfectly well.) The only new parts required are a .005 mfd. fixed condenser a .5 megohm grid leak. All connections are clearly shown in Fig. 4.

The Beginner's Supplement

THE EASY ROAD TO RADIO

Conducted by F. J. CAMM

Log-law Condenser (*continued*)
The logarithmic condenser by giving only a small increase in capacity for each degree of movement at the lower end and a large increase at the upper end tends to level up matters.

The logarithmic condenser is one of three types which all aim at this idea of equal station separation. They are the *Straight Line Wavelength* condenser (square law), the *Straight Line Frequency* (S.L.F.), and the *Logarithmic* (log-law). With the first one stations separated equally as regards their wavelength, as for example: 300 metres, 310 metres, 320 metres and so on, will come in at equal intervals on the dial. The second type, the S.L.F., is designed to give the same effect when stations are separated equally as regards frequency, while the logarithmic is something of a cross between the other two types. For ganging purposes the logarithmic has certain advantages over the other types. For an explanation of the difference between frequency and wavelength, see under those headings. See also *CONDENSER.*

Loop Aerial
Another term for *frame aerial.*

Loose Coupling
See *COUPLING.*

Loud-speaker
There are three main types of loud-speaker. They are the *Moving Iron*, the *Moving Coil*, and the *Electrostatic*. In the first type a piece of iron called the armature is attracted and repelled by means of a magnet around which is wound a coil of wire. The current from the last valve in the receiver is fed through this coil. Fluctuations in this current due to the speech or music being received cause variations in the attraction of the magnet and so the iron armature moves backward and forward.

In the second type a small coil is suspended between the poles of a powerful magnet. The current is fed to the coil and every variation causes the coil to move backwards and forwards. In the electrostatic type of speaker, of which there are at present very few examples on the market, the elements consist of two thin corrugated metal plates one foot or more square. These are placed close together and form the plates of a condenser. The output from the set is connected to these two plates and every variation in the voltage causes them to attract or repel one another. This movement of the plates causes the sound.

In the moving iron and moving-coil types the sound is produced by attaching

THE BEGINNER'S A B C OF WIRELESS TERMS
(Continued from June 24th issue, page 491.)

the iron armature or the coil to a light metal diaphragm or to a cone of some light, stiff material such as impregnated paper. The vibrations of the diaphragm or cone caused by the backward and forward movement of the armature or coil produce corresponding vibrations in the surrounding air. These vibrations or waves in the air are, of course, sound waves and travel out in all directions. In the horn type of speaker a small diaphragm is used and the waves from it are concentrated in one direction by means of the horn.

Although most moving-coil speakers are similar in construction, there are at least three distinct types of moving iron speakers. They are the simple single-pole type just described, the *balanced armature* which usually has a four-pole magnet, and the *inductor dynamic*, which is the most advanced type.

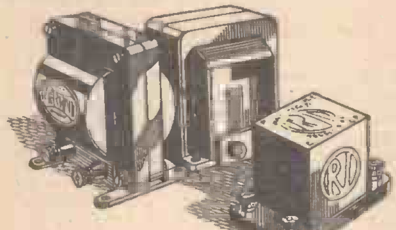


Fig. 1.—Three typical low-frequency transformers.

Low-frequency
THIS term, when applied to an electric current, wave motion, etc., means that it oscillates or vibrates at any speed from about 30 to 10,000 times per second. Above this rate the term "high-frequency" is used. See *AUDIO-FREQUENCY* and *CYCLE.*

Low-frequency Transformer
A transformer for use in some part of the low-frequency circuit of a wireless set. Usually the term is used only in reference to intervalve transformers, but output transformers and loud-speaker transformers are all low-frequency transformers, since they deal with low-frequency currents. A low-frequency transformer consists essentially of an iron or iron alloy core around which is wound two separate coils of insulated wire. These coils often contain thousands of turns of very fine wire, and the proportion of the turns in the two coils determines the characteristics of the transformer. For instance, if one coil has twice as many turns as the other then on passing an alternating current through the smaller coil a similar current will be induced in the secondary coil which has *twice* the voltage. The transformer may be said to have "transformed" a low voltage to a higher one. In a receiver a low-frequency or "L.F." transformer is frequently used to increase the voltage of the output current of a valve before it is fed to the next valve. In this way greater magnification of the signals is obtained than would be the case if the two valves were merely connected together by means of a resistance or a choke. Three different makes of transformer are illustrated in Fig. 1. The iron core and the coils are all enclosed in a metal or bakelite case for protection against damp and dust. See also *AUDIO-FREQUENCY TRANSFORMER*, etc.

Low-tension Battery
The battery, usually an accumulator, which is used in a battery receiver to heat the filaments of the valves. The heated filament gives off a stream of electrons on which the action of the valve depends. In a mains set a low-tension battery is not needed, since the necessary current is obtained from the mains by means of a transformer.

Most battery valves require a pressure of two volts to heat their filaments to the correct temperature, therefore a single 2-volt accumulator has become recognised as the standard type of low-tension battery. Actually, of course, it is not a "battery," but only a "cell." At least two cells are required to form a battery.

L.T.
Abbreviation for *low-tension.*

(Continued overleaf)

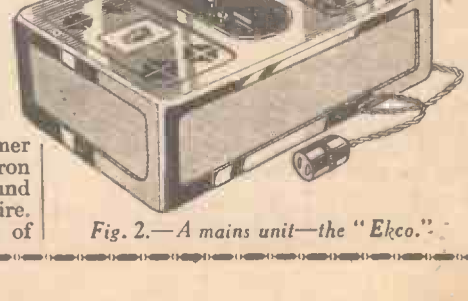


Fig. 2.—A mains unit—the "Ekco."

(Continued from previous page)

Mains Unit

A device for supplying the current required by a wireless set from the electric light mains, thus obviating the use of batteries. Mains units can be obtained for supplying the high-tension current, the low-tension, or the grid bias, or all three.

A mains unit always contains some device for smoothing the current before it is supplied to the set. This usually consists of L.F. chokes and fixed con-

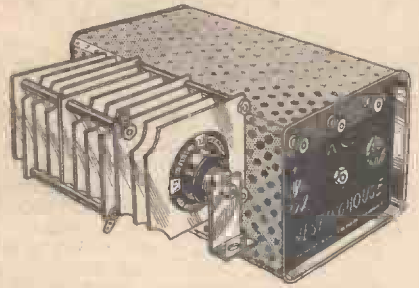


Fig. 3.—Two examples of metal rectifiers. The rear one is enclosed in a perforated iron case.

densers. There is also some means of adjusting the voltage of the output to that required by the valves of the receiver. In the case of alternating current mains there must be a rectifier incorporated as well. Usually all these components are enclosed in a neat metal case. A good example of a mains unit is shown in Fig. 2. It is of such a size and shape that it can be conveniently slipped into the receiver in the place of the H.T. battery.

Megohm

A million ohms

Metal Rectifier

A rectifier is a device for converting alternating current into direct current. A metal rectifier is one which uses plates of two different metals. The plates, which may be of copper coated with copper oxide and lead, are placed in contact with one another so that the copper plates alternate with the lead ones. An electric current will pass easily through this pile of plates in one direction, but not in the other.

The most common use for metal rectifiers in wireless is in the construction of mains units and all-mains sets working from alternating current mains. The mains unit shown in Fig. 2 contains a metal rectifier. In Fig. 3 are shown two typical rectifiers for use in constructing mains equipment. They are similar in construction, except that one is enclosed in a perforated iron case.

A recent development of the metal rectifier is the Westector, a rectifier of small dimensions which is used as a detector, and thus takes the place of a detector valve in a wireless receiver. See also *RECTIFIER, WESTECTOR,* etc.

Microfarad

A millionth part of a farad. The farad, which is the unit of capacity, is too large for most wireless measurements, and so the microfarad is used. The capacity of condensers, that is their ability to store electricity, is, measured in microfarads. See *CAPACITY.*

Milliampere

One thousandth of an ampere.

Modulation

When a broadcasting station is switched on but no music or speech is being transmitted, such as occurs during the intervals between the various items of the programme, wireless waves are being given out which are perfectly regular in form. That is to say, each wave as it leaves the aerial is of the same shape and magnitude as the previous one. As soon as anyone speaks into the microphone, however, the waves being given out alter their shape according to each little inflection of the speaker's voice. This altering of the shape of the transmitted waves is called *modulation.* It is the modulation of the waves which enables us to receive the various sounds on our receiver. Unmodulated waves cause no sound when picked up by a receiver.

Motor-Boating

This is an expression used to describe howling in a receiving set which is of such a low pitch that each separate beat of the note can be distinguished. It may vary from a slow regular "plop, plop, plop" to a throaty "brrr-r-r-r." The trouble is due to instability in the low-frequency part of the receiver circuit, and is often caused by the omission of decoupling devices, or by the use of a mains unit with a receiver of somewhat out-of-date design. Sometimes reversing the leads to the primary of the L.F. transformer (if one is fitted) will effect a cure. Failing this, the circuit must be properly decoupled by using an output filter in the anode circuit of the last valve or by fitting a decoupling condenser and resistance in the plate circuit of the detector valve, or both devices may be necessary.

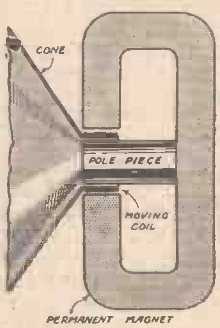


Fig. 4.—Diagram illustrating the construction of a permanent magnet moving-coil speaker.

Moving-coil Speaker

The principle of the moving-coil speaker will be understood by reference to Fig. 4. This is a sectional view of the permanent magnet type. The energized type is similar, except that an electro magnet—that is to say, a piece of soft iron magnetized by means of a coil or wire carrying a current, is used instead of a steel permanent magnet.

The magnet used in the speaker is in the form of a flattened iron ring of rectangular section. In one of the flat faces is a round hole. Through this hole projects a round piece of iron which is attached to the other flat face or back of the magnet. This round piece of iron forms one pole of the magnet, and the inside of the hole the other. As the centre pole is smaller in diameter than the hole through which it passes, it leaves a circular space between the two. It is in this space that the moving coil is placed. In this position it is in a very intense part of the magnetic field. The coil itself is wound with aluminium wire (for lightness) on a very light cylindrical former. The former is attached at one end to the cone. Wires from the receiving set are connected to the coil. Current from the set passing through it makes the coil move across the magnetic field, that is in or out, piston fashion, between the magnet poles. Every fluctuation in the current from the receiver caused by the items being received produces varying backwards and forwards motions of the coil. This in turn moves the cone and creates sound waves. See *LOUD-SPEAKER.*

Mutual Conductance

The efficiency of a receiving valve is largely dependent on the ratio of the change in anode current to the change in grid voltage. This ratio is called the *mutual conductance* of the valve and is given in milliamps per volt. It may vary in different valves from about 1 mA./volts to 4 mA./volts. A valve with as high a mutual conductance as 4 mA./volts would give exceptional amplification when used in a suitable circuit.

If a valve has a high mutual conductance figure it means that quite feeble variations in the voltage of the current fed to the valve will produce comparatively large fluctuations in the output current. In other words, feeble signals will be magnified on passing through the valve and thus become very much stronger. See also *AMPLIFICATION FACTOR.*

Neon Lamp

A well-known type of neon lamp is illustrated in Fig. 5. In size and shape it is similar to an ordinary electric bulb, but instead of containing a filament, the two connections from the contacts on the cap are taken to two metal electrodes. One of these electrodes is a little metal disc about the size of a halfpenny, while the other is a spiral of wire shaped something like the old-fashioned type of beehive. The two electrodes do not touch one another. The air is expelled from the bulb and it is filled with neon gas.

When a neon lamp is connected to an H.T. battery or to the mains the electrodes glow a peculiar yellowish-orange colour. In wireless a neon lamp has certain uses in transmitting circuits and as a visual indicator in some types of wavemeter. Its chief use for the amateur is as a circuit tester. For this purpose the lamp is connected in series with a battery or the mains and two testing prods. Naturally, when the prods are connected together the circuit is completed and the lamp glows. If, however, the prods are connected to two points which should be insulated from one another, the lamp will provide a searching test of the insulation. A leakage will cause it to light up and go out again at regular intervals. The shorter the time is between each flash the greater is the leakage. With a very high resistance between the prods, there may be several minutes between each flash.

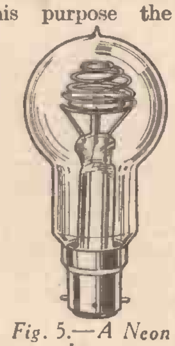


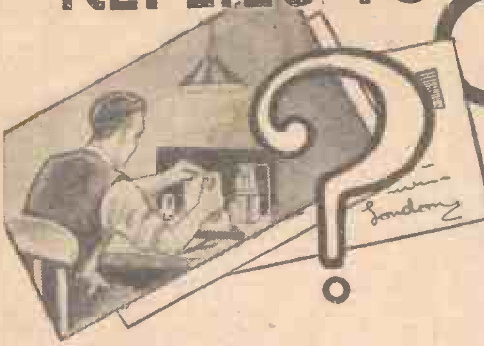
Fig. 5.—A Neon lamp.

PAGE MISSING

PAGE MISSING

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff



The coupon on this page must be attached to every query.

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent 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.

SPECIAL NOTE

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.

(2) Suggest alterations or modifications of receivers described in our contemporaries.

(3) Suggest alterations or modifications to commercial receivers.

(4) Answer queries over the telephone.

Please note also, that all sketches and drawings which are sent to us, should bear the name and address of the sender.

MAINS HUM

"Could you explain how I can stop the hum I get on my set which is worked from a D.C. mains unit. The set functions perfectly in the house next door, but immediately it is brought into my own house the hum becomes troublesome. I am told that the houses are wired up in pairs and as I am on the negative main this is the cause of my trouble. Is this so?"—R. K. (Leyton.)

Most D.C. supplies are taken on a three-wire system, of which the centre wire is earthed and connections to alternate houses are taken from the earthed "neutral" and from one of the outside wires. Thus in one house the negative main is earthed, whilst in the next it is the positive which is earth connected. When the positive is earthed the negative is "live" and must consequently be thoroughly insulated from any earthed object. This probably explains your difficulty, since being on the negative side it will be necessary to connect your earth lead to the set through a large capacity, say 2 mfd., condenser. It would also be desirable to insert a fixed condenser in series with the aerial lead-in, if this is not already included, in order to prevent the possibility of a short due to the aerial touching any earthed object, and also as a safeguard against receiving a shock while operating the set. If you find that the hum still remains after attending to the two latter points it will be evident that it is being caused by roughness in the mains supply, or by the presence of high-frequency currents set up by a machine connected to your side of the mains. In that case it might be best to call in an engineer from the electric power company, but you might try the effect of connecting a high-frequency choke in series with the negative mains lead.

PREVENTING INTERFERENCE

"I found the other evening on switching on my set that an interfering station could be heard all round the dial. Suspecting that the aerial tuning coil might be wrong I fitted a new one, but without result. It was eventually found that the station which I could hear was the one which my nextdoor neighbour was listening to. I tried removing my aerial connection, but the interference was still there, although not quite so loud. Can you please tell me how I can get over my difficulty?"—L. S. B. (Eastbourne.)

From your description it is perfectly clear that the interference is caused by your neighbour's set and we are inclined to think that it is due to oscillation. If the set were a superheterodyne of rather old-fashioned design the trouble would be quite understandable, but you do not give any details on this point. You might be able to effect a cure by screening your tuning coil, but it would be better if your neighbour also did the same, or otherwise modified his receiver. There is another aspect of the case which would apply if both sets were driven from the D.C. mains, because it would then be an easy matter for the interference to be transmitted via the mains leads. The trouble could then effectively be prevented by connecting high-frequency chokes between the mains and your set. Whatever is the cause of your difficulty it would be made worse if the earth lead were poor, so it is suggested that this item should receive careful attention before proceeding farther.

AN ELUSIVE FAULT

"I have a cabinet A.C. receiver, which has suddenly started to play some peculiar tricks. After the set has been on for some time the volume suddenly becomes so much reduced that signals only are just audible. Sometimes if the set is left switched on it will right itself without anything being touched. What do you think is wrong?"—H. J. N. (Newcastle-on-Tyne.)

Your experience seems to point to a loose connection or some similar fault. Very probably one of the valves is making intermittent contact in its holder or perhaps a feed resistance has developed a partial open circuit. The only sure way of tracking down the trouble is by a systematic test, but a start can be made on the components just referred to.

DATA SHEET No. 43

Cut this out each week and paste it in a Note-book.

WEIGHT OF METALS COMPARED WITH WATER.

Water weighs	62.3	lbs.	per	cu. ft.	0.036	lbs.	per	cu. in.
Aluminium	„ 160	„	„	„	0.092	„	„	„
Iron	„ 480	„	„	„	0.263	„	„	„
Brass	„ 510	„	„	„	0.295	„	„	„
Copper	„ 550	„	„	„	0.320	„	„	„
Silver	„ 657	„	„	„	0.380	„	„	„
Lead	„ 710	„	„	„	0.411	„	„	„
Gold	„ 1200	„	„	„	0.700	„	„	„

CIRCUITS WANTED

"I should like to know whether you have any blue-prints of an R.C. coupled set, and one using two transformers, both of which would work from eliminators. I have seen your list of blue-prints, but there is no mention of the R.C. stages or the transformers."—(W. O., Standlois, Mont.)

Several blue-prints are obtainable using the methods of L.F. coupling you refer to. The *Hobbies* Three employs two transformers and a special commercial tuner and the Autokoil Reinartz is a similar type of circuit, but employs a different make of tuner. The Straight Three employs plug-in coils and has one resistance stage and one transformer stage. These blue-prints are obtainable at 1s. each from these offices.

NEIGHBOUR AND INTERACTION

Most evenings I find on switching on my set I can hear a station right round the dial on both wave-lengths. I suspected the coil and have changed it, but to no purpose. I have since found that the station I was getting was the same as my neighbour was tuned to. I removed the aerial, but that did not improve matters. Regionals or foreigners, whatever they happen to be receiving, all come in on my set. When my neighbour shuts off her set my trouble ceases."—(C. F. C., Southampton.)

The interference of which you complain is probably aggravated by the fact that your aerial coil, and also that in your neighbour's set is unscreened. Try the effect of screening the tuning coil, and make quite certain that your earth is damp and of low-resistance. Make certain also that your aerial runs as far away from, and at as great an angle to, your neighbour's aerial as possible.

HUM AGAIN

"I am at a loss to cure the hum which has arisen in my set. I have built a three-valve A.C. mains set and mounted all the parts on a neat, thin baseboard. Every part and every connection has been traced as correct and sound, and yet I cannot listen owing to the loud hum. I have read your previous articles on the subject and made all the usual tests. But I cannot trace the cause. You may take it that all heaters are accurately earthed at the centre tap, and all cathodes are correctly connected. Can you offer any explanation?"—(T. H., Bromley.)

There are, of course, various small isolated points which can be responsible for hum, and a book could be written giving these. Generally, however, the points which have been given in our various articles are sufficient to enable hum to be traced. You say you have been all through these and yet the hum persists. Can you examine the following point. You say that the set is built on a neat, THIN baseboard. If the laminations in the transformer or smoothing choke are slightly loose, the vibrations may be transmitted to the valves via the valveholders, so remove the fixing screws of these parts in turn and hold them off the baseboard. You may find that this will effect a cure.

WEAK OUTPUT

"I have made up an amplifier to work from a gramophone, using a Pentode which the makers state gives a 2 watt output. I have carefully checked connections, but cannot get enough volume. I should say it is not 1 watt. The valve has been tested and is O.K., and all the voltages are checked and proved correct. The anode current of the Pentode has also been measured and is right. Can you offer a suggestion as to the lack of volume?"—(W. L., Glasgow.)

The valve will, of course, only give the 2 watt output when fully loaded, and if you are using the Pentode only, you are obviously not loading it from your pick-up. If, however, you have some step-up between pick-up and pentode which fully loads it, and still fail to get the maximum output, the reason is to be found in the incorrect matching of your output load. The maximum undistorted output from a valve is only obtained when the optimum load is employed. This figure should be given on the pamphlet accompanying the valve, and you should verify this.

ANODE CURRENT

"I recently bought a small meter and have been checking over my set. I found all voltages as they should be, but am rather puzzled at one point. I cannot get any voltage in the anode of the detector valve. The set works perfectly, and therefore the valve apparently must work. Why cannot I measure any voltage there?"—(G. T., Northampton.)

If the valve is working on the anode-bend principle, you are probably using a very high value of anode resistance, and resistance-capacity coupling the valve to the following one. Your meter is no doubt of the cheap moving-iron type, and you have no doubt simply connected it from earth to anode. As the value of the anode resistance is much greater than your cheap meter, the movement of the needle on the latter is too small to be noticed. If you can get hold of a good moving-coil meter you will no doubt find that quite a substantial voltage can be read across the point in question.

SHOCKS FROM 'PHONES

"I have made up a one-valve set, using a metallised general purpose valve. When I was testing out, I did not get any signals at first, and was testing different parts of the set. When I touched the valve to make certain it was firm in its socket I got a nasty shock. Can you say what is wrong? The set works all right now."—(Y. S. C., Leeds.)

You say it is a one-valver, and we therefore assume you were using headphones. These are joined in the positive high-tension lead, and the metal coating of the valve is joined to the earth line, which is H.T. negative. Any small lack of adequate insulation on the headphones would result in your head receiving contact from H.T. positive, and obviously when you touched the covering of the valve (in other words H.T. negative) you completed the short-circuit of the H.T. battery through your body. Examine the 'phones and see if any metal is bared and making contact with the leads.

FREE ADVICE BUREAU

COUPON

This coupon is available until July 22nd, 1933, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 15/7/33.

Catalogues Received

REVIEWED BY AJAX

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. Where advertisers make a charge, or require postage, this should be enclosed with applications for catalogues. No other correspondence whatsoever should be enclosed.

WEARITE COMPONENTS

THE new Wearite Class B components are fully described in their new pamphlet, reference C.B. 2263. In addition to a fairly complete description of the principle of amplification bearing the name Class B, circuits, an oscillogram, and a table enable the reader to obtain a clear understanding of the circuits and the Wearite components which are manufactured for use in such arrangements. These range from a Junior Driver Transformer at 8s. 6d., to a Senior Model at 13s. 6d. The new season's productions are described in a further folder, which includes all the more important Wearite components. Amongst these may be cited the Nucleon coils (the new iron-core tuning inductances), switches, rheostats, mains transformers, chokes, Paxolin formers, whistle filters, etc. The folders may be obtained on application to Messrs. Wright & Weaire, Ltd., 740, High Road, Tottenham, N. 17.

EDISWAN H.T. BATTERIES

USEFUL information concerning the Ediswan H.T. and grid-bias batteries is given in a neat booklet issued by the Edison Swan Electric Co., Ltd. Users of these batteries who wish to know how to obtain the maximum length of life from them, together with the highest quality of reproduction from their sets, will find the information in this booklet, which also contains a handy two-page chart for logging stations.

IGRANIC PRODUCTS

IN an attractive booklet issued by Igranic Electric Co., Ltd., a full range of their well known components is listed. Amongst the various items shown are plug-in short wave coils, H.F. chokes, fixed and variable condensers, slow motion dials, L.F. transformers, mains transformers, potentiometers, and a series of push-pull and other switches. For radiogram work there is also the "Igranovox" pick-up and a response corrector, which is designed to afford the requisite compensation for the deficiencies of the record at the lower frequencies. Constructors who look for high-class workmanship in their components would do well to obtain a copy of this booklet. The address is 149, Queen Victoria Street, London, E.C.

Replies to Broadcast Queries

C. SMITH (Gravesend): Regret, cannot trace G6XY in published lists; write to Radio Society of Great Britain, 53, Victoria Street, S.W.1. PURPLEMIST (Manchester); G2XL, Capt. E. S. Davis, 12, Hyde Park Pl., London, W.2; G6RK, R. E. Summerfield, 1, Newhall Street, Birmingham; cannot trace G6AS, G2HL, GB?X; cannot trace 2AOC, but undoubtedly an experimental "artificial aerial station." E. A. HARDWICK (Somerset): G5TX is the Portable call of G5TZ, W. G. Sherratt, 11, Bath Road, Cowes (I.O.W.); G6QH, J. Tamblyn, Barkla Shop, St. Agnes (Cornwall); G5YJ, Maj. W. H. Oates, 195, Hammersmith Road, Hammersmith, London, W.6; G5RJ, W. G. Rose, 14, Park Way, Raynes Park, London, S.W.20; G6RL, R. F. Loomes, 14, Nursery Close, Wickham Road, Shirley, Croydon (Surrey). G2WP, P. L. Waters, 18, Park Road, Whalley Range, Manchester; G6FN, S. A. French, "Valetta," Alnwickhill Road, Liberton, Midlothian (Scotland); G6KZ, W. McKenzie, 183, Great Junction St., Leith, Edinburgh (Scotland); G5QB, E. J. Reid, 120, Mill Lane, Kilburn, London, N.W.6; regret, cannot trace the following call-signs in latest published lists: G2HN, G2AB, G5NO, G6JC, G5RD, G6QS, G5MM, G6KB, G5PE, and G6GY. For Hungary, write to Kurt, Nekolny, Hungarian Short-wave Amateur Society, 1, Zirzen Janka utca 14/b, Budapest; for Poland, L.K.K. Bielowskiego 6, Lwow, Poland; for Switzerland, USKA-QSL Service, Postfach Zurich 22, Switzerland; for Czechoslovakia, C.A.V., Box 69, Praha 11, Czechoslovakia; for Portugal, *Rede dos Emissores Portugueses*, Rua Primeiro de Dezembro 33-3, Lisbon, Portugal; for Italy, *Associazione Radiotecnica* Italiana, Viale Bianca Maria 24, Milano, Italy; for Germany, D.A.S.D., Blumenthalstrasse 19, Berlin W 57, Germany; for Luxembourg, Jean M. Fontaine, 13, Rue Joseph 11, Luxembourg. PURPLEMIST (Manchester): G5QY, H. C. D. Hornsby, 7, Lansdowne Terrace, Gosforth, Newcastle; G2RA, F. F. Warner, 220, Folly Lane, Swinton, Manchester.

STOP PRESS NEWS!

Interesting items relating to the latest developments announced as we go to press. Where desirable further details will be given later.

NEW COSSOR VALVES

TWO new Cossor Valves are now ready for distribution. These are both Mains valves and are a Variable Mu Pentode, type MVS/PEN, and an H.F. Pentode, type MS/PEN. Both are fitted with a seven-pin base with the suppressor grid and the metallised coatings brought out to separate pins.

NEW COLUMBIA PICK-UP

THE latest Pick-up from the Columbia factory is fitted with a hum-bucking coil, enabling it to be used with synchronous driven turntables. Thus is another improvement in the design of pick-ups brought into effect. In addition to this feature there are several important improvements, and these will be fully described in a complete test report to be published shortly.

ADVERTISEMENT INDEX

P. W. Gift Stamp No. 42

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CUTTING OUT STATICS!

Practical Wireless

3D.

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AUTHORITATIVE — PRACTICAL — UP-TO-THE-MINUTE — FIRST!

Practical Wireless

EDITOR:
Vol. II. No. 44 || F. J. CAMM || July 22nd, 1933
Technical Staff:
H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.M.I.E.E.
W. J. Delaney, Frank Preston, F.R.A., W. B. Richardson

ROUND *the* WORLD *of* WIRELESS

Anti-Fading Aerial Towers

RESULTS obtained with the specially designed aerial tower used by the Breslau high-power station having proved so satisfactory, German engineers have decided to equip the Frankfurt-am-Main and Leipzig transmitters with one of the same type. Over a test lasting several months it has been found that the system employed greatly increases the range of the broadcasts, and that they have been subject to less fading than with aerials of a somewhat older construction.

Holland's New High-Power Station

MANY listeners have reported reception of tests recently made on 1,875 m. by a 50 kilowatt station situated at Kootwijk, near The Hague, and it was presumed that the transmitter was to be placed by the Dutch authorities at the disposal of whichever organization would be using the wavelength on July 1st. It is now stated that although negotiations are proceeding between the A.V.R.O. and the Administration of Posts and Telegraphs, so far no definite agreement has been concluded for the loan of the plant.

Experimental broadcasts from this station will also be carried out shortly on 296 m.; they will be made in the later evening hours at the conclusion of the day's programme.

Another Military Tattoo

THE sound portions of the Tattoo to be held at Tidworth on August 5th will be broadcast in the National programme. The display is on a large scale and only ranks second to that recently given at the Rushmoor Arena at Aldershot.

