G.B.

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Practical Wireless

3D.

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DESIGNED BY
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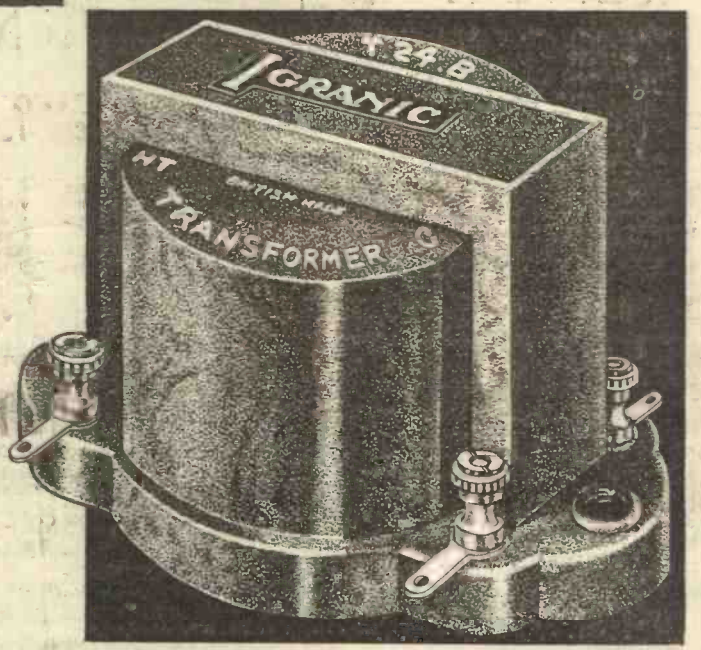

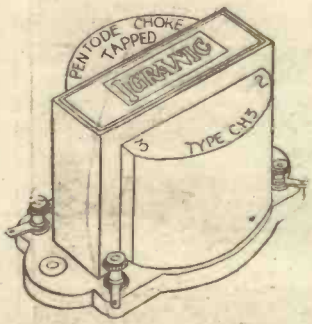

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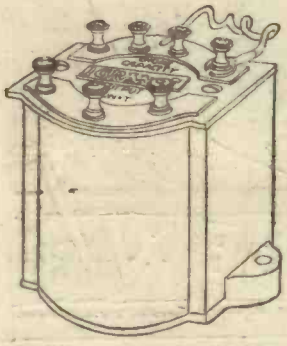

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Described in issue of October 22nd.

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The Selectivity Problem Solved by The Barton Chapple Argus Three. See Pages 340 and 341

ROUND THE WORLD OF WIRELESS

Youthful Home Constructors in Germany

ACCORDING to a recent census taken in German schools, 43 per cent. of the boys were interested in the home construction of radio receivers. Statistics show that girls in similar educational establishments were interested to the extent of only 34 per cent., and it was found that in general but few of them had any knowledge of wireless; they were merely listeners to the broadcast programmes.

Europe's Jamming Transmissions

THERE are at present in Europe roughly 250 transmitters broadcasting daily on wavelengths comprised between 200 and 2,000 metres. If a 9-kilocycle separation between channels is insisted upon, there would only be room for 150 transmitters, and for this reason some stations are compelled to use wavelengths in common with others.

Relay Programmes from Algiers

WITH a view to a development of its "relay" features in the evening programmes, Radio Alger (Algiers) now transmits from time to time operatic performances from the Paris Grand Opera House. These broadcasts are passed on to North Africa through the Pontoise short-wave transmitter, Radio Colonial.

A Tongue-Twister for the Announcer

SOME twenty-five miles from Dannevirke, in the Hawkes Bay district of New Zealand, there is a small locality which figured recently in a News Bulletin broadcast by 2YA Wellington; its name was "Taumatawhakatangihangakoauauaatanenuiarangikitanetahu," which proved somewhat of a stumbling block to the station announcer.

State Ownership of German Broadcast Stations

FROM separate organisations the German broadcast stations have been amalgamated into one corporation controlled by Berlin, and thus have been put under direct State ownership. The only exception is that of Munich and its associated relays, which has retained its independence, although on some evenings taking part in transmissions put out by other German studios.

Developing Norwegian Broadcasting

BY a recent vote the Norwegian Parliament has authorised the Ministry of Posts and Telegraphs to expend one million kronen on the full development of the broadcast system of that country. During 1933–4 complete overhaul of the stations will be carried out. The plan calls for the erection of several relay transmitters, and also for the installation of a high-power plant to replace the existing station at Bergen.

Link-up of Telephone System With Wireless

A LOW-POWER wireless transmitter has been erected at Rotterdam, in order to enable subscribers to the ordinary telephone system to be put into communication with coastal shipping as well as with barges on the Rhine and Meuse rivers, and the network of canals so widely used in Holland. Messages telephoned to the Rotterdam transmitter are re-radiated by wireless to all vessels equipped with receiving apparatus, each craft being allotted its individual call. The service has been organised mainly for the purpose of enabling owners to send urgent orders to their skippers and will, it is considered, quickly pay its way. Should the experiment prove successful, Amsterdam Harbour will be equipped in the same manner.

"Canned" Music in French Transmissions

STATISTICS published a few days ago respecting the composition of the wireless programmes in various European countries show that France heads the list in respect of the use made of gramophone records. More than 25 per cent. of her radio entertainments consist of canned music. This fact will not cause much surprise to listeners who tune in Radio-Paris, Eiffel Tower, Radio Toulouse and the like.

Moscow's Interval Signal

THE Moscow and Leningrad broadcasting stations, as an opening and interval signal, have adopted the sound of a hammer striking an anvil, in order to symbolise the industrial characteristics of the Five Year Plan.

Empire Broadcasting Transmitters at Daventry

WORK on the Empire Broadcasting transmitters which the B.B.C. is erecting at Daventry is so far forward that it is hoped to start the first tests during November. If these are deemed satisfactory the Christmas programme will be radiated for the benefit of the Dominions and Colonies. The wavelengths to be used are: 13.97 m. (21.470 kc/s.); 16.88 m. (17.770 kc/s.); 19.815 m. (15.140 kc/s.); 25.284 m. (11.865 kc/s.); 25.532 m.; at present monopolised by G5SW Chelmsford —(11.750 kc/s.); 31.297 m. (9.585 kc/s.); 31.545 m. (9.510 kc/s.) and 49.586 m. (6.050 kc/s.).

Russian Super-power Station

TESTS are being carried out by a 500-kilowatt transmitter recently installed at Moscow-Noghinsk. The wavelength on which the station will eventually operate has not been definitely fixed and experiments are being made on various channels, and in particular on 848.7 m.

Broadcasts from Paris Conservatoire

AS, following an official refusal to lease land lines for the purpose, Radio-Paris was unable to carry out relays of performances from the Paris Grand Opera House, the studio has now made arrangements to broadcast during the winter months a series of weekly symphony concerts from the Paris Conservatoire. The dates which have been provisionally fixed are: October 29, November 5, 12, 19, 26; December 3, 10, 17, 24; January 7, 14, 21, 28; February 11, 18, 25; March 4, 18, 25; and April 1 and 8. In most of these concerts some of the better-known artists of the French concert-platform will contribute to the programme.

Round the World of Wireless (continued)

New Austrian High-power Station

WORK has now been started on the aerial installation of the Bisamberg (Vienna) super-power station. The result of the experiments is being anxiously awaited, as it is of a novel design. The station will be equipped with two lattice towers, of which one will serve as aerial, its opposite number being used as a reflector to secure better radiation in the western part of Austria. Such a beam effect should prove favourable to the reception of the Austrian programmes in the British Isles.

No Applause for German Broadcasting Artists

CONTRARY to the custom in B.B.C. studios, in Germany, except in the case of some vaudeville broadcasts, the audience is not permitted to applaud the artists. This principle has been adopted from the theatre, where clapping is only allowed at the end of an act.

Short-wave Broadcast from Rio de Janeiro

EVERY evening at 10 p.m. G.M.T. the Imprensa Naçional of Brazil broadcasts through PRAB, Rio de Janeiro, on 31.58 m., a News Bulletin in English, French, Spanish, and Portuguese. Following this broadcast on alternate evenings, a short musical programme sponsored by the Radio Club of Brazil may be heard.

German Long-distance Wireless Interview

THE first long-distance wireless interview carried out by the German broadcasting stations recently, took place between Berlin and Batavia (Java) on the occasion of the arrival in the Dutch East Indies of Wolfgang Von Gronau, on his flying trip around the world. Radio-telephony communication was established *via* Nauen (Germany) and Bandoeng (Java) on the 15-metre band. As the interview took place towards midday, the two-way conversation was registered on wax records, and re-broadcast during the evening programme through all German transmitters.

Foreign Language Courses from Jugoslavia

IT is curious to note that of all the European stations, Ljubljana (Jugoslavia) should be the one which holds the record for the greatest number of foreign language courses broadcast in the course of the year. At that studio tuition is given weekly in Esperanto, Serbo-Croatian, Russian, Italian, French, and English. Announcements, also, in the course of the programmes are frequently multi-lingual.

Operatic Broadcasts from Budapest

DURING the winter season, namely, from October 15 to May 1, Radio Budapest (Hungary) proposes to relay fifty performances from its State Opera House; in some instances there will be three broadcasts weekly. In addition, foreign listeners will also be given an opportunity of hearing ten philharmonic concerts, some of which will also be taken by the main European stations.

Experimental Transmissions from Radio Luxembourg

ALTHOUGH the 200-kilowatt Radio Luxembourg (Grand Duchy) transmitter is now ready to start its daily broadcasts, no date has yet been fixed for its official inauguration. In the meantime

INTERESTING & TOPICAL PARAGRAPHS

recitals of gramophone records at lesser power are given every week-day between 11.30 a.m. and 1.30 p.m. G.M.T., and occasionally in the early evening hours. Announcements are made alternately in German and French. The calls heard are: *Hier der Versuchsender Luxemburg* and *Ici Luxembourg Expérimental.*

BUILT BY EMBRYO SCIENTISTS

An experimental radio station has been built on the limbs of a barren tree where two lads of Oakland, Calif., are making observations in scientific radio experiments. The laboratory is 23ft. above the ground and is approached by steps which the boys built on the tree. The ingenious youngsters work after school hours in the improvised station, which overlooks Lake Merritt, in Oakland.

Wireless in Paris Cinema

A CINEMA recently opened at Paris has added, as an extra attraction a special hall in which the audience, between performances, may hear relays of foreign wireless broadcasts.

Checking Radio Piracy in Canada

THE Canadian authorities are taking stern measures to deal with radio pirates. No dealer is permitted to effect the sale of a wireless receiver to any customer unless the latter can prove his possession of a licence for the current year. The penalty for using a radio set without authority is a fine of fifty dollars or, at the discretion of the judge, three months imprisonment.

French Short-wave Stations' Harmonics

LISTENERS on short waves may have been puzzled by some regular French transmissions on wavelengths comprised between 40-60 metres. They are respectively the sixth harmonic of Bordeaux-Lafayette (50.7 m.) and the fifth harmonic of Poste Parisien (65.6 m.).

Proposed 90-kW. French Station

IN the course of an official address recently given at Paris, the French Minister of Posts and Telegraphs stated that a new broadcasting bill will not be introduced before 1933. In the meantime, no steps will be taken to suspend the broadcasts of privately-owned transmitters. Work on the proposed new stations at Lille, Marseilles, Thourie and Nice is to be begun without further delay. According to supplementary—but unofficial—information the French State intends to install a 90-kilowatter at Lyons and to erect at Paris and Toulouse two high-power stations of at least 120 kilowatts.

Radio Under Difficulties

I SEE the British Trade Exhibition at Copenhagen has resulted in a few good orders for Britain, including the spectacular one for 10,000 cycles. Well, that's a lot of "bikes" to be seen on the roads of Denmark, but I wonder how our wireless firms found business. Denmark is in a good position regarding radio and I should think a good many sets ought to have been sold. H.R.H. the Prince of Wales has a distinctly happy way of creating business in his wake, and has been well-named our "Ambassador of Trade." I see also that our Prince has formed a habit of typing his speeches while flying to and from his various engagements in this country. This speaks well for his ability as a typist and for the stability of his aeroplane, because I have some never-to-be-forgotten recollections of the first attempts to receive wireless broadcasts while travelling in a car on some of the bad roads existing during the first few years after the war. We slung up an aerial inside the hood. The set was an old four-valver, with swinging coil reaction, and with condensers of the old round type that could be turned round and round indefinitely after the manner of perpetual motion. We used headphones, of course, and sometimes we got signals from the old 2LO, but our chief difficulty was stopping the reaction coil from swinging, and in getting the condenser to "stay put." When the signals were coming through they were punctuated by the machine-gun rattle of the "pick-up" from the magneto and sparking plugs. I believe the climax was reached when somebody kicked the L.T. accumulator over and spilt the acid.—JACE.

(*Continued on page 322.*)

SOLVE THIS!

Problem No. 7.

Johnson made up an ordinary one-valve set employing the well-known Reinartz circuit. The coil was home-made, being wound on a standard six-pin coil-former. When it was finished and tested out, he found that an increase in the value of the reaction condenser resulted in a reduction of signal-strength, instead of an increase. What was wrong?

Three books will be awarded for the first three correct solutions opened. Mark envelopes Problem No. 7, and send to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2, to reach us not later than November 7th.

SOLUTION TO PROBLEM No. 6.

The grid leak was joined to the wrong side of the condenser, thus causing the valve to choke.

The following readers receive books in connection with Problem No. 5:—

R. Brooks, 49, Hayles Street, Brook Street, Kennington, S.E.11; J. R. Turnbull, 160, Easter Road, Edinburgh; H. D. Wylie, 138, Corporation Bldgs., Ray Street, Farringdon Road, E.C.1.

FITTING A PICK-UP

An Informative Article, Explaining the Various Pitfalls, and How to Eliminate Defects in Reproduction.

By GILBERT E. TWINING

PLAYING records through the wireless set by the aid of an electrical pick-up is becoming more and more popular every day. Certainly the electrical method of reproducing the records is far in advance of the old sound box and tone-arm, which was, of course, operated on a more or less mechanical basis.

If the set already has provision for a pick-up—that is to say, terminals or jack connections on the outside of the cabinet—it will be an easy matter to fit up the extra parts that are necessary. Firstly, a gramophone pick-up of good manufacture, complete with carrier arm, must be purchased, and secondly a turntable with motor combined. Where the mains are available one of the good electrical turntables should be chosen. Better still, if the mains are A.C., obtain one of the latest constant speed induction motors, which are quite inexpensive. One of the advantages of this type of motor is that its speed is independent of the supply voltage; it is governed by the frequency of the current. The voltage of the mains fluctuates fairly considerably; the frequency is, however, absolutely constant. Where the current is D.C., one of the many universal motors will be quite suitable. If the mains cannot be utilized, a good double spring clockwork motor can be fitted, or even an existing motor and turntable from an old machine may be adapted. A volume control will be the only other necessity if one is not already incorporated in the pick-up itself. This should be wired between the two pick-up leads, and will have to be a high-resistance potentiometer of approximately 100,000 ohms.

Internal Wiring of the Set for a Pick-up

Several methods have been used for the fitting of a gramophone pick-up to a set, some being cheaper than others. It is possible to get results if one side of the pick-up is connected to one end of the grid leak, which is joined to the detector valve, the other lead of the pick-up being connected to low-tension negative, although generally this is not quite good enough and usually distortion is noticeable on account of the lack of bias to the valve. In a set having a low-frequency stage, where the detector feeds the power valve, the connection should be made to the grid circuit of the detector valve (see Fig. 1). One side of the pick-up—or, rather, one of the leads

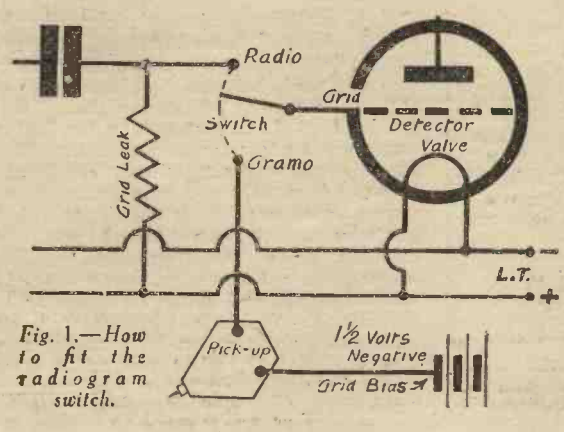
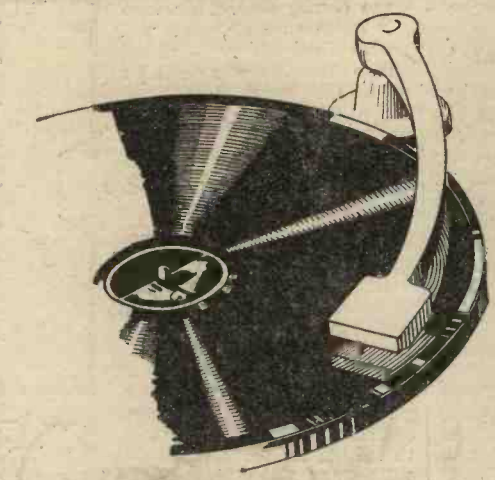


Fig. 1.—How to fit the radiogram switch.



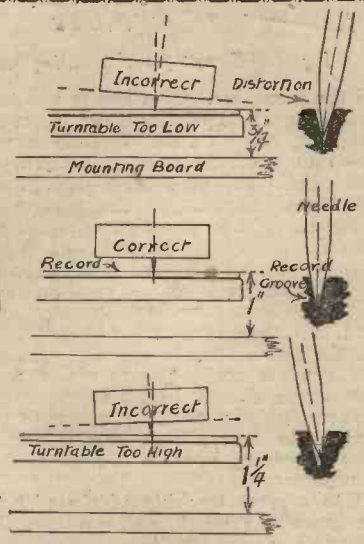


Fig. 2.—Correct and incorrect methods of mounting the pick-up.

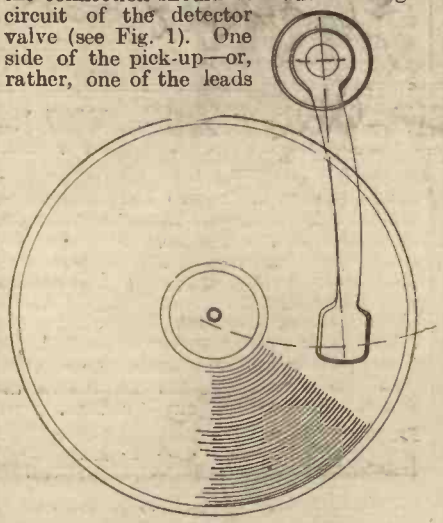


Fig. 3.—Pick-up correctly fitted in relation to axis of rotation of record.

—is wired to the grid terminal of the detector valve-holder; the other lead is connected to grid bias negative. Pick-ups generate about 1 volt, so a bias of 1½ volts is suitable. In some cases the grid bias may be altered to 3 volts, or any tapping, provided the increase does not distort the reproduction. This increase will reduce the anode current and save the high-tension battery. Bias is used to prevent the pick-up output overloading the valve. But, owing to the fact that the succeeding stages will have to handle the amplified voltage, it is necessary to fit a volume control.

A variable resistance is not considered good enough, for if one was shunted across the pick-up leads the top notes are bound to be lost, and the result would be bad distortion. The proper method, as before stated, is to use a potentiometer. Connect the two end terminals of the potentiometer across the pick-up leads, one of which also goes to grid bias negative. The slider of the potentiometer is then connected to the grid of the valve.

When making provision for the switch, enabling the radiogram. or the set to be used alternatively, make sure—and this is a very important point—that when the radio part of the set is switched on, the grid lead to the valve from the grid leak is as short as possible, for in some sets, especially those of the mains variety, a hum may be introduced. The switch should not be more than two or three inches from the grid terminal of the valve-holder, and the best place is at the back of the set, immediately behind the detector valve. A three-point switch is required of good manufacture, as stoutly made as possible, to obtain the highest efficiency; the connections are shown in Fig. 1. In some cases a hum occurs due to the interaction of the pick-up leads, and this may be cured by using shielded cable, the casing of which must be earthed. In fact, it is preferable to earth the metal parts of the pick-up itself, together with the carrier arm; in some instruments an earthing terminal is provided on the pick-up. Long leads between a pick-up and the amplifier are always to be avoided.

Mounting the Pick-up

When screwing the carrier arm on to the mounting board, make quite sure that the following points have been taken into consideration. One of these is the height

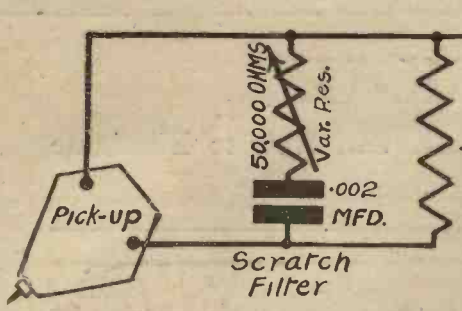


Fig. 4.—Circuit for eliminating scratch.

of the turntable. This height will tend to alter the angle of the arm; even if the tracking has been set correctly it will, if the arm is of the cranked pattern, throw the needle out of upright—*i.e.*, it should be at right-angles to the surface when viewed from the direction of travel of the record. Even if the boss of the arm is only a small amount out—too high or too low—it will force the needle to press on one side of the grooves of the records and cause wear and bad reproduction (see Fig. 2). This should not be confused with the needle angle when looking across the record; this angle should be 50 degrees. Some makers supply packing rings to place under the boss of the carrier arm, but these can easily be made of wood or ebonite if necessary.

The correct tracking of the pick-up is an important point, and care should be taken when screwing down to the mounting board. Most manufacturers supply a template to indicate the best position for the pivot point of the arm to give good tracking. It should be fitted so that the needle track when swung inwards will come to a position about one-sixteenth of an inch in front of the front edge of the motor spindle (see Fig. 3). The pick-up must be capable of free side movement; any friction will cause the side walls of the grooves of the records to be worn. Tightness is sometimes due to very thick flex leads passing through holes in the mounting board, causing a drag on the carrier arm. Thin wire is quite suitable, and will give freely if it is coiled into miniature springs where it leaves the arm. Keep the leads as far as possible from other wiring in the set, especially from the main current leads to the motor.

Some pick-ups suffer from too much top note response, which causes a high-pitched needle scratch to be strongly pronounced. A scratch filter must be shunted across the pick-up leads; it must be understood, however, that if this high needle scratch is cut out, so also certain of the top notes of the record will be lost. In Fig. 4 is a scratch eliminator having a variable resistance and a series fixed condenser across the pick-up.

A very simple adaptor which is designed for making provision in a set for a pick-up is illustrated in Fig. 5. It consists of a bakelite base, similar to a valve-holder, with four valve sockets; the filament and plate sockets are connected internally to pins on the underside, but the grid socket is left free. When the adaptor is interposed between the detector and its holder, the grid is completely disconnected from the internal wiring of the receiver, and to this the slider of the volume control is connected; the other lead from the pick-up goes to the grid bias battery.

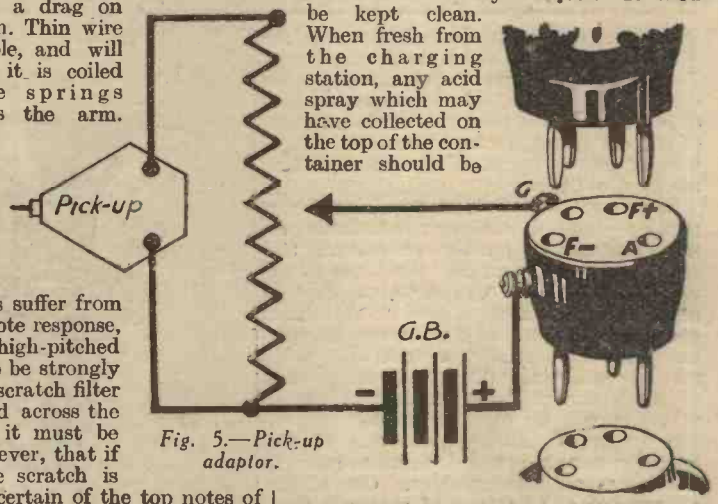


Fig. 5.—Pick-up adaptor.

Accumulator Cleanliness

THERE is no need for an accumulator to be a "messy" object. It should be kept clean. When fresh from the charging station, any acid spray which may have collected on the top of the container should be wiped off with a rag. As soon as any signs of corrosion appear, remove the terminal screws, scrape the corroded parts bright, and rub over with fine emery paper. There will be no fear of corrosion taking place on the terminals if they are kept well greased with vaseline.

Corrosion is a direct means of resistance, and will, when 2-volt valves are used, cause a drop in voltage which will bring about filament starvation.

Round the World of Wireless

(*Continued from page 320*)

The B.B.C and Short Waves.

IN opening the Manchester Radio Exhibition Mr. Whitley, Chairman of the B.B.C., said he regretted the fact that although his Corporation were doing their best to transmit short-wave programmes to our colonies very few British Manufacturers were doing their share by building receivers which could be used on the short, as well as on the normal broadcast, wavelengths. It is therefore of interest to note the introduction, by Messrs. Faraday All-wave Wireless, Ltd., of a four-range superheterodyne which operates equally well on wavelengths from 15-60 metres as it does on longer waves. The set is made in two models for A.C. and D.C., and in a recent test of an A.C. model I found it extremely sensitive besides being as easy to tune as the average "family" broadcast receiver. I am not aware whether or not a battery model is available, but that would seem to be very desirable to many of our colonial cousins.

Winter Time

I mentioned in these notes a few weeks ago that reception conditions looked like being very good this winter. Since then we have put back our clocks to "sun" time and my log of D X (long distance) stations has grown very rapidly. Whilst trying out a simple Det.—2 L.F. set last Sunday evening I found no difficulty in bringing in forty-odd stations at really good speaker strength. The strength of many of the European transmitters was so great that it was necessary to make good use of the volume control. Notable among these were Prague, Langenberg, Beromünster, Rome, Stockholm, Moscow, Bucharest, Poste-Parisen, Breslau, Hilversum and Fécamp, in order of wavelengths. In passing it is rather interesting to notice that the eleven stations mentioned are situated in nine different countries.

Frequency Separation

ONE might suggest that in view of the fact that all high-power European stations are allowed a 9-Kilocycle separation there should be little trouble from heterodyning. It must be remembered, though, that 9 kilocycles is the minimum separation permissible without a heterodyne note being produced. And some transmitters apparently find it difficult to keep exactly to their allotted frequency; in fact, reports of the International Radio Bureau at Geneva show that not a few Continentals deviate from their proper frequency by no less than 4 Kilocycles. In such cases interference is inevitable and we listeners can do nothing to overcome it.

Receiving America

BY the way, have you tried for any of the American medium-wave stations this winter yet? With conditions as they were until to-day there should be no difficulty in receiving two or three of them if you feel inclined to sit up until after midnight. My experience shows that it is little use trying for America before the zero hour because, even if the stations have begun their transmissions, they do not get across with sufficient strength to be heard through the numerous Europeans. The Americans usually come in at pretty decent strength, but it is little use sitting up to listen for them unless conditions are good. As a general guide you can take it that on evenings when the Continental stations are coming in well your time will not be wasted in trying for America.

Atmospherics

SINCE writing the above three paragraphs (yesterday) there has been rather a change in conditions. Atmospherics have suddenly made a nuisance of themselves so that when going "round the dials" this evening I found DX work very trying. On the long-wave band good reception of any other than the super power stations was impossible. When I turned to the medium waves atmospherics were (as is usual) somewhat less severe, but even there I was still troubled by a few "grinders." Short waves, below 50 metres, were scarcely affected at all, and I had no difficulty in bringing in W2XAD (Schenectady) on 19.56 metres, Rome on 25.4 metres and Moscow REM on 45.38 metres at good speaker strength during a ten minutes "run-round."

AUTOMATIC GRID BIAS FOR BATTERY SETS

This Article Gives all the Practical Information Necessary to Enable You to Obtain Automatic Grid Bias for Any Kind of Battery-operated Receiver.

By FRANK PRESTON, F.R.A.

This photograph shows Mr. Preston at work on the Experimenters' Short-wave Three, shortly to be described in these pages.

PRACTICALLY every mains receiver obtains its grid bias supply "automatically," the actual bias potential being that caused by the voltage drop across a resistance inserted in the H.T. negative circuit. This method is foolproof and eminently satisfactory, but apparently very few designers have thought of applying it to battery-fed receivers. There is certainly no snag in the arrangement, either theoretically or practically, and the writer has employed it for some time past with every satisfaction.

Grid Bias Battery Unsatisfactory

Of course, a grid bias battery is cheap and only requires very occasional renewal, so you might say, "Why scrap it in favour of some other system?" The point is that the grid bias battery is not really satisfactory, principally because its voltage cannot be regulated in any smaller steps than 1½ volts. This is not always a great disadvantage when dealing with a power valve requiring a grid-bias voltage of 9 volts or so, but when the valve is one of the newer high-efficiency pentodes taking a grid-bias voltage of only about 3, a vast difference in performance is apparent when an alteration of 1½ volts is made. The same thing applies, only with greater force, when dealing with a "first L.F." valve which is usually of the H.L. or L. type, requiring a grid-bias voltage of from ½ to 1½ volts. When the high-tension battery is brand new the above disadvantages do not always apply, because a suitable and accurate bias voltage can generally be found. But as the H.T. battery gradually runs down and its voltage drops, the grid-bias voltage should be reduced by a proportionate amount. As we have seen, such a gradual reduction is impossible and we have to effect a compromise. This usually results in the tone of reproduction suffering—as all readers will have observed after the H.T. battery has been in use for some time—or in excessive H.T. current consumption by the L.F. amplifying valves. Both conditions are undesirable and shorten the useful life of the high tension battery.

Advantages of Automatic Bias

Now when we use automatic bias, such as I referred to in the opening paragraph, the grid-bias voltage is always maintained at the exactly correct figure, whatever the state or voltage of the high tension supply.

The reason is that as the resistance is connected in series with the high tension negative lead, the voltage drop across it is dependent on the high tension current.* Thus, when the battery is new and at maximum voltage, the high tension current consumption will be at maximum. In consequence, the voltage drop across the resistance (which is, in effect, the grid-bias voltage) will be at its highest figure. But as the high tension battery runs down and its voltage falls off, the current consumption of the set will also be reduced and this will in turn effect a proportionate reduction in grid-bias voltage. This is clearly an ideal state of affairs.

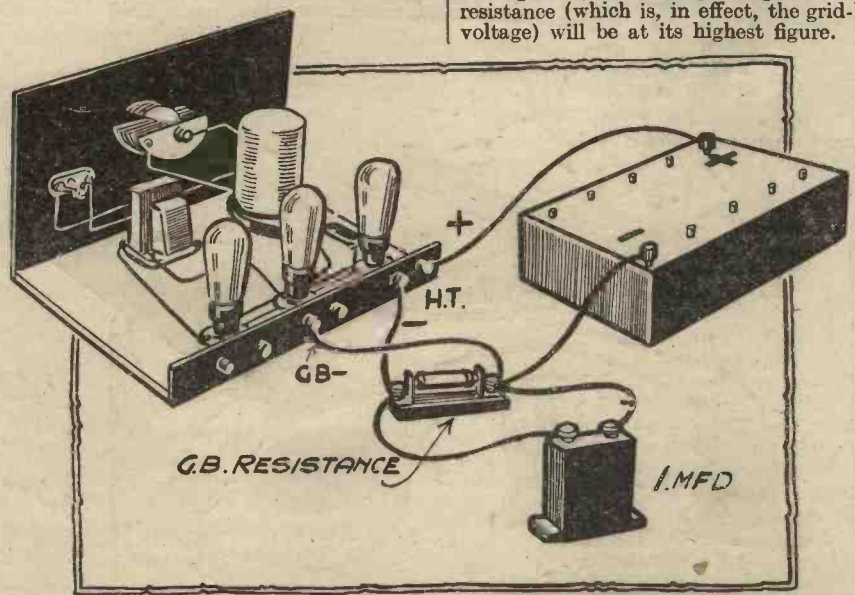


Fig. 1.—Pictorial diagram showing alterations required to effect automatic or "free" grid bias.

Obtaining Automatic Bias

The alterations required to a set in order to obtain free or automatic grid bias are illustrated in the sketches Figs. 1 and 2. Fig. 1 refers to a receiver having a single grid bias tapping, and it will be seen that the only additional components required are a fixed resistance and a 1 mfd. condenser. The grid bias battery and its connecting wires are removed entirely; the negative H.T. lead from the battery is taken from its usual terminal on the set and connected to one side of the fixed resistance and to the "G.B.—" terminal, a wire then being taken from the other end of the resistance to terminal "H.T.—." A 1 mfd. bypass condenser is wired in parallel with the biasing resistance.

Correct Value of Resistance

The only factor which remains to be considered is the value of the G.B. resistance. This depends upon the total anode consumption of the set and upon the grid-bias voltage required. If a milliammeter is not available for measuring the anode current, the latter figure can be found by making reference to the maker's instruction sheet for each valve and adding together the currents taken by each. In looking up these particulars, one must remember that the figure required is that of the current consumption when the valve is operating at the maximum voltage of the high tension battery. As an example, suppose that the first valve is a Cossor 215 S.G., the second a Cossor 210 H.L., and the third a Cossor 230 P.T., and that H.T. is derived from a 100-volt battery. The anode and screen current of the first valve will be about 2 milliamps, the anode current of the second about 1 milliamp, and of the third 8 milliamps.

* The voltage drop across any resistance is equal to the product of the resistance in ohms and the current in amperes; since the resistance remains constant the voltage drop varies in proportion to the current.

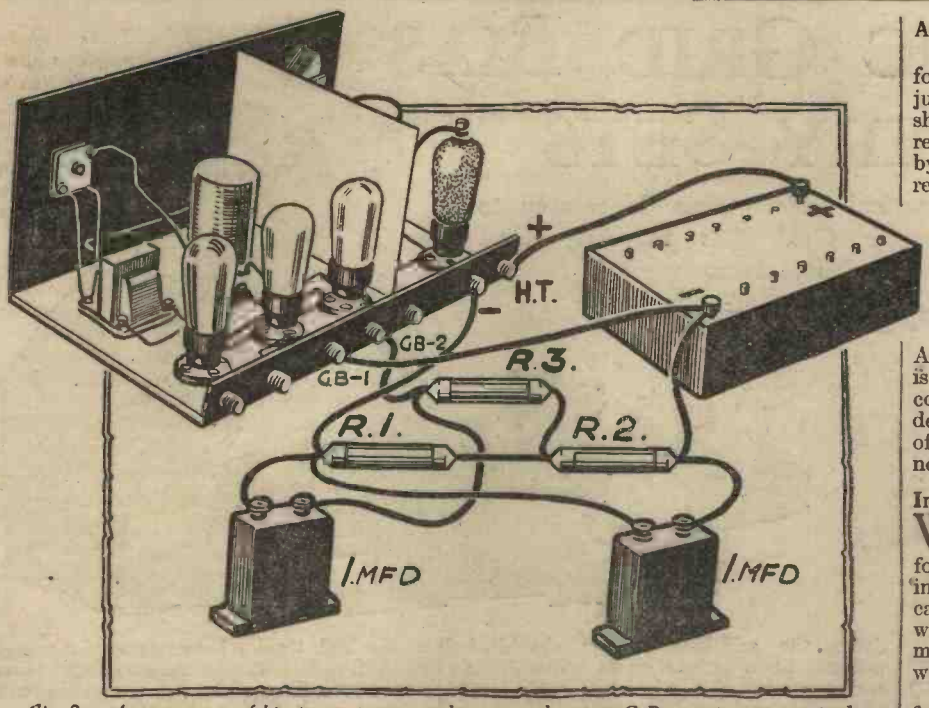


Fig. 2.—Arrangement of biasing resistances when more than one G.B. tapping is required.

This gives a total of 11 milliamps and as the pentode requires a grid bias voltage of approximately 10, the resistance should have a value in thousands of ohms of 10 divided by 11, or just under 1,000 ohms. Actually a 1000 ohm resistance would serve the purpose quite well because the exact value is not critical since the resistance is very largely self-compensating. As in nearly all cases the power valve is the principal consumer of H.T. current, the value of the resistance is more dependent upon this than upon the other valves in the set. It is, therefore, possible to give a table of resistance values suitable for use with a number of different types of output valves. The figures given below have been calculated on the assumption that the total anode current consumption of the other valves is 3 milliamps.

	Valve.	Resistance.
Cossor	215 P.	700 ohms.
	220 P.	800 ohms.
	220 P.A.	500 ohms.
	230 X.P.	750 ohms.
	230 P.T.	1,000 ohms.
	P.M. 2.	150 ohms.
	P.M. 2A.	500 ohms.
	P.M. 254	1,000 ohms.
Mazda	P. 220	1,000 ohms.
	P. 220A.	850 ohms.
	P. 240	1,000 ohms.
Six-Sixty	220 P.	1,200 ohms.
	220 P.A.	700 ohms.
	220 S.P.	600 ohms.
	240 S.P.	750 ohms.

When More than One G.B. Tapping is Required

Figure 2 shows the arrangement of biasing resistances when more than a single G.B. tapping is required. Resistances R1 and R2, being connected in series, act in the same manner as the single resistance shown in Figure 1, and, therefore, the grid bias potential applied to tapping "G.B.—1" is that developed across both R1 and R2. Thus, assuming that "G.B.—1" supplies the output valve, the combined resistance of R1 and R2 should be equal to that of a single resistance as shown in the above table. The negative potential applied to "G.B.—2," however, is that developed across R1 alone and, therefore, by choosing an appropriate value of resistance any desired voltage can be obtained. This may be calculated as explained above, but for nearly every "L" or "H.L." valve used for the first low-frequency stage a value of from 250 to 350 ohms will prove satisfactory. It will be clear that R2 must have a resistance equal to the difference between that given in the table and R1. Resistance R3 is for decoupling purposes only and may be of any value from 20,000 ohms to 250,000 ohms. Two 1 mfd. condensers are used to bypass H.F. currents and to prevent L.F. instability.

Automatic G.B. for Variable-mu Valve

A variable bias voltage, such as is required for a variable-mu S.G. valve, can be obtained just as easily as a fixed one by the method shown in Figure 3. Here the fixed bias resistance of Figure 1 has been replaced by a potentiometer from which a fixed resistance is obtained by connecting to the two outer terminals. This fixed resistance (which must, of course, be of approximately correct value), provides grid bias for the output valve, through terminal "G.B.—1," but the centre terminal (connected to slider) is made to supply a variable G.B. voltage to terminal "G.B.—2." As before, a decoupling resistance (R3), is employed as well as two 1 mfd bypass condensers. It is essential that the condenser associated with the G.B. circuit of the variable-mu valve should be of a non-inductive pattern.

Increasing the Input from a Pick-up

WITH some receivers it is difficult to obtain sufficient L.F. amplification for gramophone reproduction, especially in those circuits in which two low-amplification R.C. stages are used or, alternatively, where there is only one low-ratio transformer followed by a super-power output, and when the pick-up itself is rather insensitive.

It is often possible to boost up the input from the pick-up by inserting a step-up transformer between the pick-up and the input terminals or sockets on the set.

Use a good make of L.F. transformer of 1-4 ratio and connect it between the pick-up and the first L.F. stage of the amplifier. Join the primary across the pick-up, and the secondary to the grid and grid bias negative of the L.F. valve. An appreciable increase in magnification can be obtained by this method without any noticeable falling off in tone.

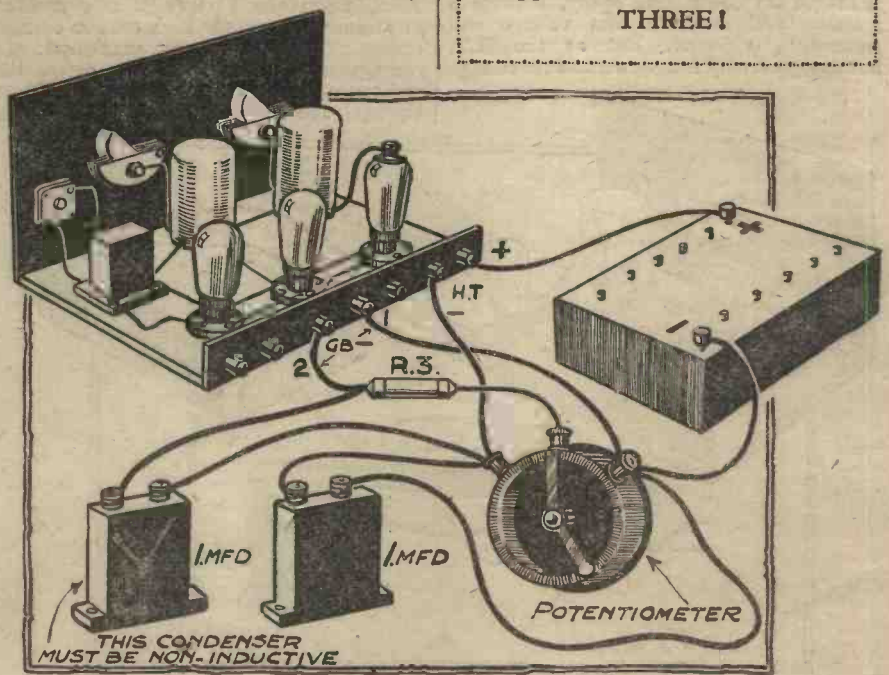


Fig. 3.—Arrangement for variable bias voltage.

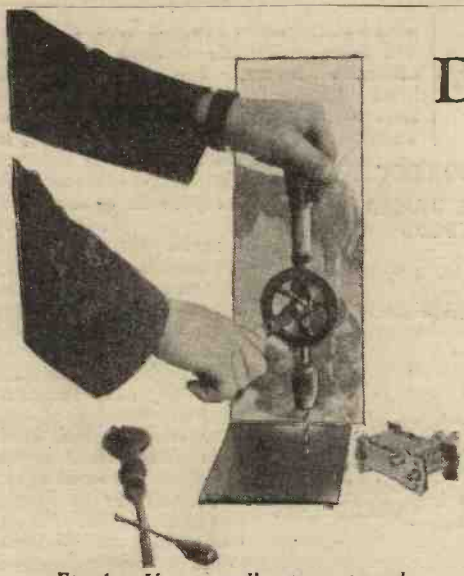


Fig. 1.—Use a small mirror to make sure that the drill is kept vertical.

DETAILS OFTEN OVERLOOKED

Attention to the Little Points Dealt With in This Article will Give Your Set a Professional Finish

By

W. H. DELLER

IT is the rule rather than the exception, to see what might have been a well-made set spoiled by inattention to usually considered trivial items. By close attention to details, particularly in the initial stages of construction, a set can be produced, the workmanship of which anyone may well be proud.

How often does one or more components have to be shifted on the baseboard, with the wiring partly, if not completely, finished, owing to lack of foresight in the placing of perhaps a variable condenser, an error which becomes apparent only when the set is ready to go into the cabinet. Upon trying it, it is found that there is an insufficient length of spindle projecting to comfortably accommodate the tuning knob. By a careful preliminary study of the parts and cabinet, snags such as this are easily avoided and the following hints will be helpful in overcoming them. After all, components are one of the main items of expenditure and are worthy of being fitted decently into position. These notes, therefore, should prove of interest to home constructors in general, but perhaps more so to those entering the field of radio.

Fitting Variable Condensers

Variable condensers of the baseboard mounting type, such as that shown, require carefully fitting. First see that the panel is absolutely vertical in relation to the baseboard, or where a chassis is employed, see that the platform portion when in its ultimate position lies square with the front of the cabinet. This is rather important, as the back of the control knob, to look smart, should clear the panel or front board by not more than 1-32in., and it is fairly obvious that any considerable error in this respect will be clearly visible. Where a panel forms the front of the completed set, a vertical line is scribed on the back of the panel at a distance from one edge corresponding with the intended position of the centre of the control knob, and a short horizontal line is made, measuring up from the surface of the baseboard, at an equivalent height of that from the base to the centre of the condenser spindle. A well-defined centre for drilling is made with the point of the scriber at the junction of these lines. Another, and perhaps a simpler way to obtain the vertical height direct, is to remove the control knob from the spindle, and draw the condenser along the baseboard with the spindle end bearing against the panel at an angle of 45 degrees when looking downwards. This will scratch a clear line at the correct centre height (see Fig. 4). From this mark a further line is made above it on the vertical line for the centre of the escutcheon hole, this distance usually being given by the manufacturers. The spindle hole is drilled and the escutcheon hole cut out with a fretsaw or by drilling a series of small holes close together (Fig. 2), removing the corrugations with a suitable file. Now temporarily fix the escutcheon and pass the condenser spindle through the hole provided in the panel, bringing the scale to within

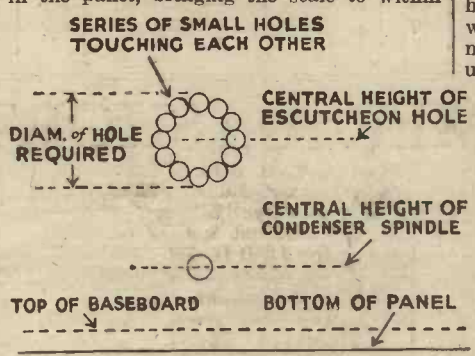


Fig. 2.—(above)—How to cut large holes.