When Greek Meets Greek

APPARENTLY, to-day, when two Greeks meet, the conversation soon turns to the necessity of a broadcasting system in that country. The Lucerne Plan provides a shared wavelength (499.2 m.) for Athens, one for Salonica (373.1 m.), and another for Southern Greece (233.5 m.), yet for the moment there are but few signs of any move being made by the Government in the matter of the construction of stations. A small transmitter was erected a year ago by a group of amateurs at Salonica, but its broadcasts have not been of a regular nature. An attempt is now to be made to induce the authorities to provide capital for the installation of a 20 kilowatt transmitter in or near that city, or alternately, to grant a concession to a native or foreign company to erect and operate such a station. The actual power of 20 kilowatts is limited to that channel by the Lucerne conference.

SERVICE!

Every PRACTICAL WIRELESS RECEIVER is made only from parts which are available to the public. Only those parts actually used by our designers are specified—no alternatives!

Every PRACTICAL WIRELESS RECEIVER is *Guaranteed* to give the results we claim under a Free Advice Guarantee.

All readers' queries are accurately and helpfully answered FREE OF CHARGE, and without onerous restrictions!

Because of the unparalleled reader service we render, PRACTICAL WIRELESS has become the **LEADING CONSTRUCTORS' WEEKLY**

New Relay for Dublin Listeners

FOR the benefit of owners of crystal sets residing in the Dublin area, the old 1 kilowatt station has again been brought into operation. It relays throughout the day and evening the Athlone broadcasts on 217.1 m. (1,382 kilocycles). It is not expected that any alteration will be needed in the Cork wavelength, as it is anticipated that the separation, namely, 45 kilocycles, will be sufficient to prevent mutual interference.

A Café Chantant Dance Band

DURING the past year, many famous orchestras, including those of Marek Weber, Dajos Bela, and the Bal Musette, have performed before the B.B.C. microphones. On July 18th, an opportunity will be given of comparing them with a new visiting dance band of the *Café Chantant* variety. Its un-jazzlike rhythms will recall pleasant memories of evenings spent on the "continong."

Vienna's Extra Special Programmes

DURING the period of the music festival, held annually at Salzburg, the Austrian station will relay a number of special operatic performances and orchestral concerts. These will open on Saturday, July 29th (7.0 p.m., B.S.T.), with a broadcast of Beethoven's opera *Fidelio*, conducted by Richard Strauss, sung by an almost all-star cast. Rossini's *Stabat Mater* will be found in the programme advertised for Saturday, August 5th (8.30 p.m.), and on the following evening listeners may hear Gluck's *Orpheus and Eurydice*, for which many well-known continental artists have been engaged. Mozart's *Magic Flute* is down for transmission on Saturday, August 12th (7.0 p.m.), and the same composer's *Cosi Fan Tutte* on August 18th. Finally, in addition to a number of concerts, *Helen of Egypt*, a lesser known work by Richard Strauss, will be relayed at 7.0 p.m. from the Vienna Opera House on August 24th. Although so far unannounced, it is expected that a number of Continental stations will take some of these Austrian programmes. Such an arrangement would prove an excellent alternative for listeners in the British Isles, as long as signals from the Vienna-Bisamberg transmitter remain below par.

Radio Svizzera Italiana

THE new transmitter on the Monte Ceneri, overlooking Lugano, is perhaps the most inaccessible station in the world to visitors. Not only is the broadcasting plant situated on the summit of a high mountain, but, in addition, it is located in a fortified zone to which entrance without special authority is *strictly forbidden.* The studios are in the neighbourhood of Lugano, on the borders of the lake of that name. After having tried various wavelengths, such as 680 and 760 metres, which unfortunately caused interference, the station has now temporarily settled on 1,143 metres.

ROUND the WORLD of WIRELESS (Continued)

This channel will be retained, barring unforeseen eventualities, until January 15th, 1934, when broadcasts are to be made on 257 metres.

Why Germans Give Up Licences

ACCORDING to recent statistics published in Germany, although a number of new licences have been taken out there has been a falling off of subscribers during the past few months. As the Reichsfunk was anxious to ascertain the cause of these cancellations, a special investigating committee was appointed. It was found that of each 100 former licence holders, 4.9 per cent. were frankly dissatisfied with the programmes, 2.6 per cent. maintained that reception in their individual districts was poor, 0.7 per cent. claimed that outside interference marred the wireless entertainments, 41.1 per cent. had to give up listening through adverse financial conditions, and 50.7 per cent., or over one half the total number, put forward vague reasons for dismantling their wireless apparatus. Apparently, the present political character of the programmes does not suit all radio fans, and in view of stringent measures taken against dissentients, the majority was afraid to state the real motive for which licences were not renewed.

Broadcasts from Dutch and Belgian Coasts

NOTWITHSTANDING rumours published in the continental press in regard to the closing down of the Ostend Kursaal, this famous place of entertainment will open again its doors and the Brussels stations will relay its concerts several times weekly. During the summer season, dance music will also be heard from the Knocke-Le Zoute Kursaal, situated somewhat higher up the coast. In the same way musical entertainments given at the Scheveningen Kurhaus, Holland, will be broadcast at regular intervals through the Huizen station on 1,875 metres.

Salvage Ship and Submarine Telephony

THE salvage steamer *Artiglio*, which achieved fame through its recovery of gold ingots from the sunken s.s. *Egypt*, has now added submarine wireless telephony to its diving equipment. A specially constructed bell is lowered from the steamer and contains an observer, who by ordinary telephony and wireless apparatus can communicate simultaneously with both ship and divers at work. This novel observation post is capable of giving valuable information and assists greatly in the search for the treasure. It is reported that an attempt will also be made to film the wreck through the massive glass portholes of the diving bell, in which powerful electric searchlights can be installed.

The Future of Radio Luxembourg

AT the Lucerne Conference five delegates fought hard to secure a longwave channel for the 200 kilowatt super-station, but they failed to secure this greatly coveted privilege. Although Luxembourg refused to sign the agreement the transmitter is expected to give up the 1,191 metre wavelength and work on 240.2 (1,249 kilocycles) after January 15th, 1934. It is unfortunate that the power in that position of the waveband should be limited to 60 kilowatts, as such a restriction completely hampers the organisers who were planning publicity broadcasts throughout Europe.

INTERESTING and TOPICAL PARAGRAPHS

JACK AND "MRS. BARTHOLOMEW."

Jack Hulbert watching Cicely Courtneidge's record of "Mrs. Bartholomew," from her new film "Falling for You," being made in the "His Master's Voice" studios. This record, H.M.V. B 4475, is considered to be one of the best performances this famous broadcasting star has recorded.

SOLVE THIS!

Problem No. 44.

Samuels rebuilt his receiver, using components which had already been in use and which were undoubtedly good. When the new receiver was completed one of the variable condensers was found to be of no use at all. It made no difference to signals when rotated through the complete scale, and yet, from the circuit, it should have been quite critical in its tuning. As already mentioned, all components were in order. What was the cause of the trouble? Three books will be awarded for the first three correct solutions opened. Address your envelopes to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2, and mark your envelopes Problem No. 44. Last date for entry July 24th.

SOLUTION TO PROBLEM No. 43.

Gibson had worked out all the figures correctly, but he had overlooked the transformer losses. The resistance should therefore have been slightly smaller than that which he chose, and consequently there would have been a smaller voltage drop across the mains primary.

The following three readers received books in connection with Problem No. 42 :—

Mr. H. S. Francis, 179, Nelson Street, Norwich; Mr. O. C. Ulthoff, Littlefield, Marlborough; Mr. Theo. Dutton, 7, Brookfield Park, N.W.5.

Germany's Music Censorship

AS only non-Jewish composers of strictly Aryan origin are permitted to figure in the broadcast programmes, the authorities have decided that these regulations must also apply to all musicians, whether dead or alive. Acting on this principle the broadcasting studios have been forbidden to transmit even excerpts from the works of Offenbach.

The Hilversum-Huizen Change-Over

FROM July 1st, broadcasts from the Hilversum studios are being carried out on 1,875 metres, and from Huizen on the lower wavelength. This change-over of the transmitters will last until the end of September, 1933.

France and the Lucerne Plan

THE only longwave channel given to France is that of 1,796 metres, which will be used by Radio Paris, now included in the State broadcasting net. French listeners are not satisfied with this allocation, inasmuch as their high power broadcasts will only be separated from those of the Moscow 500 kilowatt station by 8 kilocycles. In the medium waveband all transmitters foreseen by the Ferrié Plan have been allotted fairly favourable positions, namely, Lyons PTT (436 m.); Paris (PTT) 431.7 m.; Marseilles, 400.5 m.; Toulouse PTT (386.6 m.); Limoges, 328.6 m.; Grenoble, 309.9 m.; Rennes-Thouries, 288.6 m.; Bordeaux PTT, 278.6 m.; Nice-La Brague, 253.2 m.; Lille, 247.3 m. and Montpellier, 224 m. All stations except the last named, of which the power is limited to 30 kilowatts, may transmit with an energy not exceeding 60 kilowatts.

Manchester Airport

SIMILAR to Croydon and Heston, Manchester now has its own airport from which wireless telephony transmissions may be heard. The call letters are GEM, and the wavelength is 870 m. (345 kc/s). Morse transmissions are carried out on 900 m. (333 kc/s).

American Amusement Tax

IN view of present economic conditions in the United States, the American theatre industry has put forward a proposal to the effect that radio receivers should be taxed to the same extent as seats in the theatres. Managers contend that it would be fair to enforce an amusement tax on broadcast entertainments.

Wireless for the Blind

FURTHER orders have been placed with Messrs. Burne-Jones and Co., Ltd., of 296, Borough High Street, London, S.E.1, for wireless sets for the use of the blind. These comprise single valve, two-valve headphone, two-valve loud-speaker, two-valve screened grid, and three-valve screened grid sets.

AUTOMATIC TONE COMPENSATION

A Method of Counteracting the Distortion Normally Introduced by the Use of Reaction: Full Theoretical and Practical Details are Given in This Article. By FRANK PRESTON, F.R.A.

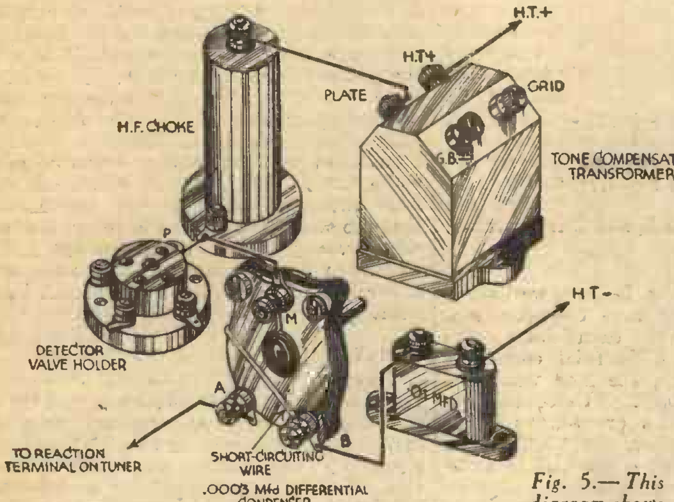


Fig. 5.—This diagram shows the practical wiring details for the arrangement shown in Fig. 4.

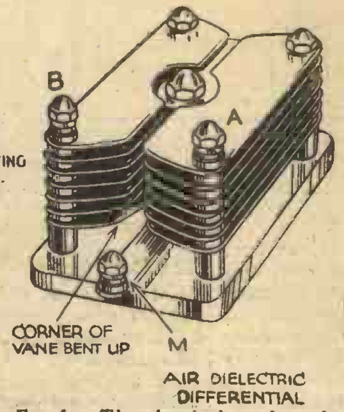


Fig. 6.—This sketch shows how the moving vanes of an air-dielectric reaction condenser can be made to short-circuit with one set of fixed vanes when the condenser is set to its zero position.

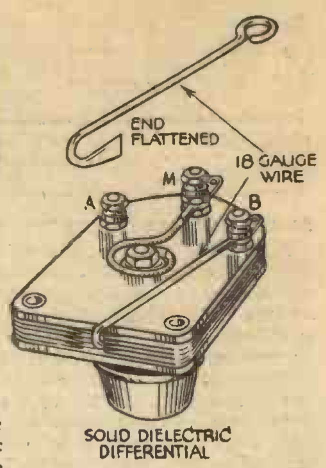


Fig. 7.—A method of short-circuiting the vanes of a solid dielectric reaction condenser.

IN this machine age, as it is sometimes called, every possible operation must be performed automatically and without effort. In radio we have automatic volume control, automatic grid bias, automatic tone compensation, and so on.

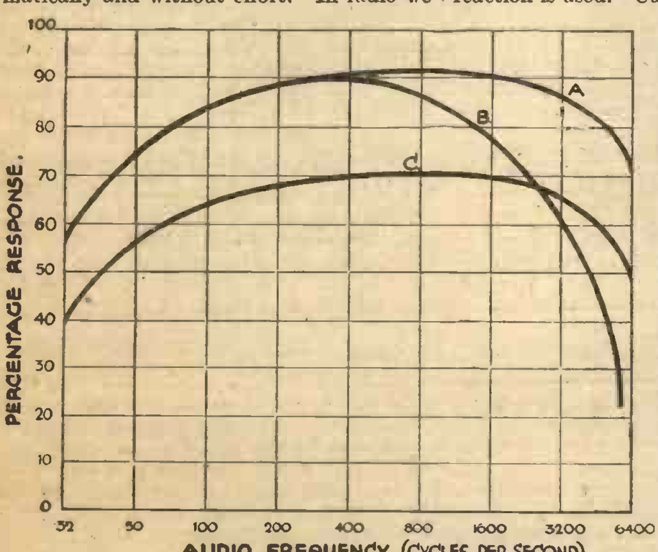


Fig. 1.—Curves which show the response of a receiver to various audio-frequencies; they are fully explained in the text.

It is the last-mentioned device I wish to deal with in this article, for it is one which has received a great deal of publicity recently. The scheme is intended to prevent the distortion brought about by using reaction, particularly when listening to distant stations. It has been explained in these pages before that as more reaction is applied to a set, selectivity is increased and, in consequence, there is a certain loss of the higher musical notes. This point is illustrated in a simple manner by the graph of Fig. 1, where curve "A" shows the percentage response of a good receiver to various musical notes from 32 cycles to 6,400 cycles per second (this is approximately the range of frequencies covered by a first class loud-speaker) when no reaction is used. Curve "B," on the other hand, represents the response of the same set and speaker when reaction is "pushed" to its limit. It is obvious that in the latter case the higher notes, especially those having a frequency of more than 1,000 cycles, are very much reduced in intensity. This explains the reason why distant stations, for which it is necessary to apply a full measure of reaction, are often badly "muffled" or "boomy"—the higher notes cannot be heard.

Tone Control

In a recent article in PRACTICAL WIRELESS, entitled "Tone Correction and Tone Control," it was pointed out that the above-mentioned difficulty might quite easily be overcome by the use of a special tone control transformer or other device which could be arranged to reduce the strength of low notes so as to make the response of the receiver more uniform to the full range of audio frequencies. The result of using a tone-control device is represented by curve "C" in Fig. 1, from which it can be seen that the set's response to the lower frequencies is reduced so that the overall response is similar to, but less than, that given when reaction is not employed. It is inevitable that there should be a certain loss in volume, but this is more than off-set by the better quality of reproduction or, more accurately, by the better tone-balance, obtained. The loss can, however, be very largely made good by the substitution of an L.F. transformer of higher step-up ratio.

The method of tone-control just referred to is perfectly satisfactory in practice, but has the slight disadvantage of requiring an extra knob for its operation. Moreover, a certain amount of T.C. adjustment is necessary for each position of the reaction condenser, and the correct setting is dependent to a large extent upon the "ear" of the operator.

(Continued overleaf)

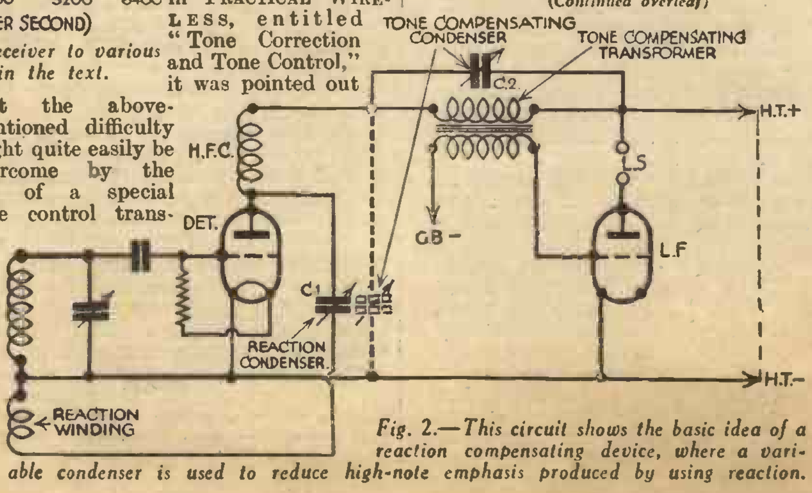


Fig. 2.—This circuit shows the basic idea of a reaction compensating device, where a variable condenser is used to reduce high-note emphasis produced by using reaction.

(Continued from previous page)

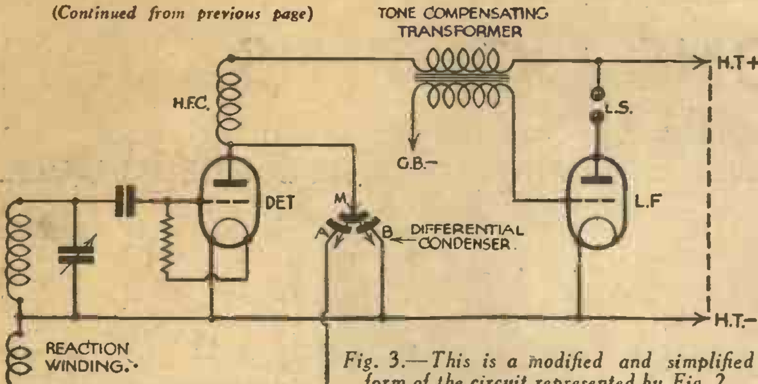


Fig. 3.—This is a modified and simplified form of the circuit represented by Fig. 2.

Automatic Compensation

Automatic tone compensation, or tone balance, to which reference was previously made, aims at simplifying the latter scheme so that the correct degree of compensation is automatically provided by the reaction condenser without the necessity for any further control. For its proper functioning it depends upon the use of a special Tone Compensating Transformer which has lately been put on the market by Messrs. Varley, and also by Messrs. Radio Instruments. This component is designed to give emphasis to the higher notes, and so to compensate for the loss in this direction caused by applying reaction. Thus, when reaction is advanced almost to the point of oscillation the transformer ensures that the frequency response shall be like that represented by curve "A," or, in other words, the same as obtained with a normal transformer when reaction is not used.

The Basic Idea

The only "snag" is that the reproduction of a set using the transformer would become high-pitched when reaction was slacked off. But we know that high-note response can be reduced by connecting a condenser across the transformer primary, and it is obvious, therefore, that if a variable condenser were wired in a parallel with the primary winding and so arranged that its capacity were increased as reaction is reduced we should have a fully self-compensating arrangement. This basic idea is shown in the circuit of Fig. 2 where separate variable condensers are used for reaction and tone-control. If these were ganged together so that the capacity of one were increased at the same time as that of the other were reduced we should obtain exactly the desired effect. On reflection it can be seen that instead of connecting the tone-control condenser directly across the transformer primary it could be joined between one transformer terminal and earth as shown by broken lines. The condenser would still be in parallel with the transformer since the second connection would be completed through the high tension battery.

This would be a workable arrangement *if* we could obtain a suitable two-gang condenser, but we *can't*, so a different scheme must be worked out. Peculiarly enough, the final arrangement brings us back to the usual differential reaction circuit of Fig. 3. It is not difficult to see that this is precisely the same as Fig. 2, because one half of the condenser (comprising the moving vanes M and the fixed ones B) is actually in parallel with the L.F. transformer primary, the circuit being completed on the one hand through the H.F. choke, and on the other, through the H.T. battery. We can see that as reaction is increased by rotating the moving vanes M into mesh with the fixed ones A, the capacity between M and B is reduced. Conversely, when reaction is slacked off, the capacity between M and B is increased.

The Final Circuit

In the circuit of Fig. 3, then, we have a system of automatic tone compensation, and, provided that the capacities on the two halves of the differential condenser were suitably chosen, the idea would be perfectly satisfactory. Unfortunately, though, the capacities are always equal in practice and, whereas, about .0003 mfd. is correct for reaction control, it is quite insufficient to reduce the high-note response of the special transformer when reaction is completely "off," the capacity actually required being about .01 mfd. A further modification is therefore necessary, and is shown in the circuit of Fig. 4; a fixed .01 mfd. condenser is inserted in series with the fixed vanes B of the differential condenser and earth, whilst the differential condenser is made to short-circuit when in the "full-off" position. In consequence of this the .01 mfd. condenser is put in parallel with the transformer primary when the reaction condenser is reduced to its "minimum" setting.

Having arrived at the final and satisfactory circuit we can consider its application to our sets. As a matter of fact, it can be used with any type of receiver by making very few alterations, and the practical wiring connections are clearly shown in the sketch of Fig. 5. To obtain full benefit from the scheme it is necessary to employ one of the special tone compensating transformers mentioned above. The idea is not by any means useless, however, even when an ordinary transformer is used, but then the fixed condenser should have a value not in excess of .005 mfd. The most suitable capacity will depend upon the actual transformer in use, and so it will be advisable to experiment a little in this respect.

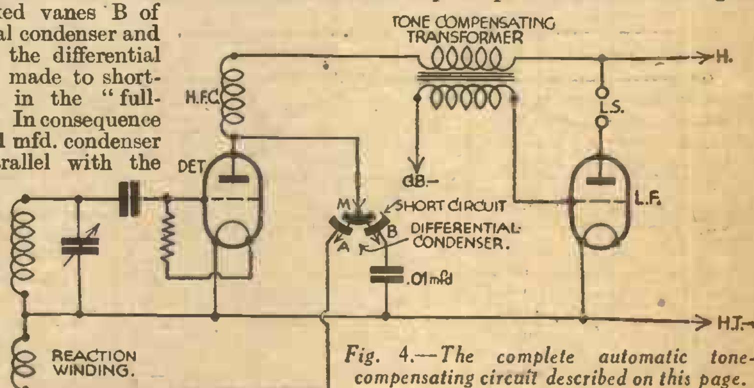


Fig. 4.—The complete automatic tone-compensating circuit described on this page.

Differential Condenser Modifications

It was stated before that the moving vanes of the differential condenser must make contact with one set of fixed ones when they are fully meshed with them. Although it is possible to buy a condenser specially designed for this purpose most readers will wish to use existing ones, so a few notes in respect to the necessary alteration will be helpful. When the condenser is of the air dielectric type it is only necessary to bend the corner of one fixed vane as shown in Fig. 6, but with bakelite dielectric components a different method must be employed. The exact alteration will depend very largely upon the construction of the particular condenser in use, but the method illustrated in the sketch of Fig. 7 will apply in most cases. A short length of 18 gauge tinned copper wire is flattened out at one end (by striking it with a hammer) and wedged between the edges of two fixed vanes. The other end of the wire is attached to the terminal corresponding with the vanes to which the short-circuit is required. The wire must be inserted so that the moving vanes do not make contact with it until they are almost fully meshed. It is very important that the short-circuit is made to the proper set of vanes because otherwise the H.T. battery will be shorted; the terminal indications in Figs. 4, 5 and 6 will make this point quite clear.

Operation of A.T.C.

Very little remains to be said in regard to the operation of a receiver incorporating the reaction tone-compensating scheme described, since it will be exactly "as you were." The differential condenser provides reaction in the usual manner and tone-balancing is perfectly automatic; as reaction is increased the transformer gives additional amplification to the high notes due to the capacity across its primary winding being reduced.

When a pick-up is connected in the grid circuit of the detector valve a certain amount of tone control can be obtained by means of the reaction condenser, but, in general, it is found that best results are given with the condenser in the "full out" position. That is when the moving and one set of fixed vanes are short-circuited.

The Ferrié Plan.

THE French parliament has adopted the plan for the reorganization of the broadcasting system; it was devised by the late General Ferrié. By this scheme, France will possess at least six high-power transmitters, namely, Paris (120 kw.); Toulouse (120 kw.); Lyons (90 kw.); Nice (60 kw.); Marseilles (60 kw.); Rennes (120 kw.) and Lille (60 kw.).

"Ostar Ganz Valves": Change of Address

AS and from June 24th all communications for Mr. Eugen Forbat, Sole Distributor for the "Ostar Ganz High Voltage Mains Valves" and Rectifiers should be addressed to: 28-9, Southampton Street, Strand, London, W.C.2.

CUTTING OUT STATICS

Precautions to Take Effectively to Cure the Trouble.

By R. P. COLE

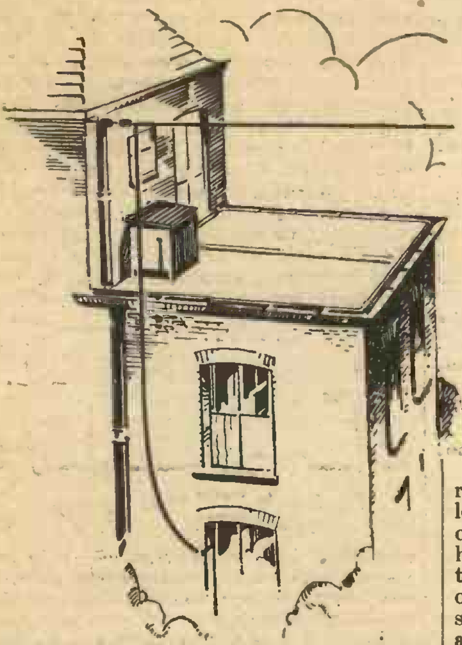


Fig. 2.—An aerial arranged close to a lead roof and guttering.

A FEW years ago when a valve set was a luxury and the majority of listeners were content with a crystal set, outside interference was practically limited to atmospherics, unless you were unfortunate enough to be situated close to a badly-adjusted electric motor or flashing lights. Nowadays, using the modern super-sensitive valve set, interference picked up from outside sources has increased tremendously. Quite apart from atmospherics, with their terrific crashes or low grumblings, according to the time of the year, some listeners are continuously receiving crackles, bangs, fryings, and a multitude of other unwanted noises.

The first search for the cause, of course, should always be made in the set, for a loose wire or a bad connection, or even a broken-down transformer or loud-speaker.

'Ware Fractured Wires

Digressing for a moment, it is remarkable to find that many listeners fail to locate the source of frying noises or cracklings in a broken-down transformer or loud-speaker because they take it for granted that if they can still hear signals at all those components are beyond reproach. This, however, is not the case, as signals can often be heard when wires are broken or disconnected, although probably at a much lower volume. Another source of crackles that are often mistaken for atmospherics because the trouble disappears when the aerial is disconnected, is a fractured wire in a stranded wire aerial. This is likely to be more troublesome if the aerial is insulated with enamel.

Of course, there are many unwanted noises over which one has very little or no control. If you are unfortunate enough to live near trams or electric trains you are almost certain to have a series of crackles each time a tram or train passes that you cannot entirely get rid of. In some districts the tramway companies have fitted a device to each tram to obviate the trouble, but the majority of trams in the country still disturb the ether to a greater or lesser degree. Noises from trams or trains can sometimes be considerably lessened by running the aerial at right angles to the wires or lines. Always remember that a large amount of pick-up of R.F. energy comes from objects in close proximity to the aerial.

Aerial and Lead-in Hints

Three or four years ago it was the recognized practice to make the aerial as long as possible within the prescribed limit of 100 feet, including the lead-in. Now, however, in order to attain greater selectivity the length is seldom more than 50 or 60 feet, and very often considerably shorter than that. In erecting these short aerials with their comparatively long leads-in the same care is not always taken as previously. The result is that long leads-in run close beside metal pipes and aerials often extend over metal roofs or alongside gutters, as shown in Figs. 1 and 2, and the pick-up from these conductors of disturbing H.F. currents, which produce the crackles, is greatly increased. The lead-in should therefore be kept as short as possible consistent with a high aerial.

Faulty Electric Light Fittings

It sometimes happens that a persistent crackle or frying noise will be heard at definite periods, while at other times reception is free from interference. After making certain that the trouble is not due to a loose wire or faulty component in the set, the search for the source of the interference must be continued outside. When there is a loose contact somewhere in the mains circuit, a small spark keeps jumping across the loose points. This sets up a series of damped oscillations very much like a miniature spark transmitter of no very definite wavelength. The receiver responds to these shock signals in the same way as it does to atmospherics. A badly-fitting electric-light bulb or a faulty contact in a switch will create quite an annoying noise in the loud-speaker, although the light may apparently be burning with its usual brilliancy. The spring-loaded contact pins in a lampholder are apt to become stuck up, and the connection with

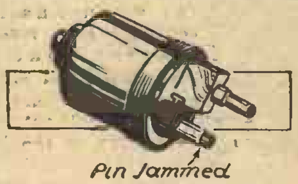


Fig. 3. — A jammed contact pin causes bad contact.

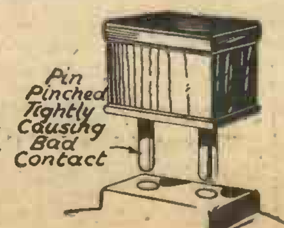


Fig. 4.—A faulty split pin.

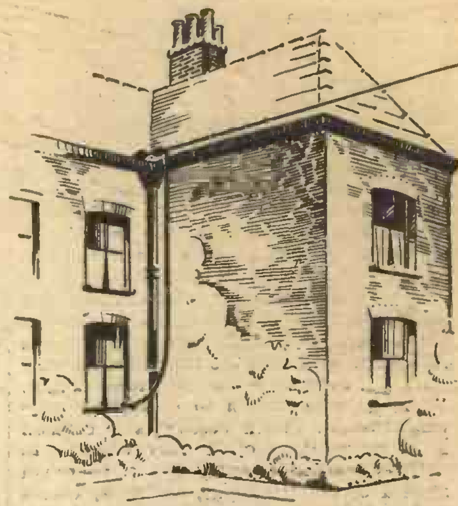


Fig. 1.—Aerial and lead-in running close to gutter and rainpipe.

the lamp is then very loose or not made at all (Fig. 3). In damp buildings the contact springs of tumbler switches often become corroded. This corrosion tends to prevent good contact being made when the current is switched on. In some of the cheaper makes of switches the spring contacts become loose, or are easily bent, with the same result. The only way of tracing such faults is by the process of elimination.

Due to the comparatively heavy current taken by electric radiators, the spark taking place at a loose contact in this circuit can be quite large, and will in time probably burn the insulation of the plug or switch, as the case may be. Sometimes a switch or plug will be found to be quite hot after the radiator has been in use for a long period.

Another source of interference due to loose connections is to be found in the fuse-box, although this is not so common as the faulty switch or lamp contact. The wire used for fuses is made to "blow" when a certain current is reached, for instance, 5 amps. or 10 amps. Actually, it burns away, due to the heat set up in it by the excessive current. However, when lower currents are passed through the fuse wire it stands to reason that the wire will warm up. With the increase in temperature the wire expands and, under the terminals, its shape is distorted and flattened because the expansion can only take place outwards. The opposite action takes place when the current is switched off and the wire cools again. The wire contracts but does not regain its original shape under the binding terminals (Fig. 5). When this procedure has taken place a number of times the wire becomes loose under its terminals, and the result is a loose contact where slight sparking will sometimes take place. The remedy is obvious, and is simply to tighten the terminals that hold the fuse-wire. You will possibly find that each terminal will allow of half a turn, whereas they were previously tight when the fuses were first fixed.

Should the contact become very bad through corrosion or for other reasons, a variable resistance is produced and when a light is switched on the sudden rise in current will cause any other lamps that may be alight to momentarily drop in brilliance.

(Continued overleaf)

(Continued from previous page)

Eliminator Hum

When an eliminator is used the mains often give rise to hum that is difficult to get rid of. In many sets the eliminator is placed directly beneath the set itself, which is mounted on a wooden baseboard. It is a good plan to place an earthed sheet of copper foil underneath the set to screen it from the eliminator. Another simple expedient, which sometimes works in A.C. sets, is to turn the mains transformer round, or even move its position altogether. This has been known to completely cure hum trouble. With positive side earthed D.C. mains it is often very difficult to entirely eliminate hum, but a thorough system of screening (*i.e.*, the coils, valves and eliminator) can work wonders. Above all, make certain that you are not trying to get more out of the eliminator than it is designed to supply. This would certainly produce a hum.

Apart from mains interference caused by hum, a large amount of H.F. interference is induced into the set *via* the mains. It has been estimated that this is as high as 90 per cent. of the total H.F. interference. The smoothing equipment of the eliminator will in many cases be sufficient to prevent these currents from reaching the set, and will effectively short them to earth. It is extremely important, therefore, to have as efficient an earth as possible.

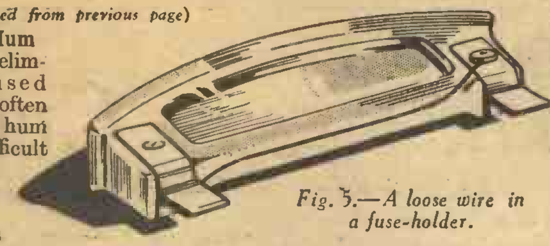


Fig. 5.—A loose wire in a fuse-holder.

The earth lead should be of heavy gauge wire, insulated for preference, and whenever possible soldered to a buried earth. The wire should be kept short.

By paying careful attention to the efficiency of the earth much of the H.F. interference can be kept from the set. If the trouble is still excessive it may be necessary to insert an interference filter in the mains. In some houses the metal conduits are not properly earthed, or not earthed at all.

In these cases it is essential to prevent the H.F. currents reaching the wiring system of the house at all and in order to accomplish this the interference filter should be inserted in the mains immediately after the electricity company's meter. As the chokes used will in this case have to carry the entire current to be used in the house, they must be made of heavy wire.

No hard and fast values can be set down for the construction of the filter. The constructor will have to decide the best values in each individual case by the trial and error method. The following details will give some idea to work on. For the chokes wind 80 or 90 turns of No. 20 gauge enamelled copper wire on 2½in. diameter paxolin formers. The fixed condensers must be of the non-inductive type, and to commence with try a capacity of 2 mfd, but again the best results may be attained with condensers of considerably less or even twice this capacity. (See Fig. 6).

Finally, prevention of interference at the source is better and usually simpler than attempted cure in the set. If you can trace from whence your interference emanates, the Post Office will be only too pleased to give advice regarding its prevention. Always be suspicious of such electrical equipment as motors, lifts, illuminated advertizing signs and in fact anything that makes and breaks the circuit during its operation. The Post Office automatic telephone dials have even been the cause of trouble.

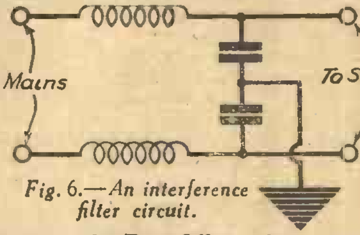


Fig. 6.—An interference filter circuit.

IRON-CORED COILS

A Brief Explanation of the Differences Between the Cores Used in the Coils Which Have So Far Been Produced.

By W. J. DELANEY.

QUITE a lot has already been written regarding the new types of coils, but it seems that some confusion exists as to the differences between them. It must be apparent to everyone that Ferrocart is a registered name, and a material which is used, at the moment at least, for only those coils manufactured by the Colvern Company. This material, the invention of Hans Vogt, was the original core for modern iron-core wireless coils, although by no means the first "dust-core." The composition of these cores, as already pointed out, consists primarily of powdered iron, and in the Ferrocart material a most interesting manufacturing process is employed. A narrow strip of paper is passed through a machine, and the iron powder is deposited on this paper. By means of combs and magnetic devices the iron powder is distributed in such a way that the iron particles are "lined up" and so arranged that eddy currents are completely avoided, and all the particles point one way. Finally, the core is built up to the required thickness by placing the paper in layers and binding with a suitable medium. The finished core is thus laminated and consists, in effect, of alternate layers of paper and iron.

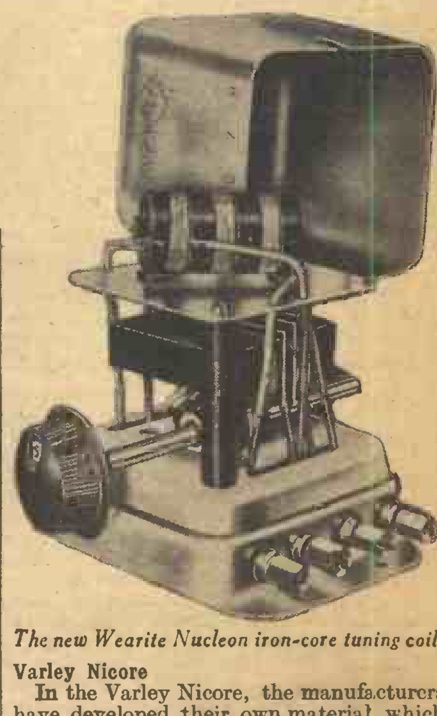
Igranicore

In the Igranic coils an entirely different method is employed, and the finished core material is of a more solid nature than the Ferrocart. It is, in fact, indistinguishable in appearance from ordinary bakelite. In this case the iron powder is mixed, in a most complete manner, with ordinary insulating material, and the process employed ensures that the mixing is so complete, and the iron so equally distributed, that when finally "cooked" and ready for assembly into a coil, an individual strip may be removed and replaced without any variation in the inductance value of the coil. This is certainly a very high standard, and assists greatly in the manufacture of accurately matched coils.

The new Varley Nicore tuning coils; they are available as single, double, and triple-gang units.

Nucleon

The material used in the Wearite coil is known as Nucleon, and this material has already been described in our pages. (See page 251 of PRACTICAL WIRELESS dated May 6th, 1933.)



The new Wearite Nucleon iron-core tuning coil.

Varley Nicore

In the Varley Nicore, the manufacturers have developed their own material, which differs from Ferrocart and is independent of that invention; quite naturally each manufacturer has ideas of his own which are included either to simplify the process or to enable a different degree of permeability to be obtained.

It is not desirable, at the present stage, to give full details concerning the individual processes, as complete patent protection has not yet been obtained in the majority of cases, but it has been thought worth while to give the above brief descriptions in order that any confusion which might exist regarding the similarity, or otherwise, of the various cores may be removed.

Operating the D.C. ACE

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

ALL the value of skilful craftsmanship expended on the building of a brand new set can be discounted, if manipulation of the necessary controls is not thoroughly understood. Acquiring this knowledge is not a matter of reading a few notes, but comes from an intelligent interpretation of the set's functioning together with a few hours spent in becoming quite at home with those panel knobs.

Do not be disappointed, therefore, if the set fails to please you 100 per cent. straight away; give the receiver a fair chance and it will return the compliment. As far as this particular receiver is concerned, there is really only a little knowledge that must be assimilated originally—the flair for "running round the dial" comes quite soon.

First of all insert the three mains valves into their correct positions, D.C./S.G. in socket on left nearest the panel, D.C./H.L. just behind, and the D.C./PEN. in the remaining holder. Do not forget to add the connections from the flex leads to the S.G. anode and the pentode screening grid. Your aerial, earth, and loud-speaker to the terminals so marked, clip on the twin fuse cover and connect the set to the mains supply *via* the lead made up for the purpose. Before switching on see that the coil covers are firmly registered in place with the base, and cover slots connecting.

Set your coil switch to either long or medium-waves as desired for the first test, the reaction control at minimum, and the volume control potentiometer about midway, as also should be the tone control potentiometer and filament current resistance knob. With your eye on the ammeter, switch on the mains, note whether the meter needle moves in its correct direction, that is, to the right. If it moves to the left switch off immediately and reverse the mains-plug, for obviously with D.C. mains working we have to consider positive and negative polarity, a factor which does not arise with A.C. mains working.

Speedily adjust the variable filament resistance so that the ammeter correctly registers the filament current, that is, half an ampere, and you will notice that as the "breakdown" resistances warm up slightly, the current drops somewhat owing to the corresponding increase in resistance. It will be a matter of a few minutes for this slight fluctuation to settle down, but the set will be "fully alive" after the passage of some thirty to forty-five seconds from the moment of switching on.

Your local station can, therefore, be tuned in after this lapse of time by turning the larger of the pair of tuning knobs. When tuned in, a fine adjustment is made by a slight movement of the smaller knob. This alters the capacity value of a single plate vernier condenser on the aerial side, and is sufficient to correct any irregularities that might be present in the ganging. I found no necessity for an extra trimmer in the second condenser section, and, in the special condenser made up for me by Polar, this was not included.

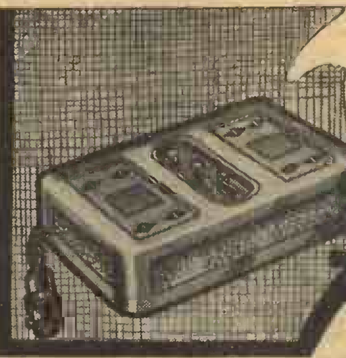
The neat appearance of the receiver may be seen from this illustration.

When tuned in to the local station the full value of the input volume control (our potentiometer-aerial feed) will be found. It is particularly smooth in operation and is a method which needs to be tried to be appreciated. Then again on your local you can see for yourself how valuable it is to have a tone-control functioning in conjunction with the transformer. This is the knob in the bottom right-hand corner. The component in question has been dealt with very fully before in this journal, but for the uninitiated let me say briefly that adjusting the knob position of the potentiometer enables a correction to be effected which will overcome defects in quality due to lack of treble or bass in a loud-speaker. It brings about a more natural tone, and permits the listener to suit his own tastes in reproduction according to the nature of the item which is being listened to at any one time.

Searching for stations follows quite normal practice and is the same both on medium and long waves. The input volume-control is set at maximum, and starting with the tuning condenser at zero, the dial is moved round slowly (coarse tuning knob—that is, the large centre one) while the set is kept in its most sensitive condition (near oscillation point) with the other hand on the reaction-control. If preferred, the set can be made to oscillate and the familiar "tweet" listened for. As soon as this is heard, turn back the reaction control slightly and make any readjustments on the tuning through the medium of the fine tuning control (small centre one). The art of station-tuning and final adjustments according to taste will soon come to you, and in any case when you hear your first station you cannot fail to be impressed with the complete absence of hum (generally a "prominent" feature in D.C. mains sets) and the first-class quality of reproduction.

COMPONENTS FOR THE D.C. ACE.

One .0005 mfd. Polar Uniknob Variable Condenser (Special type, with insulated rotor).
Two .0001 mfd. Type 34 fixed condensers (T.C.C.).
One .0003 mfd. Type 34 fixed condenser (T.C.C.).
One .001 mfd. Type 34 fixed condenser (T.C.C.).
One .01 mfd. mica condenser (Lissen).
One .25 mfd. Type 50 fixed condenser (T.C.C.).
One 1.0 mfd. Type 50 fixed condenser (T.C.C.).
Two 2.0 mfd. Type 50 fixed condensers (T.C.C.).
One 2.0 mfd. Non inductive fixed condenser type LDAA (Dubilier).
Two Type BE88 Block condensers (2 and 2 mfd.) (Dubilier).
One .0003 mfd. Polar reaction condenser, compact type.
One .001 mfd. (max.) Lewcodensor (Type O).
One 4 mfd. Power Mansbridge Type Peak Condenser (800 volt D.C.).
One 50,000 ohm Lewcos potentiometer.
Three 50,000 ohm Varley tag resistances.
One 15,000 ohm Varley tag resistance.
Two 50,000 ohm Lissen wire wound resistances.
One 10,000 ohm Lissen wire wound resistance.
One 5,000 ohm Lissen wire wound resistance.
One 1 megohm grid leak with wire ends (Lissen).
One 330 ohm Heavy duty resistance (Bulgin).
One 3 ohm resistance (special type, see last week's issue) (Wearite).
One 200 ohm resistance (special type, see last week's issue) (Wearite).
One 250 ohm 50 watt variable resistance (Rotor Electric).
One 4 megohms graded potentiometer (Multi-tone).
One General Purpose L.F. Choke (Lissen).
One Hypercore smoothing and output choke (R.I.).
One $\frac{1}{3}$ henry $\frac{1}{2}$ amp L.F. Choke (special type, see last week's issue) (Lewcos).
One Bulgin Screened Grid H.F. Choke.
One Wearite H.F. Choke Type HFPA.
Four Type B Belling Lee Terminals marked aerial, earth, input, and output.
Two Belling Lee Terminal Mounts.
One Colvern KTF Coil.
One Colvern KGR Coil.
One Multitone L.F. Transformer.
One Panel Mounting moving coil Ferranti ammeter O.D. 0.75 A range.
Three (W.B.) Sub baseboard valve-holders.
Two Belling Lee S.G. anode connectors.
One Belling Lee mains plug 1 amp fuse.
One ebonite panel 18in. by 9in. by $\frac{1}{4}$in.
One baseboard (see last week's issue), screws and Glazite.



Poin
POWE
of Special Interest
Operating Battery S

By AS

IN the course of my daily round, it falls to my lot to deal with large numbers of queries from users of mains-units, and some to these queries are frequently repeated.

The most common of these queries is that regarding the correct switching sequence. The answer is, when switching *on*, L.T. *first*, and then H.T. When switching *off*, reverse the procedure, H.T. *first*, and then L.T. The reason for this is that if the H.T. current is switched on before the L.T., the valve filaments are cold, and there is no actual H.T. circuit, the result being that the voltage stores up in the condensers in the unit. Thus abnormally high-peak voltages occur which are likely to cause premature failure of the condensers, and, furthermore, the momentary surge of current released from the the condensers when the L.T. is switched on is not good for the valves. Actually, this point is much more important in the case of an A.C. unit than a D.C. unit, as in the latter case the voltage cannot build up to more than the mains input voltage, but even so, it is not wise to leave the unit connected to the mains for long periods with the L.T. switched off.

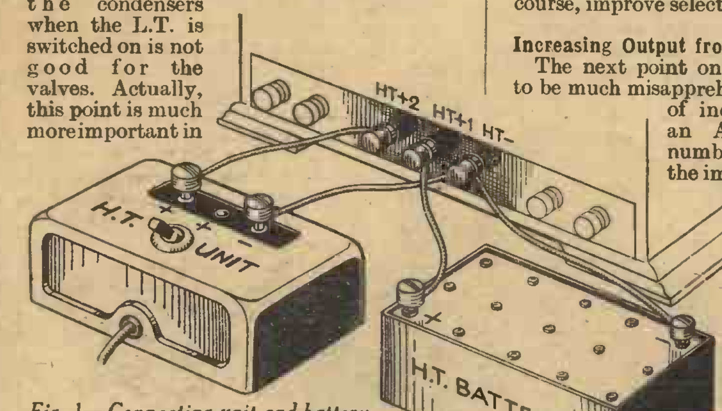


Fig. 1—Connecting unit and battery in parallel.

Another point regarding D.C. units is the fact that, upon connecting the unit to the set, the metal parts of the set often become "live" to the touch. This is merely due to the fact that the supply-main to the house in which the unit is used happens to be on the positive-earthed side of the D.C. three-wire system, the consequence being that the negative side of the set is at a potential above earth equal to the mains input voltage. If, therefore, you find that you can get a slight shock from the metal panel or grub-screws of the slow-motion dials, this does not indicate a fault in the unit —it is merely due to a peculiarity in the supply and has no bearing whatever upon the electrical performance of the unit. Furthermore, on D.C. mains, a small condenser, should be connected between the set and the lead-in to prevent damage in the case of the aerial falling to the ground. The condenser should be a good-quality component, and if a capacity of not less than .005 is used, tuning will not be affected—a smaller condenser may, of course, improve selectivity also.

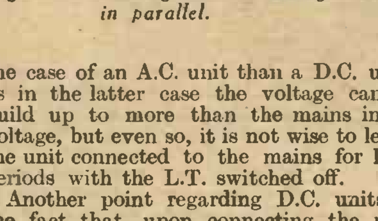


Fig. 2a.—Theoretical circuit of Fig. 2.

Increasing Output from an A.C. Unit

The next point on which there appears to be much misapprehension is the question of increasing output from an A.C. unit. Quite a number of people are under the impression that this job entails the removal of a resistance. Unfortunately, this is not so, and to increase the output is usually quite an expensive proposition. The maximum output is dependent entirely upon the type of metal-rectifier used, and of course, the secondary of the mains transformer is wound to match the rectifier used. Therefore to increase the D.C. output it is necessary to use a larger rectifier, and also to re-wind or replace the transformer with one to suit the larger rectifier. In addition, it may also be necessary to replace the smoothing choke with a larger component which will handle the increased D.C. current without saturating. Therefore, to get a few more milliamps the transformer, rectifier and choke have to be replaced, which is hardly an economical proposition. There are two ways out of the difficulty, first, to use a dry battery in conjunction with the unit, and, secondly, to use another small unit in addition to the existing unit.

Suppose the unit is rated to give 15 milliamps, and the output valve required about this current, then the entire output from the unit can be fed to the power valve, using a dry battery to feed the S.G. and detector valves. As these two valves will not require more than, say, 5 milliamps, a super-capacity battery is not necessary, and owing to the light load, the battery will give a very long service. The connections are shown in Fig. 1.

On the other hand, if the receiver has three or four valves before the output valve, as in the case of a superhet, these valves may require between them nearly as much as the last valve, in which case it is better to use another small unit for supplying that H.T. current. It is merely necessary to connect the negative sockets together and use the positive tappings as required. The connections are exactly the same as those in Fig. 1, except of course, that a unit is used in place of the dry battery. The two flex leads to the mains can be taken to one adaptor for the sake of convenience—on A.C. it does not matter which way round the leads are connected.

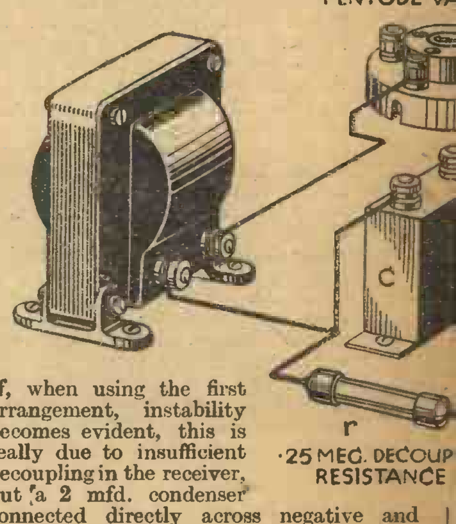


Fig. 3.—Variable "free

If, when using the first arrangement, instability becomes evident, this is really due to insufficient decoupling in the receiver, but a 2 mfd. condenser connected directly across negative and positive of the battery usually has the desired result.

Increasing Output of a D.C. Unit

In the case of a D.C. unit it is often possible to increase the output quite easily and cheaply, as in most cases the maximum output is limited by a resistance, usually in the negative lead. By decreasing the value of this resistance, the maximum output is automatically increased. For example, in a 20 milliamp unit, this resistance may have a value of some 2,500 ohms, but by reducing this value to 2,000 ohms, the output would be increased to 30 milliamps.

ts About
UNITS

to Those Readers
Sets from the Mains

TRAL

The actual resistance required is arrived at by dividing the surplus voltage by the required current. For example, assume the mains input to be 230 volts and an output of 150 volts at 30 milliamps is required, the equation is $R = \frac{80}{.03}$ amp. which is about 2,650 ohms from which must be deducted the D.C. resistance of the smoothing choke. The question of choke induct-

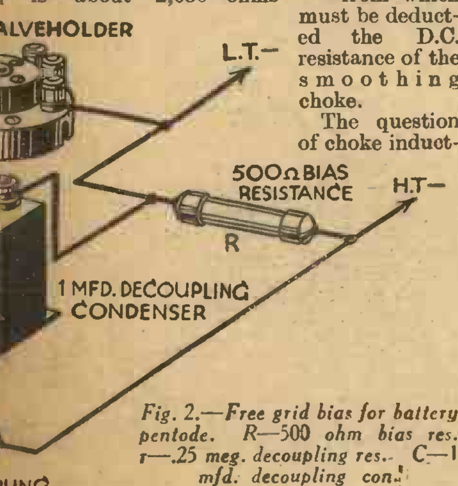
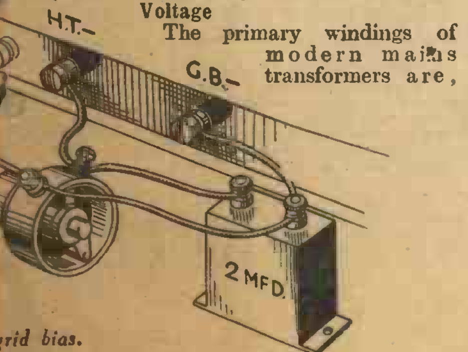


Fig. 2.—Free grid bias for battery pentode. R—500 ohm bias res. r—.25 meg. decoupling res. C—1 mfd. decoupling con.

ance still has to be taken into consideration, and, therefore, before altering the resistance value, the manufacturer of the unit should be approached regarding the question of whether the existing choke will carry the additional current without saturating. A better choke may be necessary, but as the choke possesses D.C. resistance it must be born in mind that if the new choke has a higher or lower D.C. resistance, the effect will be similar to altering the value of the mains resistance. In other words, the use of a lower D.C. resistance choke will in itself increase the output to some extent.

Adjustment Necessary for Altered Mains Voltage

The primary windings of modern mains transformers are, of course, tapped so that the unit can readily be adjusted for use on various voltages, usually between 200 and 250 volts. Many people who possess units wound for 100-volt and 200-volt mains are now faced with the difficulty that their mains have been, or are going to be, changed to the universal 230 volts, and consequently their units must be modified for use on the higher supply. There are two ways of overcoming this difficulty—one is to return the unit to the manufacturer, who will replace the transformer and charge accordingly, and the other is to insert a voltage-absorbing resistance in one side of the mains-lead, so that although the mains are 230 volts, the actual input to the unit remains at the original 100 or 200 volts. It is a simple matter to work out resistance values where the supply is direct current, but where the supply is A.C. the matter is not quite so simple. However, the method given here will give a sufficiently accurate value for all normal purposes.



rid bias.

The first step is to find the total wattage of the secondary windings. Take, for example, the case of a unit employing valve rectification, having a D.C. output of 20 milliamps at 150 volts. Wattage is the product of voltage and amperage, and therefore the wattage of the filament circuit is 4 volts at 1 amp., which is, of course, 4 watts. The H.T. circuit will be $\frac{150}{1}$ volts × $\frac{1}{50}$ amps., which is three watts, *i.e.*, a total load of 7 watts. We must, however, make allowance for transformer losses, and this is where there is possibility of some error as this is an unknown quantity, but, generally speaking, it is safe to assume this figure at 30 per cent., which brings the total secondary wattage to about 9 watts.

The next step is to determine the current which should flow through the primary, and this is computed by dividing the secondary wattage by the mains voltage. In our assumed case, the primary current is given by the fraction $\frac{9}{230}$ amps. which, boiled down, comes to about 39 milliamps. Now the value of the resistance required to absorb the surplus voltage is arrived at by dividing the surplus voltage by the primary current. The primary is wound for, say, 100 volts, and the mains input is 230 volts, therefore we require to drop 130 volts, which has to be divided by the primary current thus: $\frac{130 \times 1,000}{39}$, which is about 2,500 ohms. If the unit were already wound for 200 volts, then the resistance would obviously require to be only about 750 ohms.

Here is another point which is continually cropping up, automatic grid bias with a battery set and a mains unit. Some units are provided with special tappings for grid bias, but where these are not fitted, it is not a difficult matter to arrange for free G.B. Unfortunately, so-called "free" grid bias is not actually free, as any volts which may be used for this purpose are deducted from the H.T. volts.

Free grid bias is merely the use of the voltage difference between the ends of a resistance in the negative lead. The resistance should be connected between the grid circuit of the output valve and H.T. negative as shown in Fig. 2. The correct value for the majority of battery pentodes is 500 ohms. A condenser must in all cases be shunted across the resistance to prevent instability. If you do not wish to interfere with the wiring of the receiver, then a G.B. tapping can be provided direct from the unit, by connecting a variable resistance between H.T. negative on the set and H.T. negative on the unit as shown in Fig. 3.

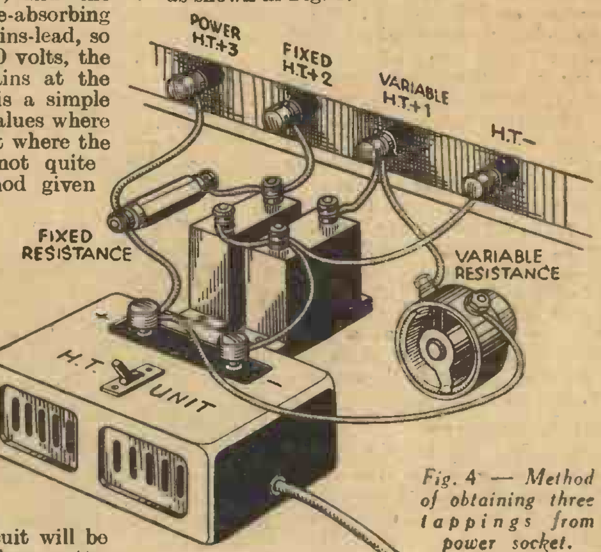


Fig. 4 — Method of obtaining three tappings from power socket.