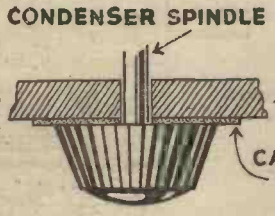


Fig. 3.—(right)—A cardboard washer (removed after fixing) will ensure that the knob is correctly mounted.

1-32in. of the back face of the escutcheon window. Before screwing the condenser down, make sure that it is laying square with the panel. A good way of doing this is to pass a piece of card a little larger than the diameter of the knob, with a hole in the centre, over the condenser spindle. The knob on being pushed on to the spindle so as to press the card against the panel will have the effect of swinging the condenser in line for fixing (Fig. 3).

The necessary hole for panel mounting condensers, should, to provide a rigid fixing, be a fairly neat fit on the threaded bush. When drilling same in the panel, care should be taken to keep the drill upright. Failure in this direction is liable to distort the condenser when the nut is tightened, thus interfering with the clearance between the fixed and moving vanes. When working single-handed, it is not an easy matter, with a hand drill that is to say, to judge if one is drilling square with the work. Here is a useful hint. During important cutting operations, arrange a small mirror nearby in which one can see that the drill is kept upright (see Fig. 1).

The same method as that adopted for squaring up the spindles of condensers might also be used for setting such items as ganged coils; in fact, if the same piece of card is used as a gauge behind the knobs of all controls on the panel, uniformity of clearance will result.

Concerning Screws

Such items that are enclosed in moulded cases are usually provided with two or more fixing lugs. In the majority of cases the screw holes are intended for round headed screws. This type should be used where the holes are not finished to accommodate flush fitting screws. The taper under the head of a countersunk screw bearing against the sharp edge of the hole is liable to split the lug of the moulding when tightening. The diameter of the fixing screws should be such that they comfortably fit the holes, and for reference the following list of small hole diameters and corresponding sizes of wood screws that will fit them with reasonable accuracy will be found handy from time to time. 1-16in. diam., No. 00; 3-32in. diam., No. 2; ⅛in. diam., No. 5; 5-32in. diam., No. 7; and 3-16in. diam., No. 9.

Bearing in mind the fact that the moulded parts are damageable, wood screws should be inserted square with the holes, and for easy starting a hole must first be made in the wood with a bradawl. With some components, an ordinary bradawl is not sufficiently long in the blade to mark the baseboard owing to the handle fouling part of the moulding. A handy tool for marking such holes can be made by driving a steel knitting needle into a file handle (Fig. 5). Where an all metal chassis form of construction is adopted, components will be fitted with metal thread screws and nuts. These should be long enough to include a nut and washer, and where cutting to length is required, it had best be done before fitting. Small screws can be cut with

Fig. 4.—Scribing the position of the condenser spindle with the spindle itself.

Fig. 5.—A handy marker.

sharp cutting pliers or wire cutters, and larger ones sawn. To rectify any damage to the threads, cut the unwanted part off with the nut screwed on beyond the cutters, and after filing the end of the screw slightly, remove the nut and clean out the thread. Two or three screwdrivers should be included in the tool kit, the blade end being ground or filed to suit the slots of the screws used. Fig. 6 shows the correct shape. A chisel pointed screwdriver is very liable to slip out of the slot, and most certainly raises the edges of the slot, as shown in Fig. 7.

When fixing woodwork together with screws, as illustrated in Fig. 8, always drill a clearance hole in the top board to clear the shank of the screw. This is most important with

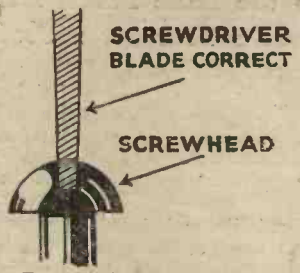


Fig. 6.—Correct shape of screwdriver end.

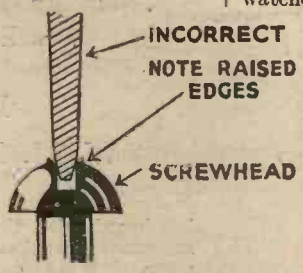


Fig. 7.—Incorrect shape.

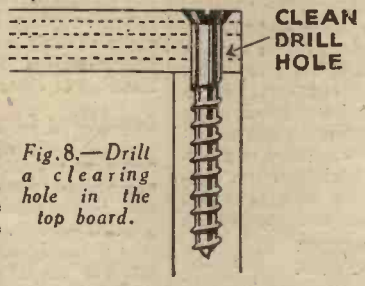


Fig. 8.—Drill a clearing hole in the top board.

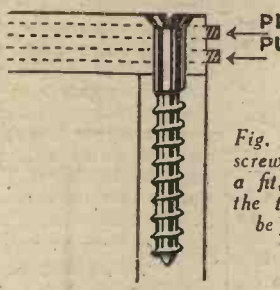


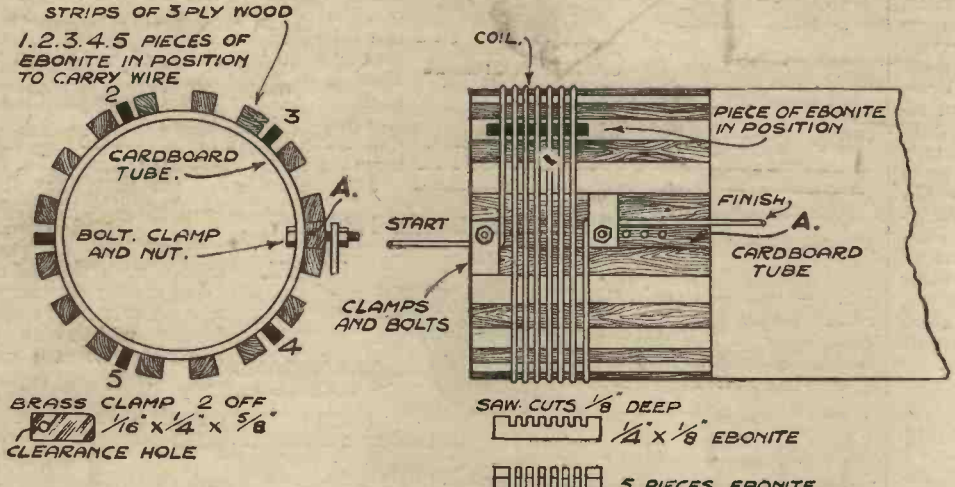
Fig. 9.—If the screw is too tight a fit, sections of the three-ply will be forced out.

plywood, as screws inserted near the edge will force out little sections of ply on alternate layers. See Fig. 9. Milled head terminal nuts should not be tightened with pliers. This point must be watched particularly on valve holders, as the metal dust created is liable to settle in an unnoticed or inaccessible position and provide a source of trouble.

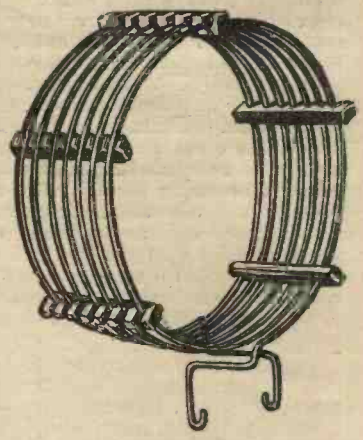
Holes in metal through which leads pass should be slightly countersunk on each side to remove any raw edges which may chafe the insulation. Finally, make sure that all controls work sweetly and spindles which pass through cabinet work really have sufficient clearance.

In the case of a control knob which rotates too easily, either through the weight of the moving body or simply through a bad fitting, the control may be improved by cutting a washer of thick felt and putting this over the spindle before attaching the knob. By suitably adjusting the thickness of the felt, a good easy movement may be obtained.

SIMPLE FORMER FOR SHORT-WAVE COILS



Details of a useful former for short-wave coils.



A finished short-wave coil, ready for mounting.

A GOOD many wireless enthusiasts still use the "plug-in" type of coil, which, apart from the slight inconvenience attached to changing coils, is still considered by some to be the best. The accompanying sketch shows an easily made former for the construction of the necessary coils for short-wave work. Coils made by this method are very rigid and efficient.

The former is constructed of a piece of cardboard tube, about 6in. long and 2⅝in. outside diameter, on which are mounted 16 strips of plywood, 3/16in. or ¼in. thick and ¼in. wide and 2½in. long, by means of liquid glue (as sold in tubes). At A an extra strip is fastened, and in it is bored a series of small holes, through which the bolts and clamps are held. The inside bolt is shifted along the former, as the number of turns is increased to accommodate the necessary width of coil. Five pieces of ¼in. ebonite are sawn off (any spare pieces will suit), about ¼in. wide. Cut five strips 12in. long, clamp them in a vice, and with two blades of same length in the hacksaw frame, which gives the necessary width to hold the wire, cut the right number of slots, ¼in. deep, 1, 2, 3, 4, 5, and so on, and then cut the necessary lengths off.

Winding the Coil

The wire is bent and fastened under clamp and the nut tightened at the start of coil. It is then wound round to the required number of turns and passed under the inner clamp and nut tightened. Wire is then cut with a piece to spare. The wire on former can then be spaced the proper distance apart to take slotted strips. One of the five strips is then slipped in a horizontal position in one of the spaces on former. It is then turned up on its edge and pressed up until the wires fill the slots, and the other pieces of ebonite are now inserted in positions shown. A little liquid glue is applied to slots in the ebonite and the whole is left to harden. On the outside bolt and clamp being withdrawn and the inside one loosened, the coil can be slid off former, which can be used for another coil.

America, Moscow, Geneva, Madrid, Lisbon, and a few other stations, which could not be identified, have been recently received with a combination of these coils on a straight Det. and 2 L.F. Reinartz receiver. The finished coils are about 3in. diameter.

SIMPLE TESTER FOR TUNING COILS

A Simple Method of Testing the Comparative Efficiency of Different Types of Tuning Coils

By W. J. DELANEY

NO doubt many listeners have often wished they had some simple way of testing coils, aerials, earths, etc., so that all doubt could be removed as to whether such-and-such a coil was better than the one at present in use. Obviously, elaborate circuits for measuring the H.F. resistance, inductance, self-capacity, etc., are out of reason for the average man, and it is almost certain that the most expensive instrument owned by the ordinary experimenter is a milliameter. It is possible, however, with the aid of this instrument to make quite a good arrangement which will enable the tests mentioned in the opening lines to be carried out, and which will, at the same time, prove very interesting to use.

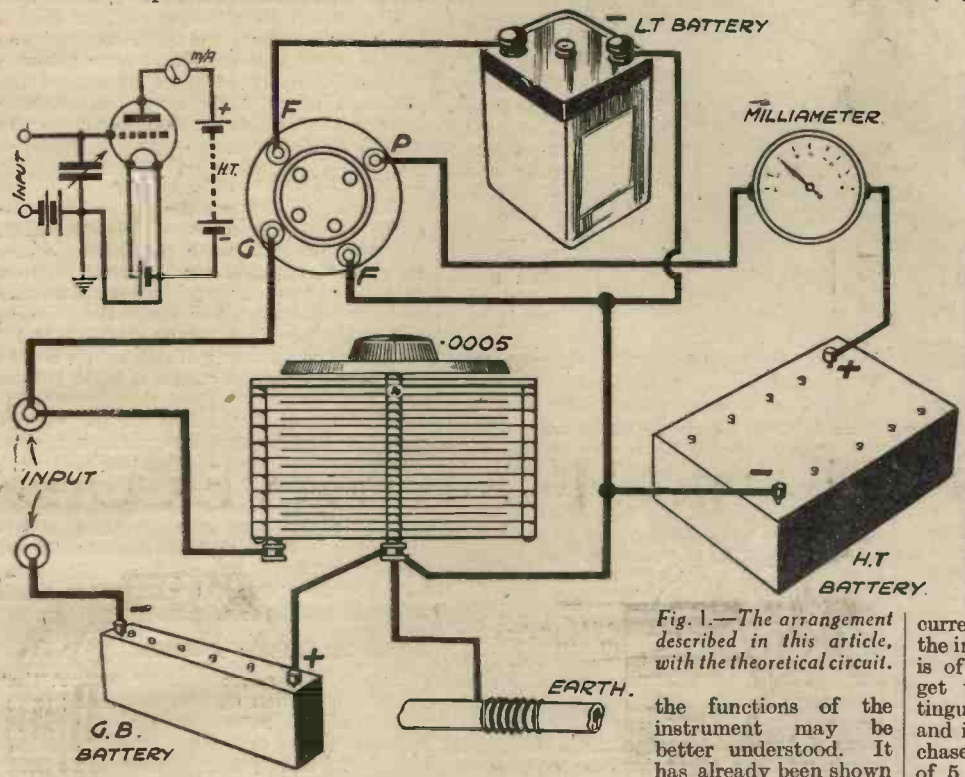


Fig. 1.—The arrangement described in this article, with the theoretical circuit.

The Principles

Before giving a description of the apparatus it will be necessary to discuss a little wireless theory, in order that the functions of the instrument may be better understood. It has already been shown in articles in these pages how a detector valve works, and when dealing with anode-bend detection it was explained that when a carrier wave was received the anode current rose. The curve, Fig. 2, shows why this is, and it will be obvious that the greater the strength of the received carrier the greater the increase in anode current. It is assumed, of course, that bottom bend and not top bend rectification is referred to. Now, the parts of a receiver which are relied upon to bring the carrier wave to the detector valve are the aerial, tuning circuit and earth, and, obviously, the better this complete circuit is the greater will be the signal passed on. This, then, provides us with the principle upon which we may make up our tester.

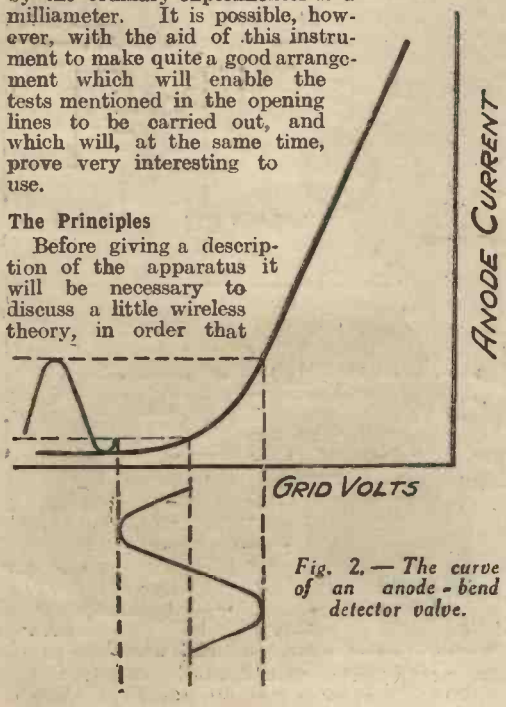


Fig. 2.—The curve of an anode-bend detector valve.

The Apparatus

Fig. 1 shows a pictorial view of a very simple piece of apparatus which will only take an hour or so to make up, and the majority of the necessary parts will no doubt be found in the average "junk box." A valve-holder, piece of ebonite, terminals, and a milliameter comprise the total list of parts, and the valve and batteries may be obtained from the household broadcast set. The connections are clearly shown, and in order to get the best from the test, it is preferable to choose a valve of the L.F. type, as this will give a higher current reading than the H.F. or detector types. The milliameter should have a fairly low maximum reading in order than small differences in anode current may be easily discernible. If the instrument at present in your possession is of the high-reading type, you will not get the fine readings necessary to distinguish between certain types of coil, and it may, therefore, be advisable to purchase a special meter. A maximum reading of 5 milliamps would prove most useful,

(*Continued at foot of page 331.*)

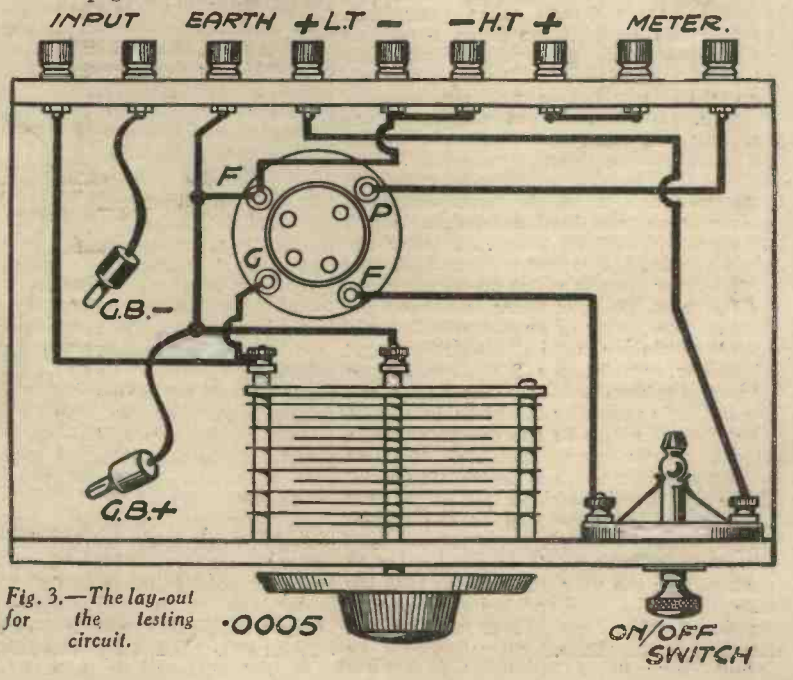


Fig. 3.—The lay-out for the testing circuit.

ECONOMICAL CONSTRUCTION

W. B. Richardson Explains How the Home Constructor of Limited Means can Still Build Efficient Receivers Without Going to Great Expense

"IS it possible to reduce my expenditure on radio without limiting its performance?" In these days of stringent economy this question is often asked. In most cases the answer is definitely "Yes." Then follows the question: "By how much?" That, I'm afraid, is not so easily answered; naturally circumstances vary considerably all over the country, and it is difficult without going into each case separately to say just how many pence or shillings may be saved on a particular installation. However, I shall endeavour to give some of the chief points in building and maintenance where reductions may reasonably be effected.

Running Costs

As you no doubt already possess a set you will probably be most concerned with the reduction of running costs. I shall, therefore, deal with that part of the question first. Take the case of a battery receiver. Do you find when your H.T. battery has been in use for a month or so that unless it is renewed your set starts to howl or "motor-boat?" If so, this is a sign that your set is not properly decoupled. If there is not already a decoupling resistance and condenser in the plate circuit of the detector valve you should fit them. You will want a 1 or 2 mfd. condenser and a 30,000 ohms spaghetti resistance or metallized resistance. Fig. 1 shows how they are fitted. If they are already included it may mean that one of the other circuits needs de-coupling.

The most likely offender is the output stage. The fitting of an output filter will almost certainly cure "motor-boating." The filter consists of a 2 mfd. condenser and an iron-cored choke. The circuit and method of connecting is shown in Fig. 2. The type of choke to use depends on the kind of power valve you have. With an ordinary power valve a 20 to 40 henries choke will be about right, but if you are using a pentode, get one of the special tapped chokes specially made for use with this type of valve. It is no harder to connect up; the only difference is that the wire from the loud-speaker goes to the tapping terminal instead of to the end terminal of the choke.

The Life of an H.T. Battery

If your H.T. battery definitely runs down within a very short period, say in a month or six weeks, you are most likely overloading it. To test this you will need a milliameter. If you have not already got one you could either borrow one just for the test, or buy one: a reliable pocket instrument can be had for about 8s. 6d. Connect this in the negative lead from the H.T. battery, switch on the set and see what it reads. If you are using a standard size battery you should not be taking more than 12 milliamps from it. If you are, then it may mean you need a larger battery; but first of all see if you cannot effect a reduction. With the average three-valver S.G.-det. and pentode, it should be just possible to get it down to the 12 milliamps figure. First of all test your grid-bias battery. If this is running down you will most likely need to look no farther for the trouble. To hang on to a worn-out grid-bias battery is the very antithesis of economy, for inadequate bias means an increase in the H.T. current consumed. Even if the grid-bias battery is O.K. it is worth trying a slight increase of bias on the L.F. and power valves—not on the screen-grid valve, of course. You will most likely find that you can put the plugs up a socket or two without any decrease in quality, but you will discover on testing your H.T. consumption once more that it has fallen slightly. *Always use the highest value of grid bias consistent with good quality reproduction.*

Grid Bias Dependent on H.T. Voltage

There is one point you must remember, however, and that is that the value of the grid bias is dependent on the plate voltage. Some people set the grid bias at a suitable value when the H.T. battery is new and thereafter do not touch it. This is wrong. As the voltage of the H.T. battery begins to fall with age you should reduce the grid bias accordingly, otherwise the value will be too high and cause distortion. Many H.T. batteries are scrapped before their time on this account. Distortion sets in and the battery is immediately discarded, whereas if the G.B.— plugs had been altered to a socket or two lower the tone would have improved, and the H.T. battery could have been used a week or two longer.

Regarding the question of how long a life to expect from the H.T. battery, you should know that it always pays to use a "super" battery in place of one of the standard size. Not being so heavily loaded it invariably gives better service in proportion to its size.

Screen-grid Volts

Assuming that you have adjusted the grid bias to its most economical value, you should turn your attention to the screen-grid valve, if one is fitted. Here a reduction in screening-grid volts will usually make a comparatively large decrease in H.T. current. Try plugging the "H.T.+1" lead, as it is usually marked, into a socket ten volts lower. Of course if there is only one H.T.+lead it means that the adjustment of the H.T. voltages for the various valves is carried out by means of resistances. To reduce the screen volts you will then have to increase the value of the resistance used in this lead or else add another one in series with it. Any spare spaghetti resistance of from 1,000 to 10,000 ohms that you happen to have by you might be tried, but do not reduce the voltage too much or it will affect the volume.

Preventing Leakage of Current

If you have any reason to suspect that your high-tension current is leaking away while the set is not in use, you should replace your ordinary on-off filament switch with a good quality three-point switch as in Fig. 3. This, as you see, is

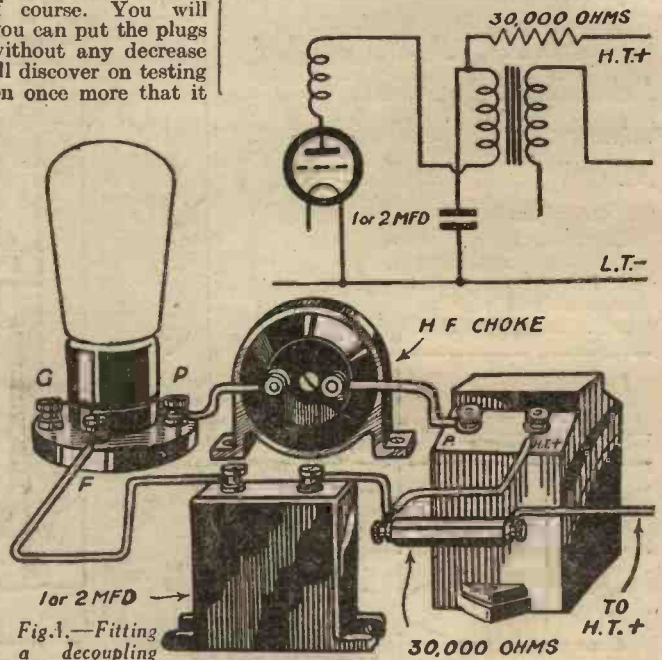


Fig. 1.—Fitting a decoupling resistance and condenser to prevent motor-boating.

COMBINED WITH EFFICIENCY

connected in the negative filament lead and not in the positive lead as is the usual practice. The object of the switch is to isolate the H.T. battery as well as the accumulator when switching off. Of course, if your set is in good condition there should be no leakage at all, but if it is very old or stands in a damp place the inclusion of the three-point switch shown, or a separate on-off switch in the H.T.— lead, will remedy matters until such time as you find it convenient to overhaul it.

Reducing L.T. Costs

The best way to economize in L.T. current, is to fit up-to-date valves of the right type, and use large accumulators. Old valves are uneconomical not only because they have deteriorated with use, but also because even when new their characteristics were not so good as those of modern valves. Early pentodes, for instance, were notorious consumers of both H.T. and L.T. current, so that if you happen to have one in your set it would be cheaper in the long run to replace it with a new one.

Regarding accumulators, you will find that the cost of having a large one charged is considerably less than that for a small one. The larger ones also have a longer life. This is due to the rate at which they are charged. There is no doubt that in nine cases out of ten small accumulators are charged by local dealers and garages at far too high a rate. Accumulators of various capacities are often all put on the same board to charge at one rate. This means that, whereas the larger ones are receiving current at a rate well within their capacity, the smaller ones are being fed too fast thus causing the plates to disintegrate before their time.

All-mains Sets

Running costs of A.C. mains sets are not usually very high, since they seldom take more than 40 watts, but in the case of those worked from D.C. there is considerable waste of power due to the necessity for breaking-down resistances in the heater circuits. However, there are now valves on the market whose heaters can be run direct from the mains and take correspondingly little current. They were described in PRACTICAL WIRELESS of October 15th, and if you are thinking of installing newvalves in a D.C. set they are certainly worth investigation. Further advice on their installation can be obtained if you write to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2, marking your letter "Mains Valves" in the top left-hand corner. The query coupon given on the "Queries and Enquiries" page of this paper should be attached.

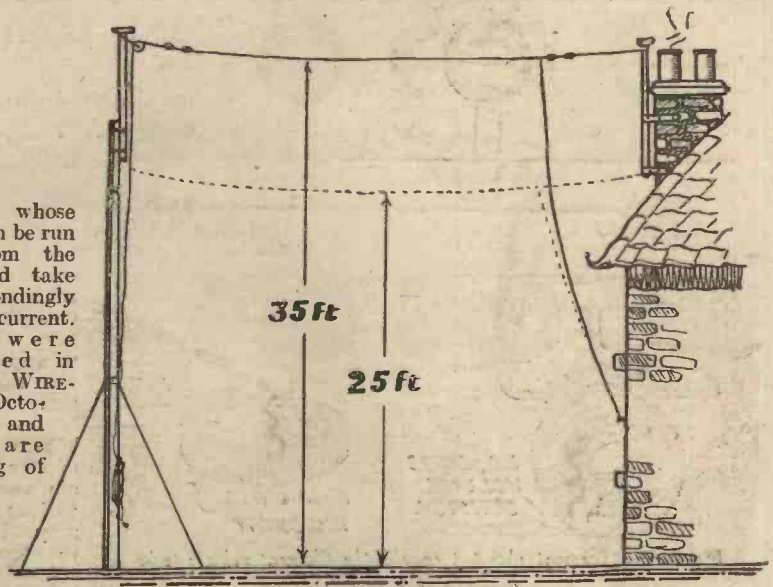


Fig. 4.—Increasing the height of the aerial is often as effective as adding another valve.

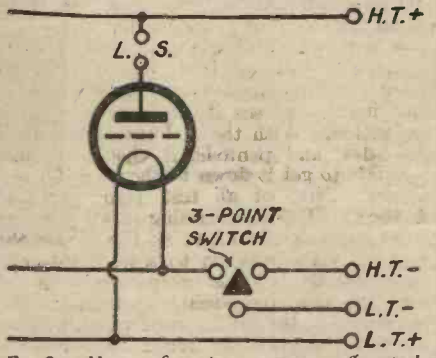


Fig. 3.—How to fit a three-point on-off-switch.

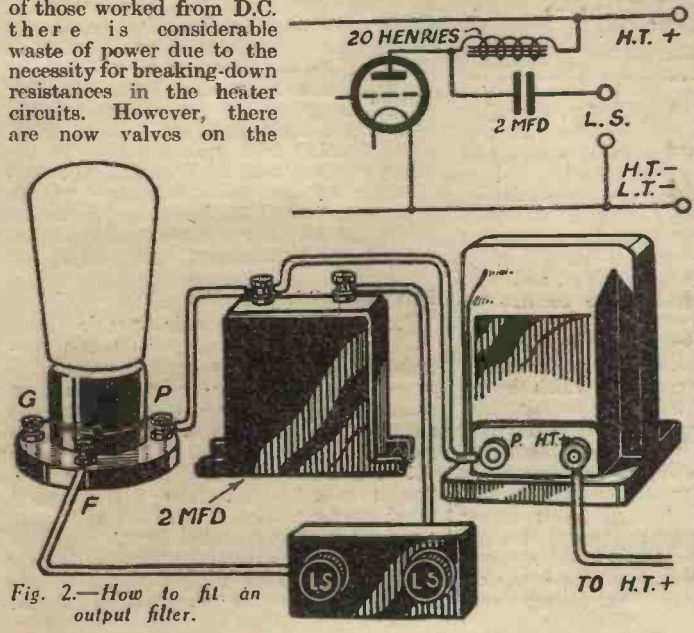


Fig. 2.—How to fit an output filter.

Building Economically

Now suppose you are contemplating building a new receiver. Here you have more chance of effecting a saving than with an existing set, as you can arrange the design throughout from the point of view of economy. First of all, choose the right type of set to meet your requirements. For instance, if you are content with receiving the local stations a simple two-valver will no doubt be quite adequate. Don't install an elaborate four-valver, simply because the people next door have one. Of course, you will have to take into account what sort of an aerial you will be able to erect.

Erect a Good Aerial and Use Less Valves

It used to be said that to increase the height of your aerial by ten feet was as good as adding another valve. In other words you could do with one valve less, if you raised your aerial by that amount. This may not be strictly true, but it serves to show the importance of a good aerial, so if you are in doubt as to whether you need a three-valver or a "four" consider the question in relation to your proposed aerial. One point you should not overlook in this connection, is that it is the *height* of the aerial, and not the *length* which determines the range of your receiver.

Now as to some of the details of the receiver itself. If you have electric light you will most certainly find a mains set pays in the long run, although the initial cost may be greater. In the case of A.C. it should be an "all mains" set, but with D.C., unless you use the high-voltage mains-valves already mentioned, you will most likely find it more economical to supply the H.T. only from the mains, and use an accumulator for the low-tension supply. A D.C. eliminator for the H.T. can be bought complete, or you can make one up for the cost of two batteries. If you have no electrical power available, and are, therefore, dependent on batteries, there are still one or two devices which can be employed to save current.

Fit a Filament Rheostat

First of all, you will find that the L.T. current of new valves in particular, can be reduced slightly without any sacrifice in power. Fig. 5 shows how to fit a master rheostat to control the low-tension current to all the valves. It should be mounted inside the set, and the control arm set to give the lowest consumption consistent with the efficient working of the valves. This refinement will also tend to lengthen the life of the valves. Another slight saving may be effected by using a similar rheostat, but with a knob control for panel operation, as the volume control. It is inserted in series with the

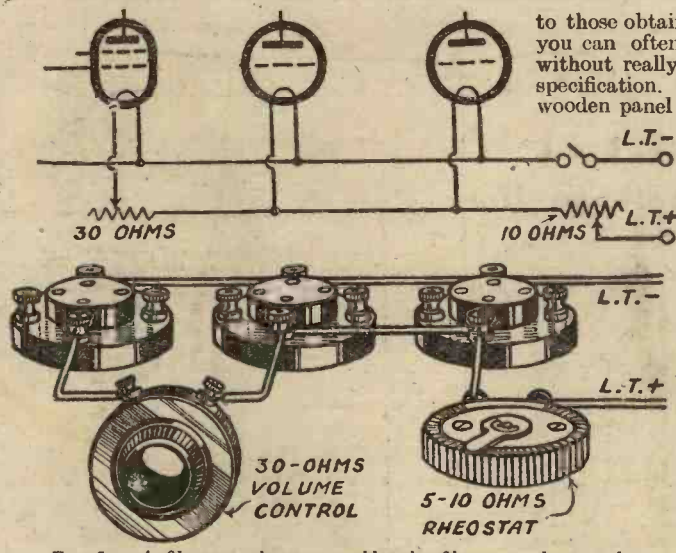


Fig. 5.—A filament rheostat enables the filament voltage to be adjusted to a nicety.

filament of the screen-grid valve, and is also shown in Fig. 5, and takes the place of the more usual anode or screening-grid controls. It is quite satisfactory from the point of view of quality, and saves both L.T. and H.T. current when in operation.

Saving on Components

Quite apart from the fitting of arrangements to reduce the running costs, there is the question of the initial cost of the components comprising the set itself. Here again a number of slight reductions can usually be made, which, when added together, may make a difference of a pound or two on the total outlay. This applies, more particularly, to a set made to your own design, but even with designs given in the various journals, such as PRACTICAL WIRELESS, where you should stick to the specification closely if you expect to get results equal to those obtained by the designer, you can often make some saving without really departing from the specification. For instance, a wooden panel can always be used in place of an ebonite one, where the control spindles are all at earth potential. If one of them, such as the reaction-condenser spindle, is not at earth potential, then a fibre bush and washers will provide all the insulation that could be wished for. Where a number of resistances are used so that various potentials may be applied to the different valves when only one H.T.+ lead is employed, they can be omitted if several tappings are used instead. Do not, of course, omit resistances used for decoupling.

When planning out a design remember that an H.F. choke in the plate circuit of the detector valve is not always necessary, and may often be replaced by a 20,000 ohm resistance or omitted altogether. This does not, of course, apply to the choke used in the plate circuit of a screen-grid valve which should be the best possible.

A Cheap Tone Compensator

A simple resistance in the grid circuit of a pentode valve, as in Fig. 6, will compensate for the over-emphasis of high notes, characteristic of this type of valve, and so obviate the necessity for a tone control in the output circuit.

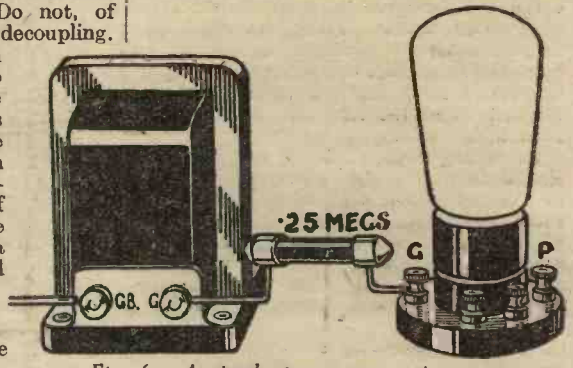


Fig. 6.—A simple tone compensator.

For small outputs you will find a balanced armature or inductor type loud-speaker cheaper to buy, and more sensitive than a moving-coil instrument.

An output transformer, and, in most cases, an output choke filter, where it is not used for tone control, may be omitted if you intend using a loud-speaker which is already fitted with a transformer. Even when the output filter is used for tone compensation of a pentode it will be unnecessary if you have a tapped transformer on the speaker. Correct matching can then be carried out with the transformer.

Buying a Set

If you are buying a new set, you will naturally wish to give it a test before signing the cheque, so here is a test which you should make a point of applying. Disconnect both aerial and earth wires and rotate the tuning and reaction knobs. A well designed set will not screech when the aerial-earth load is removed and it should be possible to stop it from oscillating by reducing the reaction coupling. Failure to pass this test is proof that the screening is inefficient, and that the degree of stability is not sufficiently high as judged by modern standards.

Information regarding this has been given in earlier issues of PRACTICAL WIRELESS.

Pick-up Hints

IF you have made a radiogram in which the high-frequency, and perhaps the detector, valves are switched off when the pick-up is put into circuit, you may have noticed that the gramophone reproduction is not quite so good as that of the radio, especially if the H.T. is drawn from some form of eliminator. This is often curable by raising the grid bias on the L.F. valves, as the anode voltage rises considerably with the removal from load of the preceding valves, with the resultant need for higher bias on the remaining valves in circuit. If your set has two stages of transformer-coupled low-frequency amplification—and I think I prefer this arrangement where both volume and quality are needed—it is a very good plan to insert the pick-up across the primary of the first transformer. In this way you provide ample volume for your record reproduction, and a considerable brightening of the upper register is noticeable, due to the step-up effect of the transformer. Moreover, the pick-up leads may be left in circuit and switched on and off with impunity, a practice that is not advisable when the pick-up is connected to the grid and filament of the detector, as switching in the detector circuit is not now allowable under any circumstances.

RADIO RAMBLINGS

JOTTINGS FROM MY NOTEBOOK

By "DETECTOR"

I say not now, because I can remember the time when a considerable amount of switching was done in receivers. In fact, switching became a fashion, and no end of combinations were achieved by means of switches of all kinds. In many cases, no satisfactory commercial switches were available for some of the electrical contortions the designers desired, and then it became incumbent on the constructor to make his own.

In this connection, I well recollect an early set I made in which a special switch was incorporated by means of which the set was a H.F.-det. receiver, or a det.-L.F. combination. I forget quite how this was brought about, but it saved a valve, which was the aim of all designers in those days when valves cost anything around 30s. each! In my case, however, this happy state was not brought about for it cost me two valves! A frayed end of a piece of flex, necessary because of the comparatively large movement of the switch arms, became mixed up with other moving parts of the switch and the H.T. battery shorted right across the filaments with, as you may guess, disastrous results. Quite recently it was usual to switch out the high-frequency stage when listening to the local station, thus reserving a little of the H.F. valve's life, and also economizing in L.T. current. This is, of course, practically dead now, but the trouble when experimenting with switches is that the subject becomes so fascinating. The self-capacity of the best "low-loss" switch is comparatively high, however, for modern circuits, so let your excursions into switch experiments be tempered judiciously.

Portable Talkie Projector

THE Western Electric people have brought out a portable talkie projector which can be carted around to offices and works to assist salesmen in obtaining orders. The film depicts the advantages and other scenes to help the sale along, while the talkie apparatus gives out a running commentary on the best "sales talk" lines. The whole equipment can be carried in the back of a baby car, and can be operated by an unskilled operator. From the seller's point of view this may be a good thing, but some people think our offices are noisy enough as it is.

A CHEAP FAULT-FINDER

A Simple Device, Home-made at the Cost of 2s. 6d., Will Enable You to Trace a Faulty Valve Circuit

By D. WATTS

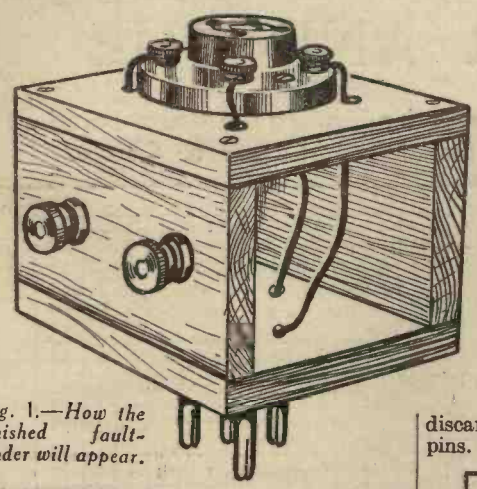


Fig. 1.—How the finished fault-finder will appear.

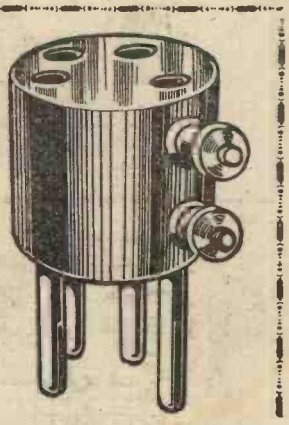


Fig. 3.—A commercial version of the fault finder.

AMONGST the many thousands of queries which have been received since the inception of PRACTICAL WIRELESS, at least 50 per cent. have been on the lines of "I cannot get the results which I ought to get from my set," and in quite a number of cases the trouble could be discovered if the reader had some ready means of testing each valve circuit in turn. Now there is no need for meters, switches, or any complicated apparatus to enable this testing to be carried out, as a pair of 'phones interposed in the anode circuit of the valves is all that is required. Obviously, this will entail breaking the anode circuit, but to do this there is no need to disconnect any component or make any alteration to the winding. Fortunately, it is quite a simple matter to break the anode lead, by using an adapter between the valve and the holder.

The Adapter

Fig. 1 shows a simple adapter which anyone can easily construct. It is, in effect, a large valve-holder, with what might be termed "all-through" connections for grid and filament legs, but a split connection for the anode leg. The base consists of a square of ebonite, upon which is mounted a discarded valve base or four ordinary valve-pins. Two wooden side pieces are attached

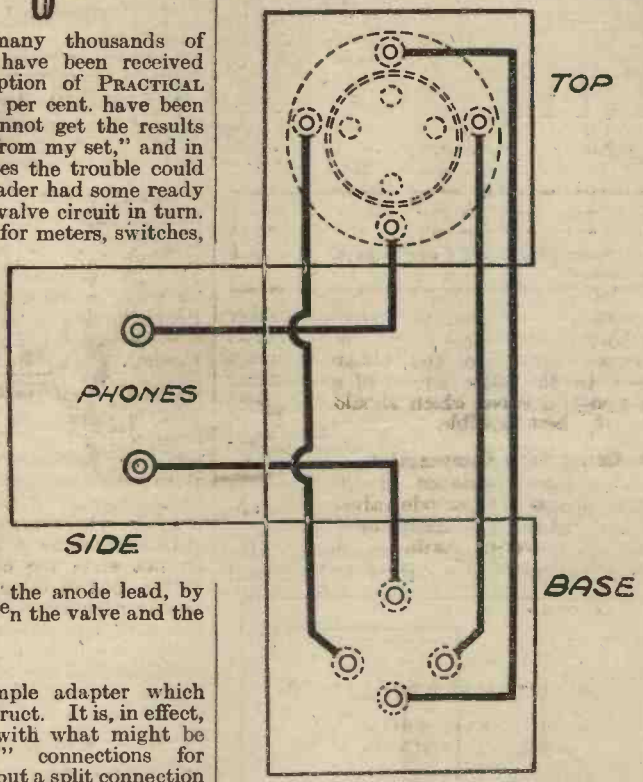


Fig. 2.—The wiring connections showing how the anode lead is split.

to the ebonite, and across the top is a further square of ebonite, with an ordinary valve-holder mounted thereon.

The connections are shown in the illustration, Fig. 2, and it will be seen that the G. and F. terminals are connected direct, whilst the two anode terminals are joined to two small terminals on the side. To use this adapter, simply remove the valve which is to be tested, plug the adapter into its place, and insert the valve in the top of the adapter. If now a pair of 'phones is joined to the two terminals it will be possible to hear the signals as they are in that anode circuit, and suppose that a three-valver is not giving what is expected of it, this adapter may be plugged first of all into the detector socket, then into the first L.F. socket and so on, enabling you to tell instantly just which stage is at fault.

Using a Meter

For those readers who are inclined to be a little more particular, or who already possess a milliameter, actual readings may be taken of the anode current of a valve by means of this adapter. All that is necessary in this case is to join a meter to the two terminals instead of the 'phones above-mentioned, and the actual anode current can then be instantly read.

The reader who is not very handy with tools, or who has not the time to make up this gadget, will be interested to know that Messrs. Bulgin sell a small edition of the same idea at 2s. 6d. for 4-pin valves or 2s. 9d. for 5-pin valves, and this, of course, answers the same purpose and is a neater article.

SIMPLE TESTER FOR TUNING COILS

(Continued from page 327.)

and if you do not already possess a meter, and are desirous of buying one, get one of this value, and it can be adapted to read higher values by shunting with various resistances.