Another query is how to provide additional tappings from a unit, either variable or fixed. This is a simple matter, the output from the power socket can be split up into three tappings, variable or fixed as desired. The connections are shown in Fig. 4; two additional tappings are shown, one fixed and one variable. The condensers should be at least 2 mfd. each.

Many of the units now on the market incorporate trickle-chargers for charging L.T. accumulators from the mains. If the accumulator is allowed to become completely discharged, the trickle-charger cannot be expected to charge it up again in a few hours. The usual trickle-charger rate is .5 amp., and it will be obvious that in the case of a discharged 30 actual-amp.-hour accumulator, the trickle-charger will take 60 hours to charge it up, or allowing for losses in the accumulator, about 80 hours. The trickle-charger is not intended to be used in this way. The accumulator should first of all be fully charged from some external source.

The result of a test which I recently took on several representative makes of units, revealed the average current consumption of a 20 milliamp A.C. unit to be six watts, a 20 milliamp D.C. unit four watts, and a .5 amp. trickle-charger twelve watts. As there are one thousand watts to a unit of electricity, obviously, the A.C. unit would give about 170 hours for one unit, at an average cost of, say, 4d.

OUR VIEWS ON RECEIVERS

H.M.V. SUPERHET SELECTIVE FIVE (Model 438 A.C.)

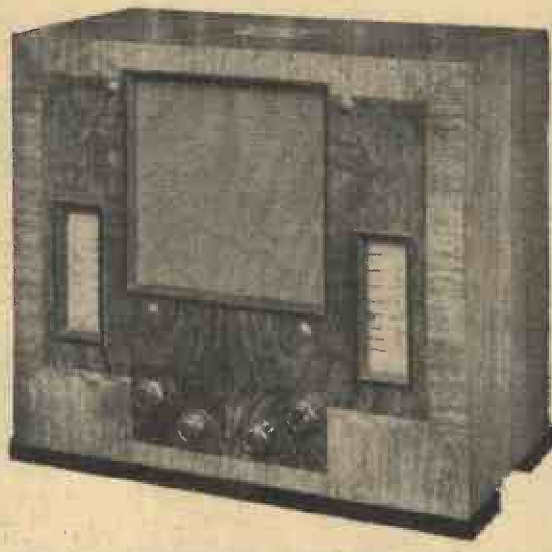
IT is an undoubted fact that the superheterodyne receiver is daily increasing in popularity, and with the increasing chaos in the ether, this is the only type of receiver which can be relied upon to furnish "perfect" reception of many stations at any time of the day or night. The time has now gone when the quality claims of the superhet could be questioned. Provided the design is correct the old-fashioned whistles all round the dial can also be completely eliminated. In fact, in handling a really well-designed, modern receiver of this type, it should be impossible to tell whether or not an ordinary "straight" receiver is being used. The latest receiver of this type to be placed on the market is shown on this page, and we have had the pleasure of examining it in detail and seeing just how far the good manufacturer can go in the way of producing a receiver which can justly be called the last word, at a price which will undoubtedly soon render the so-called "straight" receiver obsolete.

Attractive Appearance

Before passing on to the actual circuit design of this set it is essential to remark upon the really good design which is incorporated in cabinet work, actual layout, and design of controls. As may be seen, there are two tuning scales, one for the medium waves and one for the long waves. Each of these is separately illuminated, and operation of the wave-change switch illuminates the appropriate scale. This is of the only really useful type, namely the straight-line. This type of scale, when engraved with the names of stations or frequency in kilocycles, enables the tuning point for a station to be seen at a glance, and the pointer adjusted to that spot in the shortest possible time. We venture to prophesy that by next season the partially-obscured dial, showing through a small window, will have passed out of existence. However, this receiver also employs a clean loud-speaker grille, no old-fashioned fancy fretwork being employed to harbour dust or give rise to rattling. From the back, the layout of the coils, valves, etc., is just as modern, and with the choice wood which is employed for the cabinet work the receiver may take its place in any home without being obtrusive or out of place.

The Circuit

Now to proceed to the circuit, which employs only five valves, including the rectifier. The manufacturers inform us that the first experimental models of this receiver were produced as far back as March, 1932, so that it is quite conceivable that there is nothing which can be done to improve this particular circuit. When a firm spends over twelve months in perfecting a design the user can rest assured that every refinement has been included, and that, provided no revolutionary new developments come along, he has a receiver which will take some time to go out of date. The circuit consists of an S.G. combined first detector and oscillator, variable-mu I.F. stage, linear grid rectifier, and Pentode output stage. A gramophone pick-up may be left permanently connected to the receiver, and the operation of the mains selector switch will enable record music to be produced when desired without the necessity of making extra connections. The input circuit is of the band-pass type, which ensures the almost complete absence of second-channel interference when not using a signal H.F. stage. In addition, a patented feature is incorporated which acts in a different manner on both long and short waves, so that in this particular model it is possible to tune right through the scale on either waveband, and unless the user is an expert he would not hear a single "second-channel whistle." In any case, the ordinary listener will be unaware of their presence. Orthodox arrangements are employed to couple the I.F. stage and second detector stage, but in the anode circuit of the latter are no less than four resistances in series. These are arranged not only as voltage droppers and decouplers, but with the condensers which are chosen complete isolation of the H.F. currents has been obtained, and the L.F. stage rendered immune from troubles which often arise in a superhet circuit with inadequate H.F. filtering. The L.F. coupling is by means of a parallel-fed auto-transformer, in series with which is a clever tone-control circuit. This operates to give a really sharp cut-off at about 5,000 cycles, and thus reduces needle-scratch when using gramophone records, and heterodyne whistles which sometimes are received with a signal.



The attractive lines of the H.M.V. Superhet Selective Five (Model 438 A.C.), is apparent from this photograph.

Actual Results

When tested, we used the mains aerial, which is of the usual "condenser in the mains lead" type, and several continental stations were received by this aerial alone. When connected to a good outside aerial, practically all of the worth-while stations may be heard, many of them in broad daylight. Tuning is, of course, of the utmost simplicity, and there are no knacks or tricky adjustments to be carried out. The tone control acts in a most interesting manner, enabling any tone to be produced to suit the requirements of the individual listener. The volume control, too, produces a very smooth control over the output, which may be varied from the full 2 watts to a mere whisper, although in the latter position, on the particular mains which were used, the hum was louder than the signal. It is, of course, never necessary to cut down the volume to this extent. The particular loud-speaker which is fitted gives a very well-balanced output, free from boominess and characterized by that "forwardness" which is associated with the receivers produced by the H.M.V. factory. In spite of all the above good points, there is still one other which will interest every reader, and that is the price. Fifteen guineas is all that is asked for this complete receiver, and when it is remembered that less than a year ago a battery receiver, exclusive of batteries cost as much, it will be appreciated that the manufacturers have endeavoured and succeeded in producing a receiver which will find a most ready market.

For those who require it this chassis is also obtainable in a radio-gram cabinet, and the pick-up and other gramophone apparatus is already mounted and connected in circuit. Details concerning this radio-gram will be given on this page in due course. The performance is, of course, of the same order as is obtained with this particular receiver.

H.M.V. SUPERHET SELECTIVE FIVE RECEIVER: Model (438 A.C.)

MAKERS: The Gramophone Company, Ltd.

SPECIFICATION: Four valve Superhet., with valve rectifier. S.G. combined detector-oscillator; variable-mu I.F. stage; linear grid detector and Pentode output stage. Adjustable tone control, and combined volume-control, acting on either radio or gramophone. Mains energized loud-speaker. Second-channel whistles reduced to an absolute minimum. Straight-line scales for each wave-band, each separately illuminated.

TEST REPORT: Reception of dozens of stations, with the greatest facility, on either wave-band in daylight and practically any worth-while station at night. Quality of reproduction adjustable to suit any requirement characterized by "forwardness" and complete absence of resonances. A de-luxe instrument.

PRICE: 15 guineas.

The BEGINNER'S SUPPLEMENT

THE EASY ROAD TO RADIO

Conducted by F. J. CAMM

Neutrodyne Circuit

A receiving circuit designed to neutralise the inter-electrode capacity of high-frequency valves and so prevent H.F. howling. It is now no longer used owing to the introduction of the screen-grid valve, in which the neutralizing is carried out in the valve itself by internal screening. See *INTER-ELECTRODE CAPACITY.*

Nickel Iron

An alloy of iron used for making the cores of transformers, chokes, etc. It derives its name from the fact that its constituents are chiefly iron and a small proportion of nickel.

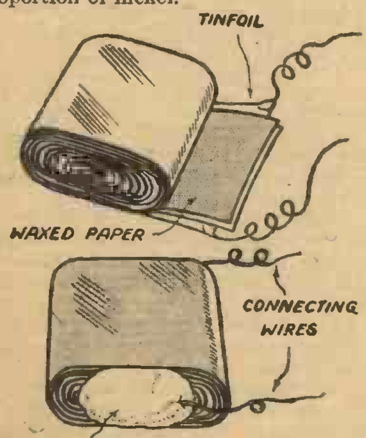


Fig. 1.—(Top): A paper condenser which would be inductive, the connections being taken from the ends only of the foil. That shown below is non-inductive since each turn of foil is connected.

One of the chief advantages of nickel iron over ordinary iron as the material for the cores of transformers and chokes is that less turns of wire are necessary for a given inductance. This means that the whole instrument can be made smaller than when iron is used. (See *TRANSFORMER.*)

Nodon Rectifier

A chemical rectifier consisting of an aluminium rod and a lead plate immersed in a solution of ammonium phosphate. It is used for converting alternating current into direct current and is chiefly employed for charging accumulators from alternating current mains. Usually four of these rectifiers are used connected in the form of a bridge circuit.

Non-Conductor

A substance which will not permit the

THE BEGINNER'S A B C OF WIRELESS TERMS (*Continued*)

passage of an electric current. An insulator is a non-conductor. (See also *CONDUCTOR.*)

Non-Inductive Condenser

A condenser with negligible inductance. Fixed condensers made of flat metal plates or foil are non-inductive, but those made by rolling up two strips of tin foil separated by waxed paper are inductive unless each turn of the protruding foil at each end is connected to the terminals. If only one connection is taken from each strip, then the rolled-up strip acts like a tuning-coil or inductance. This may impair the efficiency of the condenser at certain frequencies. Fig. 1 shows how the ends of the foil in a non-inductive paper condenser are soldered together.

Non-Inductive Resistance

A resistance with negligible inductance. Composition resistances come under this heading, but all wire resistances wound in the form of a coil are inductive to a greater or lesser degree. There are, however, special non-inductive wire-wound resistances in which the wire is wound back on itself so that the inductance of one turn neutralizes that of the next. The total inductance is thus negligible. (See Fig. 2.)

Ohm

The practical unit of resistance.

Ohm's Law

A knowledge of this law is essential for the working out of a great number of the simple wireless calculations.

It is usually stated in the following form: $I = \frac{E}{R}$ where I = current, E = E.M.F. or voltage, and R = the resistance of the circuit in question. It follows that where two of the quantities are known, the third is easily determined.

For example, if it is desired to find out the current passing through the filament of a valve when the voltage across it is 2 volts and when the resistance of the filament is 10 ohms, then we apply Ohm's Law thus: $I = \frac{E}{R}$. That is, $I = \frac{2}{10}$, that is .2 amp. This is an example where the *current* in the circuit is the unknown quantity. If it is desired to determine the resistance, then the law may be expressed thus: $R = \frac{E}{I}$, or again, if the voltage is the unknown quantity, the expression becomes $E = IR$.

There are many other cases where *Ohm's Law* is used, such as in the working out of the value of voltage dropping resistance, anode resistances, the current in the anode circuit of a valve, and the voltage dropped across grid-bias resistances, etc., etc.

Open Circuit

A circuit which is not continuous and therefore, one through which current cannot flow.

Oscillations

When wireless waves strike the aerial of a receiver they set up electrical oscillations in the aerial circuit (the aerial tuning coil and condenser). These oscillations are simply electrical currents moving backwards and forwards very quickly, or at a high frequency, as it is called. They are dependent for their maintenance on the energy supplied by the transmitting station, in other words, on the incoming waves and also on the aerial circuit being tuned to those waves. Of course, if the transmitter stops radiating then the circuit ceases to oscillate. The fact that the oscillations die down in this way as soon as the outside source of energy is removed is due to the resistance of the circuit. There is a way, however, of overcoming the resistance. It consists of utilising some of the energy in the anode circuit of one of the valves. This is transferred to the aerial circuit by a reaction coil, or some such device. The circuit will then oscillate continuously, whether the outside source of energy be continued or not.

When a receiver is said to be oscillating it means that the energy supplied by the reaction device is more than sufficient to overcome the resistance of the aerial circuit, so that the surplus energy is radiated from the aerial in the form of wireless waves. In other words, the

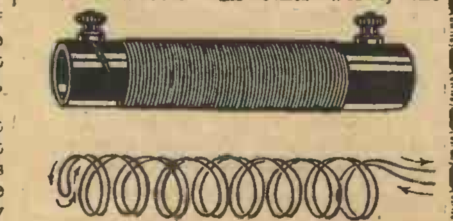


Fig. 2.—Above: Type of resistance which is inductive. Centre: How the wire is wound in a non-inductive wire resistance, and Below: Two other non-inductive resistances.

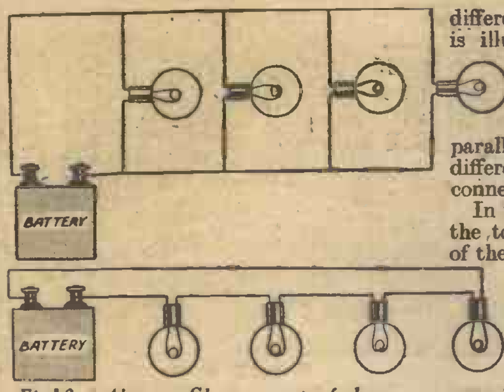


Fig. 3.—Above: Shows a set of lamps connected in parallel. *Below is shown the series arrangement. See* Parallel Connections.

receiver acts as a miniature transmitting station.

This is why a receiver which is oscillating violently will cause interference with neighbouring sets. The squeals and howls produced when the tuning dial is turned are caused by the waves which are being produced by the set combining with or *heterodyning* those radiated by the various transmitting stations "on the air" at the time. Due care should always be exercised in the handling of the reaction control to see that this sort of thing does not occur. It is quite a mistaken idea that louder signals or greater range will be attained by tuning the reaction "full on," since there is no increase in selectivity beyond the point where the self oscillation begins to take place, only the introduction of frightful distortion. It is usually easy to tell when the danger line is being approached by the fact that as the reaction control is advanced and the signals built up in volume, a point is reached where a slight rushing noise manifests itself. With some sets, however, there is scarcely any warning beyond a sudden "plop." This is due to poor design or the fitting of unsuitable valves or batteries.

See also *REACTION.*

Oscillator Valve

The valve in a superheterodyne receiver which is used to produce the local oscillations necessary with this type of receiver.

Oscillograph

An instrument for recording the shape of alternating current impulses or waves, and particularly those of high-frequency currents.

Pancake Coil

A flat type of tuning coil or inductance now practically obsolete.

Parallel Connections

When connecting two or more pieces of apparatus, such as lamps, valves, resistances, condensers, etc., to one source of electrical supply they may either be jointed together in the form of a chain and then the two ends connected to the supply or they can be connected each one separately to the supply. The former system is known as connection in series, the latter as connected in parallel. The difference between the two arrangements is illustrated in Fig. 3. Here electric lamps are the pieces of apparatus and a battery the source of supply. It is also possible to combine the two methods. This is called series parallel connection. Fig. 3 illustrates the difference between series and parallel connections.

In the case of the parallel arrangement the total current is shared between each of the lamps according to their respective resistances. Thus, a low resistance lamp would pass more current than another of higher resistance. With the series arrangement on the other hand, the current through each lamp is the same, but the voltage across each one depends on its resistance and the number of lamps in circuit.

Pentagrid

A valve having five grids.

Pentode

A valve with a total of five electrodes, namely, filament, plate and three grids. It is remarkable for its amplifying properties, having a very high rate of mutual conductance.

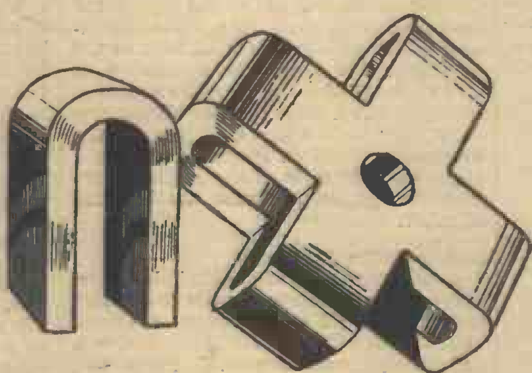


Fig. 4.—Two examples of permanent magnets. *That on the left is as used in a moving-iron loud-speaker, while the one on the right is from a moving-coil speaker.*

The commonest type of pentode is a low frequency valve, its use being limited almost entirely to the output stage of the receiver, where it may be connected either alone or in push-pull with another similar valve.

The H.F. pentode is a recent introduction, and is a modified version for use in H.F. circuits. It has certain advantages over the more orthodox screen-grid valve.

Permanent Magnet

A magnet which retains its magnetism indefinitely. Usually a special steel such as cobalt steel is employed. Permanent magnets tend to lose their magnetism if the gap between the poles is very wide. If a "keeper," which is merely a piece of soft iron, is placed across the gap this loss is greatly minimized. Blows with a hammer, dropping the magnet, or heating the steel will cause rapid deterioration. For this reason it always pays to handle permanent magnet loud-speakers with the utmost care, as apart from other damage, dropping them may demagnetize the magnet.

Permeability

This may be described as the magnetic conductivity of a material. A substance which offers a ready path for magnetic lines of force is said to have a high permeability. Substances such as air, glass, paper, and the majority of metals have a permeability of unity, whereas ferrous substances have a higher value. The highest values are found in certain special iron and steel alloys, such as the nickel iron which is used for the cores of transformers. So much easier is it for the lines of force to pass through the iron core of a transformer that practically none is radiated out into the space beyond the core. High permeability is one of the desirable properties of the core of a low-frequency transformer or choke.

Phosphor Bronze

An alloy of copper, tin and phosphorus. It has greater tensile strength than pure copper, but is equally good regarding electrical conductivity, and thus makes a very suitable material for aerial wire.

Photo Electric Cell

A device which alters its resistance according to the intensity of the light falling upon it. In appearance it is somewhat like an electric bulb, and its chief use is in connection with television and talkies.

Pick-Up

See GRAMOPHONE PICK-UP.

Plate

Another name for the anode of a valve. In a receiving valve it is usually a small box-shaped or cylindrical structure. In the centre is placed the filament or cathode and between the two is the grid or grids consisting usually of wire mesh. Fig. 5 shows a typical plate in a receiving valve.

In the ordinary type of valve the plate is enclosed in a glass bulb which is exhausted of all air, but in the new Catkin type of valve the plate itself forms the envelope of the valve.

Plate Circuit

That part of the circuit of a wireless set between the plate or anode of a valve and the H.T. supply.

Plate Voltage

The voltage applied to the anode or plate of a valve in order to make it positive in respect to the filament or cathode. The plate voltage is derived from the H.T. battery or mains unit. It is not necessarily the full voltage of the battery or unit since some drop in voltage occurs across any impedance in the anode circuit, such as the primary of a transformer, or other component.

Fig. 5.—Valve cut away to show the plate.

Converting a Short-Wave Receiver—

—How to Adapt it to the Super-Regenerative Principle

By D. P. TAYLOR

IT is well known that for reception on the short, and more particularly ultra-short, waves, the super-regenerative type of receiver offers several distinct advantages over the more orthodox type.

For example, by the use of the super-regenerative principle it is possible to make with the simplest apparatus a receiver with enormous amplification, and consequently great sensitivity.

The super-regenerative type of receiver is not as selective as the more usual type, but this is not necessarily a disadvantage at the present state of short-wave work, where it proves of great assistance in searching for stations in the very large frequency bands involved. Before dealing with the practical details of converting short-wave receivers to this principle, let us consider the super-regenerative principle from a theoretical point of view.

The Super-regenerative Principle.

As the retro-action control on a normal detector valve is increased, the negative resistance injected into the grid circuit tends to neutralise the positive resistance present.

A point is reached where the positive resistance present is equal to the negative resistance injected into the circuit by the feed-back and the effective resultant resistance will be zero.

If the retro-action be increased above this point, the resultant resistance would be negative. If a signal be applied to the tuned grid circuit when the resultant resistance is positive, this signal will be damped due to energy loss in the positive resistance.

If signals were applied at the point where the resultant resistance of the circuit were negative, the signals would build up to a maximum value limited only by the characteristics of the valve, but due to the fact that the resultant resistance is negative these oscillations will continue after the applied signal has ceased, and this is a condition of self-oscillation and will be familiar to anyone who has handled an oscillating receiver, being a condition in which it is impossible to satisfactorily receive signals.

Suppose now the signal were applied at the point where the positive and negative resistance are equal, giving an effective resistance of zero, we should then have a receiver of remarkable high-frequency properties, as any signal, no matter how small, would cause oscillations to build up to a limit dependant upon the characteristics of the valve, and yet at the same time as the effective resistance is zero, the oscillations should follow the original wave form.

This receiver would suffer from the disadvantages that any atmospheric or electrical change in the circuit would also cause oscillations to build up to the maximum amplitude.

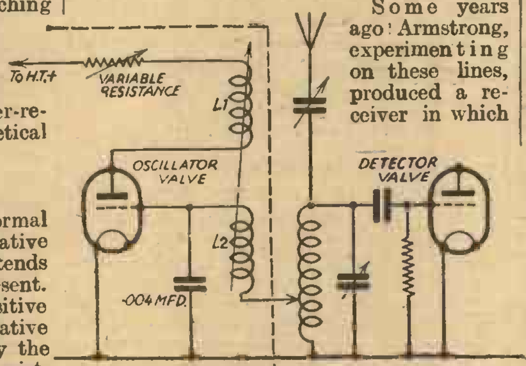


Fig. 1.—A simple regenerative arrangement.

Some years ago Armstrong, experimenting on these lines, produced a receiver in which the effective resistance was varied from a positive value to a negative value at a supersonic frequency.

It was arranged that the mean value of resistance was such that the circuit was prevented from falling into self-oscillation, and yet at the same time allowing the signal to build up to a large value in the intervals when the effective resistance is negative.

It is found that the super-regenerative effect is more pronounced (*a*) The lower the value at which the value of the resistance is changed, although it is necessary that this shall be accomplished at a supersonic rate so that it shall not be audible, (*b*) The higher the signal frequency, as under these conditions the signal builds up to a larger value in the intervals when the effective resistance is negative.

This variation of grid circuit resistance can be accomplished by several methods, but the means which we shall consider at present are :—

(1) Variation of the grid circuit damping by tapping the grid circuit return of a supersonic oscillating valve to the tuned circuit of the receiver.

(2) Variation of the amount of negative resistance feed-back by the variation of anode volts of the detector valve at a supersonic frequency.

It is possible to arrange for the detector valve to perform the dual purpose of detector and supersonic oscillator, but in doing so a certain amount of efficiency is sacrificed, and we will consider at the moment methods which entail the use of an extra valve. Let us now consider the conversion of a straight short-wave receiver to the super-regenerative principle using the method described in (1) above.

The circuit diagram is shown in Fig. 1, all the apparatus shown enclosed in the dotted lines being the supersonic oscillator. The inductances used are two coils each of 1,000 turns, the grid coil being shunted by a .004 microfarad fixed condenser.

The coils can be conveniently wound between plywood discs mounted on a rod, with suitable spacers, the end of the centre rod being fixed in the chuck of a drill for the purpose of winding.

It will be seen that the end of the grid coil, instead of being returned directly to the low-tension circuit is tapped on the grid coil of the receiver.

A variable resistance is inserted in the high-tension feed lead of the supersonic oscillator for the purpose of varying the amplitude of the oscillations which is used in practice for the purpose of effecting a compromise between signal strength and noise level. We will now consider the method shown in (2) above, for converting a receiver to the super-regenerative principle.

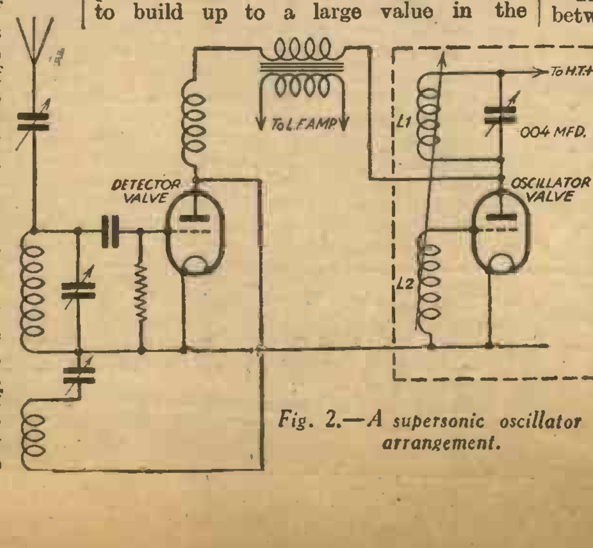


Fig. 2.—A supersonic oscillator arrangement.

(Continued overleaf)

RADIO RAMBLINGS

By JACE

Jottings from my Notebook

That Cheap Commercial Set !

HOW is it done ? The answer is that although manufacturers use components which are just as good as those which you and I buy, instead of being enclosed in prettily coloured bakelite cases and having nice nickel-plated terminals, they are left as "bare-bones" without any fancy trimmings and with soldering tag contacts. I am now wondering why the makers of components do not offer these bare-bone "manufacturers' models" to us. I am quite sure that we should not object to the appearance so long as we knew the parts were good—neither would most of us mind unearthing the soldering iron again, if by so doing we could save money. It appears that if all components could be sold in this way their price could be reduced by quite 20 per cent. in most cases.

"Standard" and "Manufacturers'" Models

IT might be added that one firm of transformer manufacturers at least do sell their products in two types—"Standard" and "Manufacturers'." The latter are a good deal cheaper as you can tell from the following specification taken at random. "Mains Transformer, giving outputs of 250–250 volts, 60 m.a. and 4 volts at 1 amp. Price, Standard Model, 26s.; Manufacturers' Model, 22s. 6d." Both models have identical characteristics, but whilst the first mentioned is fitted with terminals, the second has wire connections.

Again, there is a certain make of fixed condenser which can be obtained with either terminals or soldering tags. A .0005 mfd. component costs 1s. 3d. and 9d. respectively in the two types. Surely it is worth while to use soldered connections !

To Solder or Not to Solder

PERSONALLY, we are in favour of soldering, for after very little practice it is both easier and quicker to wire up a set in this way, and the trouble associated with subsequent loose connections is practically obviated.

The "Westector"

HAVE you tried the new "Westector" yet ? For automatic volume control they are ideal, especially in a superhet. Due to their inevitable capacity they put a fairly heavy load on the tuning circuit at wavelengths below 300 metres or so, but at 2,000 metres (the approximate wavelength at which the second detector of a superhet operates) their damping effect is negligible. Even on the medium waveband, however, the rectifier does not appear to reduce selectivity to a very great extent if it is connected to a fairly low tapping on the preceding coil.

One very interesting use for the half-wave "Westector" is as combined detector-automatic volume control in a 2 V.-M. four-valve set. By inserting the rectifier after the second tuned-grid coil, and converting the valve detector for use as L.F. amplifier, results were almost as good as before (despite the loss of reaction) and with the added advantage of A.V.C. Due to the small size of the rectifier it was an easy matter to fit it in the set without the need for any alteration to lay-out, and, by using R.C.C. coupling between it and the valve that previously functioned as detector, very little space was required for the few additional components.

Super-Power Transmitters

IT is about time that some restriction was placed on the maximum permissible power, and this alone would go a long way towards the solution of our present difficulties. We have recently tasted the delights (?) of high power by listening to the tests of the new Moscow station, which has been working on 500 kilowatts somewhere near the top of the long-wave band. We say "somewhere near" because we have been unable to locate the exact wavelength, due to the fact that the station could be heard over a band of something like 100 metres, even with a fairly selective set.

Another station which has caused not a little trouble of late is Radio Luxembourg. Although working with fair regularity on 1,250 metres and with a power of 200 kilowatts, this "giant" has, so far as I am aware, no authority from the U.I.R. to do so. He has caused no end of trouble on the long-wave band, even in this country, so he must have been much more than a nuisance in Central Europe. It certainly appears to us that the whole idea of colossal power can do no more than defeat its own objects. To enable us to cut out the interference caused by super-power stations we are obliged to build ultra-selective receivers having numerous valves, so that if the powers were reduced we should still receive as many programmes with better quality and less interference.

CONVERTING A SHORT-WAVE RECEIVER

(Continued from page 603)

The Supersonic Oscillator

As will be seen from Fig. 2 the supersonic oscillator is inserted in the anode feed to the detector valve causing the anode potential of this valve to be varied at a supersonic frequency.