Method of Testing

If a tuning coil is joined across the input terminals, and the aerial joined to the correct position on the coil, the circuit becomes a simple one-valve detector circuit, minus reaction. All that has to be done, therefore, is to join the earth to the earth terminal, connect up L.T. and H.T batteries, and apply the correct grid bias for the particular valve used, and a certain anode current will be shown on the meter. As the tuning dial is rotated, the pointer of the meter will rise as a station is tuned in, and it will be found best to make use of your local station for testing purposes. Suppose that with a given coil, aerial, and earth a normal current, with no station tuned-in, of .5 milliamps is given. (This current we will call the "standing current.") Now, on tuning-in the local, this signal may rise to 3 milliamps, a difference of 2.5 milliamps. If this is your normal coil, you may call this the "standard reading," and then, upon substituting other coils, the amount of current increase over the standing current will give a good idea of the efficiency, or otherwise, of the coil. Alterations in aerial length, insulation, etc., or improvements in earth connections, will also vary the reading of the anode current, and the best arrangement will be that which gives the greatest current when a station is tuned in. It is perhaps hardly necessary to point out that the coil to be tested should be joined to this circuit in exactly the same manner as it is to be employed in a receiver. That is to say, if a "canned" coil is being tested, the screening-can must not be removed while the test is being made, as this will not give a true indication of its function when screened.

For the same reason, all switches or other apparatus which is intended to be wired to the coil should be connected up. For purposes of comparison it is a good idea to make a special "low-loss" coil—that is, one of Litz wire wound on a large diameter air-spaced former. When the best coil has been found, this should be retained, or the exact readings noted, and then other coils may be tested and rated at a percentage of the standard coil. If serious work is to be carried out, a special valve should be kept for the work.

THE LOUD-SPEAKER AND THE OUTPUT STAGE

Simple Methods for Finding the Correct Ratio for an Output Transformer or Choke.

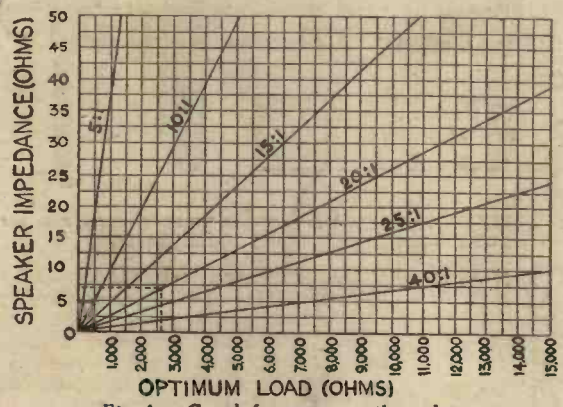


Fig. 1.—Graph for moving coil speaker.

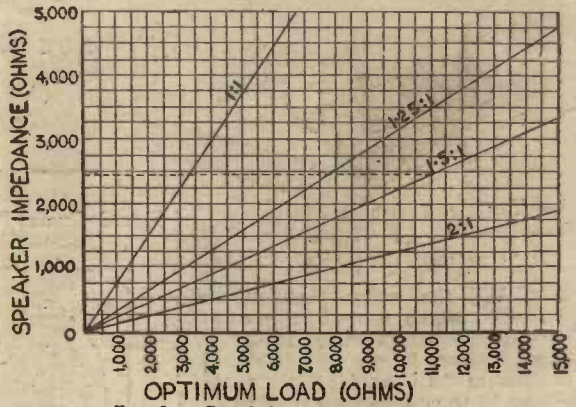


Fig. 2.—Graph for moving iron speaker.

IT is a prevalent idea among radio amateurs that an improvement in reproduction is naturally consequent upon the installation of a new loud-speaker, especially if the latter is of a type which is known to be good. But not a few have been disillusioned to discover that results, instead of being better, have actually proved to be a good deal worse. This has happened, even though the purchaser has heard the speaker demonstrated and found it just to his liking. Without for the moment going into actual details it can definitely be stated that the reason for the disappointment is that the speaker has been chosen without due regard to the set, or more correctly the output valve, with which it is to be used. Now let it be clearly understood that almost any good speaker will function satisfactorily with any efficient receiver *provided that it is connected in a suitable manner.* That last proviso is important, and really gives rise to the necessity for this article. The whole secret lies behind the fact that if it is to give of its best the speaker must be matched to the output valve. This is because any valve operates most efficiently when the impedance connected in its anode circuit is of a fairly critical and definite value; this value is called the "Optimum Load," and is measured in ohms.

The Transformer Ratio

It is evident that a speaker of different impedance could not be employed for each type of output valve, and therefore some simpler system must be devised. All my readers know that a transformer can be used to "step-up" or "step-down" A.C. voltages, and it is this instrument which is used for the purpose under discussion. If we know the optimum load required by any valve and also the impedance of the speaker to be used with it, we can find a particular transformer ratio with which the valve and speaker will be matched. In the case of a moving-coil speaker the correct ratio is obtained by dividing the optimum load by the speaker impedance and taking the square root of the answer. Stated mathematically the formula is:—

$$\text{Ratio} = \sqrt{\frac{\text{Opt. Load}}{\text{Sp. Imp.}}}$$

By FRANK PRESTON, F.R.A.

As an example, suppose a 7 ohm speaker is to be used with a power valve such as the Cossor type 41 M.P., having an optimum load of 2,600 ohms. The correct transformer ratio would be $\sqrt{\frac{2,600}{7}}$ or approximately $\sqrt{400}$ which is, of course, 20 (to 1).

For the benefit of those amateurs who are not mathematically inclined the graphs given in Fig. 1 have been prepared by the writer. To use these, first find the optimum load on the horizontal ordinate and take up a vertical line to meet a horizontal

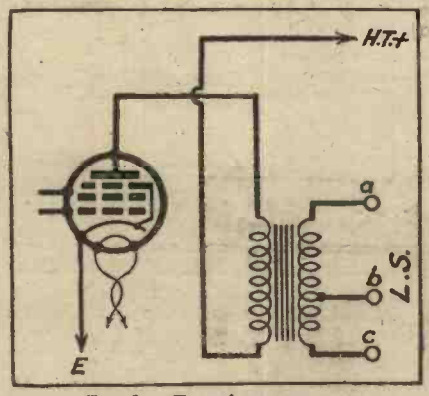


Fig. 3.—Transformer output.

one drawn from the position on the vertical ordinate which corresponds to the speaker impedance. The correct transformer ratio is given by the inclined line passing through (or near) the point of intersection. The lines corresponding to the example given above are shown on the graph. In the case of moving iron and vibrating reed speakers (most types of cone or balanced armature instruments come within this class) the calculation is rather different because the impedance of such speakers increases very rapidly with increase of frequency. To allow for this, "Half the Optimum Load" is substituted in the above equation. The formula thus becomes

$$\text{Ratio} = \sqrt{\frac{\text{Half Opt. Ld.}}{\text{Sp. Imp.}}}$$

To take another example, let us suppose we wish to use a valve like the Mullard PM22, having an optimum load of 11,000 ohms with a 2,400 ohm balanced armature speaker. The transformer ratio should therefore be $\sqrt{\frac{5,500}{2,400}}$ or approximately 1.5:1. This is shown on the graph in Fig. 2, from which other ratios can be obtained for any particular valve and speaker. Both graphs are equally applicable to either three-electrode or pentode valves and they provide a very convenient "ready reckoner."

Unfortunately some few manufacturers do not state the optimum load of their valves, but in these cases it will be sufficiently accurate to take it as being twice the A.C. impedance except for pentodes, where no definite ratio exists between optimum load and impedance. In any particular instance where the optimum load is not known the makers will be pleased to supply figures.

Moving Iron Speakers

When dealing with moving iron speakers, their impedance at about 250 cycles should be considered and not their D.C. resistance. Here again we are up against a difficulty because some makers state only the D.C. resistance of their products. In such cases the impedance can be taken as being one and a half times the resistance. It is safe to assume the impedance of moving coil speakers to be twice the D.C. resistance when the latter factor only is known.

Choke-Capacity Output Filters

So far we have considered the ratio for output transformers connected as shown in Fig. 3, but the same rules apply when a tapped choke is used with a condenser to feed the speaker. The latter arrangement is illustrated by Fig. 4.

The tapped choke serves the purpose of what is generally referred to as an "auto-transformer," and gives a step-down of voltage in exactly the same way as does a transformer having both primary and

(Continued on page 334.)

CAUSES OF INSTABILITY

With Particular Reference to Old Receivers.

By G. W. DAVEY

MANY wireless sets of old design are often subject to instability, especially if new valves have been fitted recently. Modern valves have much better characteristics than those of even a year ago, and, consequently, when fitted in a set which is not adequately "decoupled" often give rise to instability. This may not always make itself known audibly. There is, of course, the best-known form, which is an audible howl, another form known as "motor-boating"—a rhythmical popping noise somewhat like that of a two-stroke engine, and also a form where the set oscillates at a frequency above audibility. This latter form gives rise to distortion, loss of volume, and general difficulty of control. I propose, in view of these points, to give details of methods of curing instability, which readers, who feel they have reason to suspect their sets, may try out, and, even though your set is not decoupled, but is apparently quite stable, the addition of one or both of the following devices is sure to result in an easier "feel" and generally improved results, especially when working on a dry H.T. battery which has lost the vigour of its early youth, or a mains unit.

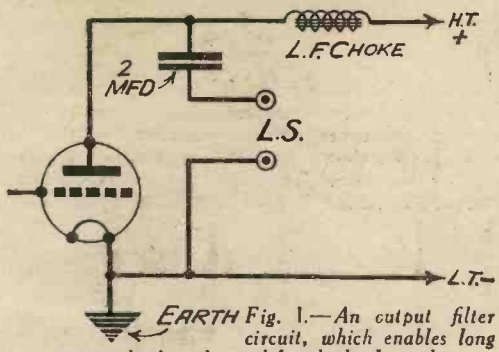


Fig. 1.—An output filter circuit, which enables long extension leads to be used for the loud-speaker.

Output Filter

First and foremost, and the most useful addition for any set that does not incorporate one, is an output filter. A good choke-condenser output filter not only allows more H.T. on the plate of the output valve by obviating the drop due to the resistance of the loud-speaker, but also enables one to carry long extension leads about the house with perfect safety. Also, of course, it is a factor towards stability. The theoretical diagram is shown in Figure 1. The components required are: a good low-frequency choke—make sure this will carry the current of the largest output valve you are likely to use without saturation of the core, and consequent loss of inductance (which should be about 20 henries)—and also a 2 mfd. condenser of reputable make. The output filter can either be wired up inside the set or as a separate unit for external attachment. Connect as follows: to the present L.S.+ terminal connect one side of the choke and the other side to L.S.—. In place of the loud-speaker you now have the choke. To L.S.— wire one side of your 2 mfd. condenser also. The new loud-speaker terminals are the remaining terminal of this condenser and earth. Whereas before it was important to keep the loud-speaker correctly connected as regards polarity, no direct current will now flow through it, so that it does not matter which way round you connect it.

Anti-motor-boating Device

The next useful instability preventer is an "anti-mobo" device in the detector H.T.+ lead as shown in Figure 2.

The components for this are a 25,000 ohms wire-wound, or spaghetti resistance, and another good 2 mfd. condenser. Although, again, this device can be added externally to the set it is preferable to incorporate it on the baseboard near the detector valve—it will not take up much room so you are sure to find an odd corner somewhere. Connect as follows:

In the anode circuit of the detector valve you will find either a transformer, a resistance (i.e., in an R.C.C. unit) or an L.F. choke. From this component,-whatever it may be in your own particular case, you will find a lead going to the H.T.+ terminal. Remove this lead and insert in its place the new wire-wound or spaghetti resistance. From that side of this resistance which is connected to the L.F. component in the detector anode circuit, take a lead to one side of the 2 mfd. condenser. The other side of this condenser is connected to the nearest point connected directly to earth. This completes your anti-motor-boating device. You may, in consequence

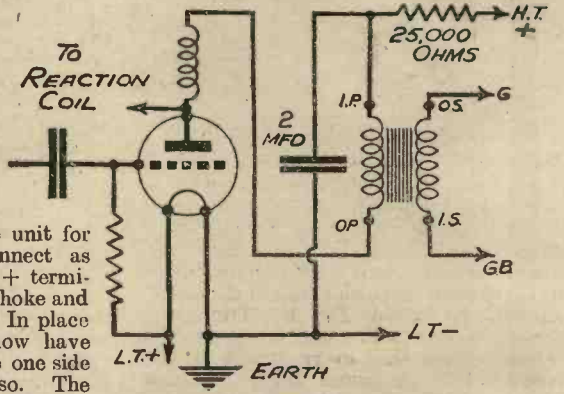


Fig. 2.—A decoupling arrangement in the anode circuit of the detector valve.

of the voltage drop which will be caused through the near resistance, find it necessary to increase the voltage on the detector H.T. tapping in order to get sufficient reaction. One final point regarding the condensers used in both the foregoing devices—make sure their *working* voltage is above that of the highest H.T. voltage you use in order to minimize the risk of breakdown and consequent shorting and ruining of your H.T. supply.

The Loud-speaker and the Output Stage

(*Continued from page 332*).

secondary windings. By connecting the feed condenser C to tappings a, b, c and d in turn a number of alternative ratios are obtained and the correct one can be chosen as explained above. When C is connected to tapping d the ratio is 1 : 1, but when it is taken to a centre tapping at b the ratio is 2 : 1. It will be clear therefore that any desired ratio can be obtained by choosing an appropriate tapping point. In practice, however, it is seldom satisfactory to employ a choke for ratios greater than about 4 : 1, so when higher ratios are necessary the transformer is to be preferred.

Special Cases

There are two special cases which require some little extra consideration. These are (1) when two or more valves are connected in parallel to enable the output stage to handle more signal power and (2) when a push-pull output stage is employed. In the former case the *effective* optimum load is found by dividing the O.L. of one valve by the number of valves in parallel. Thus,

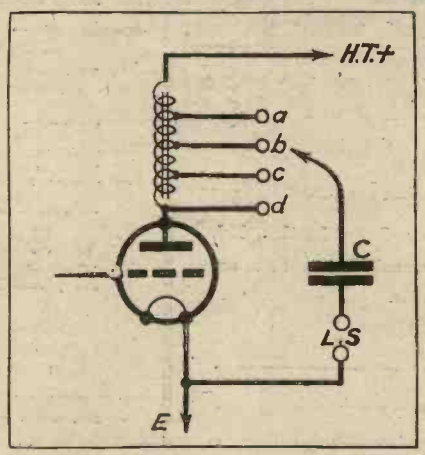


Fig. 4.—Choke capacity output.

the effective load of two Mazda P220 valves (optimum load 9,600 ohms) connected in parallel is just half of 9,600 ohms, or 4,800 ohms).

In the case of a push-pull stage the effective optimum load is twice that of a single valve, since the valves are virtually in series. In other words, the optimum load of two Mazda P220 valves in push-pull is twice 9,600 ohms, or 19,200 ohms. It is the latter figure then which must be used when finding the correct ratio for an output transformer.

The same rules apply to loud-speaker connections; if two speakers are connected in parallel, the effective impedance is halved, whilst when in series the impedance is doubled.

The Value of Accurate Matching

Some readers who have not previously considered the question of matching transformer ratios are now probably asking whether the matter is really very important.

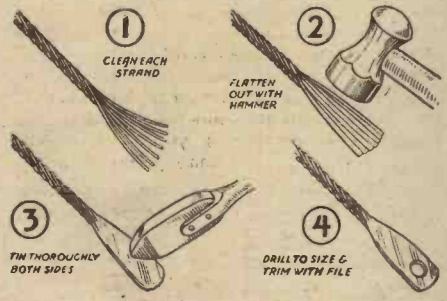
(*Continued on page 359*).

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

An Aerial Hint

MANY good aerials of 7/22 copper wire end in a poor connection to the switch or other terminal point, due to the difficulty of securing the bulk of wire under a small bolt or nut. This may be

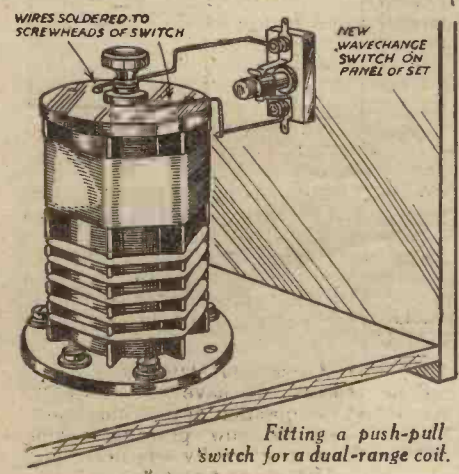


Method of ensuring a good connection at end of aerial wire.

overcome by cleaning each strand for an inch or two at the end (Fig. 1), and hammering the whole bunch to a flat surface (Fig. 2). Thoroughly coat this with solder, and the result is a flat piece of solid metal (Fig. 3) in which a hole of the desired size can be drilled (Fig. 4). Trim off as necessary with a file, and fasten up with the assurance that every strand is well connected in a sound neat joint. Inefficient joints to lead-in tubes can be avoided by bringing the aerial wire itself through the tube and down to the switch, insulating with rubber tubing where necessary. Seal points where rain or draughts can enter, with Chatterton's compound.—F. SINCLAIR (Cottingham).

Dual-range Coil Switching

SEVERAL makes of dual-range coils of the six-pin type have the wave-change switch combined very inconveniently. Perhaps the loudspeaker or something else is kept on the top of the cabinet, and these have to be moved each time we raise the lid. Why not do the wave changing from the outside. First of all, fix a two-point switch (push-pull type) to the side or back of the cabinet, or on the panel if desired, providing it is near the coil. Now examine the coil top and you will find two screws near the centre; it is these we are concerned with, not the outer ones which are only for fixing the coil together. Take two pieces of fine connecting wire and solder these to the two screws previously mentioned, and connect these to your new switch, as shown in the sketch. Now push in the plunger on the coil, shut the lid, and the job is complete.—F. J. RAINBIRD (Lambeth).



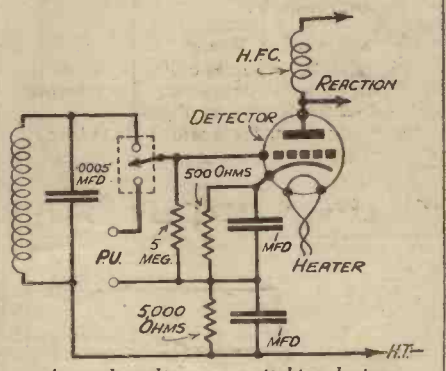
Fitting a push-pull switch for a dual-range coil.

THAT DODGE OF YOURS!

Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? For every item published on this page we will pay half-a-guinea. The latest batch is published below. 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 Wrinkle."

Pick-up Connection in Anode-bend Detector Circuit

IN some all-mains sets using anode-bend detection, the connection of a pick-up in the detector circuit is not easy. If

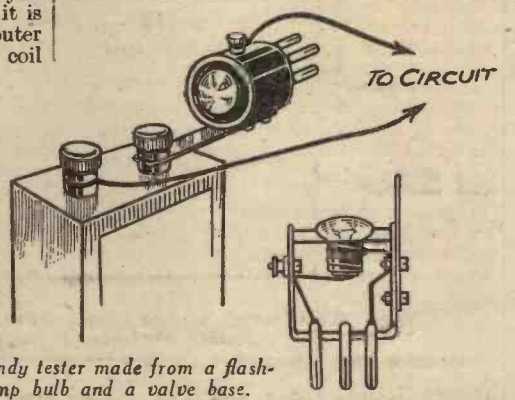


A simple radio-gram switching device.

the pick-up is connected as shown in the diagram, a simple radio-gram switch may be used, the bias on the grid is automatically adjusted, and there is no possibility of mixing the wireless programmes with the gramophone. At the same time, the circuit is stable and free from hum. While the 5-megohm resistance is not absolutely essential it prevents the grid becoming free, and also precludes any possibility of hum entering the circuit. It does not damp the preceding coil. Suitable bias resistances are indicated, but these may be altered if advisable. This arrangement is working very well in my own all-mains D.C. set.—E. B. TAYLOR (Hull).

A Handy Tester

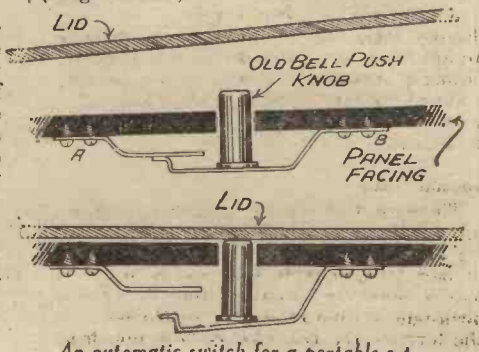
THIS useful gadget can easily be constructed from an old valve base as follows:—A strip of brass shaped as illustrated is fixed by two small B.A. nuts and bolts to the side of the valve base, a small terminal being also fixed to the opposite side. An ordinary flash-lamp bulb is wedged tightly into a small disc of wood which is cut to fit tightly into the top of the valve base. One filament leg is then wired to the small terminal and on to the pip of the bulb. The remaining filament leg is wired to one of the bolts holding the strip of brass, and on to the screwed portion of the bulb. The wood disc is then wedged into the top of the valve base, and the tester is ready for use. In use, the brass strip is connected to one terminal of the battery, and leads taken from the remaining battery terminal and the small tester terminal to the circuit under test. After constructing or re-building a receiver and connecting up the batteries for test, the tester can be plugged into a valve holder to ensure that it is safe to insert the valves.—T. W. WILLIAMS (Upper Holloway).



A handy tester made from a flash-lamp bulb and a valve base.

Switch for a Portable Set

THIS switch, which is intended for portable sets, cuts off the L.T. current when the lid is closed, as shown in the accompanying sketches. The switch is mounted on the panel-facing of the set in such a position that the lid, when closed, depresses the bell-push knob, so breaking the circuit. One of the leads from the accumulator is broken and the ends connected to the screws A and B.—N. PAGE (Leigh-on-Sea).



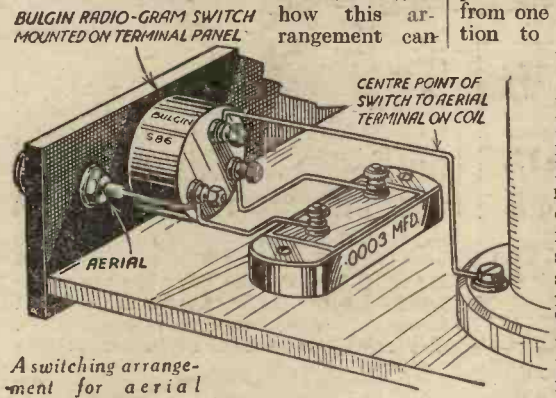
An automatic switch for a portable set.

Radio Wrinkles

(*Continued from page 335.*)

A Useful Switching Gadget

HERE is a handy gadget for those using a fixed condenser in aerial lead temporarily, to save removing leads from condenser and replacing again. The sketch shows how this arrangement can be made a permanent addition to a set. By a simple turn of the switch the condenser is put in or out of action as required.—FRED HARPER (Bristol).



A switching arrangement for aerial condenser.

Fixed Condenser Tips

WHERE it is required to ascertain the capacity of an unknown condenser of fairly small value, a simple method is to connect it across one of your tuning condensers and note the reduction necessary to tune in some strong station, which will indicate quite well the capacity which the fixed condenser bears in relation to the tuning condenser in question.

When testing a disconnected mains set in which large smoothing condensers are used, it is a good plan to short these before interfering with the wiring of the receiver.—A. J. B. (Harrow).

An Emergency Valve

IT is a good plan to always keep one valve as a spare, and let this be a "general purpose" type, which can, in cases of emergency, be used as a detector or L.F. amplifier. If the L.F. valve breaks down, a replacement will be available. If the power valve breaks down the L.F. valve can be used temporarily to take its place, and the "general purpose" valve plugged into the holder hitherto occupied by the L.F. valve.—B.

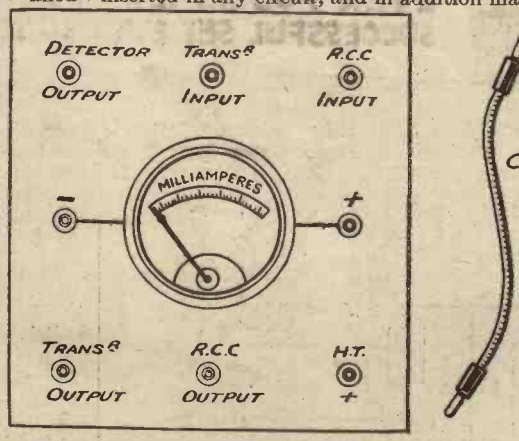
Use for Old Valve Bases

WHY throw away that old valve? The base is a very useful article, and the radio-gram user can make them into neat needle cups. A cardboard disc is cut to fit inside and four holes drilled on the motor board to take the legs. The same idea can be applied to the bench for holding small drills, screws, etc. The valve base also makes a useful short-wave adaptor plug. — F. W. REEVES Ox ford).

A novel use for old valve bases.

A Useful Adjunct to the Experimenter's Set

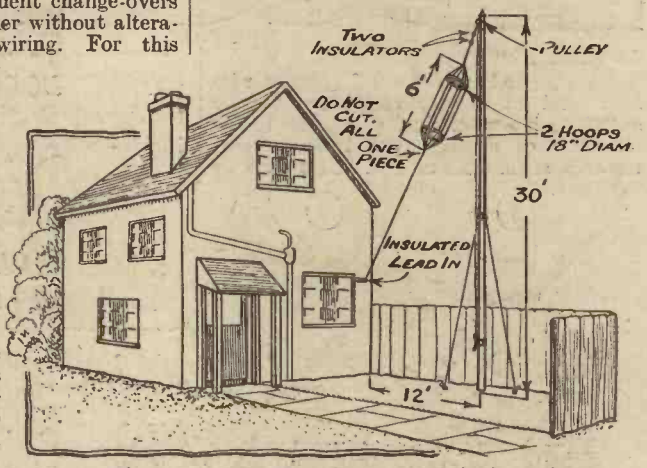
TO the keen experimenter who is continually trying out different circuit arrangements, a set with a fixed circuit is useless, and to meet his needs some provision for flexibility is essential, which will permit of rapid and frequent change-overs from one circuit to another without alteration to the internal wiring. For this purpose, the plugboard illustrated herewith has been found invaluable. Built into the right-hand side of the cabinet, it contains eight standard sockets and a milliammeter. The connections to the various sockets need not be detailed, since to anyone to whom it would be of any value, it is self-explanatory. It will be seen at once that the following are some of the possible arrangements: Detector only: Det.—trans.: Det.—RCC: Det.—trans.—RCC: Det.—RCC—trans. Loudspeaker and 'phone leads are terminated with standard plugs, and three links consisting of a short length of flex fitted with plugs at either end enable any desired combination to be obtained. The milliammeter may be inserted in any circuit, and in addition may be used as a series link when two pairs of 'phones are to be employed. When two stages of amplification are being used with the loudspeaker at a distance, one of the interstage links may be replaced by the 'phones for "listening-through." This is also of great assistance when searching for distant stations with the L/S in the final stage. It is hardly necessary to add that it must not be forgotten to change the position of the valves in order to suit the chosen circuit, also that in wiring-up parallel leads should be avoided, although no trouble whatsoever has been experienced with interaction. For the writer's own experimental work this arrangement has proved itself invaluable and I can thoroughly recommend it.—F. A. RUSSELL (Winchester).



An experimenter's plugboard.

An Efficient Aerial for Cramped Positions

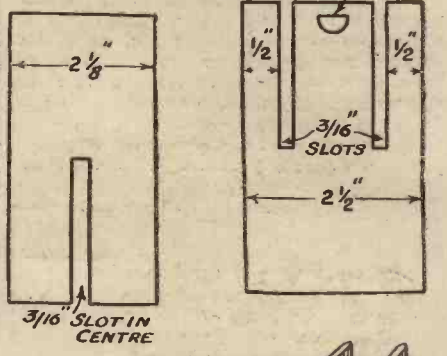
FOR small backgardens, and, incidentally, for eliminating interference from any neighbouring aerials, the aerial system shown in the accompanying sketch is very effective. Covered wire, in one piece, is used, the ends being looped and tied, then made fast to hoops with small insulated staples. The aerial is hung at an angle of 45 degrees, and the total length of wire used, including the lead-in, is 50ft. It is advisable to run the earth wire to the ground underneath the aerial.—A. May (Walthamstow).

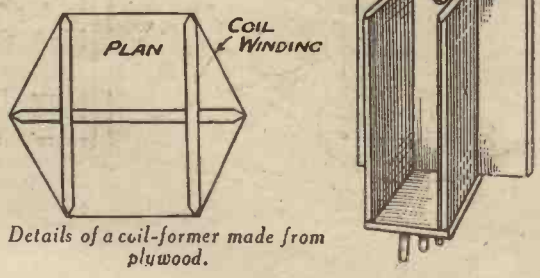


An efficient aerial system for a small back garden.

A Useful Coil Former

A GOOD coil former can be made quite simply from 3-16in. plywood or similar material. One piece, about 4½in. long by 2½in. wide, and two pieces, 4½in. by 2½in., are required, slotted as shown in the accompanying sketches. The narrow ones are then slipped into the slots of the wider one, then a piece of ebonite with six valve legs or an old valve base is screwed on the bottom for plugging in.—S. PACEY (Aylesbury).



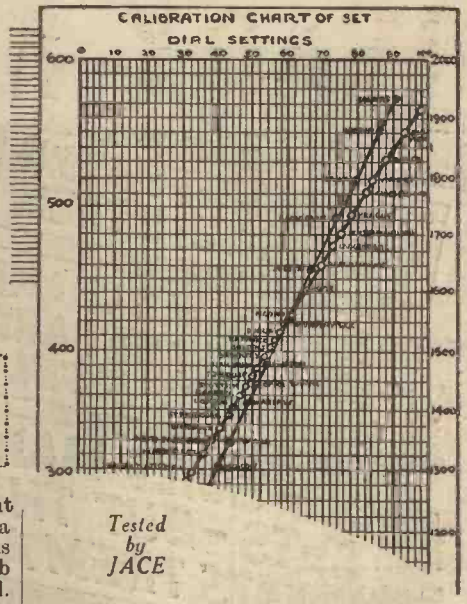


Details of a coil-former made from plywood.

Receivers and their Records

We shall be glad to advise readers regarding purchase of complete sets.

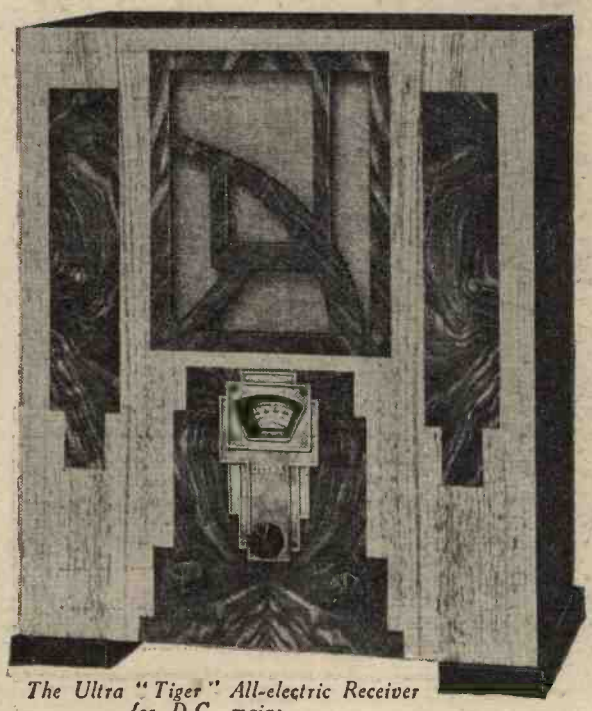
Ultra "Tiger" All-electric Four-valve Receiver.



Tested by JACE

THIS is a super four-valve self-contained receiver which can be obtained in models suited to either D.C. or A.C. mains. Its appearance is most attractive; the walnut cabinet is well proportioned, of smart design and craftsmanship, and, with its contrasting figured veneer panels, will appeal, without doubt, to the female members of the household. The D.C. model, under test, comprised a well-thought-out circuit of sound design and construction; it is built on a cadmium-plated steel chassis, with coils fully screened, and houses an energized moving-coil speaker. The circuit is a highly efficient one, and makes the utmost use of a variable-mu screened-grid high-frequency valve, a screened-grid detector, resistance capacity coupled to a power pentode output valve, all Mazda make. The fourth valve is a Philips barretter for the regulation of voltage. The receiver is ready for immediate operation on any D.C. mains from 200–250 volts, and no adjustment is needed.

The "Tiger" has been primarily designed for an outdoor aerial, but should this be found inconvenient, the mains aerial with which it is equipped will give satisfactory results. It is merely a question of connecting, by means of a short piece of flex with a plug at each end, the mains aerial and aerial sockets. Such an arrangement will be found very useful in, say, flats or apartments where an outdoor aerial is not available and cannot be easily erected.



The Ultra "Tiger" All-electric Receiver for D.C. mains.

There are only three controls on the front of the cabinet, but two of them fulfil a multiple purpose. The main tuning is effected by means of the central knob immediately below the illuminated dial. On the right-hand side of the cabinet is another knob working a combined or ganged mains switch and volume control. From the off position it is turned to the right, when the gradual rotation in that direction will bring up signals from a whisper to full strength. The control on the left of the dial is the change-over switch from one waveband to the other. One turn (short waves) shows a red spot engraved on the edge of the knob; a further turn, a green spot indicating that the long-wave coil is in operation, and if the knob is adjusted so as to show a white spot in that position, the receiver is ready for use with a pick-up for the electrical reproduction of gramophone records.

As is usually the practice, the receiver will receive broadcast transmission on two separate wavebands—namely, from 200–550 metres and from 1,000–2,000 metres. It will be found possible, however, to pick up wavelengths on the higher band down to roughly 830 metres, and, consequently, transmissions of weather forecasts from Heston Airport.

The main tuning scale consists of an illuminated dial calibrated in wavelengths and bearing in red letters, in their respective positions, the principal B.B.C. Regional and National stations. This system was found to facilitate greatly the finding of these broadcasts, and, with but slight variations, the scale is fairly accurately marked.

The newly-developed pre-selector tuning circuit, which has been adopted in the Ultra models, ensures very sharp reception, and the slow movement of the condensers proved an advantage when necessity called for the separation of neighbouring transmissions. The overall selectivity and sensitivity of the set was very good, and, with a judicious use of the volume control, many of the foreign programmes were tuned in clearly and at good loud-speaker strength.

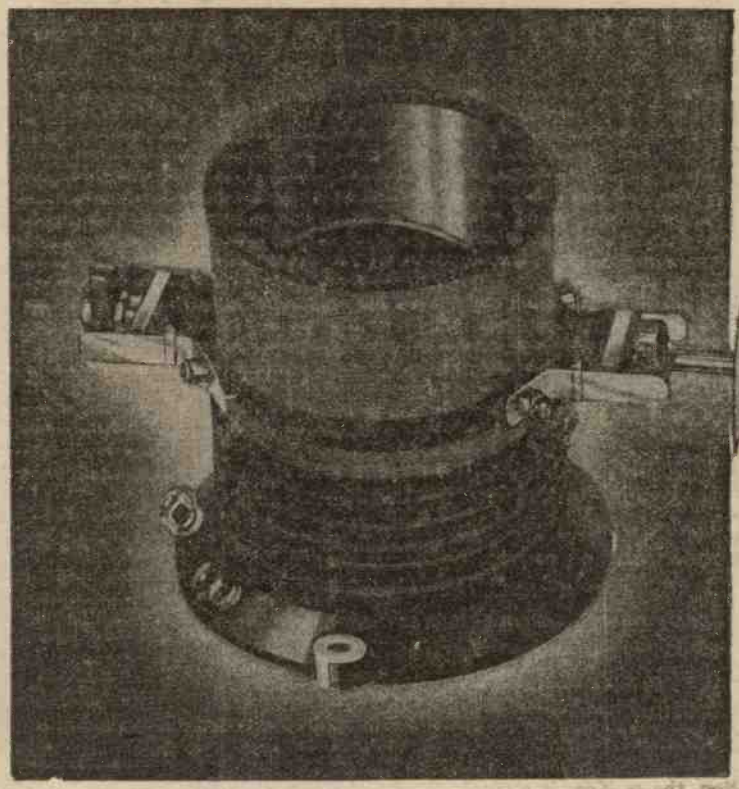
In the course of one evening, and working with a relatively short outdoor aerial (40 feet including lead in), some forty transmissions were logged, including broadcasts from Konigsberg (217 m.), Lodz (235 m.), Lille, PTT., Limoges, Bordeaux-Lafayette, Goeteborg, Lvov, Sottens, Paris PTT, Budapest, Wilno, etc.; in fact, many transmissions not regularly received with the average three-valve set. Such stations as Huizen, Radio-Paris, Daventry National, Motala, Kalundborg and Oslo in the long-wave band were heard at full loud-speaker strength. There was some difficulty in separating Eiffel Tower from Warsaw and Königswusterhausen from Radio-Paris, but this fault did not lie with the receiver.

On the medium or short-wave band, selectivity was at its best, and whilst the London National station was operating programmes were clearly received from Trieste, Gleiwitz, and Turin; North National, Hilversum, and Bordeaux-Lafayette could be easily separated, and Brussels No. 2 and Strasbourg were picked up whilst London Regional was on the air. Generally speaking, the performance of the Ultra receiver was highly satisfactory.

Provision has been made for the connection of an external loud-speaker, as well as for a gramophone pick-up. In the latter case, although it would be advisable to use an external potentiometer volume control, a test was made without any decrease in the input to the receiver, and reproduction, although at a degree of volume sufficient to fill a very large room, was remarkably pure and free from distortion.

The moving-coil speaker incorporated in the Ultra "Tiger" gives you the advantage of high quality with a good range of tonal frequencies; there was no trace of hum and, provided volume was not pushed to the extreme, no unpleasant resonance. Speech was crisp and lifelike even when recourse was made to additional strength for the reception of the more distant transmissions. The 1933 "Tiger" is distinctly an attractive three-valver in many respects, and the price of £18 18s. 0d. (including royalties) for either the D.C. or A.C. model is a reasonable one. The set may be relied upon to give you, even during daylight hours, alternative programmes from a number of British and foreign stations, and is well worthy of recommendation.

READY RADIO



Super-Selectivity and Sensitivity for the

'BIJOU'

When you build the 'Bijou' Three you are assured of selectivity and sensitivity far above the average obtained from a Det.-2 L.F. circuit. It incorporates the wonderful Ready Radio Dual Range Coil Unit, fitted with four-in-one control, which acts as combined on-off switch, wave-change switch, selectivity and volume control, thus greatly simplifying wiring and construction. Instructions are included with every unit. From all radio dealers. Price

10/6

AGAIN SPECIFIED!

All you need to convert your old set to the 'Bijou' Three is this wonderful coil unit

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Full details of how to use this amazing Coil are contained in the Kendall-Price Book. 36 pages describing 10 wonderful circuits, with photographs and diagrams, published at 1/-.

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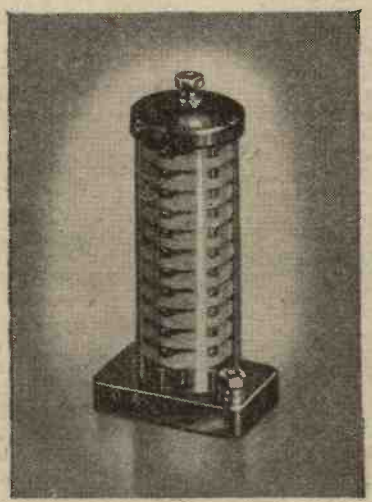


SPECIFIED for THE "ARGUS"

A new H.F. Choke specially designed for screened-grid sets. Highly efficient sectionalized windings. Self-capacity, D.C. resistance and losses are exceptionally low for a choke of such high inductance.
Its specification in a set of so high a calibre as the "Argus" is sure proof of its outstanding quality.

5/6

READY RADIO

Announcement of Ready Radio Ltd., Eastnor House, Blackheath, S.E.3. Telephone: Lee Green 5678. Telegrams: Readirad, Blackvil, London.

Introducing →

THE ARGUS TH

The Wonder Set Employing Two S.G. and Pentode Valves, the which will be Described in Next Week's 8-page Photogravu

"SOMETHING a little off the beaten track for the readers of PRACTICAL WIRELESS" was the suggestion made to me by the Editor in connection with the design of a three-valve receiver. Furthermore, it had to be reasonable in cost, use battery-fed valves, be easy for the amateur to build up, have no soldered joints, be efficient in its control of volume, possess good quality reproduction, great selectivity and, when completed and housed in its cabinet, be a receiver of which the constructor could justly feel proud.

This seemed rather a tall order, especially as some of the requirements appear to be conflicting; for example, low cost and good quality. However, I set about my task with enthusiasm and for many hours was busy with paper and pencil, and two or three alternative types of circuits were finally placed

GREAT RANGE

on the "short list." The "Argus" was finally selected as being the one that fulfilled in the best possible manner the headings set forth in the first paragraph.

Highly Satisfactory Test Results

I have put the set through some very careful and thorough tests under conditions of reception which are bad—namely, within five miles of Brookmans Park, and using a purposely made imperfect aerial system, and I am glad to say that the "Argus" has

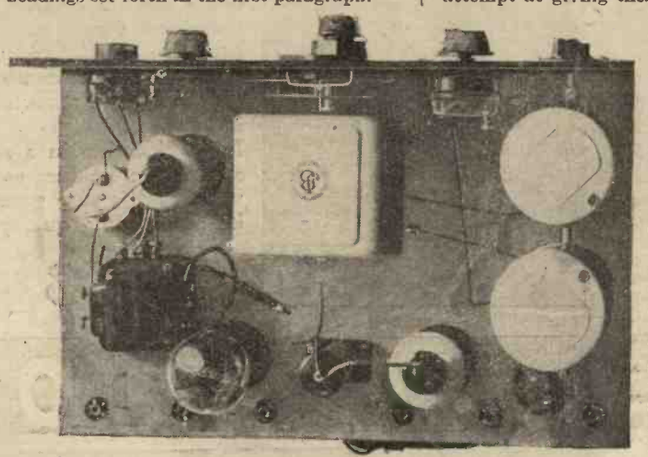
NO BACKGROUND

emerged unscathed. The combined efficiency of the final choice of components (listed elsewhere) will be found of the highest order, while the quality of reproduction should satisfy even fastidious tastes. The set handles well and the real purpose of each of the panel controls is acquired after only half an hour's practice, provided the directions which are to follow later in the article are followed carefully.

Outstanding Features

Where does the "Argus" score when compared with other three-valve sets which have been described from time to time? In suggesting the features I will make no attempt at giving them an order of merit for personal tastes differ so materially, and where one reader awards pride of place to quality and is content with three or four stations, another shows leanings towards quantity (*i.e.*, number of stations received) without emphasizing quality.

First of all the selectivity is adequate to meet any situation, except the very abnormal. This is backed up with sufficient output power to work a loud-speaker comfortably in the average-sized room from at least eighteen transmitting stations. I am not in favour of giving a list of stations which have been received in one particular locality, for conditions of reception vary so enormously over the British Isles that one single list is apt to prove misleading. One might almost say that it is a handy rule to remember that the nearer the listener is towards the west the fewer the Continental stations that will be heard, and the best reception is secured from stations located in a southerly direction, at least that has been my experience.



A plan view of the completed receiver.

PLENTY OF POWER AND EASY TO BUILD

Medium and Long-wave Reception

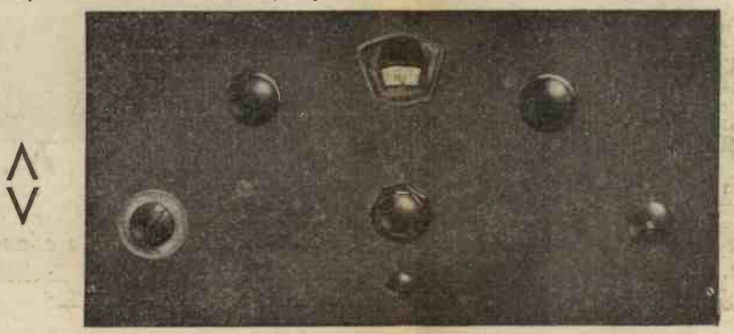
As a fair basis on quite conservative lines, it can be said that the majority of the high-power broadcasting stations on both the medium and long-wave bands can be received with the "Argus."

The quality of the reproduction is really excellent. A special tone compensator, about which I shall have more to say later, is included, and the tone of any loud-speaker can be adjusted very easily to suit any individual preference.

The reaction control, once the correct voltage for the appropriate H.T. lead has been determined, is quite smooth in operation, while the inclusion of an H.F. volume control, through the medium of a variable mu screened grid valve, indicates that modern receiver practice has been followed.