The oscillator in this case is identical to the one previously described, with the exception that in this case the anode coil is tuned by the .004 condenser instead of the grid coil.

When testing these super-regenerative adaptors the first thing is to determine if the oscillator valve is oscillating satisfactorily, this is best done by inserting a milliammeter in the anode circuit of this valve and noting if a large increase of anode current takes place on short-circuiting the anode or grid coil.

If it is found that the oscillator valve is not oscillating properly, it is advisable to reverse the connections to one of the coils to ensure that they are coupled in the correct sense, also it is often worth while trying the effect of a change in valves.

When the oscillator is working satisfactorily the circuit should be connected up as shown in Fig. 1 or 2 and, with the filament circuit of the oscillator broken, a station should be tuned in on a low wavelength with the normal reaction control at the maximum at which it is possible to receive satisfactorily.

If the oscillator valve is now switched on an immediate increase of signal strength is noted and it will be found that the detector reaction control can be increased still more without self-oscillation taking place.

If the amplification be pushed too far it will be found that background noise becomes excessive, and a compromise can be effected by the adjustment of the detector reaction control or by the resistance in the oscillator anode circuit or, in the case of the circuit shown in Fig. 1, by the adjustment of the tapping of the receiver grid coil.

It will be found, too, in practice that whilst the noise level may be high when not tuned to a station the receiver becomes quieter when tuned to a carrier wave.

In practice, the super-regenerative effect becomes more effective the greater the difference between the quenching frequency and the signal frequency due to the fact that the signal has a larger time to build up in the intervals whilst the resistance is negative, therefore the types of receivers described are very effective on the ultra-short waves.

In conclusion it might be said there is a very large scope for experiment in receivers of this type, which should appeal to many amateurs, as the apparatus required is inexpensive and should be of particular interest in connection with the British Broadcasting Company's ultra-short wave transmissions.

IMPRESSIONS ON THE WAX

A REVIEW OF THE LATEST DISCS

By E. REID-WARR

MOST of the music issued on the latest records still remains light in character. Even the London Philharmonic Orchestra, under Sir Thomas Beecham, trip delicately about with Rossini's *Scala di Seta*, finishing with Handel's *Entry of The Queen of Sheba* from *Solomon* (*Columbia LX*255). There are no "deep depressions" in Rossini, but this overture has, I fear, too close a likeness to the *Barber of Seville* to send one *quite* frantic. It is marvellously played and the contrast of Handel is clever: it "goes" so well with it. Hear this, by all means. Then come back to Town and hear Eric Coates conducting a Symphony Orchestra in his *London Suite* (*Columbia DX*470). First—Covent Garden, which is a symphonic arrangement round "Cherry Ripe." Then Westminster, very soothing and contemplative. Lastly—Knightsbridge with martial glitter and pomp. Very, very English—and three very attractively drawn sketches of London. Henry Hall's B.B.C. Dance Orchestra have made a good record in *Viennese Memories of Lehar* on *Columbia DX*472. A number of the most popular airs are selected and played in most attractive manner. This band is capable of turning out good music in a higher plane than dance tunes.

Play of Butterflies and *Fairy Tale* are two new titles by Heykens, played by Albert Sandler's Orchestra, on *Columbia DB*1131. True to type (the Serenade, that is) but the second title need scarcely have been renamed. The first is deliciously played almost as a minuet, and Sandler himself is especially good. Of similar simple strain are *Ecstasy* and *Golden Kisses*, on *Parlophone R*1533. Here Edith Lorand's Orchestra give a straight, well-balanced performance of two orthodox waltzes.

Those who like Hawaiian guitars as a judicious seasoning to a piece will like Gino Bordin and his Hawaiians, on *Parlophone R*1532. They play *The Blue Bird* and *In Vienna One Night* most attractively, letting the violins (and the melody) have their share.

For something rather more full-blooded and festive *Regal-Zono* have two records which are excellent. The first is *Marching To A Military Band* and *It's The Band* (MR954), by an anonymous Marine Pavilion Band. Very vigorously played, but the vocals would have been better omitted. The second—*Rhapsody in Blue* (*MR*957), by Billy Cotton's Band, is played with any amount of confidence. This piece really is clever, however much one may dislike jazz effects. It is a syncopated symphony *de luxe*, and nothing, since it was written, has looked like dethroning it. The heavy piano part is got through with only one or two tiny errors, a very clever accomplishment.

Really the next is a dance record, but it is so very good as to be treated and bought as an orchestral piece. (We have minuets by Mozart and Beethoven, anyway!) Hear *For You, Rio Rita* and *I Want Nothing But Your Love*, on *H.M.V. B*6342. South American stuff by Marek Weber's Orchestra, grandly played. The first, a paso doble, is packed with infectious gaiety. The very thing for the summer evenings.

One from the classics to end this section. on no account miss *Columbia DB*1133, on which the Lener String Quartet play a transcription of Bach's *Air From the Suite in D* and the finale of the *Quartet in D Major* (*Dittersdorf*). If all the chamber music we heard were as lovely as these (especially the first) there would be no more caustic postcards to the B.B.C. Hear it; I think you will agree.

Mostly Ballads

Poetical fancy flies high in the first of Lawrence Tibbett's pair on *H.M.V. DA*1313. These are *And Love Was Born* and *The Song Is You*. The first is a charming little song, and the way in which it is sung is a model to imitate (if one could!) Tibbett is a magnificent singer, especially in this sort of song. How many times *Border Ballad* has been done, I know not, but there is a satisfactory version by Irving Naismith on *Decca F*3478. He is a good baritone, and this is happily done with a nice Lowland dialect. *Fairings* backs it, but he is not quite at home with it.

Here is one for the votaries of the open road. Sit and listen to Harold Williams singing *My Sheep Dog and I*, and then continue to tramp *With A Song* on *Columbia DB*1134. Neither is original in theme or music, but for the camp or caravan they will fit the occasion to a nicety. By the way, another which might also be taken along for a sing-song is *The Ratcatcher's Daughter* and *Botany Bay*, by the Victorian Quartette, on *Regal MR*945. These absurd, attractive mixtures of bathos and pathos always seem to come up as fresh as ever.

For those who like the modern pseudo sentimental song, Morton Downey fills a need. He has *Remember Me* and *Farewell To Arms*, on *Broadcast* 3207, and the orchestra shines brilliantly in the accompaniment to the first—a pretty piece of work.

Hilarities

We can laugh heartily, and keep on laughing at four very funny records just issued. First, our old friend Stanley Holloway. Listeners will remember in a recent appearance he gave us *Sam's Medal* and *Many Happy Returns*. *Columbia* were snowed under with requests for a record of these two, and here it is—*DX*474. Sam Small didn't get the V.C. for saving the Sergeant-Major's life, but the telling of his encounters with the great ones is humour to the *nth* degree. I believe this is the best Sam Small yet, thanks also to Mabel Constanduros and Michael Hogan, who wrote it.

Then vocal humour. Try Ann Suter in *Jekyll and Hyde* and *Actions Speak Louder Than Words*, on *Parlophone R*1529. Dual

(*Continued on page 612*)

REVIEWED BY AJAX

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. Where advertisers make a charge, or require postage, this should be enclosed with applications for catalogues. No other correspondence whatsoever should be enclosed.

GRAHAM FARISH COMPONENTS

THE new Graham Farish catalogue, which is printed in either English, French, German or Spanish, will be welcomed by readers at home and overseas. Amongst the components listed are the Filt Percolative Earth, Lit-Los Condenser, Ohmite Resistances, Fixed Condensers, and a new twin-screen H.F. choke. Particulars are also given of a new precision volume control which has an element of fine nickel-chrome wire embedded in bakelite. The action is through a slipper-plate, giving a smooth, positive contact. A copy of either of these catalogues can be obtained from Graham Farish, Ltd., Masons Hill, Bromley, Kent.

UTILITY PRODUCTS

A USEFUL range of "Utility" steel ganged condensers is shown in an attractive catalogue issued by Wilkins and Wright, Ltd. The chassis is built of heavy gauge steel, and the spindles run in ball bearings of ample size which ensure smooth action. All ganged condensers are matched to less than one-half per cent. For superhet sets a model is supplied which incorporates a specially-designed section for tuning the oscillator circuit. These condensers are obtainable in the two, three or four-gang type. Other high-class components shown in the list include a new straight-line dial, anti-capacity switches, drum dials, and the "Utility" Micro-Dial with a ratio of 100 to 1. This dial, with its fine vernier adjustment and smooth action is specially suitable for short-wave tuning.

MULTITONE CLASS B CONVERTER

HOW to get all mains volume from a battery set without extra battery consumption is explained in a folder just to hand, which gives full particulars of the Multitone Class "B" Converter. This instrument, with which any Class "B" valve can be used, is simply plugged into the output valve-holder of a set, giving greater volume without added battery consumption. There are no terminals or switches. The converter, which is housed in a neat cabinet, is priced at 37s. 6d. without valve. A copy of the folder can be obtained from Multitone Electric Co., Ltd., 93-98, White Lion Street, London, N.1.

EELEX SHORT-WAVE CONVERTER

READERS interested in short-wave reception will find plenty of useful information on the subject in a new Short Wave Booklet we have just received from J. J. Eastick & Sons, 118, Bunhill Row, London, E.C.1. Details are given of the Eelex Short Wave Converter, an efficient unit working on the super-het principle, and priced at 52s. 6d., less valves. Full particulars are also given of the Eelex Modulated Oscillator. A list of short-wave stations and times of transmissions is also included in the booklet, a copy of which can be obtained from the address given above.

Replies to Broadcast Queries

VEAL (Putney): The latest published list gave the address of G2DL as Romford (Essex); possibly the address of the experimenter has since been changed. J. W. D. (Nottingham): This was a simultaneous broadcast by GSC Daventry (Empire) on 31.297 m. (9,585 kc/s). HOT BEARING (Acton): Radio Luxembourg (1191.5 m.). SPRINGBOK (Weston-super-Mare): G2LI, H. C. Wilkinson, 14, Kingswood Avenue, Queen's Pk., Kilburn, N.W.6; G2QZ, J. R. Miller, 11, Forty Avenue, Wembley (Mdx.); G2UV, W. E. F. Gorsham, 31, Rugby Avenue, Wembley (Mdx.); G2XO, A. Turner, 13, Elgin Avenue, London, W.9; G5GY, T. B. Gregory, 60, Lea Road, Wallasey (Cheshire); G6QB, L. H. Thomas, "Conway," 66, Ingram Road, Thornton-Heath (Surrey); ON4KR, S. Vanderstichele, College St. Joseph, Mouscron (Belgium). Cannot trace in latest published lists, G2SR, G2SQ, G5AY; write R.S.G.B., 53, Victoria Street, London, S.W.1. NICHOLLS (Whitley Bay): English talks from Moscow are broadcast on Monday, Wednesday, Friday and Sunday between 8.0 and 9.0 p.m. and are best heard through the short-wave transmitter on 50 m. S.B. on 1,304 m. Between 7.0 and 8.0 p.m. similar talks may be tuned in on 1,000 m. and 1,481 m., also occasionally from Leningrad on 857 m. The time of the next broadcast is usually given out at the end of the transmission. MONTAGUE (Bury St. Edmunds): Identification can only be made if full call letters are given. Cannot trace 5.0W in lists. G2OZ, J. W. Norton, "Daleside," Lincombe Drive, Torquay (Devon): G2XX, F. Wilson, Risca Road, Newport (Mon.). J. W. D. (Nottingham): Cannot trace G5YP; write to R.S.G.B., 53, Victoria Street, London, S.W.1; (2) The broadcast was from WBZA, Boston (Mass.) and heard through W1XAZ, Springfield (31.35 m.). In the U.S.A. Z is pronounced Zee, hence you mistaking it for letter B. G6QR, A. Shearer, "Orrell," Bootle, Liverpool; G5GY, T. B. Gregory, 60, Lea Road, Wallasey, Cheshire. YUGO (Wirral): G6UH, H. E. Smith, "Arawa," Granville Road, Limpsfield, (Surrey); W2MG, Willet Hamilton, 1044, Woodycrest A., New York City, U.S.A. 5 METRE (Bradford): G5RX, S. Newell, 9, Moor View, Rakehead, Stacksteads, Bacup (Lancs.); G6AZ, F. B. English, 42, Brownberrie Ave., Horsforth, Leeds (Yorks); CT1AA, Abilio Nunes dos Santos, Avenida Antonio Augusto d'Aguiar 144, Lisbon, Portugal; G6RL, R. F. Loomes, 14, Nursery Close, Wickham Rd., Shirley, Croydon (Surrey); G6SR, S. W. Rowden, "Rosebank," Pilrig St., Edinburgh, Scotland; G5XT, F. Robinson, 4, Cranford Gardens, Acklam, Middlesbrough (Yorks); G2OC, L. R. Seal, 98, Wollaton Rd., Beeston, Nottingham; regret, cannot trace G5MM, G6MR, G6IF, and G2GB; advise you to write to R.S.G.B. SUPERHET (North Wales): Sverdlovsk (U.S.S.R.) on 1,860 m., testing with other Russian stations (Samara, etc.). PIP (Sussex): Probably IAF, Fiumincino (at the mouth of the Tiber) on 10.06 m., working with IAG, Golfo Aranci (Sardinia) (9.8 m.). A. S. P. (Stockton): G2HS, J. G. Maitland Edwards, 127, Ashley Gardens, Westminster, S.W.1. VICRIS (Southport): G2QI, D. Briggs, 24, Gaer Park Crescent, Newport, Monmouthshire; G6JQ and G5CO, regret, cannot trace; advise you to write to R.S.G.B.

IMPRESSIONS ON THE WAX

(*Continued from page 607*)

personality is presented by a real comedienne, aided by a rattling good tune, and —a considerable amount of spice! It is by no means offensive: it is just one of the best songs of its kind ever done.

Then Anona Winn. This wireless favourite is a very clever artist indeed—her versatility is remarkable. She has a splendid voice and brilliant powers of mimicry. You get both on *Columbia* DB1138—*All Over Italy* and *Our Little Baby Boy*. The imitation of the two American Aunts in the second is a gem.

Lastly, Billy Caryll and Hilda Munday are at it again on *Broadcast* 3311. They indulge in some *Home Chat*, hurling verbal venom at each other without stopping to breathe. Very amusing—to the eavesdropper!

ADVERTISEMENT INDEX

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SOME OLD CIRCUITS REVIVED

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W. J. Delaney, Frank Preston, F.R.A., W. B. Richardson

ROUND *the* WORLD *of* WIRELESS

Final Lucerne Wave-plan

FOLLOWING considerable discussion, a final European wave-plan has been evolved at Lucerne and it has been accepted by the majority of delegates. Holland, Hungary, Finland, Poland, Lithuania, Sweden and Greece, however, have not agreed to the allocation of wavelengths, but as no general change-over can take place before January, 1934, there is every hope that they may be induced to give their consent before the plan is brought into operation. So far, at the time of writing, Great Britain appears to have succeeded in securing almost everything she requires—we have lost no channels—and subject to some exchanged frequencies between home transmitters, the B.B.C. stations will work on the following wavelengths: Daventry National (1,500 m.); North Regional (449.1 m.); Midland Regional (391.1 m.); Scottish Regional (373.1 m.); London Regional (342.1 m.); West Regional (307.1 m.); North National (296.2 m.); Scottish National, Bournemouth and National Relays (285.7 m.); Belfast (267.4 m.); London and West National (261.1 m.); and Plymouth (203.5 m.). It will be seen from the above that, in general, the stations have been placed somewhat lower in the broadcast band, but the actual difference will cause no inconvenience to listeners when tuning their sets.

A Novel Use for Radio in America

I HAVE so got into the habit of telling you a bit of freak radio news from America, or elsewhere, week by week, that I feel I cannot disappoint you by failing to do so even though, to be candid, I am sometimes hard put to obtain something authentic to tell you from "over there." This week I offer you two items of interest, the first of which cannot be called "freak," by any means as it goes to show the vast progress that has been made in radio design during the last few years. This takes the form of a light-weight radiophone—that is the American name for it—for use in small light aircraft. This set is able to transmit and receive at will and enables the pilot, who is often working single-handed, to call up aerodromes and inquire landing conditions, and to receive weather reports and any other information he might require. It is no larger in size than an ordinary two-valver and weighs only 11lbs! The other item is somewhat more strange! It has been found that mosquitos are attracted by the loud humming noise that the female insects make while in flight, and a band of radio inventors have imitated this noise by means of loud-speakers and oscillating valves. The mosquitos roll up in thousands to be caught in a trap, and this time radio destroys lives instead of saving them. This method of fly-catching was hit upon quite by accident for it was found that mosquitos were being burnt by the thousand in an electric furnace that made a humming noise while working in an American works. This discovery led to the production of the radio catcher!

No Channel for the Private Stations.

THE effect of the decisions taken by the Lucerne Conference on privately owned transmitters has been specially disastrous, inasmuch as no channel has been officially provided for their use, and they will be left to the tender mercies of the French State authorities. As the wavelength of 312.8 m. has been reserved to a transmitter in the Paris region, it is expected that the *Poste Parisien* will be allowed to take it over. Whether Radio Toulouse will secure authority to operate on 335.2 m. or 222.6 m. is not yet known, but the latter channel is an international common wavelength for which the maximum power allowed is 30 kilowatts. It would also be shared with a large number of foreign stations. The fate of Nice-Juan-les-Pins, Radio Normandie (Fécamp), Radio Vitus (Paris), Radio L.L., as well as Béziers, Nîmes, Agen and Bordeaux-Sud-Ouest is still in the melting pot. January 15th, 1934, will witness a "general post" and a re-logging of European stations will prove to be a pastime for many long winter hours.

If Belgium Raises the Tax

THE rumours that the Government would shortly increase the broadcast listening licence from 60 to 100 francs has raised thousands of protests from all over the country. Most of the wireless associations which provide entertainment programmes to the two Brussels stations have decided to appeal jointly to the authorities on the grounds that such an increase in cost would strangle the radio industry in Belgium. Roughly speaking there are 400,000 wireless sets registered, representing about one and a half million listeners.

The Radio Tourist Special

AS an experiment the Belgian Railway Company has brought into operation this summer a special train, "radio-touristique," working a circular tour between Bruges, Liége, Spa, Ghent, etc. All first and second class carriages are equipped with four loud-speakers connected with a microphone and amplifying panel located in the guard's van. By this means, a running commentary is given to passengers on all historical and other places of interest met with during the trip. Tests are also being carried out with wireless receivers, gramophones and electrical pick-ups. If the scheme proves successful, some 200 trains will be similarly equipped as it is calculated that the cost of the installation in each instance could be completely covered in the course of one summer season.

ROUND the WORLD of WIRELESS (Continued)

INTERESTING and TOPICAL PARAGRAPHS

Promenade Concerts 1933

A SUMMER in London is unthinkable without the "Proms." There is no need to announce that another season of them will be held this year, any more than the public has to be told that the conductor will be Sir Henry J. Wood, who, like the concerts themselves, reappears for the thirty-ninth consecutive year. A few particulars, however, may be of interest. The season is to last eight weeks, with the usual additional Saturday at the beginning. The opening concert has been fixed for August 12th, and the series will come to an end on October 7th. Needless to say, the B.B.C. Symphony Orchestra will play throughout. The programme scheme does not vary a great deal from that of previous years, but one or two features will be changed. There will be the usual generous allowance of British music, but instead of being substantially included in special "British Composer" nights, it will be fully distributed throughout suitable programmes.

Excerpts from Seaside Shows.

NO items are more welcome during the summer months than the regular relays of excerpts from the best seaside shows. One of the most popular of these is at the Beach Pavilion, Aberdeen, from which the inimitable Harry Gordon and his Company will broadcast to the Scottish Region on August 4th. While the majority of outside broadcasts to Scotland at this time of year come from the seaside, the microphone still remains faithful to the Edinburgh Theatre Royal, where the traditional spirit of Variety lives on as vigorous as ever. An excerpt from the show at this theatre will be relayed on Tuesday, August 1st, and should be a fitting tribute to the holiday season.

Royal Dockyard Draughtsmen's Choir.

THE Royal Dockyard Draughtsmen's Choir, conducted by George Bollard, will give a concert from the Plymouth studio on August 2nd. Marcel Kingdon (tenor) will sing, and Ernest Watkiss will play two groups of violin solos at this concert, which will be relayed to West Regional listeners.

Cycle Racing Broadcast

MOTOR cycle racing on grass is a sport that provides plenty of thrills, and listeners will be interested to hear that an eye-witness account of the Grass Track Motor Cycle Racing at the Maze Racecourse will be given from Belfast on August 5th. This event has been organised by the Lisburn Motor Cycle Club.

"The Week in Scotland"

DURING August the regular series of talks on "The Week in Scotland," which, since its inception at the beginning of the year, has been given with great success by Mr. George Blake, will be taken over by Mr. J. W. Herries. Mr. Blake, who combines wide knowledge with an admirable microphone technique, has set a very high standard; but Mr. J. W. Herries, who is a journalist, and no stranger to the microphone, should be equally informative and entertaining. It will be interesting, incidentally, to compare the views of a representative of the West. Mr. Herries will give his first talk on August 5th.

THE "ARTIFICIAL TRAIN" TEST

The H.M.V. way of testing. See paragraph on this page.

Dual Band Broadcast

A CONCERT which promises to provide varied entertainment will be broadcast from Belfast on August 12th. In it will be heard two bands, the Argyle Temperance Flute Band and the Sirocco Silver Band, and Samuel Adams (baritone), who is to sing a number of well-known songs.

SOLVE THIS!

Problem No. 45.

Swinburne built a simple three valver employing a variable-mu H.F. stage, S.G. Detector and Pentode output stage. A special plated chassis was made for him and he completed the wiring with great care. On switching on results were very disappointing, signals only just being audible. He tried various adjustments and made sundry small alterations in the wiring, and after ten minutes or so decided to try an alteration of the bias applied to the Pentode. When he held the grid battery to remove the negative plug he was surprised to find that the battery was quite hot. What was wrong? Three books will be awarded for the first three correct solutions opened. Address your solutions to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. Mark your envelopes Problem No. 45, and post to reach here not later than July 31st.

SOLUTION TO PROBLEM No. 44.

The circuit which Samuels built up should have been mounted on a metal chassis, when the earth connection would automatically have been made to the condenser. As he used a wooden baseboard the earth connection was omitted. This accounted for the fact that the condenser did not tune.

The following three readers received books in connection with Problem No. 43.

Mr. Herbert Fairbanks, 14, Thirsk Grove, Blackpool; Mr. James McCartney, 23, Hayfield Road, Salford 6; Mr. G. Howes, 2, Rothesay Avenue, Richmond.

Organ Recital from Broadcasting House

SIR W. G. ALCOCK will give a recital on the Broadcasting House organ on July 31st, and it will be relayed on the Regional wavelength. The programme consists of Overture in D minor (Handel-Ellingford), Larghetto in F sharp minor (Bach), Caprice (Guilmant) and Postlude in C (Alcock). On Fridays during August organ recitals will be given from the Concert Hall at noon by C. H. Trevor.

"This Radio Racket"

A CHARLES BREWER production will be a popular Midland feature on August 2nd. This is a broadcasting burlesque entitled *This Radio Racket*, the book and lyrics being by Godfrey M. Hayes and F. Keston Clarke, and the music by Jack Venables. Evelyn Over and Dorothy Summers, Peter Howard and Ernest Sefton are in the cast, and the instrumental music is by Ernest Parsons and his Revue Orchestra.

Military Tattoo Relay from Tidworth

ANOTHER important military tattoo will be heard by listeners to the National programme on August 5th, when a relay from Tidworth takes place. These tattoos are, of course, only suitable for broadcasting in sections, as listeners are at present unable to share with the audience on the spot in the visual glories of such displays. The sound portions of the Tidworth Tattoo therefore will be relayed between 9.25 and midnight, and the B.B.C. chorus, led by Joseph Lewis, with Ernest Butcher as soloist, will provide community singing from a studio during an interval.

First Artificial Train for Radio Sets

WHAT is believed to be the first artificial train in the world has just had its inaugural run at Hayes (see photo above). It has no station, no porters, no passengers, and no smoke, but its speed is equivalent to 923 m.p.h. It has been designed by the technical engineers of the "His Master's Voice" research laboratories, and its sole freight is radio receivers and radio gramophones. One of the experts who was responsible for designing the "train," in explaining its use, said, "There are about 2,300 soldered connections linking together the 600 parts of an average receiver. In designing a new set it is essential to make sure that all these parts will withstand the jolts the instruments are bound to receive in transport. Consequently, we set to work to create an 'artificial train,' which comprises a movable platform that is rocked up and down through eccentric cams operated from a powerful electric motor. In order to test a new model H.M.V. radio receiver we strap it on to the platform—start the motor and it then receives 1,500 vibrations a minute."

The BEST L.F. COUPLING

The Problem of Low Frequency Couplings is Not Always Understood by the Home Constructor. In this Article FRANK PRESTON, F.R.A., discusses the Pros and Cons of Every Type of L.F. Coupling.

THERE are so very many methods of coupling low frequency valves that the amateur is likely to experience a good deal of difficulty in deciding which is best for his own requirements. The question is not simplified by reading such bald, but oft-written, statements as "Resistance-Capacity Coupling gives most purity, but Transformer Coupling affords more amplification." Whilst this very general rule might be true in some slight measure there are so many factors to consider that it cannot be applied with impunity.

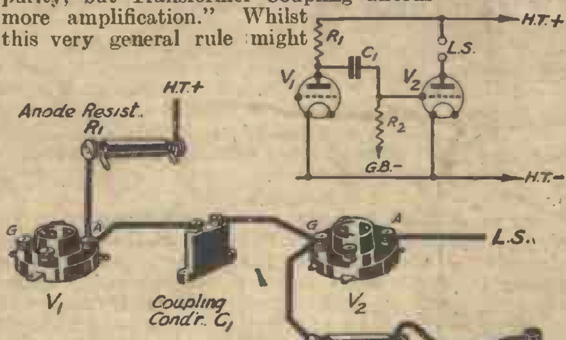


Fig. 1.—The connections for a resistance-capacity coupled stage.

Correct "Matching"

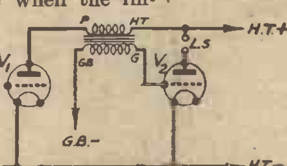
The whole question of L.F. couplings is bound up in the correct "matching" of one valve to another, and we cannot proceed to answer it without first considing certain conditions which must be fulfilled. The primary essential if we are to get the best out of any valve is that the impedance (or resistance to alternating currents) of the component connected in its anode circuit should bear a definite relationship to the impedance of the valve itself. For all practical purposes it can be taken that maximum efficiency is obtained by choosing a coupling component whose impedance is not less than twice that of the valve, or conversely, by choosing a valve which has an impedance equal to one-half that of the component to be connected in its anode circuit. An example will make this point quite clear. Suppose our valve is one of the "210 L.F." type, having an impedance of 10,000 ohms (the exact figure is always quoted on the makers' instruction sheet), the component—transformer, primary, resistance, choke, etc.—to be wired in its anode circuit should have a minimum impedance of 20,000 ohms if the full amplification of which the valve is capable is to be obtained.

If the rule just cited is kept clearly in mind the advantages and defects of the several L.F. coupling arrangements will more readily be appreciated.

Resistance-Capacity

Without any further deliberation let us examine the simplest method of feeding a low-frequency valve, that is, by means of a resistance-capacity circuit. The connections are shown both practically and theoretically in Fig. 1, from which it can be seen that a simple fixed resistance is connected between the anode of V.1—which might be either a detector or L.F. valve—and high tension positive. The grid of V.2 receives its signal voltages through a fixed condenser joined to the anode of V.1. Although it does not take any part in the transference of energy from V.1 to V.2, a grid-leak is joined between the grid of the latter valve and the G.B. battery to permit of the application of the correct bias voltage to V.2.

It is an easy matter to find the correct ohmic value for the anode resistance when the impedance of V.1 is known, but the question of deciding on the optimum capacity for the coupling condenser and the most suitable resistance for the grid-leak is not quite so simple. In practice, however, neither of these values is very critical, and they can both be determined with sufficient accuracy by rule-of-thumb methods. The capacity of the condenser is largely dependent upon the value of the anode resistance and should lie between .005 mfd. for a 100,000 ohm component and .01 mfd. for a 10,000 ohm one. The grid-leak should be from four to eight times as "big" as the anode resistance.



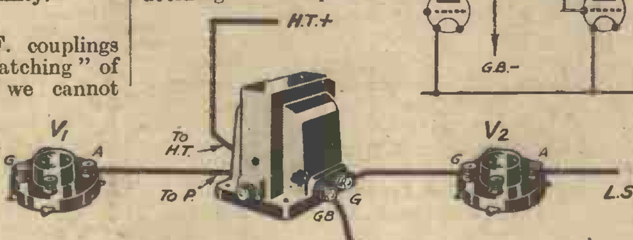


Fig. 2.—L.F. transformer coupling.