Special Combination of Valves

So much then for generalities. Is there



Note the balanced arrangement of the various controls.

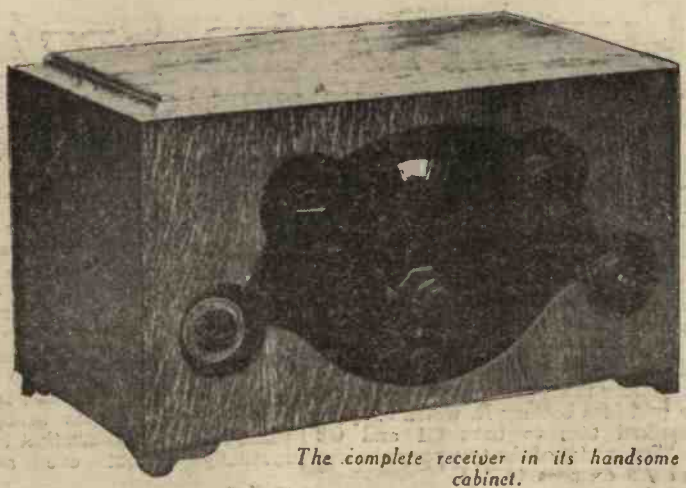
GET TOGETHER THE FOLLOWING COMPONENTS FOR THE ARGUS THREE.

One pair Telsen twin matched coils.
One J.B. 2-gang .0005 mfd. variable condenser.
One Lissen Hypernik 4-1 L.F. transformer, with Lissen tone compensator.
One Ready Radio S.G. choke.
One Bulgin Midget H.F. 8 choke.
One Polar .0005 mfd. "Compax" condenser.
One Polar .0003 mfd. "Compax" condenser.
One Lewcos 50,000 ohms Potentiometer.
One T.C.C. .0003 mds. fixed condenser, Type S.
Two T.C.C. .0001 mfd. fixed condenser, Type S.
One T.C.C. 2 mfd. Mansbridge condenser, Type 50.
One T.C.C. 1 mfd. Mansbridge Condenser, Type 50.
One T.C.C. .1 mfd. Mansbridge Condenser, Type No. 50.
One Graham Farish 1 meg. Ohmite Resistance.
One Bulgin Spaghetti Resistance, 5,000 ohms.
One Bulgin Spaghetti Resistance, 50,000 ohms.
Two Bulgin Spaghetti Resistances, 100,000 ohms each.
One Ready Radio 3-point switch.
Two Clix 4-pin chassis-mounting valve-holders.
One Clix 5-pin chassis mounting valve-holder.
Six Eelex terminals, L.S.+, L.S. —, two pick-up, aerial, earth.
Four Eelex Wander Plugs, G.B.—1, G.B.—2, G.B. — 3, G.B.+.
One Belling Lee 7-way battery cord, with terminals, marked H.T.+, H.T. +1, H.T.+2, H.T.+3, H.T. —, L.T.+, L.T. —.
Two Coils, Lewcos Glazite, connecting wire.
One W.B. Senior Model 4-pole balanced armature speaker in oak cabinet.
Three Cossor Valves, 230 V.S.G., 220 S.G., 230 H.P.T.
One Ediswan 120 v. H.T. Battery.
One Ediswan 9 v. H.T. Battery.
One Ediswan 2v. L.T. Accumulator.
One Tin Filt for Earth (Graham Farish).

HREE

Construction of ire Supplement

any novelty appeal? Yes! and this arises from the fact that no three electrode valves are used at all! The first stage is a high frequency amplifier using a screened grid valve of the variable mu type. In the second stage we have a screened grid valve functioning as a detector with the reaction fed from the screening grid, while for the third or output stage a pentode valve has been employed.



The complete receiver in its handsome cabinet.

From these preliminary remarks the reader can judge for himself that the "Argus" is a set meriting the closest attention. Nothing has been left to chance, every detail has received careful consideration, and all that is now necessary is for readers to duplicate the results I have obtained.

TONE CONTROL

Without unduly anticipating the Constructional Notes to be published next week, it may be briefly stated that no difficulties will be found, and that by proceeding in the manner described in those notes, the work will be found intensely interesting. The photographs on this page show how the receiver is built up in a chassis-form, no difficult metal work being employed. Ordinary ply-wood fully meets our requirements, and enables the Home Constructor with very few tools to make a neat piece of apparatus.

For the purposes of the photographs, it was thought desirable to show the method of mounting the L.F. Transformer and its associated Tone Control Unit. Therefore a fixed condenser and Spaghetti resistance have been removed from the side of the baseboard nearest these components. Their position and wiring are, of course, clearly shown in the Wiring Diagram to be given next week.

I have already stated that the receiver is simple to build and that there are no soldered connections. This is, of course, a feature which will appeal to the amateur who is not very adept at soldering, and with the components specified, a sound joint is just as easily made by means of the terminals fitted. As is the case with all home-constructed receivers, it is absolutely essential to adhere rigidly to the published specification and constructional details if you wish to duplicate the receiver. Little differences in components—which may have the same rating—may make all the difference between stability and instability. Do not, therefore, be tempted to fit some odd component which you may have in hand, in place of one given in the Components List. Many queries are received by the Queries Department after the publication of a receiver, asking whether such-and-such a valve may be substituted for one used in the original receiver. It may therefore be stated, here and now, that such substitutes are not recommended. No departure should be made from any of the details—even if you are an "advanced" experimenter you may make some little alteration which will mar the working of the set—and this injunction applies not only to the Argus, but to all the sets described in these pages.

SELECTIVE

Well, sufficient has now been written to give some idea of the Argus, and all that remains to be done is to start getting together the components as listed on these pages and then you will be in a position to go right ahead next week with the actual constructional work.

WATCH FOR NEXT WEEK'S ISSUE.

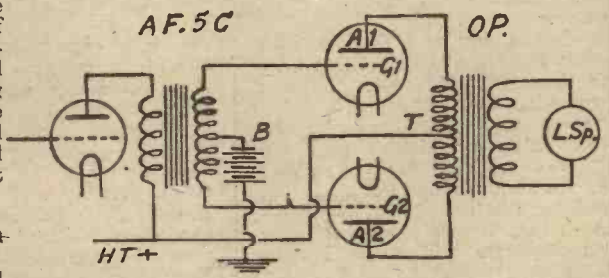
This photograph gives an idea of the extremely neat lay-out.

THE SPEAKER SPEAKS

ON THE PUSH-PULL CIRCUIT

By F. W. LANCHESTER, LL.D., F.R.S., M.Inst.C.E.

THE push-pull circuit is best described by aid of the usual diagram. Here it will be seen that the coupling of the penultimate stage is by transformer, the secondary of which feeds the grids of two power valves G1 and G2 in opposite phase, *i.e.*, when the one swings positive, the other is negative. The centre of the said secondary is tapped and goes to earth via the grid bias battery B, which supplies the required bias to both G1 and G2 alike. The anodes of the two power valves A1 and A2 connect to the terminals of the primary of the O.P. transformer respectively, and the H.T. is supplied by way of a centre tapping T. The secondary of the O.P. transformer is arranged in the usual manner, and couples to the speaker circuit "L.S."



Circuit explaining Mr. Lanchester's article on the push-pull circuit.

Advantages Derived from Push-pull

Firstly, it may be noted that the constant component of the H.T. current is divided and flows equally and in opposite directions round the two halves of the O.P. primary winding. It consequently has little or no effect as inducing magnetisation in the core; that is to say, there is no constant magnetising current, and the transformer core is normally without field. Under these conditions the effective inductance is higher, commonly about double or treble what it would be in a transformer carrying the H.T. current in the ordinary manner. This results in the bass, or low frequencies, being more fully transmitted.

Secondly, since one of the power valves is taking more H.T. current when the other takes less, the draft on the H.T. battery is almost constant instead of flowing in waves or jerks, hence the main cause of "motor-boating" is disposed of, and the need for de-coupling is far less urgent.

Thirdly, distortion, due to the curvature of the valve characteristic, is very greatly reduced; the valves being in opposite phase has for its result that the two curves mutually correct one another, and "octave contamination" is disposed of and certain other forms of distortion that go with it.

Fourthly, consequent upon the foregoing, the valve swing that may be usefully employed is considerably increased, and two valves coupled in push-pull will give far more output than the same two valves mounted in parallel. This has been variously assessed at two or two and a half times as much. In other words, the conversion of a set to push-pull and the addition of one valve (duplicate of the power valve) is, so far as undistorted output is concerned, equivalent to adding three or four valves instead of one valve.

With all these advantages, it is amazing that the push-pull system has not become almost universal, at least on sets with any pretensions to quality and efficiency. From a purely economic point of view, the greater output from a given expenditure in valves, the better service from a given output transformer, and the elimination of the prime cause of motor-boating, far more than justify the additional expenditure in the push-pull inter-valve transformer, and the trifling expenditure in other directions. Possibly the current belief that the choke-filter output circuit is in some way better than an output transformer (an entire fallacy in our opinion and experience) is in part responsible; perhaps it is the view that the push-pull system is something that comes under the head of *unnecessary complication* that holds it back; though how this can be is a mystery, when most home-made sets look as if the owner had bought the bankrupt stock of a wireless dealer and tried to use a sample of everything in his lay-out. Probably the real reason is that the overwhelming advantages enumerated above are not realised by the general public, and those who design or "shake together" sets for the market are too shortsighted to make use of transformers bearing a trade name. Whatever the reason may be, we are wholehearted in recommending push-pull to all who would strive after the best radio reception, musical or otherwise. We know that a good speaker will only do itself justice on a good set; that is why we are interested. We want every user of a Moving Coil Speaker to have a set worthy of it.

Furthermore, when designing or laying out a set or gramophone amplifier, whether push-pull or otherwise, a *milliameter in the power circuit* should be regarded as an essential. Men who neglect this simple expedient ought to be as rare as is the mariner who puts to sea without log or compass.

PRACTICAL PARS

Filament Control in H.F. Valves

TO obtain the best results from a set employing a high-frequency stage, every H.F. valve should have its filament temperature under control. This is easily effected by means of a small variable resistance, which should be connected in the positive filament lead. It will be understood that if this is connected in the negative lead the control would be extended to H.T. and G.B. as well, and would adversely influence the functioning of the circuit.

Reaction and Oscillation

THE successful working of many sets depends largely on the reaction circuit, especially in the case of sets having a screen-grid stage. Therefore, to obtain maximum results it is necessary to arrange the reaction circuit so that the reaction shall be as smooth as possible. For the best results the circuit must be capable of oscillating very gently, and it is essential that there shall be no back-lash. That is, the circuit must just stop oscillating, when reducing reaction, with the control in the exact position where the circuit was just about to oscillate when increasing reaction.

Sometimes the grid-leak must be taken from the grid to a point upon a potentiometer joined across the filament battery. A lot of time can be spent in making the reaction circuit right and the improvement in the result is worth having, for it is certain that a station may be heard well with a set having a good reaction and hardly at all when the reaction circuit is poor.

Anode-bend Detection

ANODE-BEND detection is used by many amateurs, despite the fact that the ordinary grid-leak detector arrangement can now be operated in such a way as to involve really very little distortion. One reason of the preference for the anode-bend system is that since the grid is negatively biased, so that there is no grid current flowing through the tuning coil in the grid circuit of the detector, the damping of the grid is avoided.

The effect of this is to improve selectivity, and this, in some cases, may make all the difference to the ability of the set to cut out unwanted stations.

When using the anode-bend detector a fairly high impedance should be used in the anode circuit. Incidentally, if the resistance-feed method is used, it is often quite satisfactory to use an L.F. transformer of only comparatively low primary impedance, operating with an anode-bend detector.

For Awkward Places

FOR starting a screw in an awkward corner, a good dodge is to place a small piece of adhesive tape over the end of the screwdriver and wedge it into the slot in the head of the screw. This will keep the screw attached to the screwdriver until it has got a start.—F. WILKIN (Bridlington).

An Efficient Earth

FOR the past twelve months I have been using the following earth system with extremely satisfactory results. A copper canister is filled with salt and bits of copper wire and foil. The end of the aerial wire passes through a hole in the lid, to which it is well soldered. This arrangement makes a very damp and efficient earth. Instead of the canister, a large cocoa tin can be used, but this, of course, would not last so long as a copper container.—H. CASE (St. Helens).

SELECTIVITY— WITH PLUG-IN COILS

By A. J. WOOD

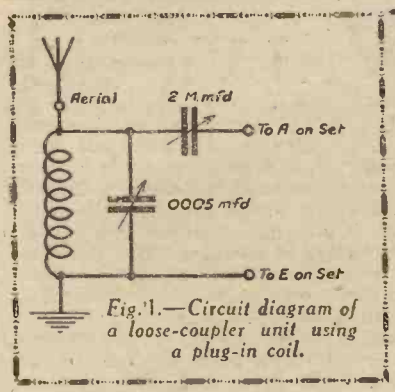


Fig. 1.—Circuit diagram of a loose-coupler unit using a plug-in coil.

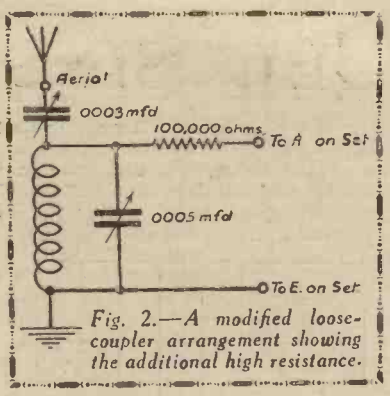


Fig. 2.—A modified loose-coupler arrangement showing the additional high resistance.

Selectivity with Plug-in Coils

IN spite of the many changes in coil types during the last few years I have stuck to my ordinary plug-in ones since I first began to use them over eight years ago. Nevertheless, from time to time, I have experimented with various dual-wave tuners, but have never found them so fully satisfactory as the others. Their chief drawback has been imperfect reaction. They never seem to be efficient on both wavebands.

The real trouble, however, with the plug-in coils began when the B.B.C. inaugurated the Regional scheme, and increased the power of the stations. Selectivity then became a pressing problem. In the end, I adopted the B.B.C. advice of a loose-coupler unit. I soon had this made up, and found when it was linked up to the receiver that it improved matters considerably. The scheme adopted is shown in Fig. 1. This satisfied me for a long time, until, in short, foreign stations began to increase their power also, when the selectivity problem again became acute. In despair I once more went in for a selective dual-wave tuner, but was again let down on the score of reaction. Moreover, I could not get the same number of stations that I could with my plug-in coils. I again began experimenting, and eventually evolved the following scheme with very satisfactory results. It is shown, diagrammatically, in Fig. 2, and is a modification of my original loose-coupler. As you will see, I did away with the small capacity coupling condenser, and inserted, in its place, a non-inductive resistance of 100,000 ohms. This is in the form of a grid-leak, and is held in a grid-leak holder. In the aerial lead, and fixed on the panel to the left of the tuning condenser, I introduced a .0003 solid dielectric variable condenser. The aerial is taken to the moving vanes, and the fixed vanes go to the coil. This arrangement is really a form of band pass, and provides a sharpness of tuning that is far superior to the original loose coupler. I found it possible to entirely cut out the powerful local station by adjusting the series aerial condenser, but, of course, this cut out other stations also. The thing to do (and it is simple enough) is to adjust this condenser until the local station comes in at just sufficient volume at the usual setting of the tuning condenser on the set, with, of course, a suitable corresponding setting of the tuning condenser in the coupler. You will then find, as both dials are moved together (either up or down), that the local will quickly disappear, and you will be able to tune in other stations free of interference. Take careful note of the dial readings when you have found a new station, and then you will be able to tune them in again when wanted without further trouble. The first night I tried out my new arrangement I logged twenty-two stations on the medium waveband, free of all interference, and I have logged others since, which is not bad at all for what would now perhaps be considered as an old-fashioned set. The coils in my receiver are No. 60 aerial, No. 50 reaction. The coil in the loose coupler is a No. 50. The whole unit can be made up for well under ten shillings.

CHOOSING A MODERN VALVE—3

PERCY RAY Concludes his Interesting and Informative Notes Concerning the Valves of To-day.

The idea of grid bias is largely to fix the valve so that it is working on a straight part of the curve, and obviously in the valve in question the best bias for 125 anode volts would be 1½, while 2 might be the best compromise between efficiency and

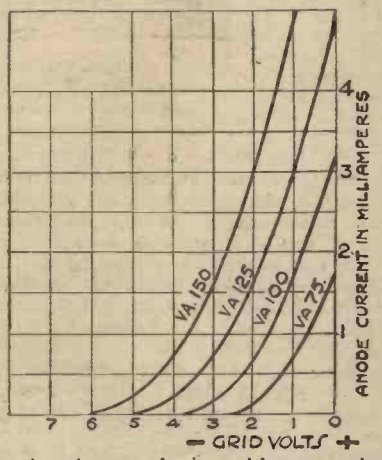


Fig. 4.—A curve of a typical battery valve.

economy. When using this valve as an ordinary leaky-grid detector the question of bias does not arise, as none is applied except a fraction of a volt automatically brought about by the grid leak, therefore it is only necessary to note, on the curve, where the anode voltage line hits the anode current scale. A glance at Fig. 4 will show that for 75 volts it is 1¾, for 100 3¼, for 125 it is 5; the value for 150 is off the "map," as it will never be used under this condition. It is not usual to use more than 100 volts high tension on a detector; generally speaking this value will give the best results on the local and a voltage sometimes as low as 25 on very weak stations, so a compromise will have to be found, possibly 75. This anode voltage on the valve, shown at Fig. 4, will only bring about an anode current of 1¾ milliamps, which will upset any but the smallest transformers. While on the subject of detector valves, it is time that the old idea of .0003 mfds. for a grid condenser is buried, as .0001 is adequate from a detection point of view, and will slightly increase the selectivity by relieving the tuned circuit from the effects of the detector, to some extent.

The Low Frequency Stage

It is seldom possible or desirable to use a separate L.F. stage with a mains set, owing to the terrific amplification of the valves, but it is still used to some extent in battery sets. The choice is governed by several factors that are common with the detector valve regarding the transformer limits, but the question of the valve's capability to handle the grid swing is of paramount importance. If the set is used on the local station within about 40 miles, an L.F. type of valve should be used, but if an inefficient aerial is employed or the set is, say, at Penzance, an H.F. type, or even an H.L. type, can be used and advantage can be taken of the higher amplification factor.

The selection of a power valve should be governed by the purpose that it has to fulfil; the power valve is required to handle the signal, much amplified by the preceding valve or valves, and to hand it to the loud-speaker in the same form that it was accepted, i.e., without distorting it. Distortion in the power-valve stage is caused by the inability of the output valve to handle the volume required from it. It is a fallacy that a super-power valve is louder than an ordinary power valve; this is true when working on the local, but not so when tuning in a weak foreign station. The average power valve having an impedance of about 4,000 ohms is suitable for use in the output stage of sets working with ordinary reed or balanced armature loud-speakers. It will give volume and quality that will please all those who have not heard better, and take only about 5 8 milliamps; these valves usually have a slope of about 2. Beware of small power valves having a slope of about 3.5 to 4 if the receiver already gives good volume. These valves have a special duty to perform. They have no more output than the valves with the lower slope, but are more sensitive, consequently they should be used when volume is poor to make it louder.

The Power-Valve

When really generous volume is required, the output valve must have a high value of undistorted output, with, if possible, a high slope. The average super-power valve of good design, having an impedance of not more than about 1,700 ohms, meets these requirements, but the anode current is high and a standard capacity H.T. battery will go to pieces in a few weeks. When using this type of valve, consult the data slip given with the valve and make sure that the H.T. battery is capable of giving the output for all the valves in the set. There is a mad race among valve manufacturers to top the record of slope, and in mains valves figures are attained today that would have been considered ridiculous if suggested eighteen months ago. While congratulating the manufacturer who happens to hold the record at the moment, it is questionable whether the constructor would not be happier with a somewhat less exciting figure and a little more margin to play with; this is, however, a matter of opinion. Sometimes a big directly-heated valve is used in the output stage of a mains set, and has much to be said in its favour provided it has a heavy filament current and is designed for the purpose: the use of 4-volt battery valves for this purpose is not to be recommended.

Pentodes

The pentode valve is designed as an alternative output valve; it is already in very wide use, but would be in almost general use if it was not so maltreated. The advantages of this type of valve are seldom appreciated unless a corrector circuit is used to rectify the unsuitability of the average loud-speaker for use with this valve.

This circuit is very simple and is shown at Fig. 5. It consists of a small fixed condenser of .015 or so in series with a fixed resistance of 20,000 ohms, connected from L.S. plus to L.S. minus. The value quoted is average, and will vary with different types of speakers. It is useful to use a variable resistance of 30,000 instead of the fixed one, so that tone control is provided capable of "knocking off" a heterodyne whistle. The large mains pentodes of to-day, such as the Cossor MP/Pen and P.T. 41B, the Mullard PM 24a, PM 24b, PM 24c, and PM 24d, and the Mazda AC/Pen, to say nothing of the several types of Osram and Marconi, are all capable of giving magnificent quality and full volume.

The Engineering Side of Valve Development

The mechanical construction of a modern valve is little short of a miracle, and the various systems used to lock and interlock the many elements together are great credit to the ingenuity of that small band of scientists that design the world's valves. Naturally the various members are in competition, but they are grouped in the

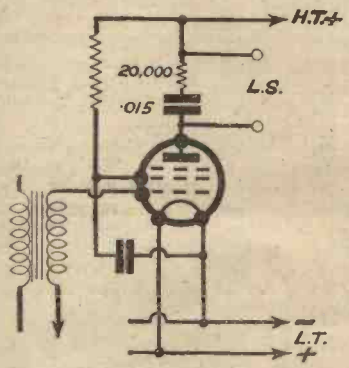
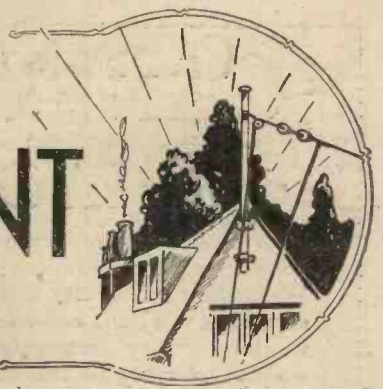


Fig. 5.—A pentode circuit.

imagination by the smallness of their numbers, and the rate with which they hurl new and confusing types of valves at the long-suffering listening public. Probably the dream of a standardisation of British valves, such as is in force in America, is about as near to reality as the wonderful invention to do away with valves altogether that regularly appears in the sensational (but dare we suggest) ill-informed columns of certain lay publications.

The BEGINNER'S SUPPLEMENT



Conducted by
F. J. CAMM

SOME TERMS EXPLAINED

This special beginner's supplement has been introduced in response to a general request from hundreds of readers who have only just commenced to take an interest in wireless construction. In it we propose to explain, week by week, in very simple language, facts about the various aspects of the practical side of wireless. To the many thousands who cannot yet understand the circuits or terms used in connection with wireless we extend a cordial helping hand.

MEGOHMS, Milliamps, Microhenries and Watts. These, and others of a similar "foreign" look are some of the terms which occur practically every week in the wireless articles in this book, and from the number of queries received from readers, it is quite obvious that they are not understood. When the various parts of the words are separated and explained, however, you will find that these expressions are no more difficult to understand than ordinary pounds, shillings and pence. The first thing to explain is, of course, the prefixes —that is, the first part of the word, and you will find that there are only four of these to be learnt and that they are easily identified. Set out in a table, they divide into two classes:

KILO=One thousand.
MILLI=One thousand*th*.
MEG=One million.
MICRO=One million*th*.

You see, therefore, that two of these terms mean quantities greater than the word to which they are joined, whilst the other two mean quantities smaller then the principal. For instance, MEGohm means one million ohms, and MICRO ohm means one millionth of an ohm.

The Decimals

It will be clear now that the terms which refer to smaller values (that is, milli and micro) will be best expressed as decimal fractions of the units to which they are prefixed. We therefore have the fraction .001 watts to represent one milliwatt; or 1,000 cycles to represent one kilocycle; or 1,000,000 ohms to represent one megohm. Now that the prefixes have been explained it should only be necessary to give the meanings of the various units used in wireless measurements to complete this description of the various terms met with in ordinary wireless practice.

Units of Measurement

The unit of resistance is the OHM. This is the amount of resistance which will permit a pressure of one volt to pass one ampere. This description brings in two other terms, or units, and therefore these will be dealt with next. The unit of electrical pressure is the VOLT. By changing round the description given above we can see that one volt is the pressure required to drive one ampere through a resistance of one ohm. The unit of current flow is the AMPERE. The two previous descriptions now make it clear that an ampere (or as it is more commonly called, an amp.) is the current driven through one ohm by one volt.

These three terms are the three fundamental electrical units, and, in view of their relationship, it is always possible to find the value of one of the terms if the remaining two are known. This gives us the famous Ohms Law, which, as has already been pointed out in these pages, is given by the equation $I=\frac{E}{R}$ which means, to find the current you must divide the voltage by the resistance. If you work out two or three small sums on these lines, you will soon appreciate the relation between these values, and will also find how simple it all becomes.

Some Other Terms

There are some other units used in wireless practice which it is necessary to explain to the uninitiated, and the principal one is the HENRY. This is the unit of inductance, and to make this quite clear it would, perhaps, be as well to explain what "inductance" is. If a length of wire is wound in the form of a spiral, or coil, the passage of a current through that coil will set up a field of magnetic influence around the coil, and this field will act on the coil in a peculiar manner. As soon as a current commences to pass through the coil the magnetic field will attempt to prevent the current flow, and directly the current ceases to flow there will be a similar retarding effect. This reluctance, or hesitation, at the change of value of a current through a coil is measurable, and the value of the inductance which will retard a change so that it takes one second for one volt to raise the current by one amp. is a HENRY. You will have no doubt observed that L.F. chokes, and the primary windings of L.F. transformers are rated in henries, and that tuning coils are rated in micro-henries.

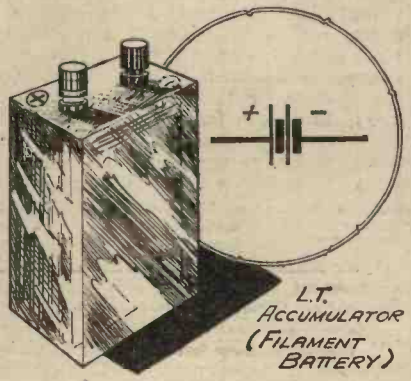
When a current is flowing through a circuit a certain amount of power is exerted, or dissipated. This is measured in watts, and one WATT is the power exerted by one amp. flowing through one ohm under a pressure of one volt. This again gives us a three-sided equation from which, knowing two figures, the third can be worked out. In other words, if we know the current flowing, and the voltage applied, the product of these two values will give us the wattage. It might, perhaps, be pointed out here that 746 watts are equivalent to one horse-power.

The principal electrical terms have now been explained, and if you work out two or three examples from the data given above you should soon grasp the relationship between the different terms, and you will find that the knowledge so gained is extremely useful in understanding the ratings of components.

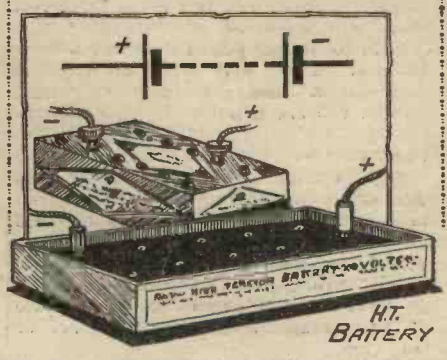
Later on it is proposed to develop these explanations by giving worked examples and illustrations. In the meantime, any reader who is not quite clear as to the meaning of terms not covered in this short article, should address a letter to the Editor.

Wireless Shorthand—2

The beginner in wireless soon encounters difficulty in reading the mystic symbols which the set designer uses in combination to form the circuit. The circuit consists of a number of conventional signs linked together, and this short series of pictorial diagrams will enable the beginner to recognise what they mean.



L.T. ACCUMULATOR (FILAMENT BATTERY)



H.T. BATTERY

CAN YOU READ A CIRCUIT DIAGRAM?

Compare the diagram below with the perspective on the next page.

This week we are reproducing a circuit diagram of a typical three-valve receiver, together with a special perspective sketch of the receiver itself showing exactly to what part each symbol refers. We believe this is the first time anything of the kind has been given in a radio journal, and venture to suggest it will help countless non-technical readers to a clearer understanding of the "shorthand" of wireless. Every component or wire represented in the circuit diagram is lettered or numbered, and by simply referring to the same letter or number on the perspective view you can see just what that particular part looks like in reality.

WHEN you look at a circuit diagram such as the one in Fig. 1 on this page, does it convey anything to you, or is it so much Greek? Do you know that every line in it refers to some particular part of a wireless set?

It is for those readers who are hazy on the point that I have had the two diagrams shown here specially prepared. As you see, Fig. 1 is a conventional circuit diagram with certain letters and numbers added. Fig. 2, on the other hand, is a perspective drawing showing how a receiver following the circuit of Fig. 1 would be made up. The letters and numbers appearing on the circuit diagram are repeated on the receiver, and show clearly to what component each symbol refers.

Why an Actual Set was Used as an Explanatory Model

You may ask, "Why show a drawing of a particular receiver? Why not explain the various symbols by means of a kind of glossary?" Well, the answer is that a glossary does not go far enough. It does not show you the relation of each part. It merely tells you that such and such a sign stands for a condenser, or that another represents a tuning coil, and so on, with the result that you are left with a whole lot of *isolated* facts. These facts in themselves are usually quite uninteresting, and are often forgotten as soon as they are learned. I suggest that what the reader wants to know when he sees a particular circuit is what it all means in terms of an actual set; not only what component each symbol represents, but also how it is placed and what it looks like in relation to the other parts of the set.

The Editor's Idea

No doubt the ideal method would be to have the completed receiver in front of you, together with the circuit diagram, and get someone to carefully explain the relation between the two. This is, of course, impossible in all but exceptional cases. It was the Editor who suggested the use of a perspective drawing of a typical receiver as providing the next best thing. This idea I worked out fully with the results shown in Figs. 1 and 2. The circuit used is the popular three-valve arrangement, consisting of a screen-grid valve, a detector valve, and a pentode-amplifier valve, while the lay-out is conventional in every respect. Of course, I realize that there are other circuits than this, and also that there are a number of components to be met with in modern receivers which are not represented here. This is unavoidable, but I think you will find that at least one type (in some cases there are more than one) of each of the more important components is included, and that practically all the symbols used in radio are to be found in the circuit diagram. There is one sign, however, which you may come across, but which is not shown here. It is the symbol for a battery. This is very similar to that used for a fixed condenser (of which several are shown), but instead of consisting of two thick lines of equal size like the condenser sign, it is made up of one long thin line and one short thick one. The long one represents the positive pole of the battery, and the short one the negative. For a series of cells the sign is usually repeated thus: long, short, long, short, etc., or one long and short stroke may be used each end, and the intermediate cells represented by a series of dots .....

What the Diagrams Show

Before you study them in detail I want to make it quite clear what the two diagrams are intended to show, and also point out the things you must *not* expect from them. First and foremost they show you what each symbol on the circuit diagram represents in the actual set. Secondly, by means of numbers every connecting line on the circuit can be identified with its equivalent wire, where there is one, on the perspective drawing. Lastly, by showing *every* wire and *every* component there is no part of the set left to your imagination apart from the accessories. The connections to these, however, are clearly indicated.

What I cannot profess to show you with the aid of these diagrams is the function of the various components, or their values. These are rather outside our present scope, and if I attempted to include them it would only tend to confuse matters. If, however, you particularly wish to know the value of some part or other, you can always refer to any similar circuit shown in the pages of PRACTICAL WIRELESS, or you can send the coupon on the Queries and Enquiries page and send it to the Editor.

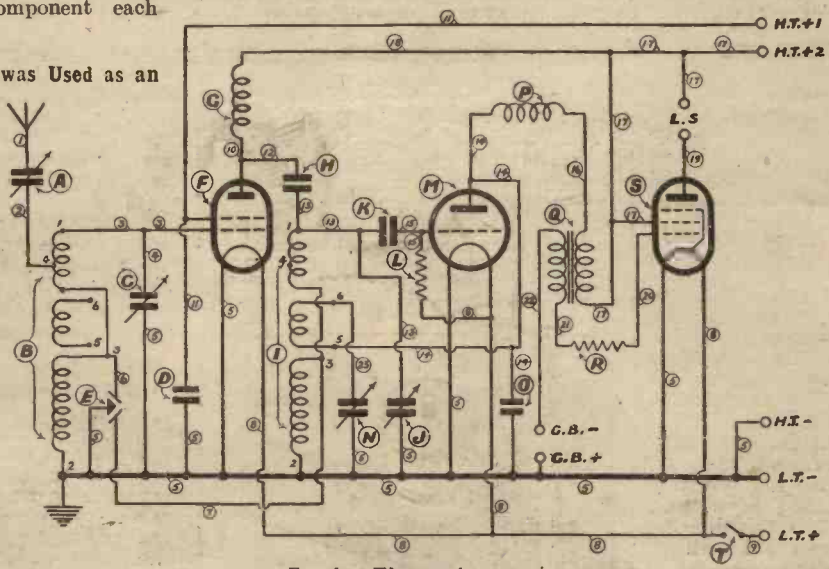


Fig. 1.—Three-valve circuit.

Valves Removed for Clarity

When you look inside a modern wireless receiver probably the first things that strike your eye are the valves, with their shining glass or white metal-coated bulbs, and also the screens covering the tuning coils, which look somewhat like aluminium cocoa-tins. In the set illustrated here, however, it has been found necessary for the sake of clarity to show it with the valves and coil covers removed. I mention this because it may give the set a somewhat unconventional appearance in the eyes of those unaccustomed to seeing the "insides" of a wireless receiver, and also because in the absence of the valves the indicating letters "F" "M" and "S" are shown against the valve *holders*.

How to Use the Diagrams

Now suppose we wish to follow the circuit diagram right through and identify each part. Where shall we start? Well, as the signals enter a set *via* the aerial I think that is where we ought to begin our investigations.

Look at the top left-hand corner of the circuit diagram (Fig. 1). There you will see a sign like a crow's foot. This is the universally accepted symbol for the aerial. The aerial is joined to the aerial terminal or binding screw on the bottom right-hand corner of the set, as shown in Fig. 2.

From the crow's foot on Fig. 1 is a line marked (1), leading to a symbol consisting of two thick lines with an arrow through them marked (A). If you look for the same signs on Fig. 2 you will see that (1) refers to the wire from the aerial terminal to a little oblong affair with a knob on it, and that (A) refers to the oblong thing itself. If you don't immediately recognize this latter as what is known as a pre-set condenser, you will be able to find its name by referring to the key published with this article.

Returning to the circuit, you will see a line marked (4) following from the pre-set condenser to one of a group of three curly-looking gadgets like springs. These are marked (B). Now turn again to Fig. 2, and you will see that (4) is a wire from the pre-set condenser to one of the two tuning coils which I mentioned previously as being shown with their screens or "cans" removed, while (B) refers to the coil itself.

Circuit Diagram Tells How Many Windings in a Coil

Why this is shown in Fig. 1 as three separate "springs" is because it contains three separate windings. The top one tunes in to the medium waves, the middle one in this case is not used, and the bottom one when joined to the top one by means of the wavechange switch (E) tunes in to the long waves. Thus you can always see from the circuit diagram just how many separate windings there are in a tuning coil.

Perhaps I should explain that the small numbers 1, 2, 3, 4, 5 and 6 round the base of each tuning coil, and shown on Fig. 1 *not in circles*, are those used by the manufacturers to mark the terminals of the coils, and have no connection with my system of numbering the various connecting wires.

Lack of space prevents my going through each part of the circuit with you in detail, but you will see from what I have shown so far how to carry on. There is one point which may puzzle you and that is that there are several wires marked (5). I will explain why this is.

Wires Connected to Earth

In the first place all these wires are what we call at earth potential, in other words they are all joined directly or indirectly to the earth terminal of the receiver. Now in the circuit diagram a connection from a particular component to earth is shown by a line connecting it to the thick line or "bus bar" lead, as it is sometimes called, which runs right across the diagram. This thick line itself is represented as being joined to earth at the extreme left-hand end by the triangular group of parallel lines at this point. Now this is purely diagrammatical, and it may not be practicable or convenient in building the set to literally connect a long thick wire to the earth terminal and then join each component that has to be "earthed" to it with a separate wire. For instance, where two components are situated close together it simplifies the wiring if they are both joined together with a short piece of wire and then a second wire is taken from one of them across to the earth terminal. Electrically it amounts to much the same thing, but the one is the theoretical arrangement and the other the practical. It is because these arrangements are not always identical that some lines on the circuit diagram have no wires exactly corresponding to them in the actual set. In order therefore that there should be no conflicting numbers I have numbered all the earthed wires the same, namely (5).

There are also one or two other numbers which occur more than once. In each case you will find that it is where a number of wires are all joined together or to the same point.

What an Arrow Stands For

In studying the circuit diagram you will notice in several cases an arrow drawn through the symbol for a condenser. This means that it is variable and the variation is usually carried out by means of a knob or some such device. Whenever you find this arrow sign on a circuit diagram it always means that the particular component has a variable control. It may for instance be shown across the symbol for a coil or a valve. In the case of variable

(*Continued at foot of page 348*)

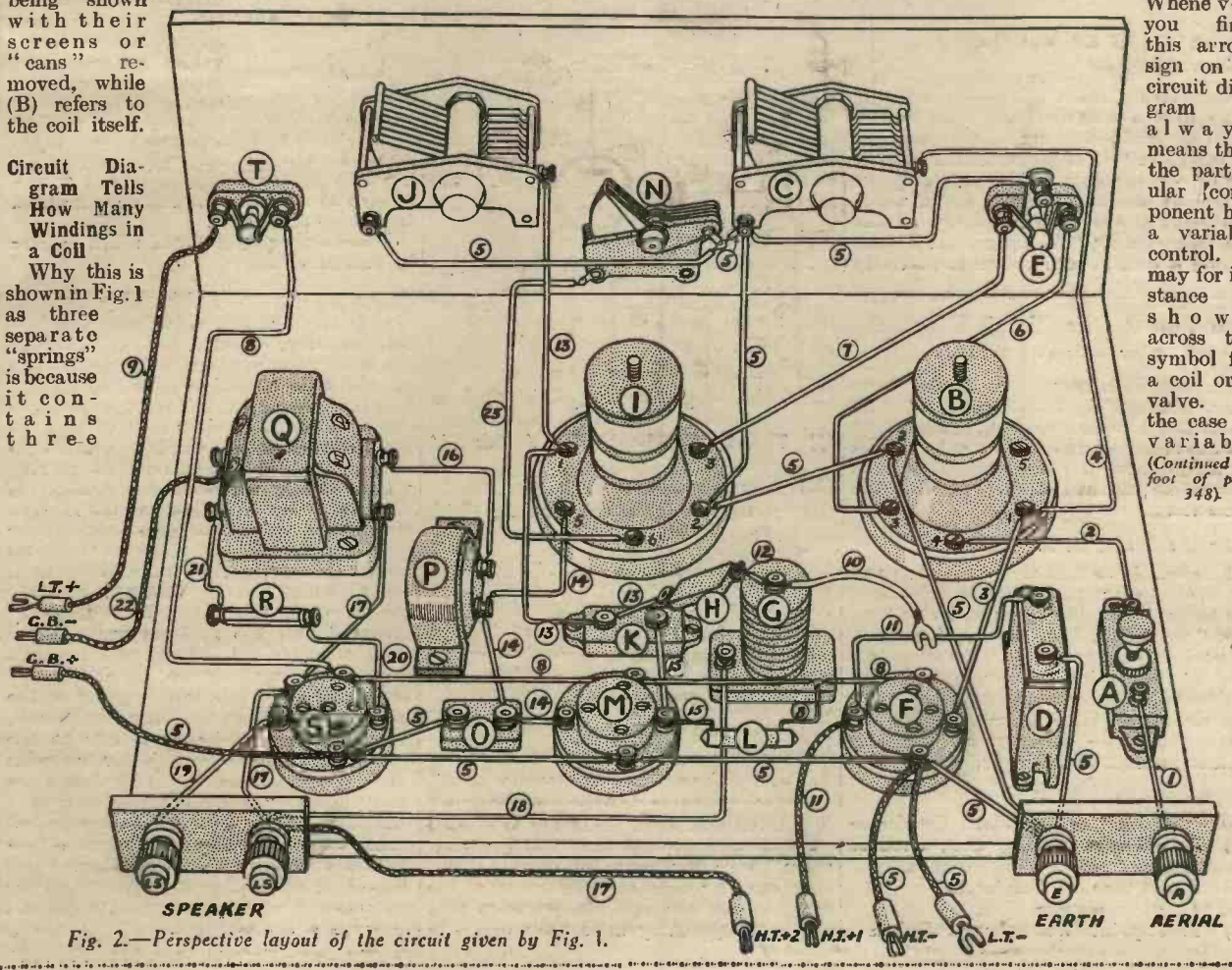


Fig. 2.—Perspective layout of the circuit given by Fig. 1.

THE LOUD-SPEAKER: VARIOUS TYPES AND THEIR PRINCIPLES—II

Concluded from page 281, October 29th issue

WHEN the armature is drawn to either side by the signal impulses it must travel in a true horizontal direction, and the restoring force in any direction is perfectly equal. The result of this is the nearest approach to the moving coil which has yet been designed, and, consequently, the reproduction is very faithful. This type of loud-speaker should, therefore, be chosen for multi-valve receivers designed for good-quality reproduction, where it is not desirable to use a moving coil, either on the ground of initial expense or running costs.

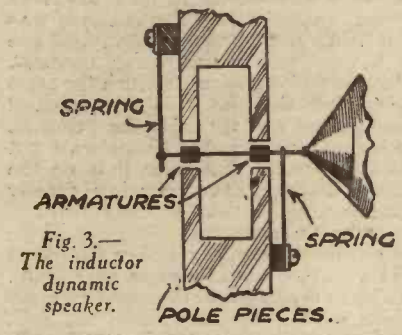


Fig. 3.—The inductor dynamic speaker.

Moving-coil Speaker

The moving-coil speaker is, of course, the best type of speaker yet designed, and, provided one of the best makes is obtained, will give on a suitable receiver a reproduction practically identical with the original. As will be seen from Fig. 4, at the point of the cone diaphragm a light ring of paper or similar material is fixed, round which is wound a coil of wire known as the "speech winding." A large metal cylinder, having a central rod, known respectively as the "pot" and "pole-piece," contains a large winding which has to be connected to some source of direct current. The actual voltage depends on the design of the speaker, and varies in most commercial speakers from 4 volts to 150 volts. The speech winding is supported in a small gap surrounding the pole-piece, and this gap should be as small as possible. Usually, it is round about ⅛in. When the field is "excited," which means when the current is applied to it, a magnetic field is set up across the gap. The speech coil is connected to the output valve of the receiver, and when the signal impulses flow through this speech winding it vibrates, travelling in and out of the gap. The edge of the cone is supported in some way, either by a ring of leather or rubber, and, therefore, the cone makes a true "piston" movement, resulting in a faithful reproduction of the received sounds. The only faults with this type of speaker arise from faulty design, and are: too heavy a speech-coil and cone; resonance set up by the rubber or leather fixing ring; resonance due to the material of which the cone is made, and one or two other little points.

To get the very best from a moving-coil speaker, a fairly strong signal is desirable, and, as it can give such a good performance, the receiver should be designed to give out a signal to justify the use of such a speaker. Particular care should be taken to look after the lower notes in the musical sale, as these can be dealt with so effectively by the moving-coil speaker.

Matching the Impedance

No matter which type of speaker you decide to use, there is one point which applies to the *correct* employment of any speaker, and that is, the impedance of the speaker must be matched to the output valve. This means that a certain valve will only give straight line reproduction with a certain impedance in its anode circuit, and although valve manufacturers give this impedance figure in the leaflets accompanying their valves, unfortunately loud-speaker manufacturers do not give us the impedance of their products. Usually, only the D.C. resistance is given, and this does not enable us correctly to match up the speaker. There are on the market, however, certain output matching transformers which have various ratios, and if you are keen on getting the best from your set, one of these transformers or matching units should be included in the output circuit, and by adjusting it to various values it is possible suitably to match-up the speaker. One final word. As the speaker can only reproduce what is fed into it, the choice of circuit should receive as much, or even more, care than the choice of speaker.

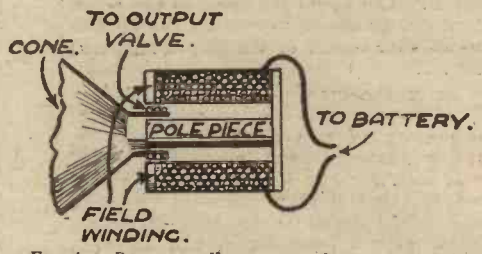


Fig. 4.—Diagram illustrating the principle of the moving-coil loud-speaker.

Later articles will explain this matter in greater detail.

Can You Read a Circuit Diagram?

(*Continued from page 347.*)

condensers it is sometimes shown somewhat differently. Instead of putting an arrow through the two thick lines, one of the lines themselves is drawn curved with an arrow head at one end. This is an alternative method of representing the same thing.

Keep the Diagrams for Reference

Finally I hope that these diagrams and the accompanying explanation will be of use to you in enabling you to understand the "shorthand" of radio. I suggest you might care to cut out the diagrams and the key table for future reference. Incidentally the Editor will welcome any comments you have to make regarding them, and also suggestions for any further features of this type.

KEY.

(A) "Pre-set" or Semi-fixed Condenser
(B) Dual Range Tuning Coil, Used as Aerial Coil
(C) Aerial Tuning Condenser
(D) Fixed Condenser
(E) Three-point Wave-change Switch
(F) Screen-grid Valve
(G) H.F. Choke
(H) Fixed Condenser
(I) Dual Range Tuning Coil, used as Intervalve Coil
(J) Tuning Condenser for Anode-grid Circuit
(K) Fixed Condenser
(L) A Resistance, in this case the Grid-leak
(M) Detector Valve
(N) Reaction Condenser
(O) Fixed Condenser
(P) H.F. Choke
(Q) L.F. Transformer
(R) A Resistance
(S) Pentode Power Valve
(T) "On-Off" Filament Switch

Tuning Condenser "Atmospherics"

VARIABLE condensers are so reliable nowadays that one seldom expects them to be the cause of trouble. But they *can* be a nuisance, and many of the crackles and artificial atmospherics that are heard probably have their origin in one of the tuning condensers. Crackles (or, in other words, bad connections) originating in a variable condenser are generally only noticeable when the dial is being turned, but this is not always the case. When a condenser is wrong, the fault can often be traced to a bad connection between the spindle of the moving vanes and corresponding terminal. If the contact is a frictional one, the rubbing surfaces may have become corroded by damp or by the gas given off from an accumulator, or the pressure between them might be insufficient. In the former case, the lower bush must be removed and the surfaces well cleaned with emery cloth, but in the latter it might be necessary to dismantle the condenser and increase the power of the pressure-spring by carefully bending it. Sometimes the crackling is due to the two sets of vanes touching at some point as the dial is rotated. This can often be detected by inspection, but, in case of doubt, a definite test can be applied by connecting the condenser in series with a grid-bias battery and loud-speaker. There should be no click in the speaker as the condenser dial is turned; a click would indicate a short-circuit.

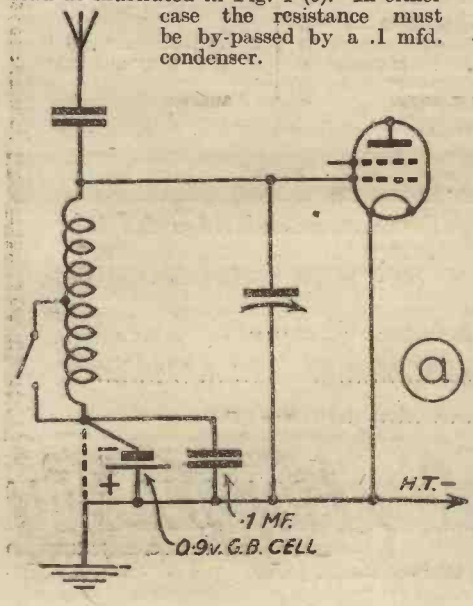
Radio Ramblings

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

Another Way of Improving Selectivity

WHEN using an S.G. valve of the usual type (that is, not a variable-mu), it is often possible to obtain increased selectivity by applying a small amount of negative grid bias. As most receivers have no provision for biasing the S.G. valve, slight alterations must be made. One simple method of applying the bias voltage is to break the connection between the aerial tuner and H.T. negative and to insert a 0.9 volt G.B. cell. To prevent instability due to the internal resistance of the cell, the latter should be by-passed by a .1 mfd. non-inductive condenser. A circuit diagram of the arrangement is given in Fig. 1 (*a*).

A different method is shown in Fig. 1 (*b*), where the bias voltage is applied direct to the grid through a 3-megohm grid-leak. To prevent the bias voltage from being short-circuited through the coil, a .0005 mfd. fixed condenser must be inserted between the "aerial" end of the coil and the grid of the valve. In this case it is not necessary to connect a by-pass condenser across the bias cell, because its resistance will have no ill effect. Of the two methods described, the former is generally to be preferred, since the latter has a tendency to cause a certain amount of "hiss." In either case the bias cell should be replaced every eight to ten months, because, if it should become completely exhausted, the valve would not be biased at all—not even by the small negative voltage developed across the filament which obtains with the normal circuit arrangement. When A.C. valves are employed, grid bias is almost invariably arranged for, but, if not, it is only necessary to insert a fixed resistance of some 300 ohms, or, better still, a semi-variable 500-ohm one, in the cathode lead as illustrated in Fig. 1 (*c*). In either case the resistance must be by-passed by a .1 mfd. condenser.



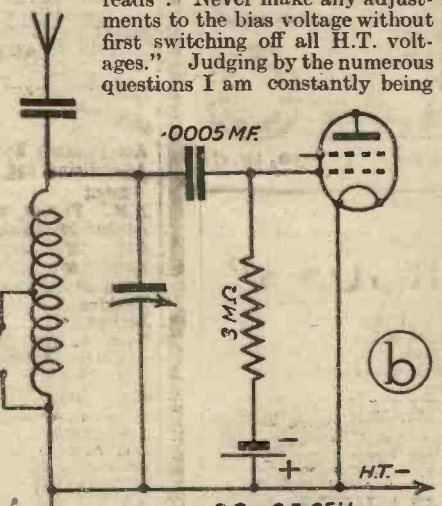


Fig. 1.—Three diagrams illustrating some methods of applying a small negative bias to an S.G. valve.

Resistance Calculations

YOU will be interested to hear of the new Watmel leaflet describing this firm's range of resistances. In addition to giving much useful data, the leaflet includes an excellent chart, which forms a "ready-reckoner" for all resistance calculations. By its aid you can find out in a few seconds the voltage drop, power absorbed, value of resistance required, etc. A copy of the leaflet can be obtained free by making application to the Watmel Wireless Co., Ltd., High Street, Edgware, Middlesex.

Grid-bias Voltage

A WARNING distinctly given on the makers' instruction sheet accompanying all power valves and pentodes reads: "Never make any adjustments to the bias voltage without first switching off all H.T. voltages." Judging by the numerous questions I am constantly being asked on this subject, it is evident that there are very many set users who do not understand the reason for the warning. Needless to say, it is not given unnecessarily, and should be taken in all seriousness. The anode current flowing across a valve is largely dependent upon the negative bias applied to the grid; to quote actual figures, the current taken by a typical power valve with 100 volts high tension and 6 volts grid bias is 9 milliamps, but by reducing the bias to 4½ volts the current immediately rises to 12 milliamps. Thus it can be seen that even a small reduction in bias voltage has a comparatively large effect on the anode current, and it is not difficult to imagine how high the current would rise during the few seconds that the wander plugs were removed from the G.B. battery, leaving the valve without any bias at all. The sudden increase in current would impose a great strain on the valve, and repetition of the process would certainly have an appreciable shortening effect on its useful life.

Incidentally, the strain would also be applied to the high-tension battery, which would suffer in consequence. The above explanation will also make it clear why it is always advisable (and economical) to employ the highest possible grid-bias voltage compatible with good loud-speaker "quality."

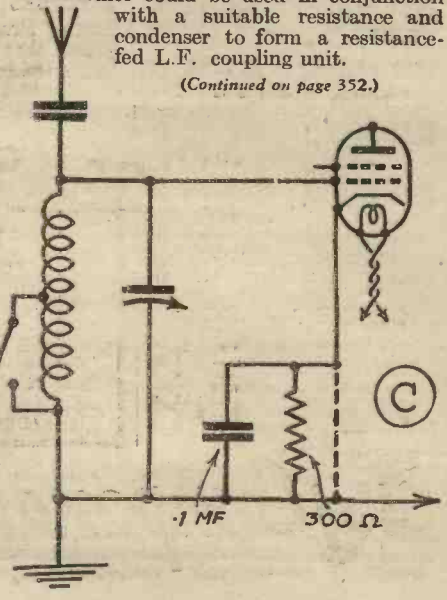
D.C. to A.C. Conversion

IF you live in one of the many districts where the D.C. mains supply is shortly to be replaced by A.C., you are probably wondering just what will happen to your D.C. eliminator or battery charger. Some authorities offer to change all D.C. apparatus for equivalent apparatus suitable for A.C. But this practice is not universal, so it is wise to tread warily. If you are in any doubt, write to the B.B.C., enclosing a stamped envelope, for their booklet, which gives all particulars regarding the legal position of both supply company and consumer. There is one thing that is certain: if your supply company has already advised you of a change, they are not obliged to take any responsibility for apparatus installed without their consent after such advice. Very often, however, the change-over is notified so long as three years before it actually takes place, and the company will then sanction the installation of new plant at its own responsibility. Be sure to get such sanction, though, before buying any new D.C. equipment.

Alternative Ratios from the Same Transformer

IT was shown in these "Ramblings" a few weeks ago how an ordinary L.F. transformer could be used in conjunction with a suitable resistance and condenser to form a resistance-fed L.F. coupling unit.

(*Continued on page 352.*)



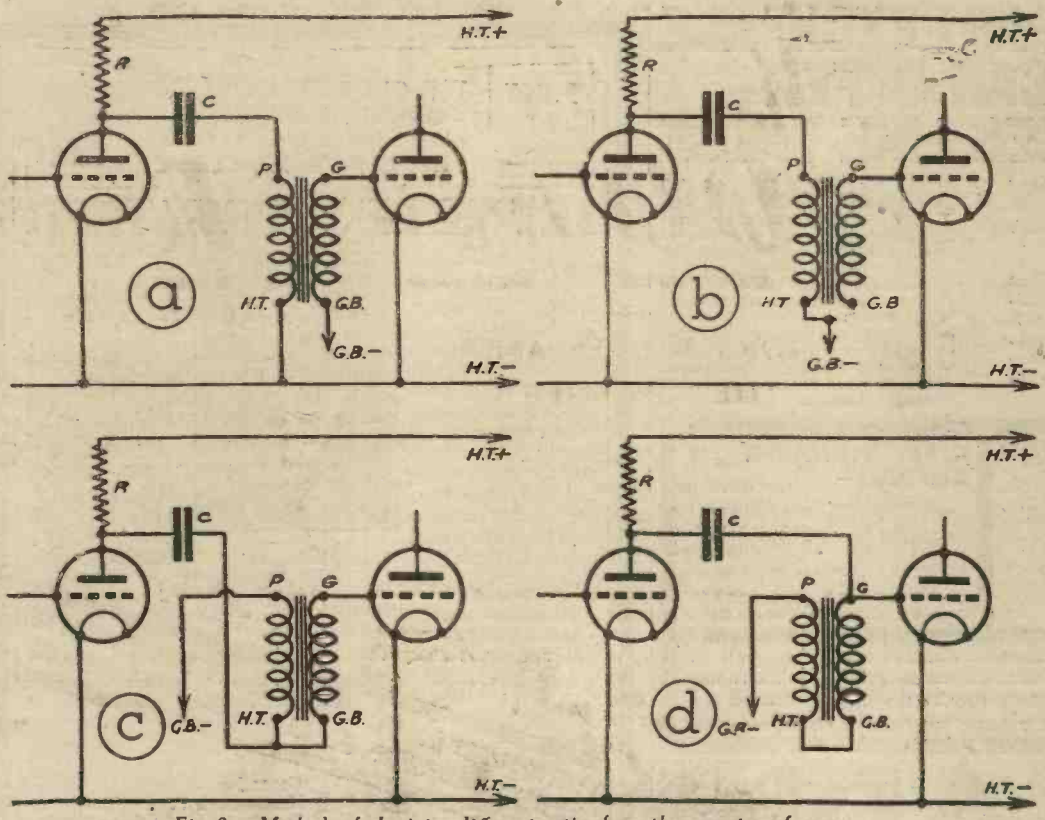


Fig. 2.—Methods of obtaining different ratios from the same transformer.

Radio Ramblings (*Continued from page 350.*)

Many readers have found this a good way of using efficiently their old transformers, which do not give very good quality in the ordinary way. The usual connections are those shown at (*a*) in Fig. 2, but the method shown at (*b*) gives the same effect. In both of these cases the step-up given by the transformer is the nominal value, being equivalent to the ratio between the numbers of turns on the primary and secondary windings. A higher step-up ratio is available, however, by connecting the transformer as shown at (*c*). This is known as auto-choke coupling, because the two windings are in series, so forming a tapped choke. By taking the plate lead to the series connection, however, the step-up ratio is proportional to the ratio between the number of turns on the primary and the *total number of turns on both windings.* Thus a transformer having a nominal ratio of 3 : 1 will give a step-up of 4 : 1, whilst a 5 : 1 transformer will give a step-up of 6 : 1. The method shown at (*c*) also uses the transformer as an auto-choke, but by connecting the plate lead to the "grid" end of the "choke" the ratio is only 1 : 1, whatever type of transformer is employed. This system can often be used effectively to improve the bass output, but much depends upon the transformer characteristics.

Stopping L.F. Feed-back

A CERTAIN amount of L.F. instability is frequently experienced in receivers having two transformer-coupled L.F. stages. The real cure is to re-design the set, adding plenty of decoupling, but there is sometimes an easier way out of the difficulty. This is to reverse the connections to the secondary terminals of the second transformer or to the primary of the first. The altered connections put the feed-back out of phase, and give a "negative reaction" effect. Another way of curing the same difficulty is to connect a .25-megohm resistance across the secondary terminals of the second transformer. The resistance reduces slightly the volume, but often gives a marked improvement in quality.

A Heterodyne "Stopper"

DUE to the crowding of the medium broadcast waveband, it is not infrequent to find two stations heterodyning each other. That is, although the programmes do not actually interfere one with the other, a constant high-pitched whistle is heard when listening to either station. As explained in these notes on a previous occasion, the heterodyne whistle can be removed by fitting some form of tone control to the set, but this is not always convenient.

Another, and simple, way is to fit a heterodyne "stopper" in the anode circuit of the detector valve. The stopper must consist of a circuit tuned to the frequency of the heterodyne whistle; it will then offer a high impedance to the heterodyne frequency, whilst offering no appreciable resistance to any others. A tuned stopper can easily be made from a high-frequency choke and two fixed condensers. These components are connected in the detector anode circuit as shown in Fig. 3, where it will be seen that the choke is additional to to the usual H.F. choke, marked H.F.C.1. The new choke (H.F.C.2) should be a high-impedance one of the type generally made for use with S.G. valves, whilst the most suitable capacity for the condensers will depend to some extent upon the actual choke employed. Usually, a capacity of .005 mfd. will be correct for both condensers, but it is as well to experiment with different valves. If too low a capacity is used, there will be a certain amount of high-note loss, whilst if the capacity is too high the stopper will not be effective.

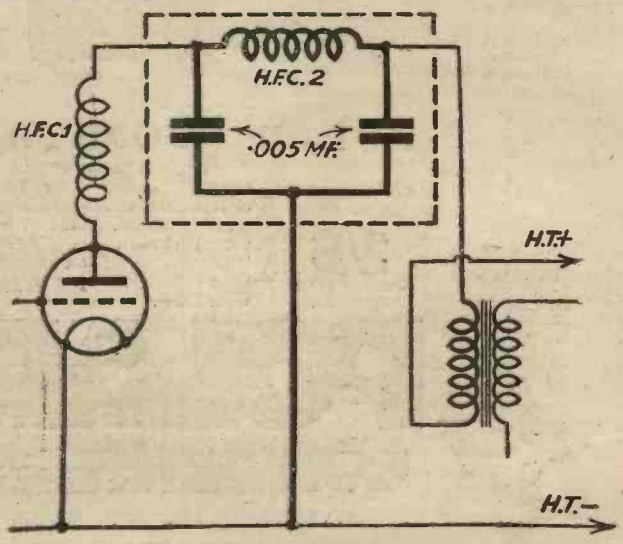
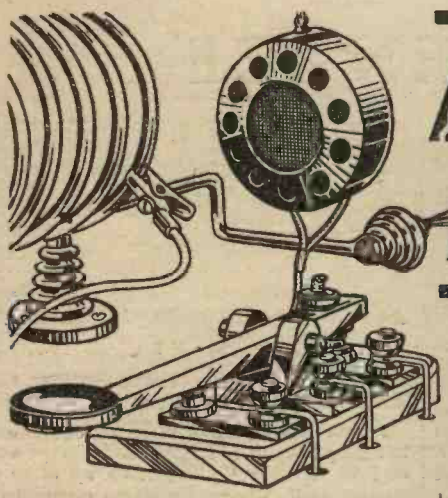


Fig. 3.—A heterodyne "stopper."

Station Position and Efficiency

WE have been informed that the B.B.C. is to build a new high-power transmitter a few miles out of Belfast, and that reminds me of the discussion that was carried on some four or five years ago as to the position of a station with regard to its efficiency. The discussion was started owing to the really excellent results obtained from the Bournemouth transmitter. I believe I am right in saying that this was situated some miles out of the town, and although its equipment was similar to that of the other B.B.C. stations then working, it was one of the star signals of the time. Listeners all over Europe got him nightly, and in this country the getting of Bournemouth was the basis on which all new sets were tested. This led to the view that the best reception was obtained when the transmitter was outside the town it was supposed to be serving, and I am inclined to think there was something in it. Careful tests have shown that better signals generally come from stations so situated, and I hope I am right when I say that the B.B.C. has not since put up a station in a town. I may be wrong, of course, but I cannot at the moment recall an instance, and I am sure that long-distance merchants are agreed that the farther away the local station is taken the better!



BELOW 100 METRES

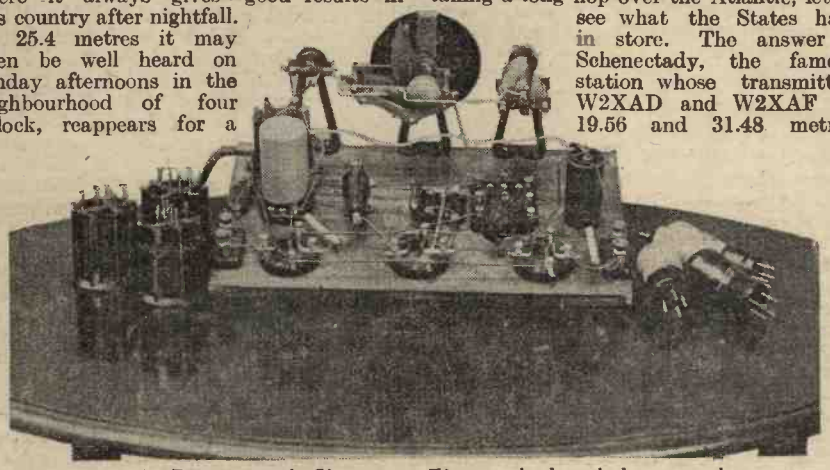
SHORT WAVES AND THE LISTENER

MODERN advance in the design of short-wave adaptors and all-wave receivers has brought the high frequencies from the experimenter's attic to the family fireside. The result is that many amateurs, and even many listeners pure and simple, who have previously confined their attentions to the two broadcast bands are now faced with an unexplored source of possible entertainment that appears on paper to offer immense possibilities and which in practice is often surprisingly unproductive.

If they are to justify the short waves in the eyes, or rather ears, of their families, it is not enough to have an efficient set and a certain skill in tuning. There is a third requirement, a knowledge of when to listen and where to listen. It is impossible to be dogmatic about the short waves, but there are certain stations that give good results throughout the British Isles all the year round, and once the newcomer becomes familiar with them he is on the way to finding a programme whenever he switches on, provided he times his demonstrations discreetly!

The European Star Turns

The star turns of the short waves are undoubtedly Zeesen on 31.38 metres and Rome on 25.4 metres. The former also uses a nineteen-metre wave in the afternoons and is sometimes well heard between 2 p.m. and 6 p.m., but it is in the evenings on 31 metres that it is at its best. On some nights it fades out soon after 10 p.m., but on other occasions it may continue at great volume until midnight or later. One must always be prepared for the times at which this station cannot be heard at all. There are sometimes long periods when it disappears from the dials altogether, but on the other hand there are also continuous patches of good reception. Rome is rather a problem. Its chief drawback is its habit of sometimes discarding its normal position in favour of its alternative wavelength of 80 metres, where it always gives good results in this country after nightfall. On 25.4 metres it may often be well heard on Sunday afternoons in the neighbourhood of four o'clock, reappears for a short time at 6 p.m., and then starts its full evening programme at 8 p.m. These last two times apply to week-days as well and Rome usually remains at loud-speaker strength until ten o'clock or later.



Rear view of the Experimenter's Short-wave Three, to be described in an early issue.

To conclude my list of reliable European short-wavers I would mention Madrid (30.8 metres) on Saturday evenings from 6 p.m. onwards, and Moscow. Moscow's wavelength is 50 metres and from nightfall until ten o'clock it is often the most powerful station on the short-wave dial. At 10 p.m. it is interesting to turn to it in order to hear the midnight chimes from the Kremlin which are broadcast nightly.

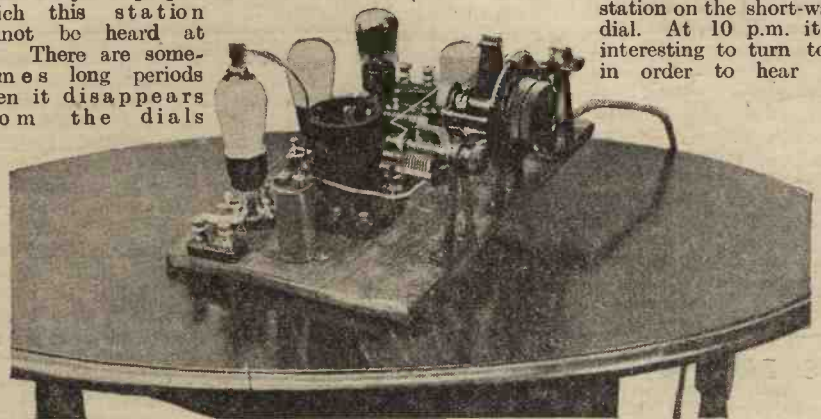
And now we will cross the Mediterranean to Africa, which is represented once a week, on Sundays, by Rabat. The morning programme on 23.28 metres is frequently well heard at midday, but for reliability it is eclipsed by the evening transmission on 32.26 metres from 7 p.m. till 9 p.m.

American Short-Wavers

However, it is safe to guess that the country uppermost in the minds of all new short-wave enthusiasts is America, and taking a long hop over the Atlantic, let us see what the States have in store. The answer is Schenectady, the famous station whose transmitters W2XAD and W2XAF on 19.56 and 31.48 metres, respectively, are the stand-bys of every long-distance listener. Both are liable to disappear entirely for nights, even weeks, on end, but when passing through a good period their programmes come over with the minimum of fading and distortion. W2XAD is good on week-days between 9 p.m. and 11 p.m., and on Sundays can be heard earlier in the evening. Generally speaking, the earlier you pick it up the better it will be, and occasionally it relays the American morning programmes and gives good signals over here at tea time.

W2XAF is a station for the small-hours enthusiast. Although it starts work at 11 p.m. it does not give of its best until 1 a.m. or 2 a.m., after which it continues strongly until closing down at 5 a.m. The listener who wants to hear America in the period between supper and bed-time has a choice of three stations. W2XAD I have mentioned already and to this should be added Pittsburgh W8XK on 25.27 metres and Bound Brook W3XAL on 49.18 metres. At least one of these should be available on most evenings during the winter.

All the stations I have mentioned should give loud-speaker signals on three-valve (detector and 2 L.F.) receivers when conditions are good, and at their best even a two-valve may put them on the speaker. The range of stations and countries obtainable with headphones is large.



Three-quarter front view of the experimenter's Short-wave Three, shortly to be described in these pages.

THE GANG MENACE

Not a Discussion of America's Social Problem, but a Talk About the Fallacies of Uni-control in Radio Receivers.

THE majority of commercial-built receivers to-day claim, as one of the principal selling points, the feature known as "one knob control." To achieve this you will find, if you look inside such a receiver, that what is known as a "gang condenser" assembly is utilised. This is, as probably the majority of our readers are aware, a piece of apparatus consisting of two or more variable condensers joined together, the fixed plates of each section being insulated, but the moving plates all being mounted on a common shaft. Each section of this condenser is used to tune a separate circuit, and it is obvious, even to the uninformed, that each section must be absolutely identical, or "matched" at every part of the tuning scale. To achieve this you will find the better makes of condenser are provided with a moving plate at the end of each section which is slotted in several places. When the condenser is completed at the works, it is matched up by bending the sections formed by the slots so that no matter where the moving plates are tuned to, each separate condenser has exactly the same capacity. If you examine a catalogue issued by the manufacturers of ganged condensers, you will find, if the article is a good one, that it is guaranteed to have a maximum error in matching the various sections which is not more than one per cent. So far so good. The tuning condensers in a receiver are employed, however, to tune an inductance or coil, and therefore, if each circuit is to be tuned to the same frequency with a multi-condenser, the coils will also have to be "matched," so that they also are identical with each other at every part of the condenser scale. Again, the catalogues will tell you that the inductances are matched to have an error not greater than one per cent. It would appear, therefore, that if we tune a set of these ganged coils with a set of ganged condensers, we will have achieved a great simplification in receiver design; in other words, only one knob will be necessary to tune two or more circuits, and we shall be able to construct a three or four valve set with only one tuning knob. As, however, with everything else in this world where we appear to get something for nothing, there is a snag.

Trimmers

The youngest wireless constructor knows that to make up a tuned circuit a coil has to be joined to a condenser, and to enable this to be done the coils and condensers are provided with terminals. Here is the first snag. *You must use wires to join the two components together.* Obviously, then, to preserve our matching, these wires must all be of the same length, and what is more important, must all be joined up in such a manner that no extra capacity is introduced in any one section. This means that one wire from one coil must not be allowed to run near to, and parallel with, a metal earthing screen, for instance. There are a dozen ways in which stray capacities may be introduced via the wiring. "Yes," the experienced amateur will reply, "that's quite right. But the condenser manufacturers have provided 'trimmers' in each section so that we can balance out these stray capacities." Well, that is quite true, but let us examine this "balancing out." We have seen that the condenser sections are matched by adjusting small sections of one plate on each condenser. Now in joining up the coils, we will assume that a very small extra capacity has been introduced into the circuit formed by a coil and the centre condenser of a gang of three. To correct this, the small trimmers on the other two condensers are adjusted to add a similar small capacity, and then everything should be all right. But is it?

Extreme Accuracy in Matching Necessary

Another point is that in the majority of these ganged tuning circuits, one of the coils has a reaction circuit coupled to it. In an ordinary one valve detector circuit, it is quite well known that you have to reduce the dial reading as reaction is increased. How then does this affect our matching? We have mentioned above that some manufacturers guarantee their condensers and coils to be accurate to within one per cent., and we will therefore see, before going any further, what this means. The broadcasting stations of Europe are subject to certain regulations laid down by a governing body having its headquarters in Berne. The most important duty of this body is that of settling the wavelength of each station, and this is done in such a way that no station may use a wavelength which is closer than 10 kc/s to any other station. (For the benefit of those who do not understand the kilocycle measurement, it should be explained that this is the frequency of the oscillations, as distinct from the distance separating the peaks of the oscillations, this latter being measured in metres.)

A wavelength of 200 metres is equivalent to a frequency of 1,500 kc/s, and one per cent of 1,500 is fifteen. Therefore, an error of one per cent. when adjusting a circuit to a frequency of 1,500 would mean that the circuit was tuned to either 1,515 or 1,485 kc/s. Imagine, now, a receiver having just two ganged circuits, and we wish to tune-in Jonköping (Sweden), which has a frequency of 1,490 kc/s. Kristinehamn transmits with a frequency of 1,480 kc/s, which is a difference of 10 kc/s, and therefore, if our circuits had an error of only one per cent, we should have one circuit tuned to one of these stations, whilst the remaining circuit was tuned to a frequency lower than the other. This is not an efficient state of affairs. Another point concerns what is known as "side-band" cutting, but there is no need to go into that now, as the above illustration should be sufficient to show the weakness of the ganged tuning circuits. It might be as well to mention here that the *best* gang condensers are guaranteed to have an error of only half per cent., and also that two well-known manufacturers have endeavoured to overcome the above objections by selling the tuning coils and condensers all mounted together on one base, the complete tuned circuits being adjusted in the works with oscillators so that they are certain to be accurate. They are, however, expensive. The moral of all this is—simplification, by the reduction of tuning controls, is quite possible, but a certain amount of efficiency is bound to be sacrificed, so where a specification gives ganged circuits, follow very faithfully the layout and wiring in order that the designer's experimental work may not be wasted by "upset" tuning.

Every Terminal Has Its Price

WHERE do your old components go to? Every enthusiastic constructor who is continually adapting and experimenting with his apparatus, has boxes full of components he cannot use just at the moment, and which he would be glad to exchange for something new and useful. Sometimes they can be sold to a friend or workmate, but the difficulty is to find a buyer at the right moment. Especially when you can't wait to build the new set or try out the new speaker!

The Coradio Part Exchange Service (Co-Radio, Ltd., of 78, Neal Street, W.C.) fills a long-felt want amongst home-constructors. They do not confine their operations only to sets, but take in part exchange for new goods every kind of wireless component—even valves and coils. They tell me that every terminal has its price! And a jolly generous price it seems to be. A look round their shop in Neal Street is certainly an eye-opener. Transformers, chokes, coils, condensers, speakers that have been taken in part exchange—everything that the heart of the fan could desire—all demonstrate the keenness of constructors to take advantage of this method. Components arrive by every post from all parts of the country. A set of super-het. coils that I would have sworn were new had come, I was told, from a lonely lighthouseman on the Mull of Kintyre, whose greatest consolation is his wireless set!

8 PAGE PHOTOGRAVURE SUPPLEMENT NEXT WEEK!

Use of Glass for Radio

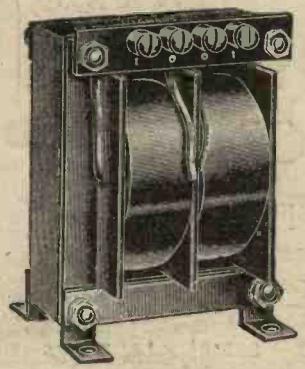
A NEW glass has been under test this week, and the results are promising. The glass is known as Armourplate glass, and in manufacture is subjected to a special toughening process. It stands impact better, and glass objects can be made much thinner for the same uses without fear of undue breakages. It cannot, however, be drilled, and when it does break it breaks up into myriads of small pieces which have no sharp edges. The pieces, in fact, can be handled freely without fear of cuts. I have often wondered why glass has not been exploited more in our wireless sets. It is an excellent insulator, and excepting for the glass bulbs of valves it is little used. There is no gainsaying that glass has an exceptionally handsome appearance, and it can nowadays be moulded to practically any form.

CHATS ON COMPONENTS

IGRANIC TRANSFORMER

WE have received two or three new lines from the Igranic Electric Co., which are quite interesting. The T.24.B transformer is a very neat L.F. coupler made in two ratios: 3 : 1 and 5 : 1. The primary inductance is very high, resulting in good amplification of the lower musical frequencies, and the component can be thoroughly recommended for general use. The price, in either ratio, is 5s. 6d.

The Binocular H.F. Choke, costing 3s. 9d., is also a very efficient component, having an inductance of 158 millihenries, and a D.C. resistance of 830 ohms. There is a complete absence of peak effects over the entire wave range of 150 to 2,500 metres



The Igranic C.H.2 choke showing the four terminals for series parallel connection.

For smoothing purposes, the C.H.2 Choke will be found a very good component. This is of the "constant inductance" type and has the winding arranged in two sections. It is, therefore, possible to arrange the coils in series or parallel according to your particular requirements. With the coils in series the inductance is 40 henries up to the maximum of 40 m.a., and the D.C. resistance is 600 ohms. When the coils are connected in parallel, the inductance is 10 henries up to 80 m.a, and the resistance is then 150 ohms. This choke sells at 9s. 6d.

KEYSTONE COMPONENTS

AMONGST the Keystone components recently submitted for test were a 4-pin plug, and two solid dielectric condensers. The 4-pin plug is a very neat component just over an inch in diameter, neatly finished in mottled brown bakelite. The four pins are arranged in the conventional valve-holder pattern, so that a valve-holder may be used to receive this plug. The uses of such a component are obvious, and the two shillings which this article costs will be well spent.

The variable condensers are made from stout bakelite, and are shaped like a keystone, with the vanes and dielectric arranged between the two plates. Owing to the smallness of this component, the whole assembly is extremely rigid, and at the same time light in weight. A pig-tail connection is provided for the moving plates, and a standard one-hole fixing attachment is fitted for mounting purposes.

MULTITONE TRANSFORMER

THIS special Tone-Control Transformer and Potentiometer (reported upon in our issue dated Oct. 8th) may be used to great advantage between the pick-up and set with any type of pick-up, no matter how high its impedance.

It enables the user, as he turns the knob:

(*a*) To compensate for the deficiency of bass reproduction usual in records and common in most kinds of apparatus. This is achieved by a positive increase of bass response;

(*b*) To control the predominance of bass or treble to suit the record, the room, or the apparatus;

(*c*) To correct booming tendencies in the apparatus or speaker, by emphasizing the treble;

(*d*) To get bass in the reproduction of records made before the days of electrical recording, and give them some of the realism of modern records.

For those who want the highest pitch of perfection, it is recommended that a Multitone Transformer with tone-control be used in the intervalve position, and one without tone-control across the pick-up or vice versa.

McDANIEL MAINS UNITS

WE have received for test a mains transformer manufactured by Messrs. G. C. McDaniel and Co., of 154, Hainault Road, Romford. This particular unit has a primary tapped at 10-volt intervals, suitable for mains voltages from 200 to 250 volts. The secondary is rated at 210 volts, 200 m.a. for a voltage doubler circuit, and two additional windings are provided at 4 volts 4 amps. and 4 volts 1 amp. The primary is screened. This unit is a massive affair, 6½ins. over-all in height, with a core nearly 1½ins. thick. The windings are wound on side by side, and the terminals are fitted to a bakelite horizontal panel on the top of the transformer. The complete unit is finished in a pleasing shade of brown. On test the ratings were found to be very exact, and on full load very little heat was generated. The component can, therefore, be thoroughly recommended for the home-constructor, who will not find the cost, which for this particular model is 24s., at all excessive.

NASH CHARGERS

A VERY extensive range of chargers is announced by Nash Products, Ltd., of Birmingham. Rectification is carried out by Westinghouse Metal Rectifiers, and a full twelve months' guarantee is given with each charger. Amongst the different types may be mentioned the "Senior" (illustrated on this page), rated at 10 volts 3 amps. (£3 15s. 0d.); "Double Senior Two-H.T.," giving H.T.200 volts at 125 m.a.-variable, and L.T. 15-17 volts at 3 amps., variable. This model costs £10.

The "Senior" Nash charger.

STOP-WATCH

THE keen experimenter can often find a use for a good stop-watch in the course of his wireless tests, etc. Messrs. A. Arnold and Co., of 122, St. John St., Clerkenwell Road, E.C.1, have sent us a very interesting wrist-watch having a centre-seconds hand with side lever action. This is graduated in ⅕th seconds, and is guaranteed for three years. The watch is made in the modern square shape, and with strap and unbreakable glass, costs 15s. To remind one that a special item is about to be broadcast, the alarm watch will be found invaluable. This is on the lines of an ordinary pocket watch, with the case acting as a bell. The alarm can be set to any time and gives quite a good warning, even when in the pocket. This model is guaranteed for three years, and costs 25s.

SERADEX RESISTORS

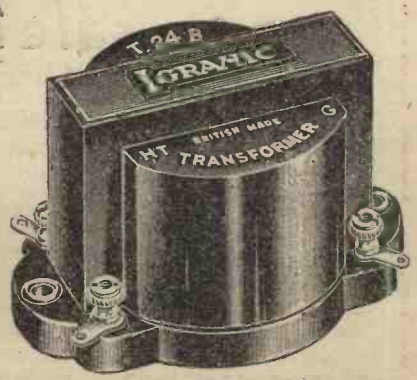
WE have received some very interesting components from Trevor Pepper of Birmingham, amongst which must be mentioned the anode feed resistances. These are made in two types, one, of the moulded variety, about 1½ins. long, with wire ends. This appears to be constructed of a graphite-bakelite combination, and the wire is looped and embedded a good quarter of an inch in the ends, so making a thoroughly sound joint. There is no possibility of the wire ends pulling out, and therefore from the mechanical point of view this is a thoroughly reliable article. Electrically, the features are just as sound, the rating being very accurate, and with a rating of 1½ watts, no heating was apparent at this figure.

The other type of resistance is wound with resistance wire on a glass tube. Wire ends for connection are provided, and this type of resistance is rated at 1½ watts. Both these resistances can be thoroughly recommended, and at the prices—8d. for the moulded, and from 9d. for the glass type—these are items which we can thoroughly recommend.

The Seradex Filter condenser is also a first-class component, finished in aluminium, and bearing a label with all working data, and—a very important point in our opinion—the date. This is a very valuable detail for the purchaser, as it enables him to have an identification for various test purposes if he desires. The condenser is guaranteed for twelve months. The rating was very accurate, test and working voltages are given, and hooked soldering lugs are fitted for connections.

UNIVOLT UNIT

READERS who are building a radio-gram often wish to convert an ordinary acoustic model into an electric model, and there are several ways of carrying out this conversion. One of the simplest is to fit a Univolt, which is a combined motor and turntable finished in bakelite, and only a few inches in thickness. It may, therefore, be simply screwed to the upper surface of the motorboard, completing the conversion in an instant. Two types of Univolt are made, the Standard and the Junior. The Standard consists of the motor, turntable, pick-up on weight-adjusted arm, volume control, automatic start and stop, switch and flex. This is made for A.C. mains, and costs 5½ gns., 15s. extra being charged for a Universal model for A.C. or D.C. The Junior unit contains only the motor, turntable, switch, flex and speed-control—no pick-up equipment being included. This model costs only 3½ gns. The motors are beautifully silent and uniform in running, and the patented governor enables a steady speed, at any revolutions from 70 to 90 per minute to be obtained. The design is such that there is no interference on the radio side, and very cheap running is obtained, namely, over 60 hours for one unit.



The new Igranic T.24.B low frequency transformer.

NEXT WEEK!

Special 8-page Photogravure Supplement of the Argus Three!

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REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

The coupon on page 359 must be attached to every query.

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SONOTONE MODIFICATIONS

"I am anxious to make up the Sonotone Four, recently described in your journal, but am anxious to save expense. I have two home-made coils which appear identical to those shown in the circuit. Can I use these? I also should like to use an R.C.C. stage instead of the Transfeeda. I should be glad if you could show me how to modify the circuit."—(F. J. H., Balham.)

We do not recommend any alteration to the circuits published in PRACTICAL WIRELESS. These circuits are the result of experiment and research, and the final result is embodied in the circuit as published. Any deviation, therefore, will affect the results, and, for that reason, we advise you to adhere rigidly to the published details.

H.F. INSTABILITY

"I have built a mains set, using commercial coils, mains valves, etc. The mains unit is admirably suited for the set, and although each stage is decoupled, I get too much reaction. The coils are supposed to have a .0005 reaction condenser, and although I have tried a .0001 condenser I still get too much reaction. I want to know how to cut out this excess of reaction all round my dial."—(P. F. R., Streatham.)

We feel that the cause of your trouble is due to instability in the H.F. stage. Make sure that your screening is adequate and every point is efficiently earthed. Also see that you have earthed the correct pin of your metallised valve, and also confirm that you are applying the correct voltage to the screen and anode of this valve.

OVERLOADING, AND CHOKE OUTPUT

(1) "I have a four-valve set, and overloading is occurring. I must run the set off batteries, and the volume control on the set—an acrial series condenser affects the quality. What do you suggest?

(2) "I have fitted this set with a choke output. If I purchase a P.M. moving-coil speaker will it be necessary to disconnect the choke and condenser and use the transformer provided with the loud-speaker?"—(G. W. V., Edinburgh.)

We suggest that you fit a slightly larger power valve than you already have, and when purchasing new H.T. batteries buy a larger capacity type, otherwise we are afraid you will always suffer from overloading at a certain volume. Your choke output will help considerably when a moving-coil speaker is used with the transformer, as if you choke-feed the transformer you will prevent the D.C. component from entering the primary, thus avoiding the risk of saturation. The connections to the transformer will take the place of the speaker connections at present used, *i.e.*, one side of primary to the Mansbridge condenser and the other to earth.

INSUFFICIENT REACTION

"I can only get reaction over a small portion of the dial on long waves. I am using an old dual range coil. This coil has already been satisfactory with transformer coupling (Det. 2 L.F.), but I have just rewired my set, with resistance coupling in the first stage. The coupling being 100,000 ohms, .01 condenser, 1 meg. grid leak (the condenser is mica), with new valve. I hope I have given you sufficient information for you to assist me."—(S. J., Harrogate.)

Your trouble is due to the insertion of the 100,000 ohms resistance in the anode circuit of the detector valve. Owing to the voltage drop your valve is not acting so efficiently as when transformer-coupled. We would therefore advise you to reduce this resistance as much as possible, and also at the same time increase the high-tension voltage. We would suggest that you try a slightly higher value differential condenser, say, .00015 or .0002 mfd.

NEW M.-C. SPEAKER

"I wish to purchase a new moving-coil loud-speaker, and am at a loss to know whether to get a P.M. or a mains energized type. Is the latter more sensitive than the former? If you recommend the mains type, can I run it without purchasing a special exciting unit?"—(C. T., Manchester.)

A mains energized moving-coil speaker is definitely more sensitive and, therefore, efficient than a permanent magnet moving-coil speaker of the same price. This is due principally to the great strength of an electro-magnet. The best place to insert the speaker windings to provide "free" current is to substitute this for one of the smoothing chokes in your H.T. unit. Make sure, however, that your H.T. supply is sufficient for this winding to dissipate not less than the 4 watts, as below this wattage the speaker will not be so efficient as one of the permanent magnet type.

NOT TRIMMED

"A few weeks ago I re-designed my set from a 3-valve to 4-valve, consisting of S.G., det., R.C. and transformer. I find I am unable to get any stations on the long waves, and only about ten stations on medium waves, yet the local station (about two miles away) comes in at tremendous power. I should be greatly obliged if you could give me some ideas of what may be wrong with the set."—(F. A. G., Ulster.)

We feel that your trouble is due to your tuning systems not being accurately matched. If ganged condensers are used, it is especially necessary to see that all trimming has been done accurately, as otherwise both tuning systems will not be in resonance and the full efficiency of the receiver is not gained. Also, make sure that your screen-grid valve is perfectly stable.

HETERODYNE INTERFERENCE

"Would you kindly advise me on this subject. I have a 2-valve set, and when I switch on to the London Regional Station, a foreign station interferes which I cannot pick up clearly, but it oscillates very much. I know it is not from anybody's set, as that is the only station I get it from."—(W. H. G., Paddington.)

There is a certain amount of trouble experienced, due to a very powerful German station operating on a wavelength very close to the London Regional. This station causes, at times, a very bad heterodyne, and, unfortunately, this cannot be cured from the receiver end.

INTERMITTENT SIGNALS

"I shall be greatly indebted to you in the following problem, arising out of my set. The set itself is engineer-built 3-valve all-mains. The fault I am going to mention may develop at once, or may not develop for some hours. What happens is this—quite suddenly the reproduction ceases or becomes very faint even with the volume control full on, and may continue like this for some time, until suddenly music or speech comes bursting through as if it had been stored up. The set may then become normal, or continue to stammer away. I shall feel deeply indebted to you for assistance."—(F. H., B.Sc., Chelmsford.)