Use a Good Coupling Condenser

There is just one important point to remember in using R.C. coupling, which is that the coupling condenser must be a "mica" one of good quality, since it is subjected to very high signal voltages. A poor condenser will "break down" in very little time, and, besides silencing the receiver, will probably cause valve V.2 to be ruined by the application of a large positive grid-bias derived through the anode resistance.

Uniform Impedance

A resistance-capacity amplifier properly set up as explained will produce very fine results in the way of good quality reproduction. The main reason for this is to be found in the fact that the impedance of the anode resistance remains practically uniform at all audio frequencies. We shall see later that the impedance of other coupling devices is subject to wide variations. Resistance-capacity is not the only form of coupling that will give pure reproduction, though it is undoubtedly the cheapest.

Disadvantages of R.C.C.

But it has two notable defects. Firstly the coupling device does not, in itself, provide any amplification and thus the increase in volume obtained is only that produced by the valves. In the second place the anode resistance has the effect of cutting down the high tension voltage supplied to the valve V.1. This loss is not serious where the resistance is 50,000 ohms or less, but for higher values the valve may be prevented from working at its best unless the H.T. battery is of unduly high voltage.

Choke-Capacity

The latter difficulty can entirely be overcome by substituting a low-frequency choke for the anode resistance, because a choke has a comparatively low resistance

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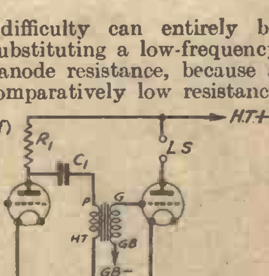

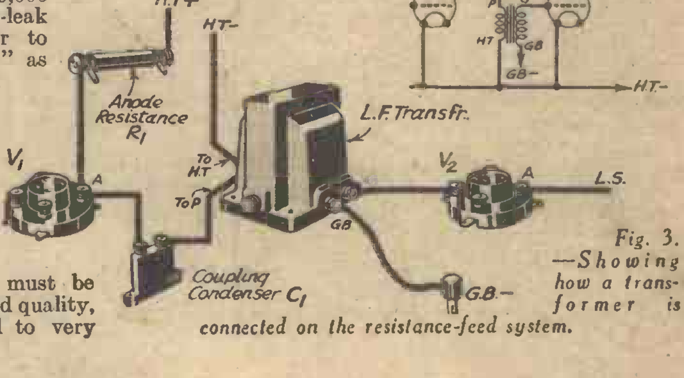

Fig. 3.—Showing how a transformer is connected on the resistance-feed system.

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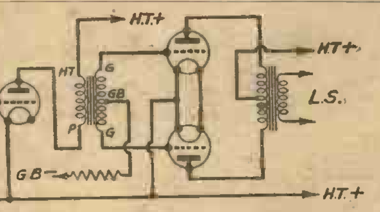
to direct high-tension current, despite its high impedance to alternating or signal currents. To be more explicit: a well-known L.F. choke rated at 20 henries inductance has a D.C. resistance of only 250 ohms, whilst its impedance at 1,000 cycles (equivalent to the average female speaking voice) is over 100,000 ohms. Choke-capacity is thus better than R.C. in one respect, but it is somewhat worse in another. The impedance of any choke varies with the frequency of the alternating currents it has to carry—it becomes less at lower frequencies and more at higher ones. For instance, the impedance of the component referred to above is only about 6,000 ohms at 50 cycles, although it is nearly 600,000 ohms at 5,000 cycles. It will be appreciated from this explanation that a choke must have a sufficiently high impedance—twice that of the preceding valve—at the lowest frequency at which perfect reproduction is required. Unfortunately most manufacturers do not state the impedance of the chokes they supply, but, instead, give the inductance. It will therefore be helpful to know that the impedance at 256 cycles (middle "C" on the piano) can be found very approximately by multiplying the inductance in henries by 1,500. Moreover, in most cases it will be found that satisfactory results can be obtained over the whole musical scale by so choosing the choke that its impedance is correct at 256 cycles.

Theoretically, of course, choke-capacity coupling cannot possibly give uniform amplification to the full range of audio frequencies due to the choke's constantly varying impedance. In practice, however, it is found that so long as the choke has a sufficiently high impedance at about 256 cycles the difference in strength at various parts of the scale is not so much as can be detected by the ear.

There is yet another point to take into consideration, because a choke's inductance varies with the amount of direct current passing through it; as the current is increased the inductance becomes less. In making the above calculation, then, it is necessary to know what inductance the choke has when passing the anode current normally required by the preceding valve. All reputable manufacturers state the inductance both "without D.C." and "on load," so no difficulty arises here. It is important, however, to ensure that the choke is never called upon to carry more than its rated maximum current, because under such conditions its iron core would become magnetically "saturated," with a result that the choke could not respond to the L.F. current fluctuations. Serious distortion would inevitably follow.

L.F. Transformer Coupling

Although choke-capacity coupling obviates one defect associated with R.C.C. it still has the disadvantage of not providing any inter-valve amplification. As a matter of fact the only coupling component which does produce a voltage step-up is a transformer. For this reason more volume can be obtained from two valves coupled by a transformer than by the use of any other device. The latter benefit, however, is obtained only at the expense of quality; but whether the expense will be great or quite inappreciable depends entirely on how "good" the transformer is. If it is a big component with a massive core and a high inductance primary winding it will produce results quite as good as those to be obtained with choke coupling. If not—well, it just won't. The transformer must be chosen in exactly the same way as the choke with a view to its primary impedance and not, as many people wrongly imagine, by its step-up ratio. *A well-designed L.F. transformer of low ratio will give distinctly better results than a poor one having a high ratio.*



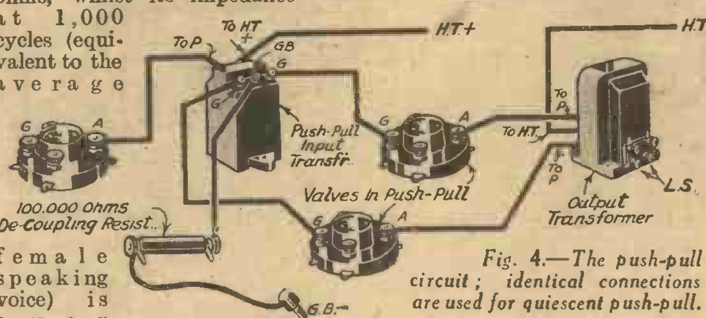


Fig. 4.—The push-pull circuit; identical connections are used for quiescent push-pull.

When more than a single L.F. stage is employed it is almost invariably better to use Resistance-Capacity or Choke-Capacity coupling for the first stage at any rate, since when two transformers are used there is always a danger of causing instability or overloading, due to the excessive amount of amplification produced. Two, or even more, transformers can be used together, but for good results great care is necessary in designing the receiver.

Resistance-Fed Transformer

Because of the disadvantages mentioned, it is more than probable that ordinary transformer coupling, as illustrated in Fig. 2, will gradually die a natural death. It is rapidly being replaced by a system which combines the R.C.C. and transformer methods, and which is illustrated in Fig. 3. The resistance R.1 and condenser C.1 are the same as the two similar components shown in Fig. 1, but a transformer is inserted between the coupling condenser and the grid of V.2. It will be seen that the anode resistance carries the direct H.T. current to the anode of V.1 and the transformer has therefore to deal with the alternating signal currents only. This component can thus be made quite small without there being any danger of its core becoming "saturated." The degree of amplification to be obtained is slightly greater than that provided by the transformer alone, and the quality of reproduction is equal to that given by the R.C.C. method of coupling.

Push-Pull

The next system of L.F. coupling I wish to mention is known as push-pull, and which has recently come into great prominence in two or three different forms. Connections for a P.-P. amplifier are shown in Fig. 4, from which it can be seen that two valves are used in the output stage. Their grids are fed from a special input transformer having a centre-tapped secondary, and an output transformer with centre-tapped primary is used to "collect" the amplified signal currents from the anodes of the two valves. It can be seen from Fig. 4 that both valves receive their grid bias through a common tapping, which is decoupled by means of a 100,000 ohm fixed resistance.

The principal advantage of push-pull is that a large undistorted output can be obtained even when the H.T. supply is of comparatively low voltage, and by using two small power valves in the last stage. This is because the two valves work together, each dealing alternately with the negative and positive half-cycles; one valve can thus be said to be "pushing" whilst the other is "pulling." In consequence, any distortion which might occur in one valve is cancelled out by the other.

Quiescent Push-Pull

The system just dealt with is that which has been in use for several years, but a newer "version" of it has only become popular during recent months. I refer to quiescent push-pull, or, by another name, "push-push." The new method differs from the old only in respect to the way in which it is used. The two valves are given a very heavy negative grid bias so that they normally pass only one or two milliamps of H.T. current. On the application of signal voltages, however, the valve which receives the positive half-cycle amplifies in a normal manner

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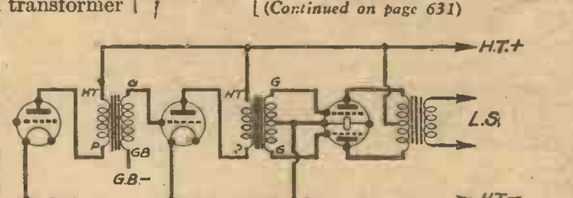

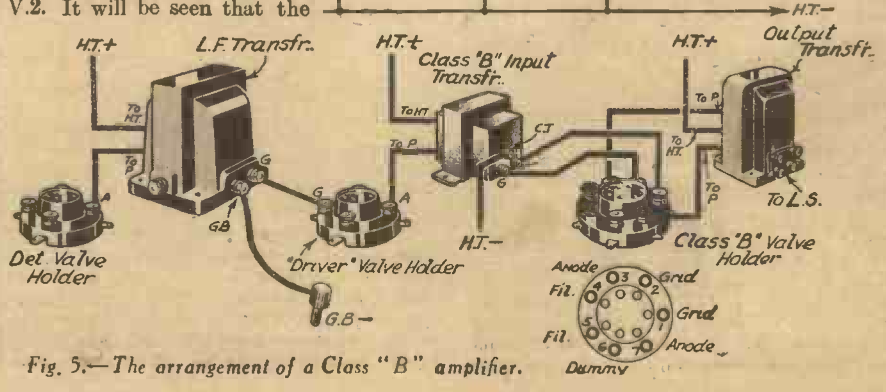

Fig. 5.—The arrangement of a Class "B" amplifier.

PLUG-IN COILS V DUAL COILS

By H. E. THOMPSON

In This Article the Author Discusses the Relative Merits of Both Types

THOSE who have followed Mr. Barton Chapple's articles on The Development of the Tuning Coil in Nos. 20 to 23 of PRACTICAL WIRELESS, will have observed that the dual coil of to-day is not an ephemeral cult of the moment, but a design evolved through many varying shapes from an ancestor remarkably like its present-day descendant. This family likeness is unfortunate in some respects, for it is primarily responsible for the idea that the reversion to type is also a reversion to inefficiency. The radio amateur who has not delved very deeply into the mathematics of his hobby may well be excused for comparing unfavourably the insignificant, and often rather shoddy-looking, wire-wound cylinder that he finds beneath his screening can with the intricate and artistic windings of a good commercial plug-in coil of some years ago. Whatever be the reason, there can be no doubt that there is a firmly-rooted belief amongst many amateurs that the plug-in coil possesses some inherent superiority—a belief that periodically finds expression in the correspondence columns of this journal, and that I have even heard avowed occasionally by dealers in wireless apparatus. Now that the series of articles on coil evolution has been completed, let us apply the theories of design explained therein to this question of coil types, in order that we may discover what justification exists for preferring one type to another, either on theoretical or practical grounds.

A Question of Efficiency

One cannot be dogmatic about such components as valves or transformers, since their functions are varied, and a change in design may not only revolutionise their efficiency but even add to their functions. A coil, however, has one function only, and its maximum theoretical efficiency, although not attainable in practice, is within the sphere of calculation. There was a time when a designer was able to set the pulses of amateur constructors throbbing by his claims for a variometer of vast dimensions wound with something like a small bale of fencing wire, but those happy days of ignorance are no more. No coil, whatever its shape, or composition, can serve, or is required to serve, more than one desirable purpose, *i.e.*, to develop as large an oscillating voltage as possible across its windings, in tune with the frequency of the required transmitter. The main factors which militate against efficiency in any coil are three in number—self-capacity, dielectric absorption, and resistance. It is assumed that readers are familiar with recent articles on the meaning of self-capacity and dielectric losses, but in order to make a better comparison between a single winding and a layer winding, it may be desirable to enlarge a little on one aspect of resistance.

Ordinary direct current flowing through a wire is evenly distributed throughout the whole section of the wire, but alternating current, which, of course, travels backwards and forwards in any given length of wire, tends to keep to the periphery. At the very high frequencies used in wireless this tendency is greatly emphasised, and the current not only flows on the skin of the wire, but also packs itself largely into one portion of the skin—the inside of the turns forming the coil. This phenomenon is caused by the fact that the currents in the wire produce a magnetic field inside the wire itself, and, as the magnetic field of the coil as a whole accentuates the effect, it follows that the greater and more bunched the magnetic field of the coil, the greater will be the unwanted ohmic resistance present.

Dielectric Absorption

Consideration will now make it obvious that, since all the self-capacity in a solenoid coil is in the form of a minimum of little condensers in series, its self-capacity must be less than that of a layer coil, where the condenser-effects are necessarily more numerous. Similarly, the dielectric absorption of the plug-in type must be less controllable, and from what has been said above about coil resistance, it is plain that the concentration of the windings in the multiple-layer system results in increased coil resistance. Again, it is not possible in any plug-in coil of normal type to obtain the big separation necessary between turns with large differences of H.F. potential. Generally, then, from a purely theoretical point of view, the solenoid coil scores over the plug-in coil as an efficient coil form.

At this point, the plug-in enthusiast may point out that the original coils were solenoids, and that they were abandoned for plug-in types. This, of course, is true, but quite apart from the fact that many of the factors which determine the efficiency of a coil were imperfectly understood at that time, the amateur of to-day often fails to realise that the principles of circuit design in those days called for a handy compact form of coil that could readily be changed for one of another value. The coil must always be considered in relation to the efficiency of the other components in a wireless set. There is no inherent merit either in a fixed coil with one or more windings, or in a combination of plug-in coils with corresponding constants, *apart from their suitability to the form of circuit in which they are employed.* For instance, when swinging coil reaction was common practice, it would have been cumbersome and ineffective to have utilised solenoid coils in the anode and reaction circuits. It would be equally ridiculous to-day to employ a movable plug-in coil in a modern design where the stability of the set is often calculated to such fine margins that the failure to utilise metallic sheathing on a small lead may set up oscillation.

Modern Requirements

A few years ago, the set designer worked to approximations and wide margins, because the efficiency of the average valve and tuning condenser was a variable quantity. It was advantageous, therefore, to be able to ring the changes on coils to compensate for deficiencies in other respects. A greater use, too, was made of plain coil coupling, particularly in inter-valve links and in neutrodyne schemes, and as components were very approximately matched, it was convenient to use a form of coil that was quickly adaptable to variations of coupling. These were really the only considerations that made the plug-in coil so universally popular. To-day, when multiple circuits are a necessity, it is essential that coils should be mathematically exact in their constants, that all windings, including reaction, should be meticulously proportioned, and that screening should be possible without loss of efficiency. From a manufacturing point of view, the solenoid coil lends itself more readily to the attainment of these ends at a reasonable price, and when all the windings are incorporated on one fixed former, the amateur is relieved of the possibility of setting up undesirable interaction effects through the use of separate coils.

It has to be understood that this discussion refers to apparatus constructed for the broadcast band. Practical considerations outside the broadcast band, where selectivity is not a vital question, may indicate a preference for other forms, but that is a matter with which the amateur is not concerned. Hypercritical amateurs may possibly be inclined to point out that the 6-pin coil was a plug-in coil, but it was a solenoid limited in its adaptability, and I have understood the term "plug-in" in this article to refer solely to the non-solenoidal type usually implied by that description.

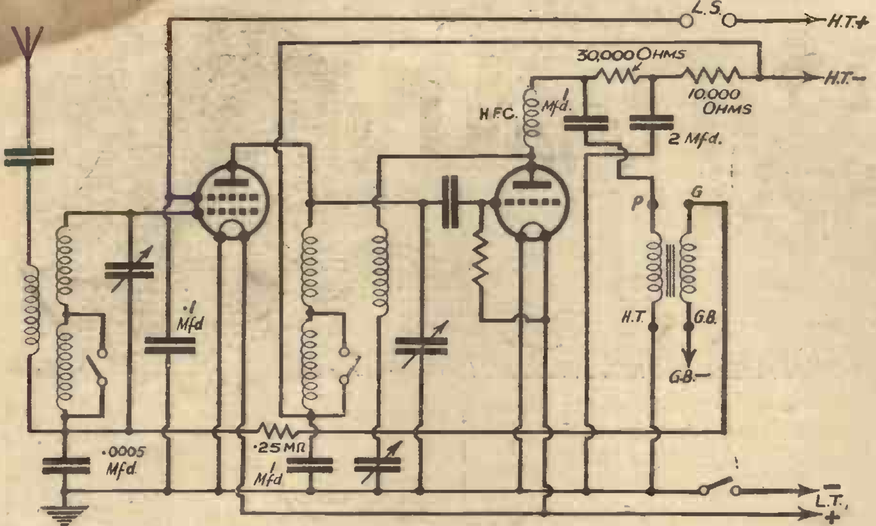

Fig. 5.—A two-valve reflex circuit which can be built from modern components.

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act as a by-pass to the H.F. Still further to improve the efficiency of the arrangement, reaction was often obtained by coupling together the tuned anode and aerial coils. It was claimed that such a circuit was capable of results equal to those given by an ordinary three-valve receiver, and although this was a rather exaggerated statement the circuit was undoubtedly capable of wonderful things once a suitable crystal and L.F. transformer had been found. In reality, the "quality" was probably extremely poor, but this generally passed unnoticed, since it was as good as contemporary speakers and other components were capable of producing. The reflex circuit was always very popular, probably because the very idea of economizing by making one valve do the work of two had a strong appeal to human nature. It is interesting to observe that the reflex is still "living" and that many amateurs would like to revive it. For the benefit of any readers who are interested in trying a reflex circuit with modern components, the circuit represented by Fig. 5 might be useful. In this case the crystal is dispensed with and an ordinary three-electrode valve employed as detector, a screened-grid valve serving the purpose of combined H.F. and L.F. amplifier. Ordinary dual-range tuners are employed and the values of the more important components are indicated.

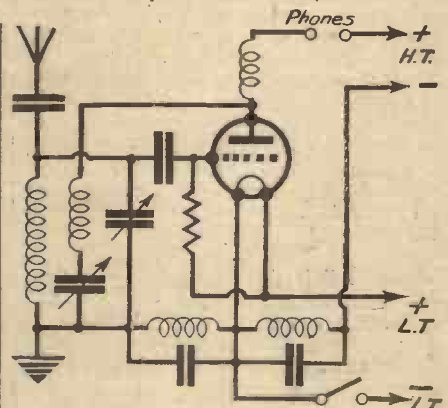

Fig. 6.—Circuit of the Armstrong Super-Regenerative single valver.

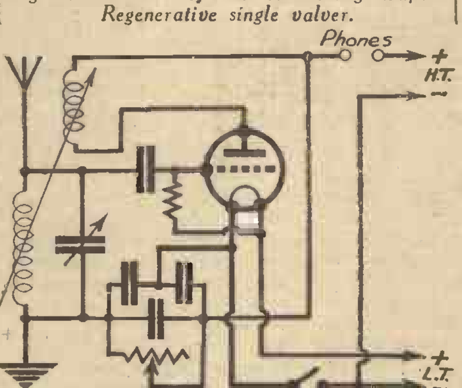

Fig. 7.—The Flewelling circuit.

Super-Regeneration

At about the same time as the reflex circuit was meriting a good deal of attention, other experimenters were trying to get a maximum amount of amplification from a single valve by a different means. It was, of course, known that a detector valve could be made to amplify by feeding back into the grid circuit the H.F. currents appearing in the anode circuit—in other words, by applying reaction. This was satisfactory up to a point, but as the valve fell into self-oscillation (so producing the well-known heterodyne whistle) when more than a very limited amount of reaction was used, it was felt that the valve was not being made to operate at its full efficiency. The consequence was that two new circuits, known as the Armstrong Super-Regenerative and the Flewelling, were invented by the American investigators whose names they still bear. With both of these circuits, which are shown in Figs. 6 and 7 respectively, the principle was practically the same, namely, that although the valve was allowed to remain in a state of oscillation the customary whistle was not heard, due to the fact that oscillation was periodically "quenched" or "damped." The quenching was provided by so arranging the circuit that the valve could oscillate at two frequencies at the same time; one of these corresponded to the signal being received and the other was of about 10,000 cycles, or just above audibility. As a result, the former oscillation was quenched by the latter at the rate of 10,000 times per second. At first, much difficulty was experienced in disposing of a constant "hiss" which marred reception, but by making various fine adjustments it could, at least, be reduced to so low a level that it was not very troublesome. Of the two circuits, the Flewelling was least used and never became very popular. The Armstrong, however, has remained in more or less constant use right up to the present time, and is, in fact, coming very much to the fore at the moment for the reception of ultra-short-waves. There is no need to describe the circuit in detail here, since that was done in an article recently published in PRACTICAL WIRELESS.

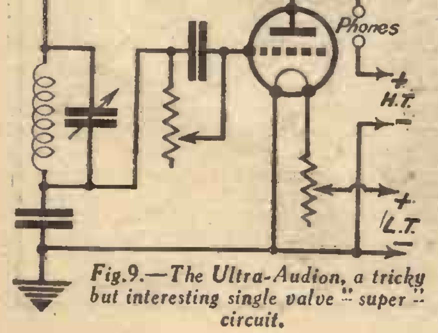

Fig. 9.—The Ultra-Audion, a tricky but interesting single valve "super" circuit.

High-Tension-less Circuits

In evolving new circuits the fundamental idea was almost invariably one of economy, of making one valve do the work of two, or of minimizing the consumption of high-tension and low-tension current. I have already mentioned some circuits whose main aim was to get equal efficiency with fewer valves, so now reference should be made to a scheme that was originated during 1924 for disposing of the high-tension supply. The circuit of a high-tension-less Det.-L.F. two-valve set is given in Fig. 8. From this it can be seen that the valves are of the four-electrode type, having two grids; diagrammatically, they are like the later screened-grid valves, but otherwise they have no resemblance. The inner grid is connected to L.T. positive, the outer one forming the usual "control" grid. To describe how this circuit worked it is necessary to refer to the normal functioning of a triode valve whose filament emits electrons ("particles" of negative electricity), which are attracted to the plate by the positive charge usually derived from a H.T. battery. In the normal type of valve there is a comparatively wide gap between the filament and plate, and to

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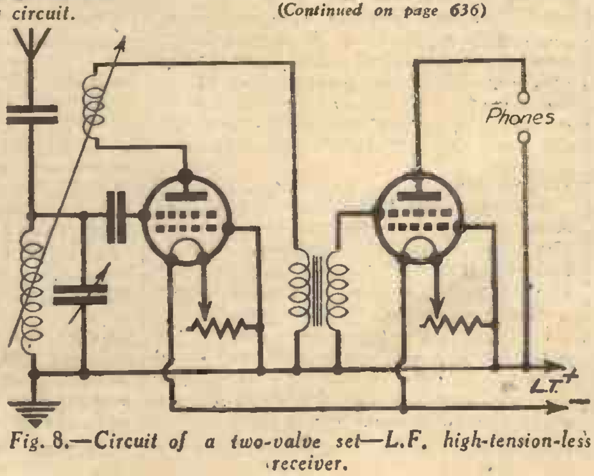

Fig. 8.—Circuit of a two-valve set—L.F. high-tension-less receiver.

THE EASY ROAD TO RADIO

The Beginner's Supplement

Conducted by F. J. CAMM

THE BEGINNER'S A B C OF WIRELESS TERMS

(Continued from July 22nd issue, page 602.)

Plug

A device which, in conjunction with a socket arrangement known as a "jack," is used for quickly making or breaking an electrical circuit or circuits. The plug consists essentially of a metal stem insulated from a metal ball at the end of the stem. The other end of the stem is supported in an insulated handle. See Fig. 1. Inside the handle are two small terminals connecting with the ball and stem of the plug. It is to these terminals that the wires from the speaker, 'phones, or other apparatus are joined so that, when the plug is inserted in the jack, contact is made.

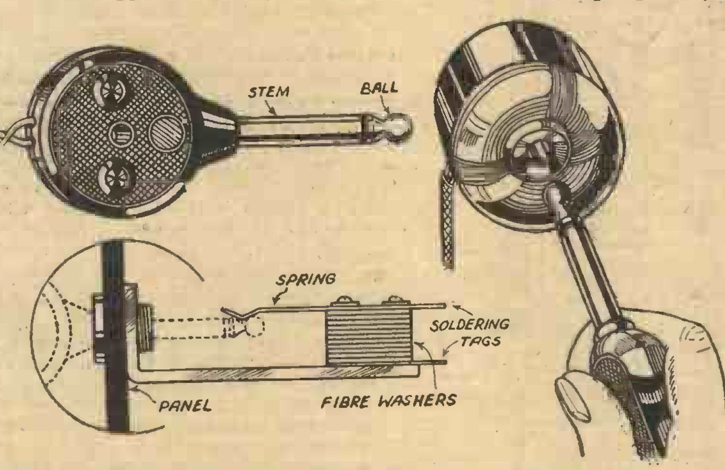

Fig. 1.—Plugs and jacks, showing how the tip and stem of the plug makes contact.

A common use for plugs and jacks is to provide a quick means of changing over the speaker from one room to another. Wall jacks are provided in each room, each jack being connected to the set with wires. A plug is then attached to the speaker cords. In this way the speaker can be plugged in at any desired point. Other uses for plugs and jacks include the plugging-in of a gramophone pick-up to the receiver, the cutting out of one or more of the valves in a multi-valve set, etc. See also *JACK.*

Plug-in Coil

A tuning coil fitted with a plug and socket arrangement specially designed for quick coil changing. The usual type of plug-in coil is illustrated in Fig. 2. It will be noticed that the coil is plugged in to a holder mounted on the baseboard. Another type of plug-in coil is shown in the inset, but this kind is more often referred to as a "six-pin" coil owing to its having six legs or pins which plug in to the six sockets on the special holder.

Plug-in coils are not now used to any great extent, except for short-wave work, as they have been replaced by the more popular dual and triple-range coils in which wave-changing is performed by means of a switch instead of by removing the coils.

Polarisation

When a simple primary cell is being discharged it will be noticed that the current rapidly falls after the first second or so. If the cell is then given a rest it will again deliver the full current, but it will also die down again in the same manner as before. This phenomenon is known, as *polarisation* and is due to the formation of small bubbles of hydrogen on the positive plate of the cell. These bubbles offer a high resistance to the passage of the current through the cell. The reason why the cell or battery recovers after a rest is because the bubbles have had time to clear away.

In ordinary dry cells as are used in flash lamp batteries, H.T. batteries, etc., a special substance is included to dissolve the bubbles as soon as they are formed. This is called the *depolariser* and prevents the battery from "running down" after being in use a short time. Accumulators or *secondary* cells do not suffer from *polarisation*, as no gases are formed during discharging. See also *DEPOLARISER.*

Polarity of a Magnet

Every magnet has what are called "poles." There is the *North*-seeking pole and the *South*-seeking pole. In the case of a bar magnet, if it is suspended from its centre it will swing round until its north-seeking pole points to the earth's north magnetic pole. The "North" pole of one magnet will always attract the "South" pole of another, but two "Norths" or two "Souths" will repel one another.

In a magnet the *North* pole, or to give it its proper name, the *North-seeking pole*, is the end of the magnet from which the lines of force are supposed to emerge, while the *South* pole is the one by which they return. With a battery or dynamo the two terminals by which the current leaves and returns are called the *Positive* and *Negative* poles respectively.

Potential Difference (P.D.)

The difference in pressure or *voltage* which causes an electric current to flow. Just as pressure is needed to cause water to flow along a pipe so pressure is required to produce a current of electricity.