We would advise you to see to the following points. Make sure that your volume control is in good condition as the winding on this may have become worn at the contact point, or may have an intermittent break; also see that all your valves are making good contact in their sockets. It would be as well to open the pins a bit with the blade of a penknife, and this should be carried out with great care; another reason for your trouble may be a faulty grid leak, and we advise you to change those in your receiver for new ones.

D.C. TO A.C.

"I have just moved from a D.C. to an A.C. district, thus making my eliminator useless. Is it possible to put a rectification unit to the eliminator, or must I buy a complete A.C. eliminator. If it is possible to use the old unit, will you please give me the necessary instructions."—(T. W. S., Paddington.)

It is possible to utilise your D.C. unit when working off A.C. mains. A mains transformer and rectifier, either valve or metal giving an output of the same voltage as your D.C., must be obtained. You will then be able to build a complete A.C. rectifying unit, using your D.C. eliminator as the smoothing section. The method of connecting will be to take the H.T. positive and H.T. negative leads from the rectifying unit to the mains lead of the D.C. eliminator. If when first connecting the smoothing does not seem adequate, reverse these connections.

FADING TROUBLE

"Could you please tell me any way in which I can prevent foreign stations fading? I have a home-made 3-valve set employing standard parts and circuit."—(G. F., Gilwern, Nr. Abergavenny.)

Unfortunately there is not a method of stopping the fading which occurs on quite a number of Continental transmissions. This is in no way due to the receiving apparatus, but to the atmospheric conditions which adversely affect radio transmissions.

POOR SELECTIVITY

"My outstanding difficulty at present, which, owing to the increased number and power of stations on the medium wave-band is likely to be intensified as winter sets in, is that fairly general one of selectivity. My present set is a commercial 3-valve all-mains. My bag of stations heard at L.S. strength is very satisfactory as regards number, but I can definitely state that fully 80 per cent. are of no use. I have had at one time as many as five stations at once. Can you suggest a remedy for me?"—(L. H., Leeds.)

We suggest that you insert a .0002 or even a .0001 condenser in series with your earth lead. This will improve selectivity, but there will be a drop in volume. However, if 80 per cent of your stations are now useless owing to the interference we feel sure that by losing one or two of these you will find a large percentage of stations to which it will be worth while listening.

TWO LOUD-SPEAKERS

"I have two loud-speakers, one having a much higher impedance than the other. As I wish to use one in one room, and the other in another room, can you suggest some way of connecting up so that I get equal volume from both."—(R. M., Birmingham.)

It is not an easy matter to work two speakers of widely different impedance from the same output. When placed in parallel, the lower impedance speaker will take all the volume, and when in series, the higher

DATA SHEET No. 7

IMPEDANCE MATCHING CHART

Giving the ratio of step-down transformer required for low-resistance loud-speakers.

Cut this out each week and paste it in a notebook.

A.C. resistance of valve.	Impedance of speaker in ohms.	Ratio of transformer required.
1500	10	18—1
	20	12—1
	30	10—1
	40	9—1
	50	7—1
2000	10	20—1
	20	15—1
	30	11—1
	40	10—1
	50	9—1
2500	10	22—1
	20	16—1
	30	13—1
	40	11—1
	50	10—1
3000	10	25—1
	20	18—1
	30	14—1
	40	12—1
	50	11—1

Where it is not possible to obtain a transformer of the exact ratio shown, the nearest value should be chosen.

impedance speaker will take the volume. The only method we can suggest is to place the two in series and connect across the terminals of the high impedance-speaker a variable resistance of about 10,000 ohms. This resistance could be varied until both speakers are giving about the same volume.

UNMATCHED OUTPUT

"I am up against a rather peculiar difficulty. I have two loud-speakers, both of which I have sent to the makers, and am assured are O.K. One works well, but the other is unsatisfactory. How can you account for this fact?"—(W. V., Sidcup.)

As one of your speakers works well, and the other one is unsatisfactory, and yet you can prove that both speakers are actually in good order, it would appear that one of the speakers is not matched to your output valve.

We therefore advise you to read our article entitled "Do you Understand your Loud-speaker," which was published in PRACTICAL WIRELESS, No. 1.

ORDINARY VALVES ON A.C.

"I am considering the purchase of an A.C. Filament Transformer as per the enclosed ad. This method does not seem to be very widely adopted, makers seem rather to favour the trickle-charging system in their H.T. mains units. Is there anything detrimental in this "direct from the mains" system. Will you kindly advise as to any difficulties that might arise. I propose to still use batteries for the H.T. supply for the time being."—(S. A., Roehampton.)

Unless you are prepared to use indirectly heated valves in your receiver you cannot supply the filament current from this L.T. transformer without a little alteration to the receiver, and we are afraid that H.T. from batteries would be rather an expensive method of supplying plate current to indirectly heated valves.

FREE ADVICE BUREAU
COUPON

This coupon is available until Nov. 12th, 1932, and must be attached to all letters containing queries.
PRACTICAL WIRELESS, 5/11/32.

The Loud-speaker and the Output Stage

(Continued from page 334)

If maximum efficiency and quality of reproduction are aimed at, it certainly is. This can easily be verified by connecting the speaker through a different number of transformer ratios in turn and comparing results. It will at once be apparent that at one ratio the volume is noticeably greater and tone appreciably better. With three-electrode valves the exact ratio is not quite so critical as with pentodes, but it is, nevertheless, sufficiently so to justify careful attention and consideration.

Fortunately most transformers and chokes are supplied with two or three tappings so that different ratios are readily available, but the ratios are always, of necessity, fairly "close." For instance, one well-known firm of transformer manufacturers supplies one transformer having ratios of 1 : 1, 1.6 : 1 and 2 : 1, and another having ratios of 15 : 1, 22.5 : 1 and 33 : 1; it would obviously be useless to buy a transformer of the latter type when a ratio in the region of, say, 2 : 1 were required.

THE ARITHMETIC OF—

How to Calculate the Value of the Various Components Used in a Wireless Set.

IF a spaghetti resistance, a condenser, a transformer, or a choke, or almost any radio component is examined, it will be found that certain numbers are printed or stamped on it. Moreover, the specification of every receiver or circuit contains precise instructions as to the value of each component used in the layout. These facts immediately suggest that there is some connection between the numbers stamped on the radio parts and their suitability for any particular purpose. The suggestion is perfectly correct, and it is the object of this short series of articles to explain the importance of quantitative design, and to show why certain proportionalities must be observed, and why components of certain values must be selected for use in radio receivers. Radio is really an exact science, dealing with minute amounts of power and with circuits balanced to a nicety. Arithmetic is the science of figures, and can help us to understand much that would otherwise seem quite meaningless. In treating this subject, no mathematical calculations will be given, and no advanced knowledge of mathematics is required of the reader, neither will he be troubled with abstruse technical formulæ.

A Question of Numbers

There are very many ways in which numbers may be related to each other. For example, a number may be the sum of two or more other numbers ; or the difference between two numbers ; or the product of two numbers, that is to say the result of multiplying them together ; or the result of dividing one number by another. Again, two sets of numbers may be such that one number in one set always bears a constant ratio to the corresponding number in the other set. It will appear, later, that examples of all these relationships, and many more, are to be found in radio design.

Beginning with simple addition, it should be noted that the voltage of two batteries connected in series is equal to the voltage obtained by adding the voltage of one battery to the voltage of the other. Thus, two 60-volt batteries connected in series will give a total pressure of 120 volts. Resistances connected in series are also additive. If, therefore, you want a resistance of, say, 4,000 ohms, and have not a unit of this value handy, you can substitute a 3,000-ohm and a 1,000-ohm resistance connected in series, or two resistances each of 2,000 ohms connected in the same way. It is also important to note that when a circuit divides into two or more branches, the values of the currents in all the branches total up to the current in the main circuit. For example, if your low-tension accumulator supplies current to three valves taking .2, .1 and .3 ampere respectively, the total low tension drain is obtained by adding these three figures together, *i.e.*, .6 ampere in all. Similarly the total output of a high-tension power unit is equal to the sum of the anode currents of each of the valves in the set plus, of course, the screen current of any screened grid valves, and the auxiliary grid current of the pentode if one is employed.

Inductance and Capacity

A familiar example of the way in which one radio quantity depends upon the product of two quantities, is the question of tuning. The wavelength to which a circuit is tuned depends upon the product of the inductance and capacity of the circuit. Actually, it is equal to the number 1884 multiplied by the square root of the product of the inductance and the capacity, the former being expressed in microhenries, and the latter in microfarads. Why is it, then, that a tuning condenser of .0005 microfarads is invariably specified for a broadcast receiver ? The answer is that considerations of size and overall efficiency more or less settle beforehand the inductance of tuning coils, values of approximately 200 microhenries for the medium waves, and about 2,000 microhenries for the long-wave band, having become standard. In conjunction with an aerial possessing average capacity to earth, a variable condenser of .0005 mfd. will comfortably tune either coil over the normal range of wavelengths. If a condenser of, say, .0003 mfd. were substituted, the receiver could not be tuned to the higher wavelengths in each band. On the other hand, a larger capacity of tuning condenser would not decrease the wave range of the set—would, in fact, increase it beyond the useful range, and the actual broadcast band would be crowded into a small section of the dial, making accurate tuning difficult, and giving a spurious "sharpness" to the tuning.

Voltage Drop and Resistance

A further useful example of the value of one quantity depending upon the product of two others is the voltage drop in a resistance, which is equal to the current in amperes, multiplied by the resistance in ohms. To take a concrete case, a resistance of 4 ohms in a circuit carrying 2 amperes will cause a drop of 8 volts. The practical use of this relation can be seen when it is desired to break down the voltage of a high-tension power unit in order to apply a voltage less than the maximum to one valve, say the detector. In order to do this, the formula must be turned round a bit, and restated to the effect that the resistance required for a given voltage drop is equal to the required voltage drop divided by the current in amperes.

If the current is expressed in milliamperes, the answer must be multiplied by 1,000, because a milliampere is one-thousandth part of an ampere. For instance, suppose your high tension unit gives 250 volts, and you want to apply only 100 volts to your detector, which takes an anode current of 2 milliamperes, the value of the dropping resistance should be 150 volts, multiplied by 1,000 and divided by 2 milliamperes, or 75,000 ohms. Grid bias resistances are calculated in exactly the same way, the required bias voltage

WIRELESS-1

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

being divided by the anode current of the valve, and multiplied by 1,000.

The relationships dealt with so far are all quite simple, and result from easily understood electrical laws. There are hosts of others, however, which are not so obvious, and which cannot be explained quantitatively without going too deeply into technicalities. In most cases, however, it is possible to give a reasonable explanation which will, at any rate, show that there is nothing in the nature of a "hit and miss" in the design of an efficient radio receiver.

Grid Leak and Condenser Values

Let us take first the values of condenser and grid leak employed in a leaky grid or power grid detector circuit, or in a resistance capacity coupled amplifying stage. For the average leaky grid detector a condenser of .0003 mfd. capacity and a grid leak of about 2 megohms resistance usually are recommended, while for the low frequency R.C. stage the condenser may be as great as .05 mfd. or even more and the grid leak of the order of 250,000 ohms. What are the rules governing the choice of these values, and to what extent, if any, can the recommended values be departed from? Without going too deeply into theory, it can be stated that the function of the coupling condenser is principally to convey the alternating signal to the grid of the valve, while the grid leak acts as a discharge resistance. Now the reactance, or opposition offered by a condenser to the passage of an alternating current is high at low frequencies and lower at high frequencies. At the enormous frequencies used for broadcasting, which are of the order of a million cycles per second, a small condenser, of about .0003 mfd. is quite satisfactory over the whole radio frequency range. But in a low frequency amplifier the ratio between the lowest frequency it is required to pass (perhaps 12 cycles) and the highest (say 12,000 cycles), is in the neighbourhood of 1,000 to 1. If, therefore, the coupling condenser is very small, its reactance at the lower audio frequencies will be so high that the lower notes will be weakened or "attenuated" and serious amplitude distortion will occur.

The grid leak is called upon, in a detector circuit, to discharge the electrons accumulated on the grid during alternate half cycles, while in the resistance capacity coupled stage it has to complete the grid circuit of the valve and discharge it continuously and rapidly so that the voltage at the grid at any instant accurately follows the signal voltage fluctuations. Its value, therefore, must be such that the "time constant" of the grid circuit is small compared with the frequency of the incoming signals, so that at all times the grid is "cleared" ready for the next signal wave. The value of the grid leak in conjunction with other constants of the circuit, plays an important part in the time factor, and although the value is not very critical it should be understood that too high a value will result in a "choking" of the grid, causing serious distortion, while too low a value will result in a loss of signal strength and distortion in addition.

Coupling Condenser Values

A 50 per cent. or even a 100 per cent. departure from the recommended value of grid leak will not usually make any *serious* difference in performance, but greater differences should not be risked. In the case of a detector valve, the value depends to some extent upon the constants of the valve and upon operating conditions. In a power grid detector, for example, where the coupling condenser usually is smaller than the conventional .0003 mfd., say .0001 mfd. and the valve is operated at a high anode voltage and current, a much smaller grid leak, generally of the order of quarter megohm, is necessary. We will revert to the question of grid leak values in R.C. coupled stages in the next article, as this is also bound up with the value of the anode resistance. A fairly wide range of choice is usually given for the value of the coupling condenser in low frequency resistance capacity coupled amplifiers. A capacity value between .005 mfd. and .05 mfd. will be perfectly satisfactory, but the actual choice depends very much upon the band of frequencies it is desired to pass. If the set builder wishes for full round tone with plenty of bass, then the value of .05 mfd. or even greater should be chosen, while a lower value, by cutting off some of the bass response, will give a higher pitched and perhaps more brilliant tone.

(To be continued next week.—Ed.)

Practical Letters FROM OUR READERS

All letters intended for publication must bear the name and address of the sender, not necessarily for publication.

The Editor does not necessarily agree with opinions expressed by his Correspondents

Articles in Order of Merit

SIR,—Just a line to say how pleased I am with the great new paper PRACTICAL WIRELESS. I think it is the goods. As soon as I saw in *Hobbies* that you were publishing a new wireless paper I went straight out and ordered a copy weekly from my newsagent. I think it is written in a concise and interesting manner, and I was very much surprised that you managed to produce such a big paper, seeing that it is only the first issue. I have read it through and through, and the following are a few of the articles which interest me most. I have placed them in the order in which I like them.

1. Radio Wrinkles.
2. Replies to Queries and Enquiries.
3. The Why and the Wherefore.
4. A Chat about the Latest Components.
5. Round the World of Wireless.
6. Radio Fads and Fallacies.
7. Is Your Set Off Colour ?
8. Do You Understand Your Loud-speaker ?
9. Radio Ramblings.
10. How to Place Your Components.

Will you be including a few articles on Television ? What about having a special Christmas Number of PRACTICAL WIRELESS ?—NORMAN CLARK (Whitley Bay).

Cure for Broken Hearts

SIR,—We thank you for the Weekly Wireless Magic, as we call it. We must say you have responded to a broken-hearted cry of "Who will issue a real practical paper on wireless problems ?" We may say you have done, and, what's more, have done it well. PRACTICAL WIRELESS beats all comers. We are delighted with your great paper.—JOSEPH H. BARTON and ISAAC AITKEN (Maryport).

Difficulty in Obtaining Components

SIR,—It repeatedly occurs that certain specified components are required for a particular circuit. In spite of the fact that these makes of components have been advertised for a considerable time before the publication of the circuit, they are not obtainable when required. This seems to me a very bad state of affairs, for the manufacturer loses business, as the prospective purchaser, being eager to proceed with the circuit, is tempted by his dealer (who states that he cannot get delivery of the specified parts) to accept an alternative make, which often spoils the whole effect. Is it that the manufacturers at this stage cannot reasonably estimate the demand, or that they await the extent of the demand before commencing manufacture ?

Your views on this unsatisfactory state of affairs will, I am sure, be appreciated by the large number of home constructors who welcome PRACTICAL WIRELESS.—F. RIVETT (Lewisham).

A Hint About Binding Volumes

SIR,—Congratulations on your new paper PRACTICAL WIRELESS. I think it beats all others.

May I suggest that, if possible, all advertisement pages back each other, then they can be torn out when each volume is complete, leaving reading matter ready for binding.

I am sure there are many readers who will have their books bound in volumes, and it would be much better without the advertisement pages.—REGULAR READER (Cambridge).

An Earth-connection Hint

SIR,—When reading your articles on Radio Wrinkles, I saw one on a simple earth. I should like to point out that this is a very good way, only in the case of a novice he is apt to screw the bolt or screw too much to tighten the wire, with serious results to the lead pipe. A safer plan is to place a piece of metal on the pipe first so that the end of the bolt presses against this, and not against the lead pipe.—F. SMITH (Bootle).

A Beginner's View

SIR,—I would like to write to congratulate you on your journal, which is very helpful, and, in my view, the contents are put in such a way that even a beginner should understand it. I think your article "Radio Wrinkles" a good idea, as it not only allows a reader to air his views on radio defects but also gives other readers ideas which perhaps would not otherwise be published.—J. W. Y. MUMMERY (Ashford).

Some Suggestions

SIR,—I should like to express the favourable impression that "No. 1" has made on me, and trust—seeing that I have given a permanent order for its delivery—that it will continue to do so, and possibly become still better.

I am a "practical wireless" fan—have been so from the earliest days of broadcasting, when the reception of Writtle was thought magical—if not devilish ! And ever since have preferred to *construct*, not assemble. No doubt there are thousands more the same, and we would rather make our own special coils, for instance, than buy patent arrangements ; not because we, in many cases, begrudge the outlay, but for the added interest the work provides.

Invariably when a new circuit is published it is necessary—when it is desired to keep to specifications—to purchase more or less expensive components, which, after all, are only simple arrangements neatly enclosed. And when a "better" design follows in a few weeks a different article has to be purchased, instead of making use of the old one. It is quite possible, for example, in the case of a certain tuner, that values have to be exactly calculated for perfect results, so that a home-worker would have difficulty in making one so efficient. But, on the other hand, is not such exactness unnecessary—may not defects in other parts of the set neutralize it ? Of course, if the original circuit is followed absolutely, results should be as claimed. But do not most "practical wirelessers" use the nearest similar component they may have on hand ? I should think very few who make a habit of reconstruction buy a fresh kit each time. So that I hope you will see your way to giving us circuits that *can* be home-made sometimes, or at least publish the necessary data to wind, for example, a band-pass arrangement.—A. S. (Woking).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—That band-pass coupling condensers and resistances must be "non-inductive" to preserve the band-pass characteristics.

—That if a single coil of the "canned" variety is used, the can must not be removed, or the tuning range of the coil will be altered.

—That a mains set operated from D.C. mains should have a switch in *both* mains leads.

—That it is possible to insert a biasing resistance in an indirectly heated valve cathode so that a simple switch for the pick-up will enable the valve to act as Grid Detector or L.F. amplifier.

—That a screen-grid valve makes a very sensitive detector valve.

—That a temporary small-value fixed condenser may be simply constructed by twisting two lengths of flex together.

—That with some types of valve an "anti-microphonic" valve-holder will aggravate microphonic troubles.

—That a choke in each lead of an eliminator often increases hum, due to induction effects between the two coils.

"Radio Fads and Fallacies"

SIR,—If you are unable to find room to publish the following, perhaps you will kindly pass this letter on to the individual concerned.

Your contributor, W. B. C. Richardson, in his article "Radio Fads and Fallacies," states that both designers and constructors are not consistent. It would appear from Mr. Richardson's remarks, however, that it is he who is not consistent. He states : "We are told that since H.F. currents travel only on the surface of the wire, we should have multiple strand aerial wire and thick connecting wire." This in itself is fallacious. There is no point in using stranded aerial wire *unless each strand is insulated from its fellows.* If the strands are not insulated the wire acts as a single conductor. Admitted the surface area is larger in 7/22 wire than in, say, single 22 wire. But here again he is wrong, since for a given frequency the H.F. resistance of a conductor increases as the diameter increases. Your contributor leads your readers to believe that the thicker the wire the less the H.F. resistance. He is only right in so far as D.C. resistance is concerned.

He goes on to say that the aerial, earth, and aerial coil should all be of the same gauge wire. Obviously this is hardly practic-

able. The tensile strength of 30 S.W.G. wire is not sufficient to enable 30 or 40ft. of it to be used as an aerial—at least not permanently. Conversely, it is hardly possible to construct a coil wound with 7/22 aerial wire, unless a special room is set aside for the tuning coils! Theoretically your contributor is doubtless correct, but he misleads your non-technical readers. In the first sentence of his second paragraph he is certainly not correct theoretically.

In conclusion I would state that no wireless amateur worthy of the name throws old or "obsolete" apparatus away. It usually comes in useful at some time or other, and is certainly not a sign of "meanness."—MAXWELL G. SMITH (Thornton Heath).

[*In my opening sentence of paragraph two I merely state what the text-books tell us—namely, the well-known fact that owing to the uneven distribution of H.F. currents in a conductor, stranded aerial wire is more efficient than single wire of the same cross section. This is not my own personal opinion, it is general knowledge. It is also well known that in practice it does not matter greatly whether the strands are insulated from one another or not, since the oxide which quickly forms on the wire is practically an insulator. However, I cannot find that I stated anywhere that the strands should* not *be insulated. My point was that, in view of the fact that emphasis is generally laid on the necessity for a low-resistance aerial and earth system, then low-resistance coils should also be used in order to take full advantage of it. I do not suggest that a practical system would consist of aerial and coil both composed of 7/22 S.W.G., or indeed that they should both consist of 30 gauge wire, but there are many values between these two extremes. Regarding the coil itself, if this is wound with the usual cylindrical wire, there is, of course, an optimum point above which it is useless to increase its diameter, since losses occur due to eddy currents in the wire itself. This diameter is dependent on the frequency, but is nevertheless considerably greater than that used in many canned coils.*

Your remark that "for a given frequency the H.F. resistance of a conductor increases as the diameter increases," I find particularly interesting, especially in view of the fact this is the converse of accepted theory. Perhaps, however, you have discovered some new principle. Naturally, since you say the H.F. resistance increases as the diameter increases, it must follow that it decreases as the wire gets thinner, until it, no doubt, reaches its minimum value when there is no wire at all! Just a strip of hot air!—W. B. RICHARDSON.]

Stronger Building!

SIR,—It gives me much pleasure to endorse the praise accorded to your Journal, by its readers, on the correspondence page of No. 4, and trust you will be able to maintain the same high standard of excellence in future issues, when I am sure the paper will achieve the popularity and success it honestly merits in these first copies.

May I say in passing that after reading the suggestions, your remarks at the head of the page meet with my profound approval in regard to most of them, though I should like to lend my support to A. Benham (weekly index), A. T. Pym (Exchange and Mart) and F. S. Coley (Foreign Programmes). A condensed Home and Foreign programme feature would, I am sure, make the paper all that could be desired.

And now for my complaints; in the first place, I value my copies of "P.W." very much, and suggest that you provide us with some kind of strong case to put them in, so that we may continually use them without their becoming damaged. Then finally you have so intrigued us with the glowing description of the Encyclopædia, that I believe many of us are counting the Wednesdays till we have qualified.—JOHN K. ELVIN (Skipton).

The Right Note!

SIR,—Having now read No. 4 of your new publication, I take this opportunity of wishing your venture every success for the future. As one who has lived through the various phases of radio from the early days I feel I am in a position to criticise, or otherwise, a publication on radio. Personally I think you have "struck the right note." Continue with your articles, which are to my mind a little more complete than elsewhere.

Personally I find pleasure in reading an article on an elementary subject; if well written it generally gives food for thought.

I handed No. 2 on to a non-technical friend of mine. I asked what he thought of same. These were his remarks: "I have read heaps of wireless books, but this is the first time I have found an explanation in a simple form of the various condensers." Now for a suggestion.

I would like to see you include a weekly article, Television Topics. This would complete your PRACTICAL WIRELESS. Readers would be agreeable to help you with this; possibly Mr. Barton Chapple might find time to foster the idea to your satisfaction. He would supply the copy. If you consider this suggestion let us know. I enclose a card of a recent effort of mine in connection with Television, being one of the very early workers in this country.—R. W. CORKLING (Wembley).

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.

IGRANIC PRODUCTS

A FULL range of components is listed in an attractive booklet we have just received from Igranic Electric Co., Ltd. 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 should make a point of obtaining a copy of this booklet. The address is 149, Queen Victoria Street, London, E.C.

PILOT AUTHOR KITS

HOME constructors will find in the latest list issued by Peto-Scott Co., Ltd., 77, City Road, London, E.C.1, a useful guide to the trend of modern receiver design. A fine range of manufacturers' kits, including three, four and five-valve receivers and all-mains sets are listed, together with several makes of moving-coil speakers, and eliminators. Particulars are also given of various radio envelopes containing full size blue prints and simple instructions for making different types of receivers. This firm, which has been established since 1919, specialises in radio service in all its branches, and expert opinion and advice are always at the disposal of prospective customers as well as those who regularly purchase their radio requirements from the firm. As will be seen in this firm's announcement on page 317, Messrs. Peto-Scott are able to supply complete kits of the receivers described in these pages, and quite a lot of trouble is therefore saved for the Home Constructor who can obtain all the necessary components at one time.

Broadcast Query Corner

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

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

1. Write *legibly*, in ink. Give your full name and address.

2. State type of receiver used, and whether transmission was heard on headphones or on loud-speaker.

3. State approximate wavelength or frequency to which receiver was tuned, or, alternatively, state *between* which two stations (of which you have the condenser readings) the transmission was picked up.

4. Give date and time when broadcast was heard. Do not forget to add whether *a.m.* or *p.m.*

5. Give details of programme received, and, if you can, some indication regarding the language, if heard.

6. State whether and what call was given and/or kind of interval signal (metronome, musical box, bells, etc.) between items.

7. To facilitate publication of replies, append a *nom-de-plume* to your inquiry.

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

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

Replies to Broadcast Queries

J. L. S. DUNDEE (Dundee): Kharkov, U.S.S.R., on 368.1 m.; early morning physical exercises. GRID BIAS (Thornton Heath): (1) LSY, Buenos Aires (Argentine Republic) on 14.47 m. (20,730 kc/s.); Interval Signal, three notes (oscillating valves); (2) Possibly W9XAA on 49.34 m., relaying WCFL, Chicago, U.S.A.; (3) If call letters, W3AHR are correct, Amateur experimental transmitter at Philadelphia (Pa.) U.S.A. RADMORE (Woodlands): On the date on which you heard these stations, we were still on British Summer Time, namely one hour *in advance* of G.M.T. to which Spain works. The broadcasts picked up were from the Seville, Madrid, and Barcelona studios; on about 335 m., you will have heard LR2 Radio Prieto, Buenos Aires (330 m.); LR3 Radio Nacional and LR4 Radio Splendid in the same city respectively operate on 316 and 303 m. There is no reason for which you should not hear Croydon Airport on 900 m.

ADVERTISEMENT INDEX

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A FEW ITEMS IN EARLY ISSUES

PART 1.
Servicing EKCO Receivers.
Screen-Grid Pentode Two.
Double Cone Portable.
Mains Transformer.

PART 2.
Servicing EKCO Receivers.
Pedestal Receiver.
Set Construction.
Methods of Volume Control.

PART 3.
Pre-Tuned Three.
Servicing PYE Receiver.
Safety Regulations for Mains Sets.

PART 4.
Servicing PYE Radiograms.
Six Designs for Radio Cabinets.
Short-Wave Broadcasting.

PART 5.
Servicing H.M.V.
The 7-Metre Three.
Fault Tracing Chart.
Making a Wave Meter.

PART 6.
Servicing H.M.V. Valve and Set Tester.
Ganged-Coil Circuits.

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Faults in Home Constructed Sets.

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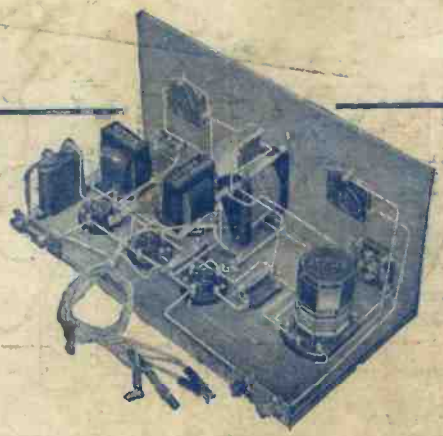

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Practical Wireless

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Published by
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Vol. 1— —No. 8
NOVEMBER 12th, 1932
Registered at the G.P.O. as a Newspaper

BUILDING THE ARGUS THREE

by H.J. BARTON-CHAPPLE WH.SCH., B.Sc.(HONS.), D.I.C., A.M.I.E.E.

INSIDE

how to bring in more stations

fit COSSOR S.G. VALVES

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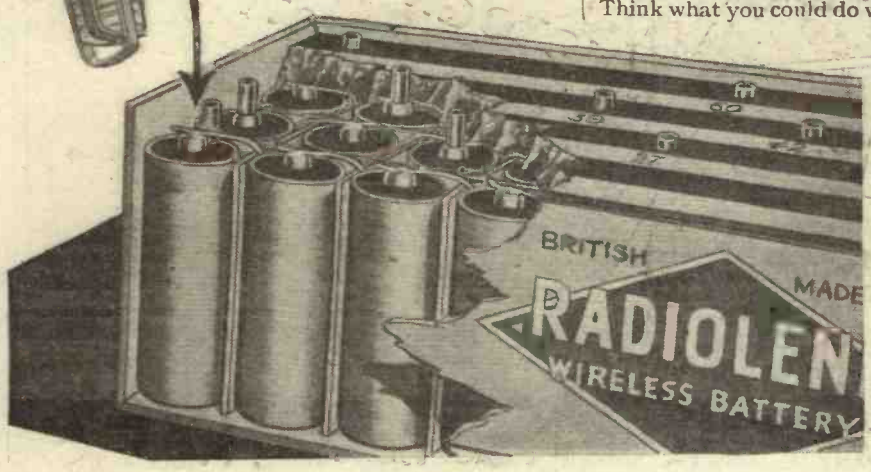

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ARGUS 3

As described in this week's issue

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		£	s.	d.
1	Red Triangle panel, 14in. x 7in. Ready Drilled		3	6
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1	J.B. Type No. 2069 2-gang .0005mfd. variable condenser with dial		18	6
1	Lissen Hypernik 4-1 L.F. Transformer with Lissen tone compensator	1	2	6
1	Ready Radio S.G. Choke		5	6
1	Bulgin Midget Screened Choke. H.F.8		2	0
1	Polar .0005mfd. Compax Condenser		2	9
1	Polar 0003mfd. Compax Condenser		2	6
1	Lewcos 50,000 ohms potentiometer		4	0
1	T.C.C. .0003mfd Condenser. Type "S"		1	3
2	T.C.C. .0001mfd Condenser. Type "S"		2	6
2	T.C.C. 1mfd Condenser. Type No. 50		5	8
1	T.C.C. 2mfd Condenser. Type No. 50		3	10
1	T.C.C. .1mfd Condenser. Type No. 50		1	10
1	Graham Farish 1 meg. Ohmite		1	6
1	Bulgin Spaghetti Resistance 5,000 ohms		1	0
1	Bulgin Spaghetti Resistance 20,000		1	3
2	Bulgin Spaghetti Resistances 100,000		5	0
1	Ready Radio 3-point switch		1	6
2	Clix 4-pin Chassis mounting valve-holders (with terminals)		1	4
1	Clix 5-pin Valveholders, chassis mounting, with terminals			9
6	marked terminals		1	9
4	Marked wander plugs			6
	Screws, Flex, Connecting Wire, etc.		1	6

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Constructed in Walnut with inlaid Walnut Veneers.

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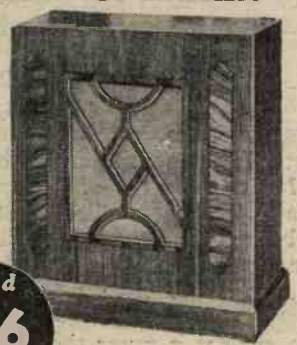

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ROUND THE WORLD OF WIRELESS

French Tax on Receivers

NOTWITHSTANDING violent opposition, it would appear that the next French Budget will include the long-threatened tax on wireless receivers. So far as can be ascertained an annual charge of fifteen French francs (roughly 3s. 4d.) will be levied on crystal sets and fifty francs (about 11s.) on valve receivers. The new broadcasting Bill destined to regularise all transmissions of radio entertainments in France has again been shelved for an indefinite period.

Wavelength for Budapest Transmitter

ALTHOUGH no authority has yet been obtained from Geneva, Hungary has decided to adopt a wavelength of 840 metres for the Budapest (2) transmitter and the Magyarovar 1 kilowatt relay station will take over the 210-metre channel.

Number of European Stations

IN 1926 the number of European transmitters was 123; by the end of 1931 254 stations had been brought into operation. Since that date a further twelve high-power transmitters have been added to the list, and before the end of the year another four are expected to take the air. These figures do not take into account the new stations which France, Russia, Hungary, Norway and Sweden propose to erect during 1933–34.

Relays from Berlin Short-wave Station

THE Berlin ultra-short-wave station, which has been devoting its activities to television on 7 metres, now relays excerpts from the Witzleben entertainment programmes. In future, relays of these broadcasts will be made every Wednesday and Saturday between 7.0 and 9.0 p.m. G.M.T., and on Mondays and Thursdays from 10.0 to 11.0 p.m.

Armistice Day Transmissions

ARMISTICE DAY (November 11) is commemorated in Europe by Great Britain, France, Belgium and Italy. On that date listeners to the French transmitters may hear an interesting ceremony relayed by Radio Strasbourg from the Douaumont (Verdun) War Memorial, followed by a special broadcast from the Cathedral of St. Guillaume at Strasbourg. This will be taken by all French PTT transmitters.

New Radio Toulouse Transmitter

ALTHOUGH the 60-kilowatt transmitter built to the order of Radio Toulouse was ready to work several months ago, official permission to use it has not yet been granted by the French authorities. In view of a possible reorganisation of the broadcasting system it has been suggested that the new station be taken over and run by the Ministry of Posts and Telegraphs in connection with its provincial transmitters.

Palermo's Wavelength

DURING the past two months Palermo (Italy) has carried out several alterations in wavelength, and has broadcast on various channels between 525 and 545 metres, thus causing interference with its neighbours. Pending the advent of the new Munich super-power transmitter Palermo has adopted temporarily 538.6 metres (556.9 kilocycles).

THE "ARGUS" THREE

By

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

See the Special 8-page Photogravure Supplement in the centre of this week's issue

Russia's 500 kW. Station

MOSCOW-NOGHINSK, Russia's 500 kilowatter, will shortly take over the wavelength hitherto used by Moscow-Komintern—namely, 1,481 metres. In the meantime, with a view to experimental broadcasts, the Komintern station is working on 1,000 metres, and Leningrad, thus displaced, has lowered its wavelength to 848.7 metres. These alterations, however, are of a provisional nature, and other channels may be adopted at a later date.

Operatic Broadcasts by NBC of America

NEGOTIATIONS have been satisfactorily concluded between the National Broadcasting Company of America and the Metropolitan Opera House (New York) in regard to regular relays by the former of performances from that well-known theatre. The NBC proposes to transmit these broadcasts through a number of short-wave stations for the benefit of European listeners. As the special matinées given every Saturday will also be the subject of these relays, the five hours' difference between Eastern Standard and Greenwich Mean Time will permit reception on this side of the Atlantic at a convenient period of the evening.

Czech Authorities and Local Interference

IN view of the number of complaints received from listeners in respect of interference caused by local wireless oscillators, the Czech authorities have threatened to cut off the electric light supply to the house of any person who may be convicted of spoiling, in this manner, the reception of the broadcast programmes.

Belgian Radio Pirates

IN Belgium, where a listening tax is now strictly enforced, the police are taking drastic steps for the discovery and punishment of radio pirates. It is estimated that in Brussels alone some 8,000 persons possess radio sets without official permits. A house to house search was recently carried out in the Liége district with the result that a large number of receivers were confiscated by the police and dealers in Belgium are anxious to know the way in which the authorities will dispose of the big stock acquired.

Rehearsal Transmissions from Radio Paris

LISTENERS to the Radio Paris transmissions are sometimes puzzled by broadcasts heard on Saturdays at 9.0 a.m., as no details of these concerts are published in the weekly programmes. They are, as a matter of fact, merely general rehearsals of future performances to be relayed from the Paris Conservatoire. It will be noticed that on these occasions the broadcast is frequently interrupted by the musical director, and various passages of the work under study are repeated.

New Spanish Broadcasting Bill

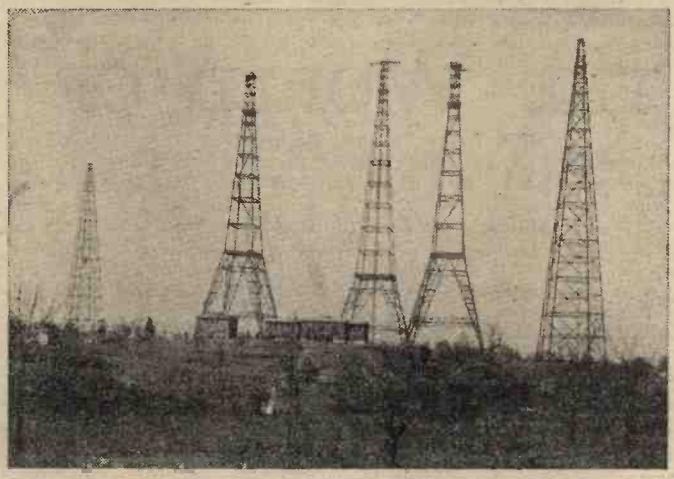
FOR the fifth time in less than two years the Spanish Government will endeavour to pass a new broadcasting Bill through the Cortes. The present scheme

Round the World of Wireless (continued)

includes provision for a tax on all radio components, the payment of which is to be effected by affixing postage stamps when a sale is made by dealers to their customers. In addition, the authorities intend to introduce a listening licence, on a sliding scale, the cost of which will vary according to the class of radio receiver registered. If the Bill is adopted the State will erect one high-power station in the neighbourhood of Madrid and six smaller relays in provincial cities.

Post Office Tests on Ultra-Short-Waves

IT is a strange coincidence that the scene of some of the earliest of Marconi's activities is again figuring in radio tests. I refer to the headland known as Lavernock in the Bristol Channel on the Welsh side, from whence Marconi sent out some of his first messages across the expanse of water into which runs the River Severn. Here the technical research department of the Post Office are carrying out experiments on ultra-short-waves in an endeavour to ascertain if radio links can be inserted in telephone circuits to give more direct connection between places which now can only be reached by circuitous telephone routes. The circuit has been set up to transmit signals between Lavernock and Hutton, Somerset, and the success of the trials leads to the hope that the radio link will be used in other estuaries with which the coast of Britain abounds. The radio link has been incorporated in a circuit between places as far apart as 300 miles in this country, and the saving in telephone wires and the elimination of line troubles in difficult places will be considerable by its use.



The antenna system and operating station of the naval radio station N.A.A. at Arlington, Virginia, U.S.A. The transmitters are operated by remote control from the navy building in Washington. It was from this station that the first Trans-Atlantic radio 'phone conversion was sent out. The towers are 300 to 600 feet in height.

Licence Figures

AS I pen these notes the five-millionth receiving licence might be issued. In his opening speech at the Manchester Radio Exhibition, Mr. J. H. Whitley expressed the hope that the 5,000,000 mark would be reached before the close of the Exhibition, but whether or not that has actually happened I cannot yet say. I did hear it rumoured that it was the intention of the B.B.C. to persuade the five-millionth licencee to give a five-minute broadcast talk—perhaps on the "Compleat Art of Pirate-ing?"

The World Radio Conference

ACCORDING to figures issued at the recent Madrid Radio Conference, there are now 140,000,000 receivers in use in this little world of ours. Apart from this tit-bit, there seems to be very little news available regarding the progress and conclusions of this World Radio Conference. We can only hope that "no news is good news."

S.-W. Aeroplane Transmissions

SHORT-WAVE experimenters will be interested in the proposed non-stop monoplane flight from Cranwell to Cape Town via Tunis, Duala, Boma, St. Paul de Loanda and Walfish Bay. The flight, which is being organised by the Air Ministry, is to commence between November 9th and 15th, or December 9th and 15th, depending upon weather conditions, and the aeroplane will carry a transmitter using the call sign GEZAA. Transmissions will take place every two hours commencing at 6 a.m. on a wavelength of 33.71 metres. Transmissions will be in morse, and the Air Ministry ask any amateur picking up the signals to forward them to the Head of Signals, Air Ministry, Kingsway, W.C.2. In case of a distress call, the Air Ministry should be notified at once by telephone or by the quickest available method.

INTERESTING & TOPICAL PARAGRAPHS

Screened Chokes

HIGH-FREQUENCY choking coils can now be obtained with a screen. Plain chokes may cause a good deal of trouble, and in sets where the parts are fairly close together some sort of shielding is desirable. A metal cover must not be too close a fit. As with coils, the effectiveness of the choke may be spoiled if the metal shield is too close to the windings.

Catching "Pirates" Again.

I SUPPOSE you know that the Post Office Engineers are "on tour" with their notorious detector vans again. And you have probably read in the daily papers of the magic devices the vans contain for tracing pirates. A writer in one daily even went so far as to say that the "secret devices" employed by the engineers were so sensitive as to detect the presence of a portable set which was not even in use. I should think the "secret devices" would receive something of a shock if they were put into action anywhere near a factory where hundreds of sets are being turned out every day.

German Broadcasts to Assist Unemployed

IN conjunction with the Koenigsberg Labour Exchange, the Heilsberg transmitter broadcasts twice weekly, at the end of the news bulletin, details regarding vacant situations, with a view of assisting their unemployed listeners to find work. The feature is being introduced in other German cities, as the number of unemployed persons in that country is assuming proportions which cause anxiety to the authorities.

Street Noises in Paris—and a Sequel

FOLLOWING complaints received from its readers in respect to the use of loud-speakers in public thoroughfares, a French newspaper took a census of the various street noises heard in Paris over a period of twenty-four hours. The relative percentages were estimated as follows: Traffic noises, 45 per cent.; *radio and gramophones*, 5 per cent.; machinery, 10 per cent.; starting up of motor-cars, 10 per cent.; whistles, sirens, bells, gongs, etc., 5 per cent.; dogs, cats, children's voices, and street cries, 2 per cent.; aeroplanes, rain, hail, etc., 3 per cent.; *female conversations*, 20 per cent. In consequence many subscriptions held by women readers of the paper were immediately cancelled by telephone!

B.B.C. Continuous Broadcasts

FROM December 16th, when the present term of school broadcasts comes to an end, the B.B.C. will carry out from most transmitters continuous broadcasts from noon until midnight. The new arrangements will not affect Sunday programmes, but during the week there will be no transmissions from any station between 11.0 a.m. and noon, as this daily period is used by the engineers for the resting and maintenance of the plant. No details have yet been received regarding the Christmas broadcasting arrangements, but no doubt these will follow on the lines of previous transmissions, and will be aptly seasonable.—JACE.

SOLVE THIS!

Problem No. 8

Jones constructed a Band-Pass Tuner. The coils were accurately made up, and the inductance value of each coil was matched correctly. The coils were fitted to a Mains set, and a .04 condenser and 1,000, Spaghetti resistance were used as couplings. Matched tuning, however, did not hold over the entire scale. What was the cause?

Three books will be awarded for the first three correct solutions opened. Mark envelopes Problem No. 8, and send to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd. 8-11, Southampton Street, Strand, London, W.C.2, to reach us not later than November 14th.

SOLUTION TO PROBLEM No. 7

The reaction coil was wound in the wrong direction.

The following readers received books in connection with Problem No. 6.

J. R. Wilson, 23, Salters Road, Gosforth, Newcastle 3; F. Cutler, 52, Marshall Road, Langley, Nr. Birmingham; L. R. Harper, 33, Newark Crescent, Park Royal, N.W.10.