Potentiometer

Strictly speaking this is a "measurer of potential," but the term is used in wireless to indicate a divider of potential. It consists essentially of a resistance with a slider, which can be moved along the resistance element at will. In this way any intermediate voltage can be obtained between that of the two ends. As you know, when a resistance is connected in a circuit there is always a difference of

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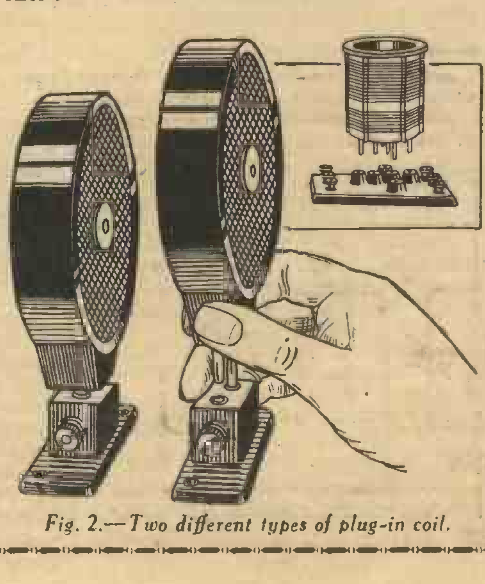


Fig. 2.—Two different types of plug-in coil.

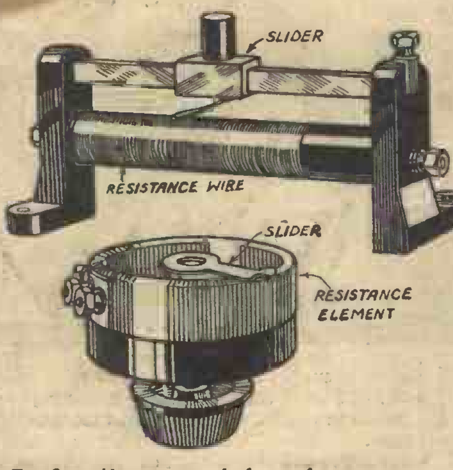


Fig. 3.—Above, a simple form of potentiometer, and below, the more usual type.

(Continued from previous page)

electrical pressure (voltage) between the two ends. If it is desired to connect, say, the grid of a valve or some other part of the set, to a point at a pressure somewhere between that of the extreme ends of the resistance, then a potentiometer is used in place of an ordinary resistance and the connection taken to the slider. By moving the slider the desired potential can be obtained. Fig. 3 gives an idea of what a potentiometer looks like. Two examples are shown.

Power Grid Detector

Probably the commonest way of connecting up the detector valve of a receiving set is as what is known as a "leaky-grid" detector. This method necessitates the use of a grid leak and grid condenser. It is very sensitive if the right values of leak and condenser are chosen, but suffers from the drawback that it is likely to distort when overloaded if the signals being received are too powerful. However, it can be made to handle very powerful inputs if the anode voltage of the valve is increased to about 200 volts and the values of the leak and condenser each reduced. This method is then called *power grid detection*. It should be noticed that it does *not* increase the power of the set, but merely enables it to handle loud signals without distortion.

Power Valve

A valve for use in the output stages of a receiver and, therefore, designed to handle considerable power as compared with valves in the earlier stages.

Primary Cell

A piece of apparatus for producing an electric current by chemical action. In its simplest form it consists of two plates or strips of dissimilar metals dipping in a solution of acid or salt. The acid slowly attacks the metals, or one of the metals, and on joining the two strips with a piece of wire a current will flow. In the Leclanché and bichromate cells one of the metal strips is replaced by a carbon rod. A primary cell cannot be recharged. See *CELL*.

Primary Winding

The winding of a transformer to which the power from the source of supply is fed. From the primary winding it is transferred by *magnetic induction* to the *secondary* winding. See *TRANSFORMER*.

Push-Pull

A method of connecting up two amplifier valves so as to share the total grid swing between the two valves. Its advantages are greatly increased handling power, freedom from distortion, less need for decoupling, etc. The connections for two valves in push-pull are shown in Fig. 4, which also gives the normal connections when using only one amplifier valve. The push-pull arrangement must not be confused with two valves just connected together in parallel. It has definite advantages over parallel connection.

Quiescent Push-Pull

A modification of the push-pull arrangement in which the power consumed from the high-tension supply is proportional to the signal strength. Thus during intervals or quiet parts of the programme practically no current is taken. This is attained by using a very high grid-bias voltage. Quiescent push-pull is an extremely economical method of power amplification and therefore particularly suited to battery sets. Fullest advantage of the system is obtained when the valves used are pentodes.

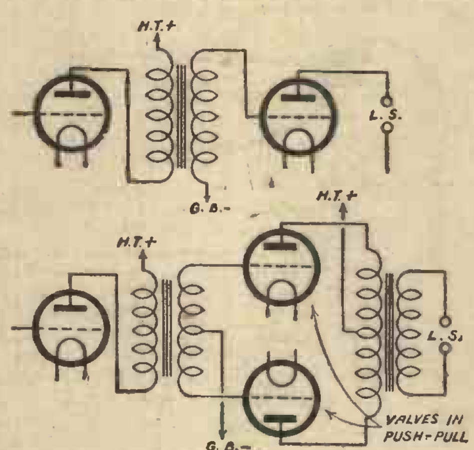


Fig. 4.—How valves are connected in a simple output circuit and in a push-pull arrangement.

Radio-frequency

Frequencies from about 15,000 cycles upwards. See *HIGH-FREQUENCY*.

Reaction

An arrangement by which some of the energy in the anode or output circuit of a valve is fed back to the grid or input circuit. This has the effect of overcoming the resistance of the grid circuit and so gives an increase in signal strength. Reaction can be controlled by a movable coil (magnetic reaction) or by a variable condenser (capacity reaction). If the control is advanced too far the energy fed back more than compensates for the losses in the grid circuit and the circuit breaks into *self oscillation*. When in this state the receiver will produce howls and whistles when tuned to a broadcasting station and will also cause interference with other nearby receivers. See *OSCILLATIONS*.

Rectification

The process of converting alternating current into direct current. The detector valve in a receiver *rectifies* the high-frequency current produced by the incoming waves, that is to say, it changes it from a current moving rapidly first in one direction and then in the other into a current going in one direction only, but still rising and falling according to the rise and fall or *modulation* of the original currents.

Another case where rectification takes place is in the case of a receiver operated from alternating current mains. Here the current must be converted into non-pulsating (direct) current before it can be used to supply the valves. This is carried out either by a *metal rectifier* or a special *rectifier valve* in conjunction with smoothing chokes and condensers.

Rectifier

A device for converting alternating current into direct current. See *RECTIFICATION, VALVE, METAL RECTIFIER*, etc.

Resistance

The opposition that a substance offers to an electric current passing through it. The energy expended by the current in overcoming resistance produces heat. In the case of an electric lamp, for instance, the heat produced is so great that the filament becomes white hot.

The term *resistance* is also used to denote a *resistor*, that is, a device used to introduce a certain resistance in a circuit. Resistances or resistors are made in various forms. Some contain a coil of special resistance wire and are called *wire wound resistances*, while other types include *metallised resistances, composition resistances*, etc.

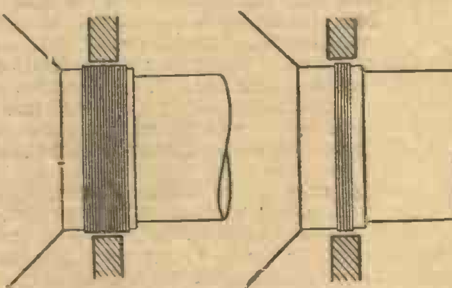
Fig. 5.—Two types of primary cell—the Bichromate battery and the Leclanché cell.

FROM THE FLASHLAMP

By Photon

The Speech Coil in the Gap

THERE are two complementary functions performed by the moving coil, the one of these is to receive electrical energy and the other to deliver this as mechanical energy to the diaphragm and so to the air. The speech coil in its magnetic field is thus a specialized form of electro-motor, and is thus subject to the ordinary electrical laws—namely, the cutting of the magnetic lines of force by the conductor gives rise to back E.M.F., which may be calculated in the same way as the E.M.F. of a dynamo or electro-motor; and the current flowing in the winding gives rise to forces dependent upon the strength of the current, the length of wire in the winding, and the value of B in the gap. The calculation connecting the electrical and acoustic quantities based on these fundamental laws is most instructive, but this does not form the subject of the present article.



Figs. 1 and 2.—Showing broad and narrow wound speech coils.

The essentials for good performance from the standpoint of design are:—

1. That the moving coil shall be capable of sufficient free movememt, especially for the rendering of low tones.
2. That the maximum movement permitted shall not affect materially the mean strength of the field or the number of turns within the field.
3. There shall be no selective resonances such as will interfere with a good frequency characteristic.
4. There should be a certain amount of damping to avoid resonances.
5. The motional impedance should be high and the copper resistance low.

Now (1) depends very much on the centring; it is unusual to find the movement unduly limited by the surround, but the centring at the small end of the cone is often cramped. The importance of (2) is often overlooked. If, as in many of the moving-coil speakers of a season or two ago, the winding be made of exactly the same length as the gap, just to match it exactly, then, when any movement of the coil takes place, the number of turns *in the gap* will diminish—this is inevitable. But it may be avoided by making the speech coil winding either much greater than the gap length, Fig. 1, or alternatively very much less, Fig. 2. In either case a quite considerable movement of the coil may take place without any change in the number of turns in the gap field. The type of winding shown in Fig. 1 is the better from the point of view of cost limitation; the whole field is in use all the time. Fig. 2 is most extravagant in the matter of field, but it results in a much lighter moving coil for the duty performed. The winding shown in Fig. 1 is found more suitable for the usual open cone type of speaker; in this the weight of the moving coil and diaphragm as a matter of experience is not a difficulty; in fact, if it be made too light the very high frequencies come through too strongly, and the 9 kilocycle heterodyne from the adjacent station becomes a constant source of annoyance. The type of winding shown in Fig. 2 has been found better suited to the horn type of M.C. speaker, and is used in the Lanchester acoustic tube type.

On the question of clearances. There is a natural tendency on the part of designers to cut the clearances down to a minimum in order to obtain a stronger field for a given cost in magnet steel. In the writer's opinion the internal clearance between centre pole and sleeve should not be less than 5/1000 of an inch, that is, a diametral clearance of .01in. or ¼ mm. and the external clearance about half as much again, *i.e.*, a diametral external clearance of .014in. It may be asked why a greater clearance on the outside? The reason is that if the sleeve touches the centre pole very little harm is done, but if the winding should touch on the outside not only will there be a much greater acoustical disturbance due to momentary shorts, but actual injury may be done, and the coil may have to be rewound.

The question of resonant frequencies, (3) above, also the questions of motional impedance and copper resistance (4 and 5), will be dealt with in a later article.

Composition Resistances

THERE are still many receivers about using old type composition anode resistances. Many of these fall short of the modern variety, inasmuch as their value does not remain constant, but increases with time. An ordinary composition 50,000 ohm resistance may steadily increase in value until there is only a volt or so on the detector valve, with consequent loss of reaction, quality and volume.

Grid Leaks and Instability

GRID leaks have a habit of increasing in value when their age is considerable, resulting in reduced handling capacity, instability and considerable backlash on reaction.

Tuning Correction

THERE has been much written on the subject of tuning correction by cutting off the top notes with a condenser or stopping them by means of series resistance, but it is seldom that reference is made to increasing low base.

When a resistance-fed L.F. transformer is used much can be done in this direction by choosing a suitable condenser. If the value chosen is such that with the inductance of the primary the circuit forms a tuned acceptor at some definite frequency, say, 60 cycles, the response curve will rise sharply at this frequency.

RADIO RAMBLINGS

Jottings from my Notebook

By GRID LEAK

He Never Switched Off !

A GOOD French story was recently published in one of the Paris "dailies." It concerns a forty-year-old citizen who, wishing to secure an annuity policy from an Insurance Company, consulted his doctor as to the means to be adopted to live to the ripe old age of four-score-and-ten. The practitioner examined him and pronounced him a perfectly healthy case. "Do you smoke ?" he asked the patient. "No." "Do you drink ?" "No." "Do you enjoy big meals ?" "Not particularly," was the answer. "Do you listen to the Paris radio programmes ?" "Yes, I never miss an item." "Great Scott !" said the doctor, "what do you want to live so long for ?"

Another Kind of S.W. Interference

WHILST trying out a short-wave set the other day a rather peculiar form of interference was noticed, which might be of interest unless you have already had the same experience. The set worked very well, and in about half an hour we had made a good "bag" of stations on the 31-metre band, but as soon as it was made to oscillate a programme of dance music could clearly be heard no matter what wavelength the receiver was tuned to. We didn't bother about this for some time, but eventually decided to see who it was. On settling down to listen to it, there was no doubt that the music was being made by Henry Hall and his boys, so we concluded that we must be listening to a gramophone record "churned out" by a local amateur. This theory was soon disproved, because announcements were given by H.H. himself. Could it be an Empire transmission ?

Well, to cut a long story short, the interference turned out to be coming from a neighbour's set which was tuned to the National, because immediately that set was switched off the interference ceased. Rather peculiar, though, that the music should only be heard—and quite clearly at that—when the short-waver was actually oscillating !

Electrical Interference

INTERFERENCE with wireless reception by electrical apparatus appears to be getting worse every day, and it really does seem time that some preventive measures were taken by the authorities. If a man drives down the street in a car whose exhaust emits a "healthy" burble he is liable to be hauled before the magistrates and fined ten shillings and costs for disturbing the peace, and yet a person who causes an ear-splitting noise to be heard in every loud-speaker over a radius of a hundred yards or more, by using a flashing electric sign, does not receive so much as a caution. The Post Office has gone to no little trouble and expense to devise means for "silencing" every form of electrical apparatus and offers to trace and cure interference at a purely nominal charge, but I gather that its services are not very frequently called upon. In more than one European country a person is forbidden to instal any piece of electrical machinery which is not guaranteed to be silent, in the radio sense of the word, so surely it is not beyond the powers of the Government of England to introduce laws which will make electrical interference illegal here.

Precautions Necessary with Mains Apparatus

I SEE that in electrical circles there is some concern being felt about the undue publicity given to cases of electrical shocks resulting in deaths through the use of electrical apparatus in bathrooms. There have been several sad cases of this sort lately, but it has been pointed out that prejudice should not be felt against the use of electricity any more than against such power mediums as petrol or gas. One does not need to be told that it is dangerous to look for gas or petrol leaks with a lighted match, although perhaps it is not so commonly known that it is dangerous to use such apparatus as hair-dryers and massage machines whilst in a bath. All the same, it is not to the interest of progress or to we who, by our constant experimenting, do much to assist the development of radio and electricity in general that fear should be felt by the public in its use. You may say that it is not everybody that wants to listen to radio programmes in the bath, but if I am correct in my opinion of eager radio fans they are not above using their sets anywhere. Therefore, if you use the mains to work your set be scrupulously careful how you wire up the mains leads to the set. Make as few joints as possible and well cover them with insulating tape, or preferably use the special bakelite covered connectors that can be purchased quite cheaply and which make a neat and safe job when two leads have to be joined together. See that the metal case of your mains unit is connected to earth, and also for general safety try to earth any other piece of electrical apparatus that may be in use in your home. Another set of leads that is sometimes abused is that which feeds loud-speakers in distant rooms. There is an idea prevailing that "it is only the speaker lead" while the fact that quite hefty shocks can be obtained from speaker leads from fairly powerful sets is often overlooked, and some people are susceptible to quite low voltages. If you are sufficiently capable to fit further power or lighting plugs in your house, a thing you shouldn't do unless you are sure of what you are doing, find out which is the earthed lead of your mains, as nasty shocks have been obtained from lamp-holders, and the like, even though the switch controlling it was in the off position. This is due to careless wiring, as if the switch is placed in the un-earthed lead there is a danger of a return flow of current to earth via the body of the person who happens to make contact with the other lead. In conclusion, in your own interests and in the interests of radio and electrical development generally, treat the power at your command with the respect your knowledge of it gives.

Carrying Capacity of Fuses

FOR a fuse to be efficient it should be capable of carrying a maximum current considerably less than the filament current of any one valve. It is often found, however, that quite large fuses have to be used, as smaller ones blow every time the set is switched on. This is caused by the momentary heavy current drawn through the fuse to charge the fixed condensers which have discharged while the set has been idle.

This trouble can easily be overcome by connecting such condensers as go to H.T.— or L.T.—, straight to the H.T.— terminal and putting the fuse between H.T.— and L.T.—. Admittedly, this will not offer any protection should one of the condensers break down, but if these are of reputable make there is nothing to fear.

The Valve of the Future !

AT the present moment there seems a rapidly growing danger of valves becoming so complicated and having so many grids in them that the price will be exorbitant, unless the constructors' point of view is carefully watched. There appears to be no limit to the possibilities in this direction. In a recent issue of PRACTICAL WIRELESS, details were given of the new Hexode, but this is only a starting-point for all sorts of possibilities. How about a Class B valve made up of two pentodes ?

Grid Glow Tubes

GRID glow tubes are quite commonplace in America, and there is some possibility, we understand, of their appearing over here. This gadget consists of a little Neon tube which provides a visual indication of tuning.

The general idea is that with a station calibrated A.V.C. set the loud-speaker is shorted by a switch, the wanted station tuned in by watching the grid glow tube brilliancy, and then the L.F. portion is switched on and there is the wanted station, correctly tuned. The idea is to obviate the annoyance of passing over a few dozen stations when tuning from one to another.

THE BEST L.F. COUPLING?

(Continued from page 616)

due to its negative bias being momentarily reduced by the positive signal voltage. The other valve, which receives the negative half-cycle, is biased still more heavily and, therefore, does not operate, or, in other words, it remains "quiescent." As positive and negative half-cycles are alternately applied to both valves, the latter work "in turns." In consequence of this the average anode current remains very small in amount, and it can thus be supplied by an ordinary dry battery.

It has become customary to employ a pair of pentode valves in the Q.P.-P stage, and although these do give more amplification there is no reason why small power valves should not be used.

Special input and output transformers must be used for Q.P.-P. for reasons which will be explained. To load the valves fully the input transformer should have a step-up ratio of about 9:1 (as compared with 3:1 for ordinary push-pull). Since the current flowing through the primary winding of the output transformer is rapidly fluctuating between, say, 2 and 20 milliamps, this winding must have a low D.C. resistance of the order of 400 ohms.

Another modification of push-pull is that known as Class "B" amplification. This has the same objects as Q.P.-P., namely, of giving a large undistorted output for a minimum consumption of high tension current. A special "double" valve has been developed for Class "B," and this really consists of two triodes in a single glass bulb; it has two filaments, two grids and two anodes. The new valve functions in almost the same manner as the two valves in Q.P.-P., but instead of requiring a heavy G.B. voltage it is so designed that it passes an almost negligible amount of high-tension current when the grids are at zero potential.

Since the grids actually become positive it is evident that there will be a flow of grid current through the secondary of the preceding transformer. To prevent distortion it is therefore essential that the secondary winding should have a very low resistance, and to ensure this, it must have comparatively few turns. This fact makes it necessary to use a step-*down* transformer in order that the primary may be matched to the preceding valve. To make up for the loss of amplification caused by the step-down transformer an additional L.F. valve must be used prior to the Class "B" stage; this valve is referred to as a "driver," but it is really an ordinary small-power valve.

The circuit arrangement for a Class "B" amplifier is shown in Fig. 5, where the names of the various parts are indicated.

By way of "summing-up" the conclusions drawn above it can be said that the best form of coupling for a battery set which is required to give only a comparatively small volume, or for a mains receiver, is the resistance-fed transformer. For a battery set intended to give a large volume sufficient to produce really good reproduction with a moving-coil speaker the constructor cannot do better than employ Class "B" or Q.P.-P. Special "constant-voltage" eliminators are now made for use with the new systems of amplification, whilst most ordinary eliminators can be suitably modified by connecting a "neon stabilizer" across the output terminals.

Facts and Figures

Components Tested in our Laboratory

BY THE PRACTICAL WIRELESS TECHNICAL STAFF

PREH VALVE-HOLDER

A NEAT bakelite chassis-mounting valve-holder has been submitted for test, and is illustrated on this page. The top is of brown bakelite and is provided at the side with lugs to facilitate the attachment to a wooden or metal chassis. The sockets are slotted

Preh 7-pin chassis mounting valve-holder.

and grip the valve legs sufficiently hard to ensure good electrical contact, but not so tight that the valve may not easily be withdrawn. The illustration is of a 7-pin holder, but it is also obtainable in 4 and 5-pin types. The 7-pin costs 1s.

NEW FERRANTI VALVES

THE well-known firm of Ferranti, specialists for many years now in high-quality transformer manufacture, have turned their activities to the production of valves, and some interesting developments may be expected from this source. Samples of some of the preliminary types have already been submitted to us and are illustrated on this page. They include the first double diode-triode which we have received, a full wave rectifier, and a special H.F. pentode. The full-wave rectifier is known as Type R.4, and is of the directly-heated type, consuming 2.5 amps at 4 volts. The rectified output is 350 volts at 120 mA., and the curves show remarkably good regulation. For instance, with a current of only 40 mA. and an input of 200 volts a D.C. output of nearly 200 volts is obtained. When the current consumed rises to 120 mA. the output is still over 100 volts, so that there is a variation of less than 100 volts between the extremes of 40 and 120 mA. A slightly more powerful rectifier is also produced and bears the reference R.4A. The filament potentials are similar to type R.4, but the output voltage is increased to 500 with a current of 120 mA. The regulation is of the same high order. The electrode construction is very sturdy, and there should be no cause for complaint on the ground of mechanical breakdown. The H.F. Pentode is Type VPT.4, and this is of the indirectly heated type with a 4 volt 1 amp. heater. Maximum anode volts are 200 and the screen voltage is given as 100. Maximum anode current is approximately 5 mA., with a further 2 mA. from the screen current. The impedance is rated at approximately 1 megohm, and the conductance at 2.6. The valve has, of course, a special application. The remaining sample is most interesting, as it is the first of a new type of valve which has already been described in these pages, namely, the Double Diode Triode. (See PRACTICAL WIRELESS, dated April 22nd, page 190.) This is of the indirectly-heated type with a 4 volt 1 amp. heater. It is fitted with the new 7-pin base, and has a cap on top of the bulb. The connections to the pins and cap are given in a recent Data Sheet. The maximum anode voltage is 200, and the impedance is 14,500 ohms. Amplification is rated at 39, and the mutual conductance at 2.7. The special uses of this type of valve have already been given in the article referred to.

AMPLION TAPPED OUTPUT CHOKE

THE correct matching of loud-speakers to a Class B or Q.P.P. output stage is a matter of some importance, and the correct transformer should in all cases be used, not only in the interests of obtaining the best quality, but also to operate the valve correctly. Most loud-speakers are already fitted with a transformer, but this is not always suitable for Class B circuits, and there is then a question as to how best to carry out the matching. Messrs. Amplion have produced a 3-ratio tapped output choke which is designed to enable a Class B or Q.P.P. stage to be coupled to any speaker fitted with a transformer. Three ratios are provided, 1 to 1, 1.5 to 1 and 3 to 1. A trial will soon indicate the correct connections to employ. The component is nicely made and finished in a bakelite case, and a terminal is provided for earthing the core. The price is 9s. 6d.

TUNGSRAM CLASS A OR B VALVE

AN interesting new valve is announced from the Tungsram factory. This is the PX.46, which contains two grids in addition to the usual filament and anode. By connecting the two grids together the valve acts as half of a Class B valve, and by connecting the grid nearest the anode to the anode it acts as a Class A valve. As a Class A valve the impedance is 2,350 ohms and the amplification factor 5.6. For Class B operation the anode to anode load should be 5,800 ohms. A driver transformer of 1.5 to 1 ratio is required, and the output approaches really large dimensions. It should be noted that for the correct operation of the Class B arrangement two of these valves are required, and each one is treated as the half of the standard Class B valve. The anode voltage may be of the order of 400 when the undistorted output is 21 watts. This represents a really radical departure from present practice, and we hope to have more to say regarding this valve at a later period.

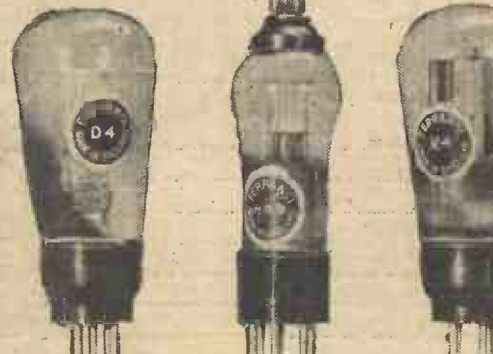
O'CONNOR DRY CELL

WE have received a 60-volt dry battery from the O'Connor Dry Cell Manufacturing Company of Ballina, and we are submitting this to tests for shelf-life and discharge. A full report will be given in a future issue.

BULGIN COMPONENTS

TO facilitate connections for battery receivers, mains receivers or experimental apparatus, the Bulgin Multi-Cable Plug will be found a valuable accessory. This consists of an ebonite plug, very similar to an ordinary valve base, and is fitted with either 4 pins or 5 pins. A domed metal cap is provided with a thread and fits over the terminal ends of these pins, and the ends of a battery cord or similar cable may be passed through this cap, attached to the different pins, and the cap screwed into position to furnish a really neat end to the cable. An ordinary valve-holder then serves to complete the connection to the receiver or experimental apparatus. The price of the 4-way plug is 2s., and the 5-way is 2s. 6d. The Spirohm resistance has also been improved, and these are now rated at 20 watts. A special heat resisting core is employed, and this is wound with nickel chrome wire. A porcelain former is provided with a spiral thread, and the resistance element is wound round this. So that various values may conveniently be tapped off, special clips are obtainable, and these clamp round the element. These are 6d. each, and the resistances are obtainable at 3s. 6d. to 6s., in ratings of 300 ohms to 100,000 ohms.

The new rotary toggle switch is also interesting as it may be mounted on a panel and furnished with a knob in the same manner as the remaining controls of a receiver and operated by a rotary movement of the knob. The switch itself is of the usual quick-make-and-break 3 amp. type.



A group of new Ferranti valves.

LISSEN I.F. TRANSFORMERS.

A VERY neat intermediate frequency transformer for superheterodyne receivers has been produced by Messrs. Lissen and this incorporates some interesting features. Of the band-pass type, the two coils are wound on paxolin formers, and these are fixed at the correct distance apart on a central column. The two trimming condensers are fitted under the bakelite base of the coil, and these are adjusted at the factory to provide the necessary frequency, which in this

The Lissen I.F. transformer.

particular case is 126 cycles. There is thus no need for the amateur to touch the condensers and they are covered by the metal base out of harm's way. The screen fits down round the bakelite base and when used with a metal chassis complete screening is effected. If a wooden baseboard is used, however, a separate earthing lead should be joined under the terminal on top of the coil and connected to a convenient earthed point. The transformers may be recommended, and the price is 7s. 6d.

WHARFEDALE LOUD-SPEAKERS

WE have tested the Bronze chassis speaker manufactured by the Wharfedale Wireless Works, and this is only one of a range of loud-speakers manufactured by the firm, and which include the Blue Wharfedale, the Golden Wharfedale, and the Energized models. The particular model under review is priced at 39s. 6d. and is rated to handle up to 4 watts without distress. When given this load it was found to function perfectly, and 5 watts was handled quite well. The frequency response is rated at 50 to 8,000 cycles, and this is certainly borne out on an ordinary radio test. There is no undue resonance at any part of the musical scale, and the bass is well reproduced, although not boomy. The top is clear without being squeaky, and speech is characterized by a forwardness and cleanness of tone which is very satisfactory. The transformer which is fitted seems to be a really high-class job, and is available for practically any type of output circuit. The current carrying capacity is 50 mA. For those who prefer a more expensive speaker, the Golden Wharfedale is available at 63s. This model is rated to handle 6 watts.

NEWS ITEMS

A NEW iron-core coil, with adjustable core, will shortly make its appearance. Tuning may be adjusted by the user to line up with already calibrated receivers.

* * *

A COMPLETE Class B stage, built on a loud-speaker, is also shortly being introduced.

* * *

A COMPLETE television receiver, with viewing screen and loud-speaker will be seen at the Exhibition.

* * *

THE new season's full vision scales will, in many cases, be provided with a dial light which moves with, and behind, the pointer.

Practical Letters from Readers.

The Editor does not necessarily agree with opinions expressed by his correspondents.

'Phone Portable Two-Valver Wanted

SIR,—I have been very interested in your paper and have taken it since the first issue. I have been especially interested in the articles on portables which I have found very helpful, as I am a keen portable builder. I should like to ask you, on behalf of some of my wireless friends and myself, if you could publish an article on the small type of "'phone" portable. I mean, by this, a two-valve set working on a frame aerial, to work a pair of 'phones which would fit entirely into an attaché case. I know that such a thing is possible, and I think it would appeal to a lot of fellow readers. Wishing your paper the best of luck.—R. A. F. WINSLOE (Godalming).

Radio and the Next War

SIR,—I wonder what the feelings of radio folk, of all classes, will be, at the outbreak of the next war, when they find their programmes jammed every evening by

1. Propaganda from the enemy;
2. "Blanketing" and deliberate interference, to prevent this propaganda being heard, by military authorities;
3. Counter propaganda, and
4. Sundry transmitters, gloriously ignoring international radio conventions, putting out propaganda, messages, and news on any old wavelength they happen to hit on!

If only one could listen clearly to the various governments "out-Ananiassing" each other, in their endeavours to infect their enemies with seditious ideas it might be extremely funny. Unfortunately, it will be merely a hideous uproar!

Also, the authorities might proclaim a ban on all receivers, in case any wicked people listened to propaganda! Jail, for having a 2-volt valve in one's possession! Six months, for a condenser. . . .

The next war means the finish, I think, of all pleasantness and international friendliness "on the air," that radio has done so much to promote. And the gigantic radio industries, including the editors of wireless papers, will go bankrupt.

Is there any radio fan who seriously hopes for another war, or thinks it will do the slightest good to either side? I should be interested to know what your readers think.—W. H. CAZALY (London, W.C.1.).

[*Although we do not agree with the view expressed by our correspondent, his letter may prove interesting to some of our readers.*—ED.].

From a Reader in New Zealand

SIR,—My copy of the Wireless Constructor's Encyclopædia to hand by the last Home Mail. Having examined same I hasten to thank you for such a very fine volume, and at the same time to congratulate you on the production of same.

PRACTICAL WIRELESS seems to go on from strength to strength, and I am sure that once it becomes known in this Dominion it will find many staunch supporters.

Some time ago you published a letter from a gentleman in Christchurch, N.Z., and amongst details of broadcasting stations in New Zealand and Australia he mentioned that nearly all the sets in use here were A.C. This statement I desire to amend slightly. While it is quite true to say that the majority of the sets in use in the cities and towns are all electric there are still many hundreds, if not thousands, of battery sets. Many of the country districts have electric light, especially in dairying districts, but the majority of the back-country people still depend on kerosene and benzine for its lighting and, consequently, batteries for its wireless.

Best wishes for the future of PRACTICAL WIRELESS.—NEIL THOMPSON (Wairo, W.B. New Zealand).

From a Reader in Singapore

SIR,—Please permit me to congratulate you on the publication of so splendid a paper as PRACTICAL WIRELESS.

I have been a consistent reader right from No. 1 of Volume 1, and I find that PRACTICAL WIRELESS is indeed all that it claims to be. The title is indeed most appropriate—practical in every sense of the word. I am a keen experimenter

(*Continued on page 634*)

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT the heaters of A.C. operated valves are joined in parallel.

—THAT the heaters of D.C. operated valves are joined in series.

—THAT valve design is being changed in many directions during the present season.

—THAT microphonic valves will be non-existent within a few months.

—THAT special non-resonant material, resembling wood, is now obtainable for the construction of loudspeaker baffles.

—THAT compressed sugar-cane, wood pulp, cardboard and other materials are used in its construction.

—THAT unlike most non-resonant baffles, the high notes are strengthened.

—THAT a new type of receiver may make its appearance in the new season.

—THAT the ordinary Mansbridge type condenser is not non-inductive.

NOTICE.

The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

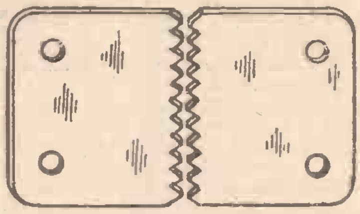
(Continued from page 633)

and home constructor, and I find that PRACTICAL WIRELESS is of invaluable assistance to me.

I sincerely hope that it will continue to be so packed full of useful and important information and I take this opportunity of wishing PRACTICAL WIRELESS continued success.—D. A. MARTIA (Singapore).

"A Simple Lightning Arrester"

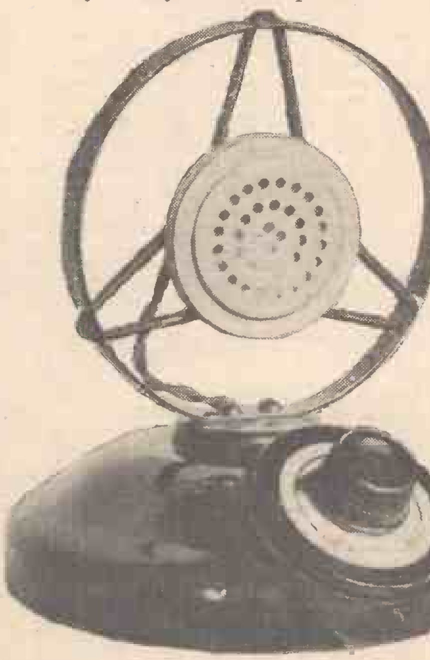
SIR,—With reference to a note in your issue of the 8th inst., page 538, on "A



Simple Lightning Arrester," we supply plates, as shown in the accompanying sketch, which may interest your readers. The price is 6d. per pair, or 1s. 6d. mounted. —J. J. EASTICK AND SONS (London, E.C.).

G.E.C. HOME BROADCASTER

THIS new and novel instrument consists of a small microphone suitably mounted in a suspension ring, which is fixed to a neatly moulded base. On this is also mounted a volume control and switch. It can be used with any radio receiver fitted with pick-up terminals. All you have to do is to follow the simple instructions for connecting up, talk into it quite normally, and your voice will be reproduced by your set as clearly and distinctly as any wireless reproduction.



The neat and cheap microphone made by the General Electric Co., Ltd., and retailing at 18/6.

There is no end to the uses to which this wonderful little "mike" can be put—S.O.S. messages on the stage at amateur theatricals; "news items" that will surprise guests at your party; imitations of wireless turns and sound effects—all will be reproduced accurately and realistically.

Moreover, this little microphone is not a toy, but a scientific instrument that will make an instant appeal to the wireless enthusiast who will find its high sensitivity, robust construction, and its efficient volume control invaluable in his experiments.

Some additional uses of the Home Broadcaster are announcing the titles of gramophone records at dances; operating "home recording" apparatus; amateur transmitting work and testing and standby work on public address equipment.

The accompanying illustration shows the neat and businesslike appearance of this useful instrument for which we predict a large sale. It is made by the General Electric Co., Ltd., and its price is only 18/6, including 25ft. of screened connecting cable.

RADIO CLUBS & SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

ANGLO-AMERICAN RADIO AND TELEVISION SOCIETY

Have you sat up in the hopes of hearing America and, after getting thoroughly tired, retired without hearing anything more exciting than static and code stations? If you have not you are indeed a lucky listener. In order to make it unnecessary for enthusiasts to waste a night at the dials, the Anglo-American Radio and Television Society have arranged a special service for members. If you are a member, and if you contemplate spending a night at the dials, you may send a letter, enclosing a stamped addressed postcard, to the headquarters of the Society, at 11, Hawthorn Drive, Willowbank, Uxbridge, England. By return you will receive details as to whether you are likely to "strike lucky." If you are not a member you are cordially invited to join. There are no fees, and members are under no obligations. All you have to do is to send your name and address to Leslie W. Orton, at the address given above. If you desire a reply kindly enclose a stamped, addressed envelope. Readers interested in short-wave reception have a chance of winning the "Denton DX Cup," full particulars of which may be obtained from the Society. This cup is being presented by Mr. Clifford E. Denton, of New York, U.S.A. It will be awarded to the person obtaining the greatest number of verifications of short-wave *broadcasting* stations between August 1st, 1933, and February 1st, 1934. All entries must be submitted by April 15th, 1934.

SLADE RADIO

The talk given by Mr. A. F. Poynton, at a recent meeting of the Society, was upon subjects chosen by the members. A number of suggestions were made, and when a vote was taken "Class B high power" was chosen, tone-control L.F. amplifiers taking second place. The two subjects were dealt with at some length and a good deal of interesting information given. Time was also found to deal with a further subject, and the choice was "Pentode H.F.," which again proved exceptionally interesting. Wireless enthusiasts living in the Birmingham district may be certain of an enjoyable evening if they attend the meetings of the Society. Full details and advance programme will be forwarded on request. Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

LEICESTER SHORT-WAVE CLUB

From their Headquarters at Broad Street, Enderby, the Leicester Chapter of the International Short-Wave Club have carried out a series of experimental reception tests recently. Using several types of short-wave receivers, exceptionally good results have been obtained. The clubroom at the above club is ideally situated for DX work, and two all-night tests have already taken place. Much interest was shown in the demonstration given by C. L. Wright, assisted by A. G. Woofenden and S. Harden. Anyone who is interested in short-wave work can obtain particulars of the club from the secretary, Alfred G. Woofenden, 10, Shortridge Lane, Enderby, nr. Leicester.

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

The coupon on this page must be attached to every query.

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent 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.

SPECIAL NOTE

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.

Please note also, that all sketches and drawings which are sent to us should bear the name and address of the sender.

HIGH-PITCHED WHISTLE

"I have finished a three-valve set employing S.G. valve, detector, and a pentode output. I am troubled by a very high-pitched whistle all the time the music is on, although signals are fairly clear and loud. The whistle is still there when the station closes down. Can you help me to get rid of this annoyance?"—(R. P., No address.)

There are several causes of whistles in a simple receiver, some of which are due to H.F. instability and some to L.F. instability. For a start, reverse the connections to the secondary of the L.F. transformer feeding the pentode valve. This may cure it. If not, examine carefully the H.F. end of the receiver and make certain that the H.F. valve is not oscillating. Connect the aerial to the anode lead of the S.G. valve, and remove that valve. If the whistle ceases it is due to the H.F. valve, and it should be examined for faults and the various voltages checked. A resistance in series with the pentode grid lead may also prove of assistance. A value of about 100,000 ohms should be tried.

BROKEN GRID CIRCUIT

"My set has developed a very peculiar fault which prevents our listening-in. When we switched on the other night things were all right for about twenty minutes, and then suddenly there was a faint plop and the music stopped. Within a few seconds it had come on again just as loud, but it gradually got quieter, there was another plop, and it was gone. This kept on, and it won't keep playing for any time now, but just goes plop and stops for about ten or fifteen seconds. Where shall I look for trouble?"—F. H. (Brixham).

It is almost certain that one of the grid circuit leads or components has broken down. First of all, examine the grid-bias battery and make certain that this is not exhausted and see that the bias plugs are fitting tightly in their sockets. Then examine all wires leading to grid terminals and make certain that none has come adrift. If you can do so, replace the grid leaks and transformers (where such are fitted) to ensure that these are in order. We think one of the above tests will find the fault.

MUSICAL COMPONENTS

"I do not understand all the mysteries of wireless, but here is a point which I cannot understand. I have read most of your articles on the working of a wireless set, and according to these the signals appear from the valves and their action. This is what I do not follow, however. When I disconnected my speaker the other night I could still hear the music coming from the set itself, and although it was faint it was apparently perfect in quality. We did not, in fact, need a loud-speaker. How can this be?"—S. J. L. (Romford, Essex).

The sounds you could hear were coming from the L.F. transformer laminations. The sound impulses pass through the windings of the transformer, and these are wound over a number of thin pieces of iron (the laminations). Theoretically, these should be tightly clamped by means of bolts, but in many components this point does not receive sufficient attention, and the bolts are either insufficiently tightened at the factory, or they work loose in transit, etc. Consequently, the thin strips are made to vibrate in sympathy with the impulses through the windings in exactly the same manner as an ordinary armature loud-speaker. If the transformer is in a case you will probably be unable to do anything. If the clamping bolts are visible, however, they should be tightened, and you will then find that the sounds will cease. There is risk of microphonic troubles if the vibrations are permitted to continue.

IRON SCREWS

"I should like to receive your advice on the following delicate point. I have built several sets, and have suddenly thought of the point of the type of screws used. Will iron screws introduce any losses or other troubles? Should all the components be fixed down with brass screws or otherwise? Please give me your ruling."—R. A. (Scarborough).

DATA SHEET No. 45

Cut this out each week and paste it in a notebook.

CONVERSION TABLE—METRES TO KILOCYCLES

Metres	Kilocycles	Metres	Kilocycles
10	30,000	600	500
25	12,000	650	461.5
50	6,000	700	428.6
100	3,000	750	400
150	2,000	800	375
200	1,500	850	352.9
250	1,200	900	333.3
300	1,000	950	315.9
350	857.1	1,000	300
400	750	1,250	240
450	666.7	1,500	200
500	600	1,750	171.4
550	545.4	2,000	150

Iron screws would, of course, give rise to certain effects if they were included in a magnetic field. The majority of wireless components are usually designed so that the fixing holes are out of the fields, but provided a little care is exercised in the choice of the size of screw and the components which are fixed by iron screws, we do not think you will find that any troubles can arise from their use.

A.V.C. AND QUALITY

"I would like to raise the following point regarding the quality of reception obtained when automatic volume-control is employed. As this method of control acts upon the strength of the carrier-wave which is received, surely it is logical to suppose that it will also act upon loud and soft passages in the modulated carrier-wave and so even up the musical piece and cause it to be reproduced at one even strength. Thus the A.V.C. method will ruin that which it sets out to obtain, namely, quality of reception."—S. K. (Kensington).

The method in which automatic volume-control functions is such that only the carrier wave is employed to produce the required voltage for H.F. control. It does not take into account any modulation of that wave and consequently there can be no effect on the material which is being received by means of the carrier wave. You may therefore employ A.V.C. without any qualms as to the quality of reception.

FOREIGN VALVE

"The second valve in my set has burnt out, and I have seen some very cheap valves in a local shop. Is it worth while buying one of these to replace my old one? I do not want to waste any money and am therefore asking your opinion first."—G. T. (Birmingham).

While it is possible to obtain cheap valves which will apparently work as well as good ones, you will find that the life of such valves is usually fairly short. On the other hand, it is not a bit of use going into the shop and asking for one of those valves without first of all ascertaining that it has similar characteristics to those possessed by your old valve. Differences in anode current, impedance, etc., will affect results, and therefore, if you are unable to obtain the characteristics of the cheap valve you must replace your valve with one of similar make. In any case, remember that cheap valves invariably only give "cheap" results.

FAULTY SWITCH

"I used to get very good results on both wave-bands on my commercial set, but now I can only get faint signals on the medium waves. There does not appear to be any alteration in the strength on long waves, but when switching over the medium I can only just hear London fairly faintly. Can you suggest what is wrong?"—T. H. (Barking).

The most likely cause of such a fault is a wave-change switch. We do not know what type of switch is fitted but if you can gain access to it, examine the contacts which are made when the switch is turned to the medium-wave position. You will find that they have either got dirty or corroded, or that the springiness has gone out of them and they do not make proper contact. As the receiver still functions on the long waves the coil winding must be in order, and the switch is the most likely cause of the difficulty.

SHORT CIRCUIT IN SPEAKER

"I have a D.C. mains receiver with mains excited moving-coil loud-speaker. When I turn the volume up on the loud side I get a nasty 'spitting' sort of noise in the speaker. It is something like a sharp crackling very sudden and hard, and only comes on when the set is working nearly all out. I have searched all over the place, but as it comes from the speaker I feel it must be there, although I know that all the sounds in a set also come from the same source eventually. What can I look for which is most likely to be the cause of this noise?"—T. M. C. (Teddington).

Before doing anything to the set itself we would recommend you to examine the loud-speaker. If there is the slightest sign of a short-circuit between the speech coil and the pole-piece this is the cause of the noise. As the field is excited direct from the D.C. mains, and as the mains are no doubt employed for the H.T. supply of the set, it is quite simple to short the mains through a partial short in the speaker, and the sound is similar to that described by you.

GRADED POTENTIOMETERS

"I have bought a potentiometer to connect across my gramophone pick-up to control the volume which I get from the gramophone. When I unpacked the component I see that the strip on which the wire is wound is wider at one end than the other. How is this intended to be used. It cannot surely give an even control of volume if the resistance is not even. I should like to have your remarks before sending the component back."—D. C. M. (Pontypridd).

The component is intentionally made that way, D. C. M., and it serves a very useful purpose through being so wound. As you remark, the resistance will vary throughout its length, and, therefore, there will be a greater variation in resistance at one end for a given amount of movement than there will be at the other end. Connect the instrument across your pick-up with the thin end joined to grid-bias negative (or earth, if it is a mains set). The arm is, of course, joined to the grid of the L.F. valve. Now, when you rotate the arm from the point of maximum volume towards the other end you will find that the sound output may be very evenly reduced whereas, if the resistance was of equal value throughout its length there would be only a small part of the resistance which would be of real use, and then volume would drop off suddenly.

FREE ADVICE BUREAU
COUPON

This coupon is available until August 5th, 1933, and must be attached to all letters containing queries.
PRACTICAL WIRELESS, 29/7/33.

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. Where advertisers make a charge, or require postage, this should be enclosed with applications for catalogues. No other correspondence whatsoever should be enclosed.

BROADCASTS TO SCHOOLS

THE annual programme of Broadcasts to Schools for the year September, 1933, to June, 1934, is now available, and may be obtained free on personal application to Broadcasting House, London, W.1, or for one penny by post. This publication covers the whole of the school broadcasting programme for the three terms; in it are included a review of the general principles of school broadcasting, notes on each subject and a separate schedule of timings and subjects for the Autumn Term only, giving all the talks for that term in a handy form. Similar schedules will be published in December and March, giving details of the Spring and Summer Terms of 1934, respectively.

FERRANTI ELECTRIC CLOCKS

A CLOCK which always keeps correct time, requires no winding or regulating, and costs only 1d. per quarter to run with electricity, has many advantages over an ordinary timepiece. In Ferranti Electric Clocks, which are for use only on A.C., accuracy of timekeeping with a minimum of attention are outstanding features. The usual spring and escapement mechanism is replaced by a small, beautifully-made electric motor, so designed that its speed is proportional to the supply frequency. In a booklet we have just received from Ferranti, Ltd., a fine range of these clocks is given. Most of the timepieces are for mantel use, and are available in highly finished cases, either in bakelite or polished oak, mahogany or walnut. A Ferranti movement, specially designed to replace movements in existing clocks, is also available. The address is Hollinwood, Lancs.

DUBILIER COMPONENTS

SOME constructors will find much to interest them in two booklets recently issued by the Dubilier Condenser Company. One deals with condensers and resistances and gives particulars of mica condensers, paper condensers, block condensers for use with mains receivers and battery eliminators, and high voltage electrolytic condensers. Resistance capacity coupling units and anti-interference filters are amongst the other components listed. The other booklet deals with Dubilier metalized resistances, designed especially for use in mains-operated receivers for voltage dropping and decoupling purposes. Useful tables giving maximum currents and voltages, and graphs showing the voltage and current ratings at a glance, are also included in the booklet. Interested readers should write for copies of these booklets to Dubilier Condenser Co., Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.

ALL ABOUT CLASS "B"

EVERYTHING in connection with class "B" amplification and its associated equipment is fully dealt with in a twelve-page folder we have received from Radio Instruments, Ltd. Diagrams, tables and technical data are given for the application of the class "B" system of amplification to battery sets, and to enable constructors to easily select the right valves and appropriate Drivermu transformers and output chokes. Prices of these components are also included in the folder. The address is Purley Way, Croydon, Surrey.

GARRARD SERVICE MANUAL

THE Service Manual for the new Garrard Automatic Record Changing Unit is now ready, and gives full information concerning this interesting piece of apparatus. Whilst intended primarily for Service Engineers, users of the apparatus will find the information very useful in understanding the working of the mechanism.

CORRECTION: A Simple Distributor Switch

A SLIGHT error occurred in respect to Fig. 2 of the above article (which appears on page 388 of the issue for June 3rd). Terminals 2 and 6 of the distributor switch on the right of the drawing should be connected together. If this connection is omitted the switch will not operate when the arms are on the contacts marked "2."

STOP PRESS NEWS!

Interesting items relating to the latest developments announced as we go to press. Where desirable further details will be given later.

NEW FERRANTI COMPONENTS

We have just learned that Messrs. Ferranti are producing the latest type of valve for use in superheterodyne receivers. Commonly termed the Pentagrid (although we see no reason for departure from the usual "ode" nomenclature), this valve is being named by Messrs. Ferranti under the name of Heptode—a term which is, of course, more in keeping with the English method of describing valves. In addition, a constructor's kit for a short-wave receiver, and a novel valve-tester will also be produced in time for the Exhibition. They are also producing a home-constructor's television kit.

TELSEN IRON CORE COILS

From the Telsen factory comes the announcement that iron core coils will shortly be produced. Full details are not yet available.

LISSEN IRON CORE COILS

Lissen coils on the iron-core principle are now in our hands, and these possess many novel features. The principal point of interest is the very small former upon which the coils are wound.

Replies to Broadcast Queries

P. THOMAS (Aberystwith): Details given are too vague to trace transmitter, but possibly aerodrome station working with 'planes. ALLAN (Newburgh): G2CK, City and Guilds College, Exhibition Road, London, S.W.7; G2YM, R. W. Piper, Chiltern View Road, Uxbridge (Mdx.); G2KO, J. A. North, Thorndale Farm, Wetwang, Malton (Yorks); G5NW, E. J. Allan, 8, Westfield Place, Dundee; G5BR, G. L. Brownson, 13, Redbourne Av., Church End Finchley, London, N.W.3; G5NZ, P. Nicoll, 167, Todmorden Road, Burnley (Lancs); G6LY, J. H. Blakeley, 2, Hazel Grove, Blackpool (Lancs); G6GG, G. Golding, 5, Elm Cottages, Elm Road, Shoeburyness (Essex); G6WL, J. Kyle, Hillend, Dalry, (Ayrshire, N.B.); G6RO, O. H. Reilly, 29, Ocklynge Road, Eastbourne, (Sussex). Cannot trace G6FB and G5KO.

OLD CIRCUITS REVIVED

(Continued from page 626)

make the electron stream traverse this gap a high positive charge must be applied to the plate. With the special two-grid valve, however, the inner grid is very near to the filament, so that its small positive charge (derived from the accumulator) is sufficient to attract the electrons shot off from the filament and to give them so much impetus that they are able to pass through both grids and reach the plate. The valves in use at the time the "Unidyne" (as this circuit was called) was being tried out were of the four or six volt type, and consequently, the filaments were fed through rheostats. Due to the method by which the inner grid was connected the voltage drop across the portion of the rheostat in use was employed to provide an additional positive grid potential.

Despite the fact that the H.T.-less set could show numerous advantages over one of the normal type, especially when built in portable form, and although the circuit was given wide publicity, it never proved to be a real success. It lacked power, and was incapable of giving sufficient output to operate a loud-speaker in anything like an efficient manner. The idea was, nevertheless, of more than passing interest to the experimenter in that it defied conventions.

A single-valve arrangement that met with a fair amount of success in the early days of broadcasting was that known as the Ultra-Audion circuit. A diagram of this is given in Fig. 9, from which it can be seen that a single coil was used both for aerial tuning and reaction. Instead of controlling reaction by the usual swinging coil or variable condenser method, it was done by adjusting the variable grid leak and filament rheostat. The circuit was extremely critical, and depended very much upon the correct choice of valve and associated battery voltages, but despite these disadvantages, however, the Ultra Audion has often been known to produce excellent results when handled by the patient experimenter. Even at the present time it is worth a trial as a short-wave receiver, although some difficulty might be experienced in obtaining a variable grid-leak.

In writing this article I have not by any means mentioned all the "super" circuits that have been used since broadcasting began, but reference has, I think, been made to all the more important ones. During the next few years there will probably be many more circuits evolved, and there is still plenty of scope for the amateur experimenter.

ADVERTISEMENT INDEX

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AI	277453	AK	326649	AM	742005	AN	383264	AO	181856	AO	796213	AP	218756
AI	004992	AK	721385	AM	360925	AN	637123	AO	753609	AO	190300	AP	991006
AI	863751	AL	792854	AM	252531	AN	060488	AO	522616	AO	802699	AP	330412
AI	420096	AL	929656	AM	699902	AN	342222	AO	944237	AO	337011	AP	027599
AI	375268	AL	257895	AM	001984	AN	007005	AO	99318	AP	561208	AP	692437
AJ	598810	AL	416423	AM	876752	AN	951904	AO	415339	AP	383055	AP	166642
AJ	41674	AL	561754	AM	520766	AN	96438	AO	058787	AP	822543	AQ	040536
AJ	338920	AL	838536	AN	650976	AN	859712	AO	994026	AP	407938	AQ	413074
AJ	041677	AL	680917	AN	239590	AN	164444	AO	832525	AP	042888	AQ	170218
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This offer applies to licences which are actually in force on Saturday, July 29, 1933.

Before the awards are paid, claimants will be asked to undertake a simple publicity service in distributing leaflets to encourage the sale of licences amongst those who at present do not fulfil their obligations by taking out a Post Office Wireless Licence before receiving broadcast programmes. Claims cannot be considered in connection with any Licence the date of issue of which is after July 27, 1933.

AWARDS MUST BE CLAIMED BY AUG. 4, 1933

If the number of your wireless licence appears above you only have to forward the licence for official verification by registered post, and state the name and address of the Newsagent who supplies you with your weekly copy of "Practical Wireless." Address your application to Wireless Dept. (74), 8-11, Southampton Street, Strand, W.C.2.

Claims received later than Friday, Aug. 4, 1933, will be disqualified.

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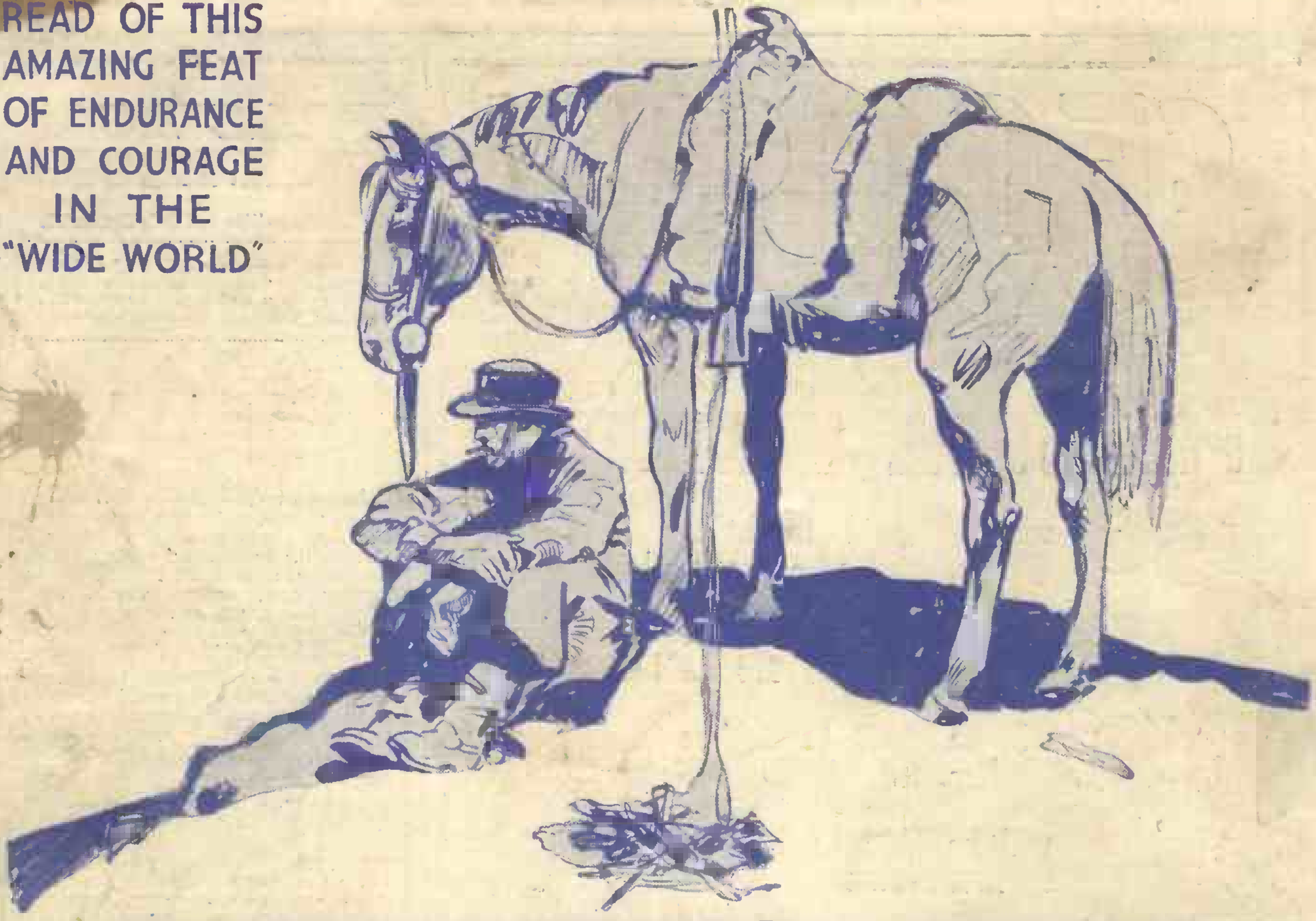

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