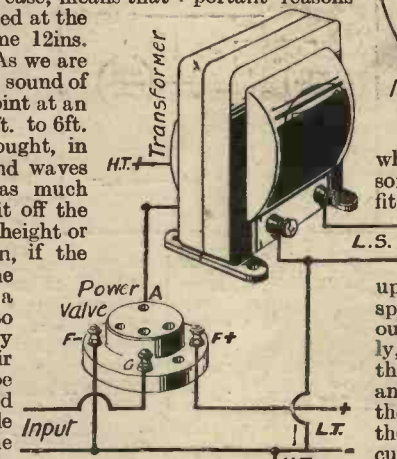
USING THE LOUD-SPEAKER

Some Hints on Arranging the Loud-speaker and Connecting it to the Receiver.

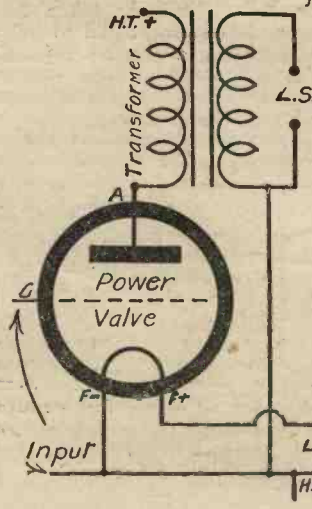
By G. E. TWINING

THERE are a number of points relating to loud-speakers which are well worth remembering. It must be understood that when a set is switched on, the music or speech which we hear is conveyed to us in the form of sound waves or vibrations of the air. These vibrations are set in motion by the cone of the speaker. It must stand to reason, then, that the position of the speaker in a room in relation to curtains, furniture, etc., is very important.

The self-contained set of to-day has a great deal in its favour from the point of view of neatness; but it often tends to sacrifice quality of tone. The set will undoubtedly have to be placed near a window to facilitate the fitting of short aerial and earth leads. This means that it will be practically impossible to move the speaker about the room to find the best position for it. Another point about the modern self-contained pedestal set is that the position of the tuning control, and possibly of a gramophone turntable, having to be placed at a convenient height to enable them to be operated with ease, means that the speaker has to be placed at the bottom of the cabinet some 12ins. or 18ins. from the floor. As we are accustomed to hearing the sound of the human voice from a point at an average height of from 5ft. to 6ft. above the ground, we ought, in order to receive the sound waves from the speaker with as much realism as possible—raise it off the floor to a corresponding height or even higher. Then, again, if the speaker is very low and the cabinet is standing on a thick pile carpet close to heavy curtains, as very often is the case, the air vibrations are bound to be damped considerably, and alter the tone of the whole reproduction, hence, the reason why some people still advocate having the speaker as a separate unit away from the set, for it is then possible to find by experiment the best position in the room. A corner can often be utilized to advantage owing to the deflection caused by the diverging walls and frequently more pleasing results are obtained when the speaker is placed fairly high, as there is a certain amount of sound reflection from the ceiling. It can easily be arranged to operate two speakers from the set and fit a switch to change over from the built-in speaker to one placed elsewhere in the room, or, alternatively, have them operating together, for the trend now in design is to have one speaker accentuating the notes in the higher register and the other the bass, working together and so producing a much better overall tone. Without a doubt, there is more realism in reproduced music coming from more than one point, apart from the improved range of the reproduction.



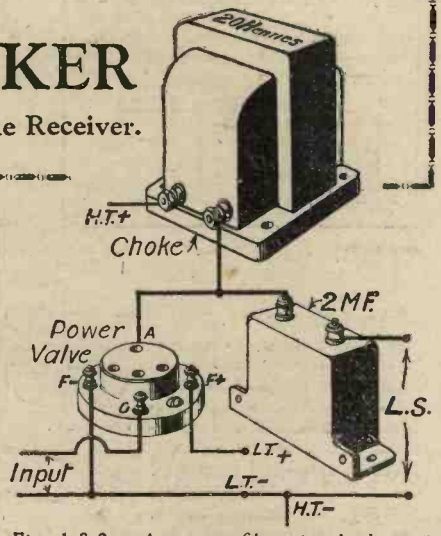
Figs. 3 & 4.—The output transformer in pictorial and theoretical form.

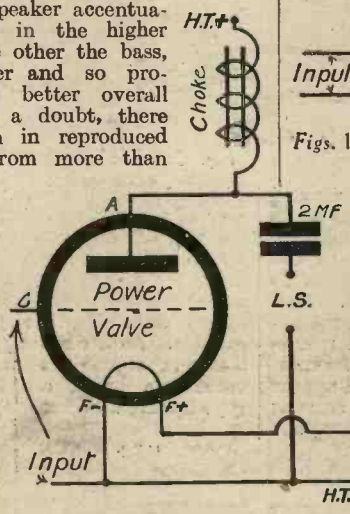


Fitting an Output Filter

The two important reasons why an output filter of some kind should be fitted to a set are, firstly, that the filter, if properly arranged, will tend to match up the impedance of the speaker with that of the output valve, and, secondly, that the filter isolates the speaker from the anode current flowing in the power valve. Only the low frequency signal currents pass through the loud-speaker, and this is a very important point in a mains set. It not only eliminates all chances of shock if the L.S. terminals are accidentally touched, but also saves the magnet windings of the speaker unit from possible breakdown and demagnetization. In some instances it will also greatly help in decreasing hum.

There are two types of output filters which may be adopted: one, the output choke; and, two, the transformer. Dealing first with the output choke unit; this is illustrated in Figs. 1 and 2, the first being a diagrammatic plan and the second a pictorial representation of the components. This is a straightforward method, and has the advantage of low cost, for neither an output choke, nor a fixed condenser, are very expensive. The choke should have an inductance of 20 henries and the condenser should be of 2 microfarads capacity. The big advantage of this scheme is that when long extension leads are used it is only necessary to run one wire from the





Figs. 1 & 2.—An output filter circuit shown in pictorial and theoretical form.

one side of the fixed condenser of the output filter to the speaker, the other wire from the speaker being taken to any convenient earth point. The unit should be wired up as closely as possible to the set, and if there is room without undue crowding, it can actually be built into the set.

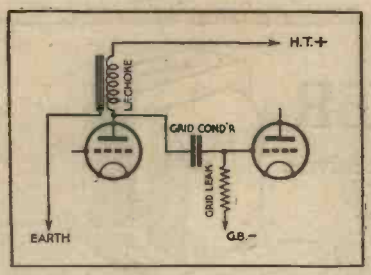
The Output Transformer

It is just as simple to incorporate a transformer in the output stage of a set as a choke and condenser (see Figs. 3 and 4); as a matter of fact, there is a great deal of controversy over which is the better. The main point concerning the transformer is, however, that it must be of first-class manufacture, for it is of no use fitting an inferior article. The voltage of the secondary is often slightly less than that supplied to the primary, even though the turns on the primary and secondary are exactly the same. In many cases a drop in signal strength is noticed when using a 1 to 1 transformer as compared with a choke-output; it need not be so, but it is sometimes found with poorly-designed transformers, and this is accounted for by the fact that the resistance of the winding has to be taken into consideration. It is found that sometimes a 1 to 1 ratio is quite suitable, especially when a high impedance speaker is used, but it is preferable to obtain a tapped transformer, that is to say, one with adjustable tapping on the secondary winding.

A few words regarding the different types of speakers now on the market may not be out of place. The main principle upon which the loud-speaker works is the conversion of electric current variations into sound waves. The speaker is actuated by the flow of low frequency currents passing through the windings of the magnet coils, so producing variations in the magnetic flow; this causes vibrations of the diaphragm, either a disc of thin metal or a fabric or paper cone, which in turn, as before stated, produces the sound waves.

There are three outstanding types of speakers in use at the present time: firstly, the balanced armature; secondly, the inductor type; and, thirdly, the moving coil. The balanced armature speaker is

(Continued on page 378.)



ALL ABOUT LOW-

In this Article, which will Appeal to the Experimenter and Valves are Discussed and Rapidly Reviewed

THE multiplicity of methods of low-frequency coupling makes it rather difficult for the set builder to decide which he should adopt: resistance-capacity, choke-capacity, ordinary transformer, resistance-fed transformer, tone-control transformer, push-pull, or what? It really is a question worthy of consideration, for the answer affects not only the volume and quality of reproduction, but also—the pocket. Before discussing the pros and cons of the various systems, it might be as well to explain that any form of coupling device must always be matched to the valve *preceding* it, or in other words, in whose anode circuit it is connected. As a matter of fact, correct, or incorrect, matching has a greater influence on the results obtainable than has the actual form of intervalve coupling employed, so if I appear to overstress this point in the ensuing paragraphs, I am sure my readers will forgive me.

The impedance, or resistance to alternating current, of the anode circuit should remain reasonably constant at all frequencies and should be equal to about twice the A.C. impedance of the valve. When the anode circuit consists of a resistance it is not difficult to find a suitable value, but when a choke or transformer is employed the position is not quite so straightforward. This is because the impedance of the latter components is liable to vary with the frequency of the (sound) current and with the amount of steady high-tension current passing through their windings. The latter consideration scarcely applies when the decoupling unit follows immediately after a detector valve which consumes only a small amount of H.T. current, but is very important when it follows a small power valve. One is always safe in buying a choke or transformer which maintains a fairly constant inductance up to maximum H.T. current to be passed through it, whilst nearly all good transformers made nowadays maintain a reasonably uniform impedance over the whole of the range of musical frequencies, provided they are not called upon to carry a current in excess of their rated figure. As a rough guide, it can be stated that a choke or transformer inductance of 100 henries is equivalent to an impedance of about 50,000 ohms, and that an inductance of 35 henries equals an impedance of 20,000 ohms. And now let us proceed to consider the different methods of low-frequency coupling.

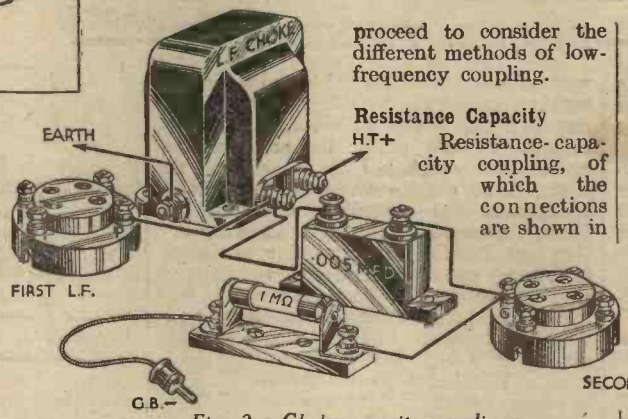
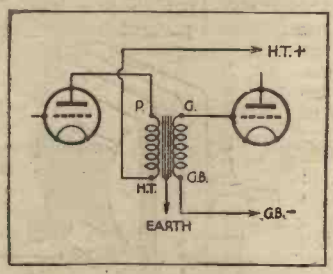


Fig. 2.—Choke-capacity coupling.

Resistance Capacity

Resistance-capacity coupling, of which the connections are shown in Figure 1, provides just about the cheapest way of connecting a low-frequency amplifier and has much to recommend it. This form of inter-valve connection does not in itself provide any amplification, but enables us to make use of the full degree of amplification of which the previous valve is capable. And, what is more, that previous valve can be of a type having a higher amplification factor than would be satisfactory with most other forms of coupling. R.C.C. is therefore eminently satisfactory for use immediately after the detector valve because a high-mu valve of the "H" or "HL" type is particularly suitable for that position. The unfortunate part is that a second L.F. valve would be necessary if any more than moderate loud-speaker volume were required. At the same time a second L.F. valve could be employed without the least fear of causing instability. It is often claimed that R.C. coupling gives more perfect reproduction than does any other form because the impedance in the anode circuit of the preceding valve remains constant. This claim is scarcely justifiable at the present day, although there used to be much truth in it. Nevertheless the fact remains that many manufacturers of high-grade power amplifiers, talkie equipment and the like still prefer to use three or four R.C. coupled valves to two transformer-coupled ones.



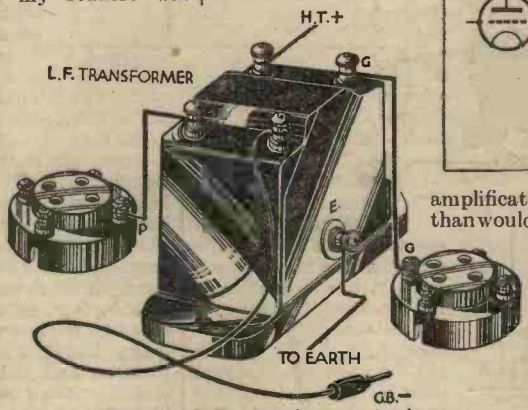


Fig. 3.—L.F. transformer coupling.

Let us suppose that we have decided to use this method for coupling the detector valve to the first L.F. We shall probably buy a ready-made R.C.C. unit consisting of two resistances and a condenser mounted together in one component as shown in the photograph on page 374. The capacity of the condenser will have been chosen by the maker and will be in the region of .005 mfd., but the resistances are interchangeable, so we may choose our own values. The anode resistance (which is connected between terminals "A" and "H.T.") is most important and its value should be equal to approximately twice the impedance of the preceding valve. For example, when the unit follows a type "H" detector valve of, say, 22,000 ohms impedance, the anode resistance should be of about 50,000 ohms. The resistance of the grid-leak is not by any means critical, but it should be no less than four times as great as that of the anode resistance; therefore any value from ¼ megohm upwards would serve our purpose.

One rather serious objection to resistance capacity coupling, and which we have not previously considered, is that the anode resistance causes a very marked voltage drop. This does not matter when the unit follows a detector valve having a low anode current consumption and not requiring a high voltage, but it might make the system quite impracticable in the case of a large power valve and when the available H.T. voltage is limited.

Choke-capacity Coupling

The latter difficulty can easily be surmounted by replacing the anode resistance by a low-frequency choke. The choke should offer A.C. impedance (at a frequency of some 300 cycles) equal to twice that of the preceding valve, but its D.C. resistance to the steady anode current will be almost negligible, and will therefore cause very little voltage drop.

The connections of a choke-capacity stage are shown in Fig. 2, where it will be seen that three separate components—choke,

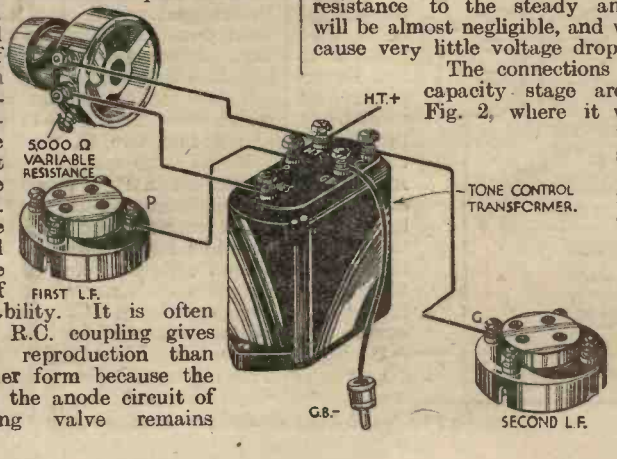
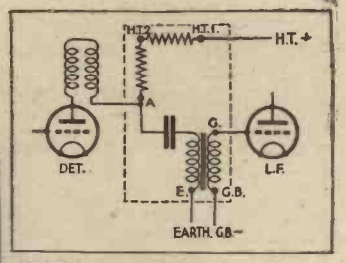


Fig. 5.—Tone-control transformer coupling.

FREQUENCY COUPLING

Novice Alike, the Various Methods of Coupling Low-frequency

By FRANK PRESTON, F.R.A.



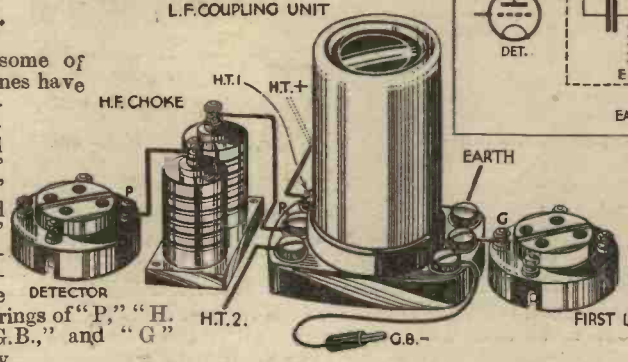


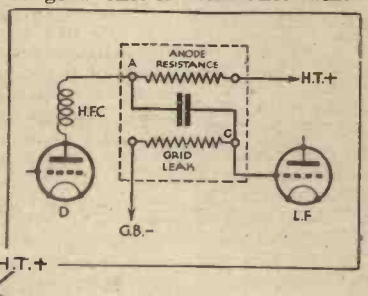
Fig. 4.—Resistance-fed transformers.

condenser and grid leak—are used. (So far as I am aware, there is no complete choke-capacity unit on the market at the present time.) A capacity of .005 mfd. is again chosen for the coupling condenser, whilst the leak may have any value from ½ megohm upwards. It is essential that the condenser should be a good quality one having a mica di-electric, because it will have to withstand high A.C. voltages. The choke shown in the sketch has a side terminal which is joined to earth; the terminal is in contact with the iron core, and so the earth connection tends to improve stability. It will be understood that the choke-capacity coupling system possesses all the advantages, and all but one of the disadvantages, of resistance coupling. As with R.C.C., two L.F. stages are necessary for good loud-speaker volume.

Transformer Coupling

This is perhaps the best-known and most popular method of coupling L.F. valves. It has a great advantage over the two previously discussed schemes, in that it does give a definite voltage amplification. Theoretically the voltage step-up is equal to the ratio between the numbers of turns on the primary and secondary windings. In practice this does not apply, unless the transformer is a very expensive one, designed on generous lines and having a large core and low-capacity windings. The reason for the disparity is that the inductance of the primary winding (upon which its impedance depends) is reduced by the passage of D.C. anode current. As in the case of other forms of coupling, the impedance in the anode circuit, in this case the primary winding, should always be about twice the impedance of the valve.

Connections for a transformer-coupled stage are given in Fig. 3. It will be seen that an earth terminal is provided on the transformer illustrated, but many transformers do not possess this minor refinement. In some cases the same effect can be obtained by taking an earth connection from the metal casing. Again, some transformers having a bakelite case have one of the holding-down screw eyelets connected to the core, so that an earth connection can be made to the screw itself. The connections, shown in Fig. 3, relate to the average type of transformer, but some of the older ones have their terminals lettered "I. P.," "O. P.," "I.S." and "O. S." These latter correspond to the newer letterings of "P," "H.T.+," "G.B." and "G" respectively.



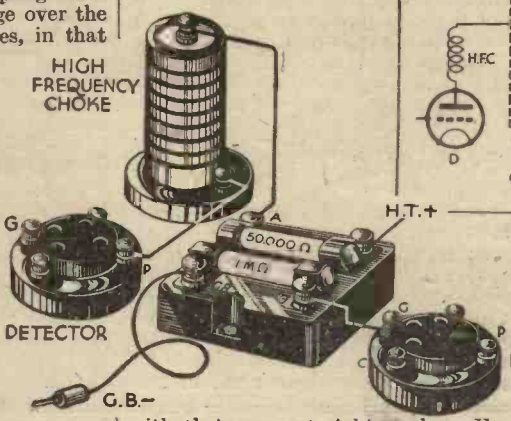
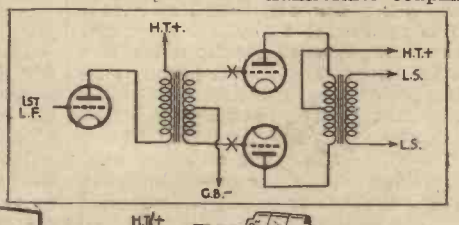


Fig. 1.—Resistance-capacity coupling

A single transformer-coupled stage, if correctly designed, will give all the amplification necessary for most purposes, but when two stages are required a good deal of care must be taken to avoid L.F. instability. The transformers should be good ones of low step-up ratio, and should be mounted with their axes at right angles. Earthing the cores is very helpful, and it is also very desirable to decouple the anode circuits of both the detector and first L.F. valves.

Resistance-fed Transformers

Transformers of this type have lately come into prominence and well deserve the popularity they now enjoy. As shown in Fig. 4, the resistance-fed transformer combines R.C.C. and transformer coupling in an effective manner. It possesses all the advantages of both the latter systems and overcomes many of the disadvantages. Most of the resistance-fed transformers now on the market contain a 50,000 ohm anode resistance which has a tapping so that either 30,000 or 50,000 ohms may be employed at will. By connecting the H.T. positive to terminal "H.T.+1," the total resistance is in circuit, but by transferring the connection to terminal "H.T.+2," only the 30,000 ohm portion is in use. It is thus possible to "match" with fair accuracy the preceding valve in the manner explained at the beginning of this article.



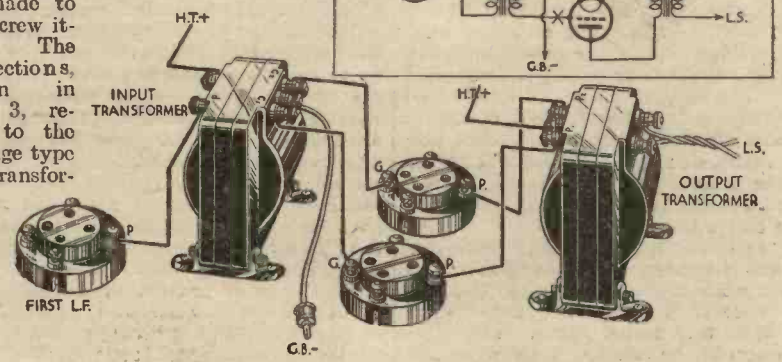


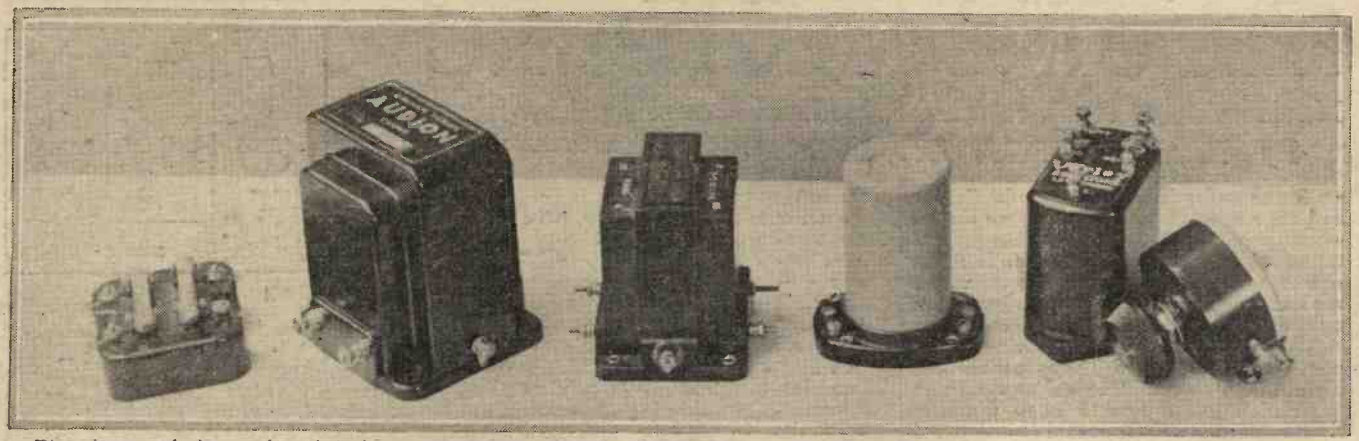
Fig. 6.—Push-pull system of L.F. coupling.

Tone-control Transformers

Transformers of this type operate in a similar manner to ordinary L.F. transformers, but have the added advantage that they can be "tuned." That is, by connecting a variable resistance across two of the terminals, the transformer can be made to give emphasis to notes of certain frequencies; when the resistance is removed the transformer functions in the normal manner. The tone-control transformer is especially suitable for use in a very selective receiver in which a certain amount of high-note loss takes place in the tuning circuits. By operating the variable resistance, the high notes can be restored to any desired extent. The method of connecting a transformer of this type is illustrated in Fig. 5, but in this case a circuit diagram is not given, because alternative arrangements are employed by different makers. Generally the "transformer" consists of both a transformer and special choke mounted together in the one bakelite case.

Push-pull

The push-pull system of L.F. coupling is not very often employed in amateur-built receivers, principally on account of its greater cost, but it can offer very many real advantages in the way of undistorted output at high volume levels. The arrangement of a push-pull amplifying stage is shown in Fig. 6, where it will be seen that two transformers (input and output) are required. The primary winding of the input transformer is connected in exactly the



This photograph shows a few of the better known low-frequency coupling units. They are:—(1) A Dubilier R.C.C. Unit. (2) A Graham Farish L.F. Choke. (3) Lotus L.F. Transformer (4) A Benjamin "Transfeeda" and (5) A Varley Tone Control, Transformer and Resistance. All are referred to in the text.

same way as a transformer of the ordinary type, but the secondary has three terminals. Of these, each of the two outer ones feeds a separate amplifying valve; the third terminal, which is really a centre tapping, takes the grid-bias supply for both valves. It will be seen that half the output from the transformer is fed to each amplifying valve, and since the valves are connected to opposite ends of the secondary winding, one receives the negative half of any cycle, while the other receives the positive. The positive half-cycle is the only one which operates the valve, and consequently the two valves work in "turns," but as one end of the winding is always positive, one valve is always functioning. The operation can be likened to that of two men sawing through a log with a cross-cut saw; one man pushes the saw, while the other pulls. The men in this case represent the valves. This analogy is not quite correct, because the man who pulls is actually doing part of the work, whilst it is only the "pushing" valve that contributes toward the output.

Where the Output Transformer Differs

The output transformer is practically the reverse of the input transformer, in that its primary winding is centre-tapped and "collects" the output from the anodes of the two valves. The correct ratio of this transformer is dependent upon the impedance of the loud-speaker to be employed. It will be seen that the push-pull system is more efficient than any other, since it utilizes both half-cycles of the signal frequency. A push-pull stage will also handle twice the volume of a single transformer-coupled valve, but as it does not give any appreciably greater degree of magnification, it cannot provide any greater loud-speaker volume than a single valve unless the input to it is greater.

To sum up, push-pull is best for use after one or more L.F. valves, when a good input is available. Comparatively small power valves can be used without overloading, and this makes it possible to obtain good results without the use of excessively high H.T. voltages. Any kind of power valves can be used in push-pull, but the two should have similar characteristics. It should also be explained that the filaments of ordinary directly-heated valves used in push-pull can be fed from raw A.C. without causing mains hum. The hum in each valve is, in fact, neutralized by that in the other. Valve makers will always supply matched pairs of valves for use in push-pull, but, even so, the two valves often "wear out" at different rates and in time tend to become "unmatched," if one may use such an expression.

Decouple the Grid Circuits

To obviate this difficulty, and to ensure freedom from certain forms of instability, it is usual, and better, to decouple the grid circuits by inserting a non-inductive resistance of about 100,000 ohms between the transformer secondary and the grid terminal of each valve holder. The positions of these resistances are indicated by two crosses in the circuit diagram of Fig. 6.

INDOOR AERIAL ERECTION

I AM in the unfortunate position of having probably the largest postbag of any radio adviser in the journalistic world, and I am astonished to find how often it is the misfortune of so many people to be so situated in a large block of flats or congested neighbourhood, that an aerial cannot be erected out of doors without disfiguring the premises or interfering with nearby aerials. Thus, the owner of the set is placed in a pretty difficult position—that of having a radio set and not being able to get the full benefit from it. There are more ways of getting around the problem than by treading on everybody's corns. A very good aerial can be put up in houses of the slanting-roof type, of which the top floor, or garret over the ceiling, runs from one end of the house to the other with little or no obstruction. Enamelled 7/22s stranded copper wire should be used. Start on the side opposite to that from which you want to take the lead-in.

Fixing the Wire

Fasten an end of wire to an insulator and staple driven into the rafter or support, about halfway between the floor and the top of the roof. Run the wire in a straight line, taking care there are no kinks in it, to the other end of the house, and there fasten it in the same manner. Continue the wire to a point one-quarter of the way across to the other side, and fasten it up higher than where the first wire ends. In doing this, just run the wire up diagonally. Now bring it back in a straight line to the starting-point side, and you have the aerial half up. Care should be taken the wires are placed equi-distant from each other. The starting point will be the free end of the aerial. Continue the wire exactly as before without break on the other side of the house, and take the lead-in from the finishing point. The lead-in can be run to the set through a small hole in the ceiling of the room, directly over the set. With this type of aerial no lightning conductor or switch is necessary. Quite good results will be obtained with its use, and the interference from static will be less than when using an outdoor aerial. This type of aerial can be erected with a double cotton covered wire near the ceiling of any room. I must add that for a screened area, and any district where it is absolutely essential to use an indoor aerial, it is always preferable to have one or two stages of screened-grid high-frequency amplification.

HIGH-TENSION BATTERIES

How many times have you invited friends round for a wireless evening, or desired to show off the capabilities of your set to another wireless enthusiast, only to find the high-tension battery has suddenly let you down? Just as such an experience has occurred to you, so it has happened to thousands of others. That is why I am very intrigued by the announcement that Ediswan are giving a guarantee with their H.T. batteries. This guarantee is against failure to give absolute satisfactory service, and undertakes to give the customer satisfaction within twenty-four hours should he have cause to complain of the service the battery has given. The company must have complete confidence in the quality of their product to be able to do this, and I feel they are to be congratulated on their enterprise in giving such a service on the most maligned component of any radio receiver.

THE SCREEN-GRID VALVE AS A DETECTOR

W. B. Richardson Here Gives Valuable Practical Information on the Function as a Detector of a Valve Usually Associated with H.F. Amplification. He Points Out that it has Certain Advantages Over the More Orthodox Triode Detector.

IN the past it has been the almost unquestioned practice to use as the detector a three-electrode valve. Of course, with the exception of the original two-electrode valve, the triode is the oldest type known, and until comparatively recently was universally used in all parts of the circuit quite apart from the detector. Within recent years, however, the introduction of the screen-grid valve has quite ousted it from the H.F. stages, while the pentode seems to be trying to do the same thing in the output stage.

In the case of the detector the challenge has been nothing like so marked, and even at the present time the use of the diode, the pentode or the screen-grid valve in this position is looked upon as something of a novelty, and yet each of these has certain merits of its own to recommend it. The diode can safely lay claim to purity of reproduction, the pentode will work a loud-speaker without the addition of a low-frequency stage, and the screen-grid is capable of high amplification with very little damping of the input circuit. It may be argued that both the diode and the pentode, by reason of the nature of their particular claims, must be somewhat limited in their application, but there are no such arguments against the use of the screen-grid valve. Its high amplification factor and small input damping are on the face of things very strong recommendations in its favour; the question is whether it will function in practice as well as might be expected from its characteristics.

Not Fully Exploited

Ever since its introduction the possibilities of the S.G. valve as a detector were recognised, but they do not seem to have been exploited to the extent one would expect. The chief reason for this is apparently that when it came to practical details certain rather unforeseen "snags" arose. In order to overcome these the ordinary circuit had to be modified, and these modifications not only added to the cost of the receiver but were also inclined to reduce the very high amplification which it was hoped would be secured. This, together with the rather high cost of the valve itself, tended to negative its advantages over the more orthodox valve. However, experiments have shown that by careful design of the circuit the screen-grid detector can and does give greater amplification than the triode besides being quite equal to it as regards quality. Its one drawback is that it will not handle a large input, although even this is not so serious as it might at first appear, as where, for instance, pre-detector amplification is employed the use of variable-mu valves is all that is required to ensure that it is not overloaded.

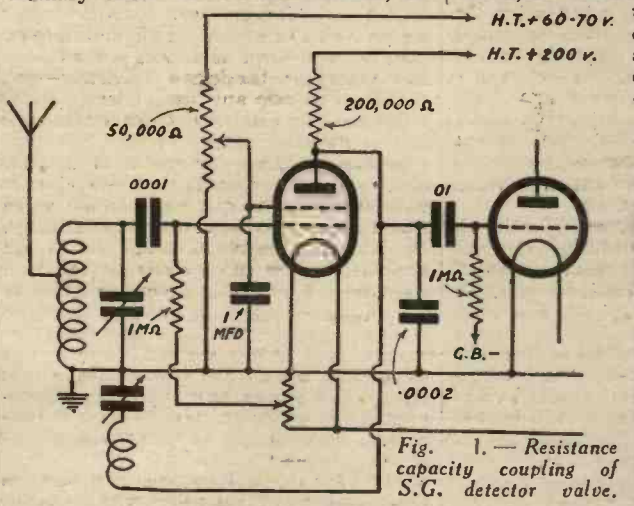


Fig. 1. — Resistance capacity coupling of S.G. detector valve.

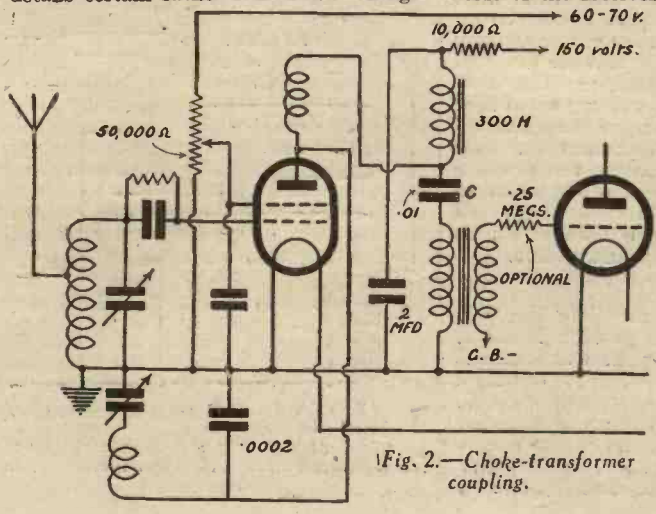


Fig. 2.—Choke-transformer coupling.

A Suitable Coupling

When it comes to practical considerations it is at once apparent that the screen-grid valve has quite different characteristics from the ordinary detector and that the circuit will have to be modified accordingly. For instance, the usual transformer coupling would be unsuitable since it is designed to work with a valve having an impedance of about 20,000 or 30,000 ohms. The impedance of the screen-grid valve, on the other hand, is something like ten times this figure and therefore requires a correspondingly higher external anode impedance in order to obtain the maximum amplification.

This immediately suggests the use of resistance-capacity coupling, but then, of course, there is no step-up as with a transformer, so that here again full amplification cannot be obtained. This circuit, however, is very excellent, and where it is used to replace an existing circuit in which an ordinary triode detector is followed by resistance coupling, it will be found to give superior results. The circuit is given in Fig. 1. Best results are obtained with an anode resistance in the neighbourhood of 200,000 ohms and an H.T. voltage of at least 200 volts to make up for the voltage drop across this resistance. On the other hand, a lower voltage is applied to the screening grid than when the valve is used as an H.F. amplifier, about 30 volts only being required. This figure, however, is rather critical, and for that reason it is

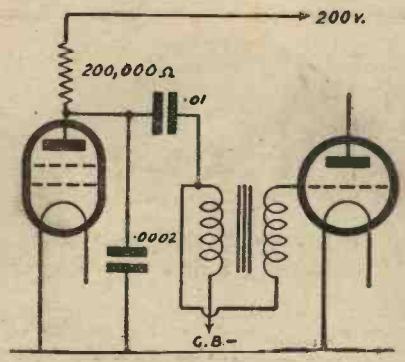


Fig. 3.—Parallel feed.

almost essential to include some means of fine adjustment such as the potentiometer shown.

The Reaction Control

Another refinement that will be noticed is the other potentiometer controlling the grid bias. This allows a choice of bias between zero, or earth potential, and two volts positive, and by adjustment of the slider the best value from the point of view of sensitivity and smoothness of reaction control can be obtained. If this potentiometer is omitted it will usually be found that the best connection for the grid leak return is to L.T.— and not to L.T.+, as is more often the case with a triode.

By-passing the H.F. Component

There is no doubt that when using the S.G. valve as a detector there is always some tendency for it to function as an H.F. amplifier as well, and this results in a rather larger H.F. component. It is best, therefore, to include a condenser of about .0002 mfd. between the plate and filament so as to provide a constant by-pass for the H.F. currents in addition to that provided by the reaction condenser.

Where a stage of H.F. amplification is used, it may be necessary to employ a grid-stopper resistance in the grid circuit of the valve following the detector. A suitable value for this is 100,000 ohms. A higher value should not be used unless the next valve is a pentode, or else there will be a reduction of the high note response which is one of the good features of the S.G. valve as a detector. For the same reason, the by-pass condenser just mentioned should not be larger than necessary.

Choke-transformer Coupling

Although neither ordinary transformer coupling nor resistance coupling obtains the greatest amplification possible with the S.G. detector, there are other methods of a more efficient nature. One of these is to employ a choke-fed transformer coupling. Here the idea is to include a high inductance L.F. choke in the plate circuit. This has an inductance of about 300 henries, and is a much better "match" for the high impedance of the valve than the comparatively low-inductance primary of an L.F. transformer. The voltage generated across the choke is now applied to the primary of the transformer through the condenser "C" and stepped-up through the transformer before being applied to the grid of the next valve (see Fig. 2).

The advantage of this method over resistance-capacity coupling is not only that a step-up is obtained, but also that a lower H.T. voltage can be used, since the D.C. resistance of the choke is exceedingly small compared with that of the anode resistance used in R.C.C. coupling.

Undoubtedly the choke-fed transformer method delivers the goods as far as amplification is concerned, but when it comes to the question of quality of reproduction it is apt to be a little high-pitched in tone unless the choke is of the very best design. This is due to the fact that the majority of chokes offer a considerably higher impedance to the higher frequencies than to the lower, thus over-emphasising the treble notes. Of course, with a modern very selective circuit this may prove to be a blessing in disguise, and serve to compensate for side-band cutting. With non-selective or band-pass circuits, on the other hand, an increase in the value of the grid-stopper resistance previously mentioned to a figure in the neighbourhood of .25 megohms will be all that is necessary to restore the balance of tone.

Parallel Feed

Another way of matching the high internal impedance of the S.G. valve and at the same time securing a step-up is to use resistance-capacity-fed transformer coupling. This is shown in Fig. 4. Either a high inductance transformer of the old type intended for use with this form of coupling or one of the complete parallel-feed units, now so popular, can be used. In the latter case, the anode resistance included in the unit should be supplemented by an additional external resistance to bring it up to about 200,000 ohms. This will usually mean an extra 150,000 ohms. As with resistance-capacity coupling, a high H.T. voltage is necessary. Now, if for any reason you cannot obtain this admittedly high voltage—and it should be at least 200 volts for maximum efficiency—you will have to use a somewhat lower anode resistance, say 100,000 ohms or 150,000 ohms. This is because the drop in voltage across a resistance as high as 200,000 ohms would be so great that the *effective* voltage applied to the plate of the valve would then be too low to operate it properly. Don't think for one moment that I am implying that 200,000 ohms is too high a figure—it is not. But if you are forced to use an inadequate H.T voltage, then you must compromise on the anode resistance or the valve will be starved. I want you to get this point quite clear, because it is one which often crops up where resistance-capacity coupling or parallel feed is concerned. Many people who are used to transformer coupling cannot see why so high a figure for the H.T. is necessary when in the ordinary way the detector takes about 80 volts. They fear that 200 volts will destroy the valve or something of that sort. The answer is simply that the anode resistance cuts it down to the proper working figure. Of course, many sets are designed with lower anode resistances so that they may be used with smaller voltages, but they do not give the *maximum* amplification possible, or if they do it means that they use a very low-impedance valve whose amplification factor is of a low order so that the maximum amplification here represents a lower figure than would be possible with a high-impedance valve.

Comparative Merits

If you examine the circuit in Fig. 3 in conjunction with those of Figs 1 and 2, you see where it resembles and where it differs from the others. It combines the quality of tone and cheapness of R.C.C. (no L.F. choke or H.F. choke is required) with the step-up properties of the circuit of Fig. 2. On the other hand, if it is to give the high magnification of the Fig. 2 circuit, it must be supplied with the same H.T. voltage as is required for resistance-capacity coupling. Incidentally, this circuit finds certain favour commercially, especially in all-mains sets where high voltages are easily obtained.

Salient Features

To summarise, let us consider the salient features of the S.G. detector. They are, I think, its low input damping, its high magnification, and its somewhat limited handling capacity. The first results in sharper tuning and the development of higher signal voltages than with a triode, and also assists in obtaining accurate ganging across both wavebands where several tuned circuits are used. Again, there is a general liveliness apparent with this form of detector.

The high magnification, as I pointed out previously, is dependent on the arrangement of the circuit. For instance, if you merely substitute an S.G. valve for your present detector without altering the circuit beyond providing an extra H.T. tapping for the screening grid, then the results from this point of view will be no better, since it would not be working under the most advantageous conditions. However, with a suitable circuit, such as that given in Fig. 2, amplification is definitely above the average.

Regarding its power-handling capacity, this is definitely inferior to that of the triode, and as I mentioned before, some such severe form of pre-detector volume control, such as the use of a variable-mu valve, is necessary where H.F. amplication is used.

Reaction from the Screening Grid

Another way in which it does not compare any too favourably with the triode is in the control of reaction which is inclined to be rather ploppy and very sensitive to changes of capacity in the previous tuning circuit. Here again everything depends on the design of the circuit. One form of reaction control designed to overcome this defect is shown in Fig. 4. The reaction is obtained from the screening grid instead of from the anode.

Concerning the "brilliance" of reproduction usually claimed for it, I have not personally found this so very striking. Of course, this may be due to my own peculiar acoustical reactions. After all, what may appear to be brilliant to some people may be considered as something quite different by others. I do notice, however, a very good response to the high notes of the musical scale.

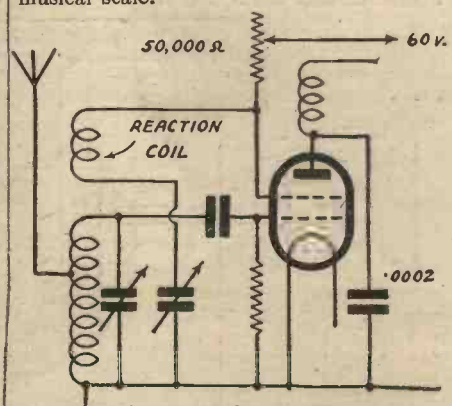


Fig. 4.—R.C. transformer coupling. Also a form of reaction control for S.G. detector valve. Reaction obtained from screening grid.

Do You Understand Characteristic Curves?

There is No Need to be Perturbed by the Chart which Accompanies a Valve, and This Instructive Article Shows How Useful the Chart Really Can Be to the Keen Home-constructor.

By W. J. DELANEY

WHEN you buy a valve of well-known make you will find in the box a small pamphlet—the actual arrangement differing with different makes of valves, but all of them give

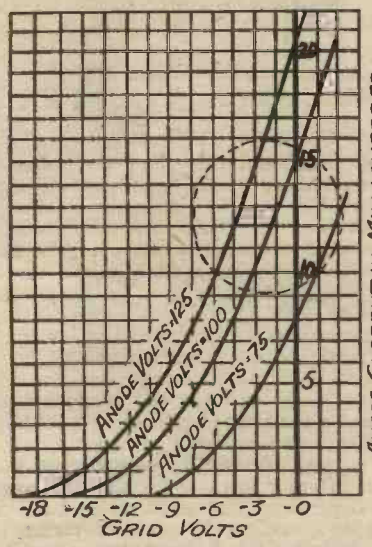


Fig. 1.—The ordinary grid volts-anode current curves.

certain data relative to the valve, and these details are known as the valve's "characteristics." In addition to the tabulated details, there is a chart similar to that shown in Fig. 1. The majority of listeners think that this is only for the use of advanced experimenters who have a good theoretical knowledge, whereas it is actually quite a simple thing to understand, and it is a knowledge of all these little points which adds interest to the art of Radio. It is proposed, therefore, to explain in this article the meaning of the curves, and to show how all the details given in the tabulated characteristics of the valve may be ascertained, and how you may work out a set of curves from any valve which you may have in your possession and of which the details have been mislaid or lost.

What the Curves Indicate

First of all, if you examine the curves you will find that the bottom line of the squared section bears a number of figures, marked "Grid Volts." The right or left-hand edge of the squared section bears a number of figures marked "Anode Current," and the thick lines running across the squares are labelled with figures termed "Anode Volts." Sometimes these three sets of figures are referred to by the technical references Vg for Grid Volts, Va for Anode Volts, and Ia for Anode Current. The grid volts line is usually divided into two parts, a zero line being placed near the right-hand edge, and the volts to the left of this being marked "negative," and those to the right "positive." Now this set of curves will give us all the details which are known as the valve's characteristics, and they may be ascertained in the following manner.

How to Ascertain a Valve's Characteristics

Connect up a valveholder, grid bias battery, H.T. battery and L.T. battery, as shown in the diagram Fig. 3. A milliammeter should be inserted in the anode lead between plate and H.T. positive. Now prepare a piece of squared paper with a zero grid-potential line, as shown in Fig. 1, and mark the right-hand line with a series of numbers from 0 to 30, and insert a valve in the valveholder. With no grid bias and 60 volts H.T., note the current indicated by the milliammeter. On the squared paper on the zero line make a dot where the line corresponding to the anode current intersects. Now plug the grid-bias plug into the 1.5 volt socket and note the anode current, making a dot on the chart above the 1.5 volt line at the point of intersection with the new anode current. Proceed in this way with various H.T. and G.B. values, joining up all the dots for each H.T. value. The result of this will be a set of curves exactly the same as those supplied by the valve-makers, and

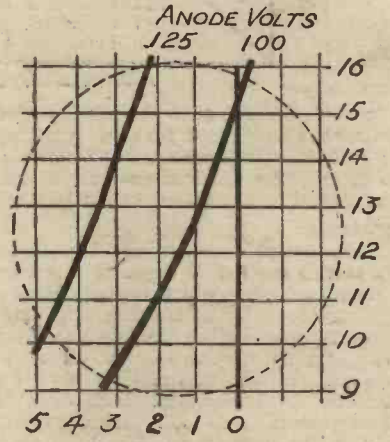


Fig. 2.—An enlarged view of the section shown in Fig. 1.

the various figures such as amplification ratio, slope, etc., may now be found.

Amplification Ratio

This figure (which is wrongly termed "Amplification *Factor*") is the ratio of change in anode voltage to change in grid volts. (The sign μ, which is the Greek letter Mu, is used for this particular characteristic). When you were preparing your curves as explained just now, you noticed that as the grid bias was increased and the H.T. volts left unaltered, the anode current decreased. In our example, you will see that with 100 volts H.T. and no volts on the grid, the anode current is, roughly, 15 milliamps. When the grid bias is increased by 3 volts the anode current will drop to just under 10 milliamps., a drop of approximately 6 milliamps. Therefore, to obtain the same anode current without altering the bias it will be necessary to increase the H.T., and in the example you will see that about 24 volts are required to get the same anode current. We have, therefore, to add 24 volts H.T. for every 3 volts G.B. added, and this ratio, 24 over 3, is the amplification ratio, which in this case is 8 (see Fig. 2). There is nothing very frightening in that, is there?

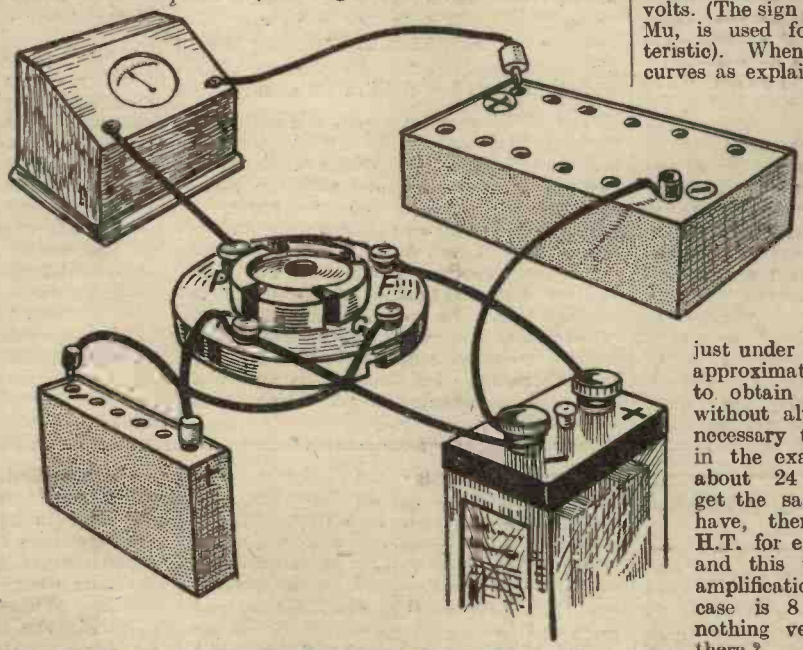


Fig. 3.—How to arrange the necessary parts in order to read a valve and prepare your own curves, or check your valves.

(Continued on page 378.)

Slope

This term is the same as "Mutual Conductance." It is the change in anode current divided by change in grid volts, or, put in another way, the anode current change per volt grid-potential change. For this factor, the anode potential, or H.T., must be left untouched, and the grid bias only altered. As the bias is increased, we have just seen that the anode current will decrease. Therefore we can obtain a set of figures from which we can see, as in our example, that the anode current decreased 2 milliamps. for every volt that the grid bias is increased, and therefore the slope is 2 milliamps. per volt, or, as it is expressed on the valve chart, 2.0 mA./v.

Impedance

This is one of the most important figures to know, as upon it depends the value of resistance, etc., which is to be used in coupling the valve to a subsequent stage. No further working has to be done to obtain this figure, as the two previous items, slope and amplification ratio, are used to ascertain the impedance. Simply divide the amplification ratio by the slope, and multiply the answer by 1,000, which in the example we are using will be 8 divided by 2 multiplied by 1,000, or 4,000, and this figure is quoted in ohms. The diagrams accompanying this article should make the foregoing details quite clear, but it is so simple to rig up the apparatus described in the first part of the article, that it is worth while carrying out the operations described, as then the whole idea is more easily grasped.

A Snag

Unfortunately, the above details—those which are given to you by the valve manufacturers—are what are known as "static characteristics," that is, they are only applicable to a valve which receives constant voltages, and as everyone knows by now, when the valve is being used to receive signals the grid and anode voltages are constantly changing. It is, therefore, impossible to ascertain from the curves we have so far studied such details as the "maximum undistorted output," correct "anode load," percentage of "second harmonic distortion," etc., and we have, therefore, to prepare a set of curves known as "dynamic" curves. These curves, unfortunately, are rather difficult for the amateur to prepare, and what is still more unfortunate, the valve manufacturers for some reason or other hesitate to publish them for us. As a matter of fact, during the last few months there has been a suggestion that the manufacturers are alive to the position, as dynamic curves are now issued with some types of power valve. But if with one type of valve, why not with them all? However, to get back to our study of these curves. Fig. 4 shows the way these are drawn, and it will be observed that the values of both grid bias and H.T. are carried to a value higher than is normally used. Actually, in order to make use of these curves we must show the current at the correct working point, that is, correct anode volts and correct grid volts, and in addition at half and double these values. From what has been said in previous articles on the working of the valve, it is taken for granted that the reader appreciates the fact that during the operation of the valve (we are, of course, dealing with the valve as an L.F. amplifier) the grid potential varies, when the valve is operating on the proper part of its characteristic, from half the applied bias to double that bias. If it does not do this, then distortion is taking place. The effect of the variation in bias is, as our other curves have shown us, equivalent to a change in anode volts, and, therefore, the dynamic curves will show the anode current at various grid and anode volts.

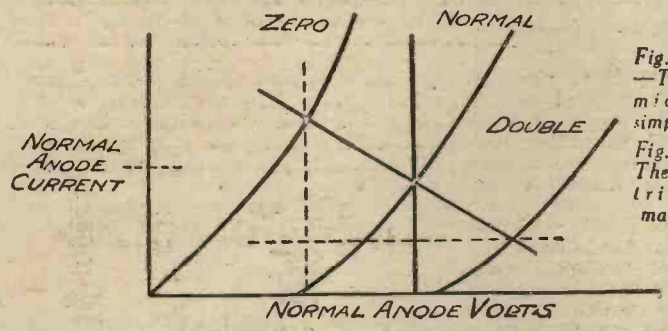
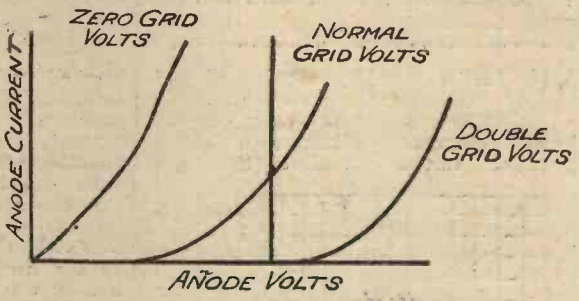


Fig. 5 (right).—The dynamic curves simplified, and Fig. 6 (left).—The "power triangle" marked out.



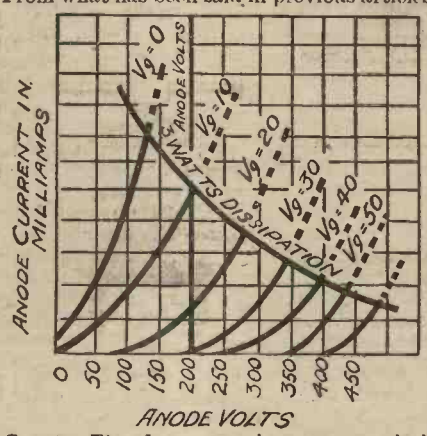


Fig. 4.—The dynamic valve curves—which are the most important curves to have.

Undistorted Output

The curves shown in Fig. 4 may be expressed in a much simpler way for the purpose of explaining the manner of ascertaining the undistorted output of the valve and the percentage of second harmonic distortion, etc. We, therefore, draw Fig. 5, which is the anode-current curve at normal grid bias, double and half-grid bias, all the other lines in Fig. 4 being omitted. The diagonal line running across the curves is what is known as the "load line," and this gives the value of the resistance, which must be included in the anode lead to obtain the maximum output from the valve, or in other words, the correct matching resistance. The line is drawn by placing a ruler on the curves with its edge at the point where the normal grid-bias line, normal anode-current line and normal anode-voltage line all intersect. The ruler is then swung about this point until an equal distance separates the zero grid-volts line and the line corresponding to double the normal grid bias. (Actually the distances should not be equal, but one side should be slightly larger than the other, in order to obtain what is known as a 5 per cent. distortion scale—but this need not confuse us at the moment.) Having drawn this line, we drop a vertical line at the point of intersection of zero grid-volts, and draw a horizontal line at the point of intersection of the load line and the line corresponding to double the grid bias. This gives us a triangle as shown in Fig. 6. Now the formula for finding the undistorted output is

$$\frac{(I_{max} - I_{min}) \times (E_{max} - E_{min})}{8}$$

In other words it is the anode *current* difference multiplied by the anode *voltage* difference, divided by 8. This figure is the most important in the list of valve details, as it gives a true indication of the power which the valve will deliver. For instance, if we know that Cossard's P.5 valve will give an undistorted output of 500 milliwatts (or .5 watts), and that Mullor's D.7 gives an undistorted output of 900 milliwatts, we know that the latter valve is nearly twice as loud as the former.

There are several other factors which can be ascertained from these dynamic curves, but they will be reserved for a later article, as I have already overrun the space allotted to me.

USING THE LOUD-SPEAKER.

(Continued from page 371.)

still very popular with small battery sets on account of its high sensitiveness to small inputs. The matter of price also enters into the case, for this type is quite inexpensive. The inductor dynamic movement is to be preferred on account of its ability to stand up to much larger inputs than the type previously mentioned. It is very sensitive, and handles the bass notes well; it, therefore, does not need such a large baffle board, and is quite suitable for the average battery set, although it will not stand up to very large inputs without over-accentuating the bass, that is to say, the lower register notes tend to boom.

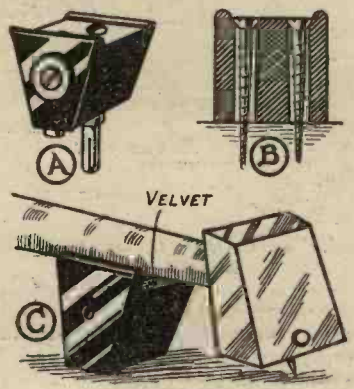
The Moving Coil

This type is generally taken as being the last word in loud-speakers; it certainly does reproduce the sound waves as nearly as possible in their original state. It will also handle very large inputs without distortion. Where mains are available an energized type should be used, but where this is not practicable a permanent magnet model must be fitted.

THE HALF-GUINEA PAGE — Radio Wrinkles FROM READERS

An Improvised Pick-up Rest

A PLUG-MOUNTING (shown at A in the sketch) from an old two-pin coil, when divested of its metal fittings, can be used to form an improvised rest for supporting a gramophone pick-up in the non-playing position. The moulded

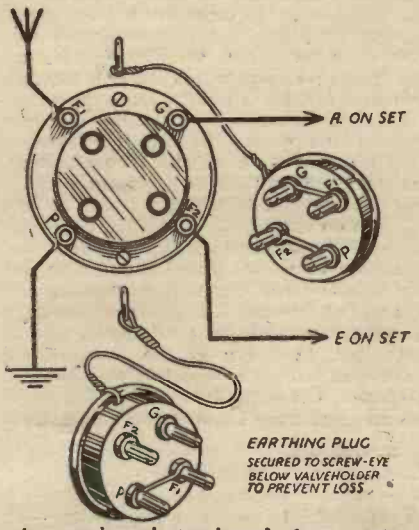


A handy pick-up rest.

block is secured to the motorboard of the radio-gramophone, as shown at B, by passing a couple of long, thin woodscrews down through the holes in the moulding from which the plug and socket have been removed. The heads of the screws are countersunk. To complete the pick-up rest thus improvised, a small piece of velvet (to match the gramophone turntable covering) is glued over the top of the moulding, as shown at C.—NORMAN HURST (Wimbledon).

A Handy Aerial-earth Switch

A VALVE HOLDER and two old valve bases can be used to make a handy aerial-earth switch in the following manner.



An aerial-earth switch made from a valve holder and old valve bases.

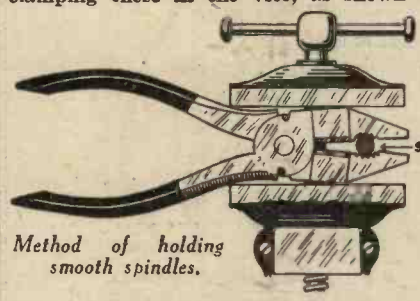
Fix the valve holder near the lead-in, and connect the aerial and earth leads, as shown in the accompanying illustration. In one valve base connect the pins as shown in the right-hand sketch. This is plugged in when the set is required for reception. The other valve base has only two of the pins connected, as in the bottom sketch. When this is plugged in, the aerial is earthed and the set is completely isolated.—H. E. WINTER (Liverpool).

THAT DODGE OF YOURS!

Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? For every item published on this page we will pay half a guinea. The latest batch is published below. 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 Wrinkle."

Holding Smooth Spindles

THE following hint may be useful to amateurs who find difficulty in holding smooth round spindles and screwed rods in an ordinary bench vice. By holding the rod or spindle in the serrated jaws of a pair of electrician's pliers, and clamping these in the vice, as shown in



Method of holding smooth spindles.

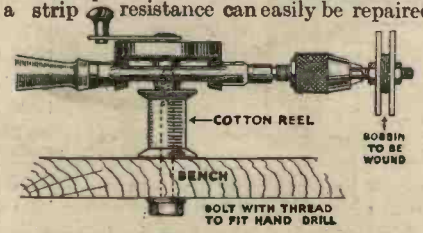
the accompanying sketch, the grip will be found perfect. For a screwed rod, wrap a thin piece of sheet lead round to protect the threads.—H. COAKES (Smethwick).

Using a Drill as a Coil Winder

A GEARED hand-drill can easily be adapted for use as a winder for small bobbins by mounting it on a bench, as shown in the sketch in column 3. An ordinary cotton-reel, with a bolt passing through, forms a convenient support. The thread on the end of the bolt must fit the screwed socket which takes the removable handle, as indicated in the sketch. In addition to its use for winding, this arrangement is also handy for polishing and other jobs where a revolving chuck is necessary. —L. DONATI (Harringay).

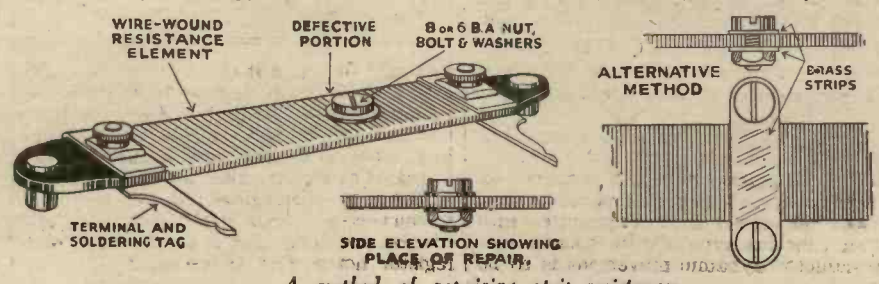
Repairing Strip Resistances

MANY amateur-constructed all-mains receivers make use of various values of the popular makes of wire-wound strip resistances. In the higher values, the wire on these is exceedingly fine, and in some cases is easily broken by coming into contact with a sharp edge, or by over-running the rated maximum current. Whatever the cause, an open circuit in a strip resistance can easily be repaired



A hand drill used as a coil winder.

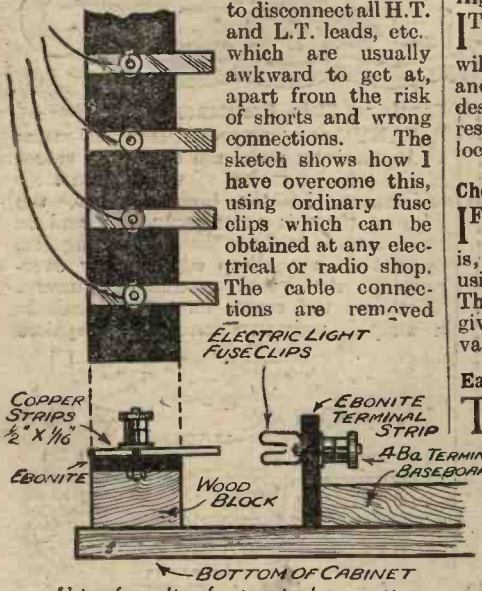
in the following manner. Locate exactly the point of fracture, by means of milli-ammeter and battery, and drill a small hole right through the resistance wires and fibre strip at the same place as the fracture. The size of the hole should be 8 B.A. clearance (3-32in.), and then an 8 B.A. brass nut and bolt should be passed through, as in sketch, and tightened up firmly, a small washer being placed on either side to prevent damage to the fine resistance wires. The resistance winding should previously be rubbed gently with emery paper round the hole to obtain good electrical contact. The bolt and washers have the effect of shorting-out the defective part of the resistance, and the latter is again ready for service. Its value will now be about 10 per cent. less than before, but usually, for decoupling, etc., this will be of no consequence, as designs allow a little latitude in this respect. The writer has used the above method of repair with entirely satisfactory results, and would point out that *it is also of use for making tapping points to existing resistances* which may be in the set. An alternative method of repair is to secure a thin strip of brass round the resistance at the defective part —and this has the same effect in shorting-out the defective portion. This also obviates having to drill a hole through the strip, although the drilling operation, if carefully carried out, is quite satisfactory and the wire has no tendency to unravel. —G. M. MEW, B.Sc. (Portsmouth).



A method of repairing strip resistances.

Handy Terminal Connecting Clips

WHEN any alteration to a large set is required, especially when experimenting, it is very troublesome having to disconnect all H.T. and L.T. leads, etc. which are usually awkward to get at, apart from the risk of shorts and wrong connections. The sketch shows how I have overcome this, using ordinary fuse clips which can be obtained at any electrical or radio shop. The cable connections are removed



Using fuse clips for terminal connections.

and a 4 B.A. clearance hole drilled in bottom of each clip. The clips are then fixed on the usual terminal strip at the back of the set and corresponding strips on the bottom of the cabinet. In my own set I have H.T. from eliminator, raw A.C. for power valve, battery L.T. for other valves, and loud-speaker all connected as above, and I can pull the whole set out of cabinet while it is working, on to a convenient table. I have had this idea in use for over a year and find these clips make excellent contact, and, of course, in any set working from the mains the current has to pass through the house-fuses, which are of similar pattern.—F. FARRELL (Liverpool).

For Awkward Places.

FOR starting a screw in an awkward corner, a good dodge is to place a small piece of adhesive tape over the end of the screwdriver and wedge it into the slot of the head of the screw, as shown in the sketch. This will keep the screw attached to the screwdriver until it has got a start.—F. WILKIN (Bridlington).

Starting a screw in an awkward place.

Eliminating Hum from Mains Units

SOME amateurs seem to think that a certain amount of hum must be expected when using a mains unit. In most cases, however, this hum can be eliminated, and if it is tolerated at all it should only be because it is so slight as to be almost unnoticeable. A simple and often effective remedy is to put an L.F. transformer primary (or secondary) in the H.T. lead that supplies the detector, then join a large fixed condenser between the H.T. negative and H.T. positive (detector) terminals of the receiver.

Another easily-tried expedient which often considerably diminishes hum is the reversal of the secondary leads of an L.F. transformer. Instead of "G" going to grid and "G.B." to grid bias, take "G" to grid bias and the "grid bias" terminal to grid.

High-resistance Grid Leak

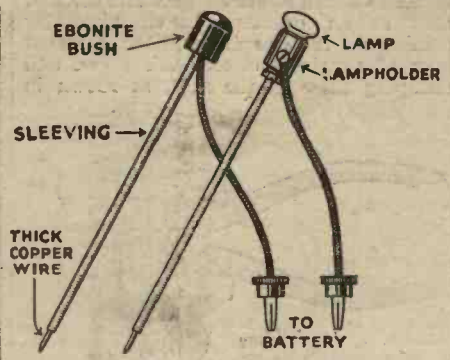
IT may not be generally known that a high-resistance grid leak of about 5 megohms will make an ordinary set very sensitive, and can be used with advantage when it is desired to receive distant stations. A lower resistance, however, gives a better tone for local station reception.

Checking Over-oscillation

IF your set is based on a capacity reaction circuit which oscillates too readily, and is, therefore, inclined to be unstable, try using an L.F. valve in the detector holder. This is likely to stabilize the circuit, and may give better results than a detector or H.F. valve of much higher impedance.

Easily-made Testing Prods

TO make the testing prods shown in the accompanying sketch, a lamp holder, a 2-volt bulb, a piece of sleeving, a length of 16-gauge wire, and an ebonite bush are required. Cut the wire and sleeving into 6in. lengths. Take the sleeving and push over wire, then on one fix a piece of flex and push on the bush. On the other, make a loop screw to underside of holder, and then fix



Easily-made testing prods.

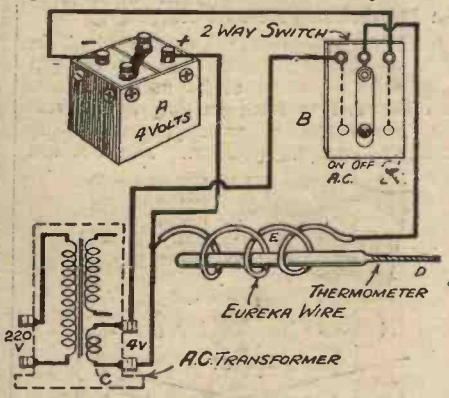
flex to side of holder as shown in the sketch. Of course, commercial testing prods, like the Eelex, are much to be preferred.—C. REEVES (Maidstone).

Method of Testing Transformer Output

BELIEVING the rectifier filament secondary of my A.C. transformer was delivering more than 4 volts, and not having an A.C. voltmeter, the method shown in the sketch in next column was used. Current from the 4-volt accumulator (A) is passed through the eureka wire coil (E) by moving switch lever to D.C. Note the time it takes for the thermometer (D) to reach 100 degrees Fahr. Place switch-lever to "off," taking care that during the whole of the tests the position of the thermometer and wire remain in the same position.

When the reading of the thermometer has gone back to normal, move switch-lever to A.C. and close main switch of transformer. Note the time thermometer takes to reach 100 degrees Fahr. If the time is shorter than that with D.C., add a resistance in series with the 4-volt winding of transformer till the reading of thermometer, and time it takes to reach 100 degrees Fahr., is the same as the D.C. test.

In order to get the best from this test, a sufficient quantity of wire should be used to regulate the amount of heat. Only a few



A simple method of testing transformer output.

turns are shown in the illustration in order to avoid confusion.—D. J. BENFORD (Exeter.)

A Handy Wire-looping Device

THIS gadget for making terminal loops on connecting wires can be made for less than the price of a pair of round-nose pliers. The materials required are:

1 piece of wood (hardwood for preference), 3in. by 1½in. by ½in.
1 piece of thick strip brass about 2in. by ½in.
3 French nails about the diameter of a 4BA screw.

Two holes are drilled in the brass to take the pins B and C (Fig. 1). Pin B is large enough in diameter to allow the brass strip to swivel round it. Pin C should be a tight fit, as it must be rigid. The distance between the holes should be such that when the pins are in place the wire to be looped should pass between them. The pins are made from the French nails with the heads cut off. Sweat or solder C into the hole prepared for it in the brass strip. Place the strip of brass in the position shown in Fig. 1, and drive pin B through the end hole into the wood block.

Pin A is then driven in the block in the position indicated. To use the device, strip the insulation off the wire as far as necessary. Swing the arm back, as shown in Fig. 2, so that pins C and A are in line and B is on the right. Insert the bare end of the wire between C and B, with the insulation touching A, and then move the arm in the direction of the arrow as far as it will go (see Fig. 3). To finish the loop off, give the insulated part of the wire a movement, as shown by the dotted lines, a sufficient distance to form a shoulder on the loop. On releasing the arm the wire can be lifted off.—H. G. WRENN (Dudley).

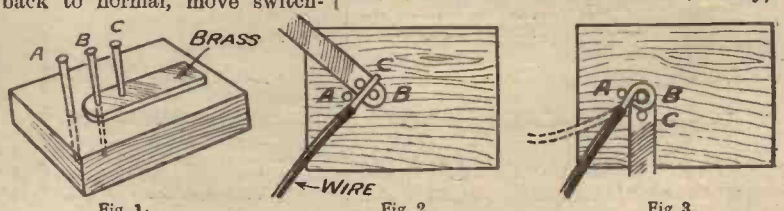
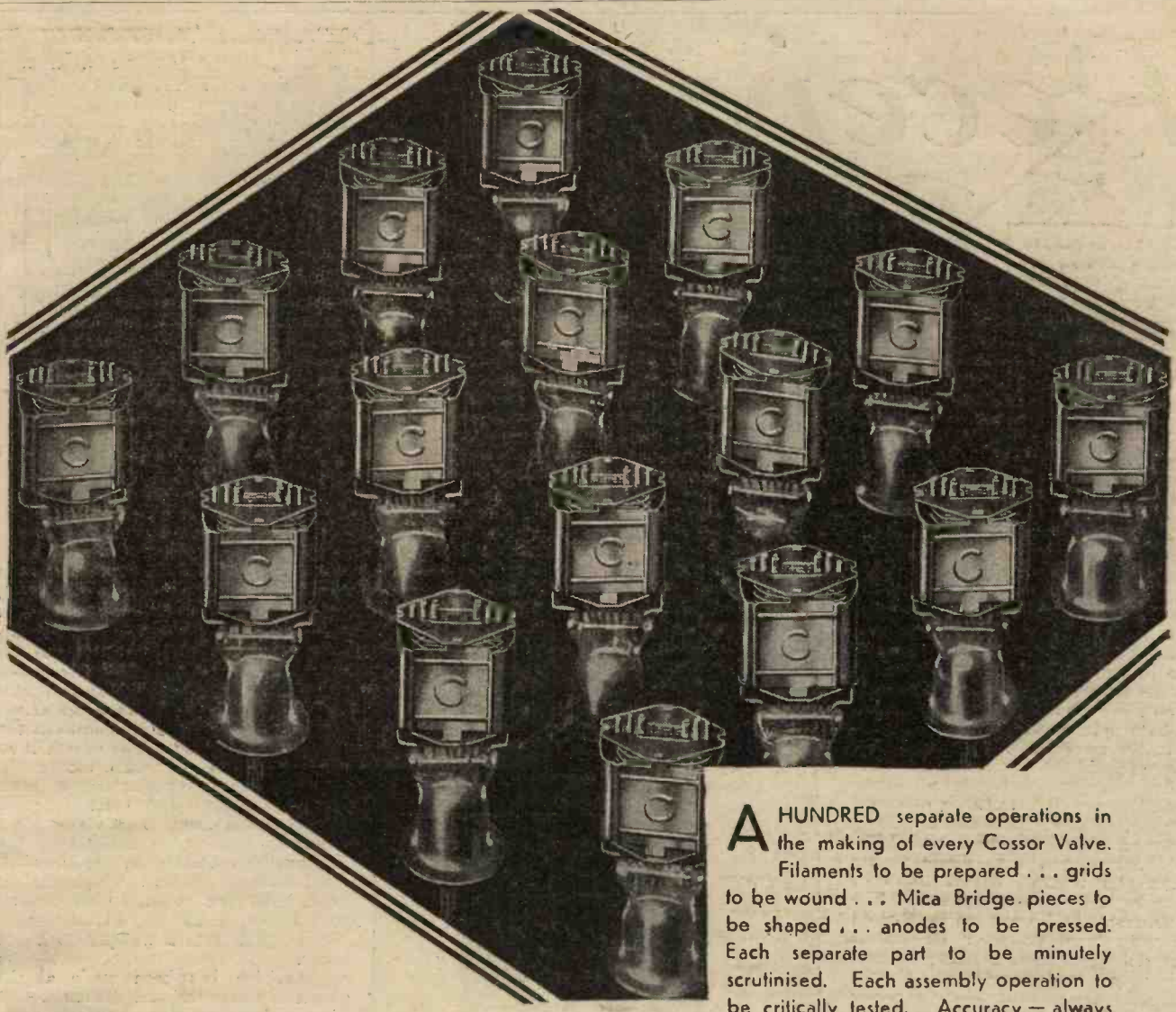


Fig. 1. Fig. 2. Fig. 3.

A simple device for making wire loops.



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Receivers and their Records

We shall be glad to advise readers regarding purchase of complete sets.

WHEN the superheterodyne was first introduced, it enjoyed considerable popularity. Then, as later, other circuits of a less complicated nature were designed, and provided better quality of reproduction, and except for special purposes, this class of receiver waned in the affection of the average listener.

To-day, in view of the ever-growing number of transmitters lodged in a comparatively limited broadcast band, and, in addition, the fact that with modern valves and improved components reproduction of music can be obtained of a quality in no way inferior to that secured from other types of receivers, the Superheterodyne has again come to the front; in fact, its principle has been re-adopted by a number of up-to-date manufacturers.

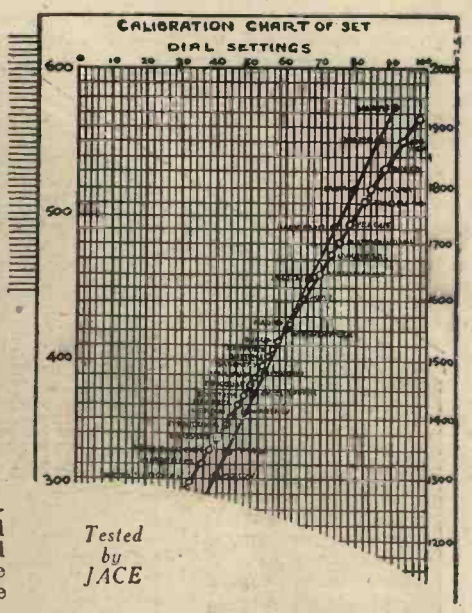
The Faraday All-electric, All-wave Super-het. Model S620

In the Faraday All-Electric, All-Wave (Model S620), the makers offer a five-valve superheterodyne receiver operating on all four bands of wavelengths, namely, 15-28 metres; 30-60 metres; 215-550 metres, and 1,000 to 2,000 metres, with single tuning knob and without the necessity of plugging in or exchanging coils. The instrument is housed in a figured walnut cabinet designed on simple and strictly utilitarian lines; it comprises a well-thought-out circuit, including pre-selector high-frequency stage, coupled by double-tuned circuit to a combined detector oscillator of patented design, band-pass coupled to high gain intermediate stage, band-pass coupled again to screen-grid demodulator working into a compensated pentode valve transformer coupled to a "Rola" moving-coil loud-speaker. The valves used—two metallized variable mu (DC2/SGVM), two screen-grid (DC2/SG), and a pentode (DC/2 pen)—are all of the latest Mazda type, and with the screened coils and other components, constitute a careful lay-out on a steel chassis.

The Faraday All-electric, All-wave Super-het. Model S620.

A 9 kilocycle selectivity, with absolute separation, has been aimed at, and in this the makers have been remarkably successful. On the front of the cabinet, below the loud-speaker grille and tuning scale, there are but three controls, two of which fulfil several duties. The main tuning condensers are worked by one knob, which rotates a dial showing the four individual waveband scales graduated in four one-hundred equal divisions, and, in addition, in the case of the medium and long waves, accurately calibrated in metres. Below this on the right, will be found the wave-change switch, which, by means of an electrical device, automatically throws a strip of light on to the actual working sector of the dial scale in the waveband selected. The switch is so designed that, by each movement, the necessary combination of coils and condensers for each separate waveband is brought into play. Its opposite number on the left of the cabinet is a combined on-and-off switch and volume control, which enables one, in so far as average transmissions are concerned, to bring up the strength of a signal from a whisper to a full roar.

Three-quarter rear view of chassis, showing the neat and compact layout.



Tested by JACE

Provision has been made at the back of the chassis for the connection of a pick-up for the electrical reproduction of gramophone records; no external potentiometer is needed, as for this purpose the radio volume-control on the set can be brought into action. In addition, although this model is essentially designed for use with outside aerial and earth, it is also equipped with a mains aerial device, by which means a number of stations can be received, a valuable feature in the case of dwellers in flats.

Over emphasis of high notes may be reduced by putting the small switch at the back of the receiver in the "down" position, and a more mellow tone from the speaker can thus be obtained. Interference from atmospherics can also be considerably mitigated in the same manner. Means are also furnished for accurately balancing the receiver to any individual aerial. Generally speaking, the mechanical construction of the Faraday "All-Wave" Superhet. is of a high standard, and its designer is to be congratulated on the simplicity of its controls. On test, the receiver gave an absolute superhet. performance on all wavebands, and in the course of one evening broadcasts from some seventy European stations were faultlessly tuned in—in most instances, the volume obtained and the purity of tone assuring good entertainment value. In every case in

(Continued on page 384.)

TAPPING AND ITS USES—1

A Full Explanation of the Reasons for Tapping Coils and Components, and the Methods Adopted.

By
H. BEAT HEAVYCHURCH

The second article on this interesting subject will appear next week.

ONE of the most common words in the specification of radio apparatus is "tapped." One reads of a "tapped" coil, a "tapped" choke or a "tapped" resistor. Transformers have centre-tapped secondaries, grid-bias batteries are tapped at 1½-volt stages, and high-tension batteries are tapped in 1½-volt, 4½-volt or 9-volt steps.

What exactly does "tapping" mean, and why is it done? Now a tap, in ordinary domestic parlance, is a device by means of which water can be drawn off from the main or from the water tank. Is there any connection between the homely water tap and the tapping on, say, a coil or transformer? Well, in some cases there is, and in others there is not. To comprehend the real meaning of tapping in the electrical sense, we must take a somewhat wider view of the word, and realize that a tap cannot only be used to draw off, but also to permit water to flow into a vessel. The phrase "a tapped coil" means, in effect, that in addition to the usual connections at the start and the finish of the coil, one or more additional connections are made to intermediate positions on the winding.

Various Reasons for Tapping

Tapping is resorted to for one or another of several purposes. A tapping may, for instance, be provided to allow a portion only of a piece of apparatus, or a part of its properties, to be utilized. Again, a tapping may be intended to permit a portion of some piece of apparatus, such as a coil, to be included simultaneously in two different circuits, thus serving as a coupling between the two. We shall see later that coupling of this nature will sometimes exist even when the "tapping" is used for quite another purpose, and that it sometimes has very inconvenient results.

Tapping is sometimes used to allow some electrical phenomenon to be applied to a part of a coil or other piece of apparatus, and thus to be transferred to the whole of the device; or it may be employed to permit a part of the electrical effects in the complete apparatus to be transferred to another circuit. Some practical examples will assist in making these applications clear, and may serve at the same time to explain a few interesting properties of radio circuits.

We will commence with the simplest possible case, namely, that of a grid-bias battery. The object of such a battery is to apply suitable negative potentials to the grids of amplifying valves, in order to bring the operating point of each valve to the mid-point of its effective grid base. Early-stage low-frequency valves have to deal with comparatively small signals and are, in consequence, designed to have correspondingly short grid bases. They require, therefore, a grid bias of the order of 1½ to 3 volts only. Output valves, which handle much bigger grid swings, have longer grid bases and need a greater amount of bias. A typical small-power valve, for example, operating at 150 volts high tension, requires a grid bias of about 6 volts, while a representative super-power valve requires from 12 to 15 volts at the same high-tension potential. It is convenient to be able to obtain both voltages from one and the same battery.

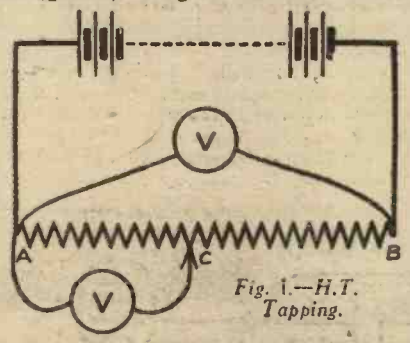


Fig. 1.—H.T. Tapping.

A very useful size of grid-bias battery is that giving 15 volts. It is composed of ten small cells, each giving 1½ volts, and is "tapped" in 1½-volt stages, that is to say, a connection is made to a socket between each pair of cells, enabling any multiple of 1½ volts up to a maximum of 15 volts to be "tapped off."

H.T. Tappings

High-tension batteries are made up in a similar way from much larger numbers of 1½-volt cells, and intermediate tappings are provided to enable the user to apply appropriate high tension to the anode circuits of the various valves in his set, perhaps 50 volts to the detector, 120 volts to the high-frequency valve and 150 volts to the output valve. Because it is seldom necessary to adjust the high-tension voltage so critically as the grid-bias voltage, the tappings on high-tension batteries are not often provided at 1½-volt steps, but at 4½-volt or even 9-volt intervals.

A Potentiometer is a "Tapped" Resistance

A tapped battery, we have seen, is a device for obtaining voltages of various values. There is, however, another method of doing this. Suppose we take a resistance wire and connect it in series with a battery or some other source of electric supply. There will, of course, be a drop of voltage across the resistance. If a tapping is taken off at some intermediate point, as at C in Fig. 1, the voltage drop between the end A of the resistance and the point C will be a portion only of the voltage existing between the two ends of the resistance AB, and its actual value will depend upon the proportion which the resistance AC bears to the total resistance. For example, if the total resistance of AB is 1,000 ohms and the current flowing through it is 100 milliamperes, the difference in potential between the points A and B will be 1,000 multiplied by 0.1, which equals 100 volts. If C is the exact mid point of AB, the voltage between A and C will be 50 volts. On the other hand, if the resistance of AC is only one quarter of the total resistance of AB, then the voltage drop across AC will be only a quarter of 100 volts, namely, 25 volts.

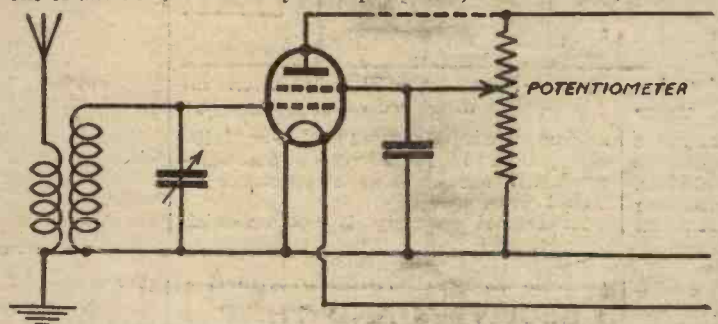


Fig. 2.—Potentiometer used as a tapped resistance for obtaining intermediate voltage.

Such a device is termed a potentiometer or potential divider. It is extensively used in electrical testing for obtaining very accurate voltage adjustment, and hence its name "potentiometer," which means a measurer of potential or voltage. In radio apparatus it has many uses. For example, it may be employed to obtain an intermediate voltage from a constant potential supply such as an eliminator. Fig. 2 shows such an application, the potentiometer here supplying the screen

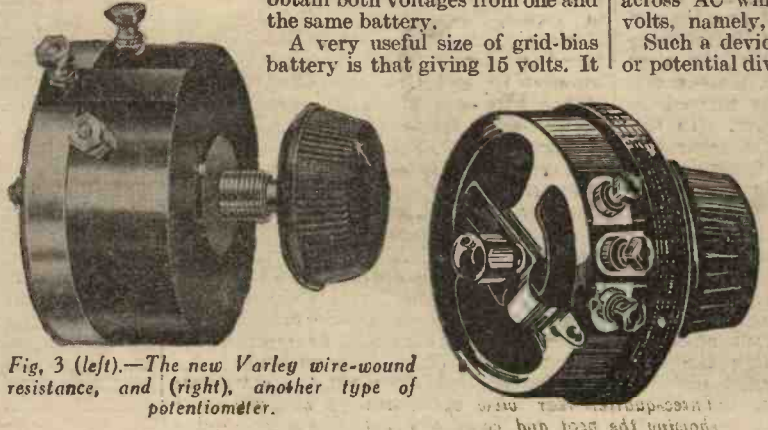


Fig. 3 (left).—The new Varley wire-wound resistance, and (right), another type of potentiometer.

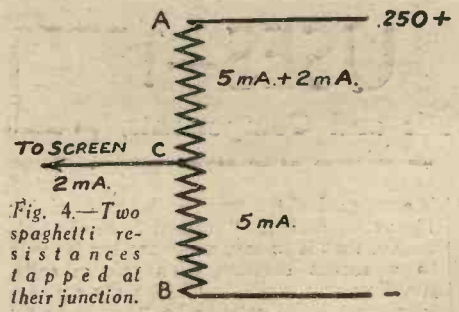


Fig. 4.—Two spaghetti resistances tapped at their junction.

voltage to a screened-grid valve. In this case the potentiometer may be continuously variable for fine adjustment, the resistance wire being bare and wound over a circular former, with a rotating arm or similar device for tapping off the intermediate voltage. A typical construction for such a potentiometer is shown in Fig. 3, while the accompanying photograph illustrates a modern form of construction. If the desired value of voltage is not very critical, a "fixed tapping" potentiometer may be used, and this may consist of two "spaghetti" resistors connected in series, the tappings being taken at their point of junction as indicated in Fig. 4.

Tapped Voltage and Total Drop

One important point must not be overlooked in designing and using potentiometers, namely, that if the current taken by the circuit tapped off from the potentiometer is considerable, compared with the "steady current" flowing through the potentiometer, the proportionality between the tapped voltage and the total drop will not exactly be equal to the ratio between the resistance of AC and AB.

This will be understood from the example shown in Fig. 4. Let us assume that the total high-tension voltage is 250 volts and that the screen voltage is to be 100 volts. Let us also suppose that the standing current of the potentiometer is to be about 5 milliamperes. On these assumptions the total resistance of the potentiometer should be, according to Ohm's Law, 250 volts divided by .005 amp. which gives us the figure of 50,000 ohms. We must not forget, however, that the screen current of the screened-grid valve will also flow in the part of the potentiometer marked AC. Suppose this screen current is 2 milliamperes. Then the current flowing in the arm AC will be 5 milliamperes plus 2 milliamperes, or 7 milliamperes in all. It is necessary to drop 250 volts minus 100 volts, or 150 volts in all between the points A and C. The correct value of resistance to drop this amount at 7 milliamperes is 150 divided by .007 or 21,400 ohms, while to drop 100 volts at 5 milliamperes CB should have a resistance of 20,000 ohms.

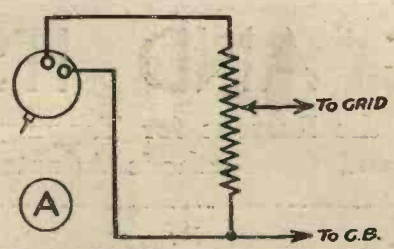


Fig. 6.—Potentiometer connected across pick-up terminals to prevent overloading.

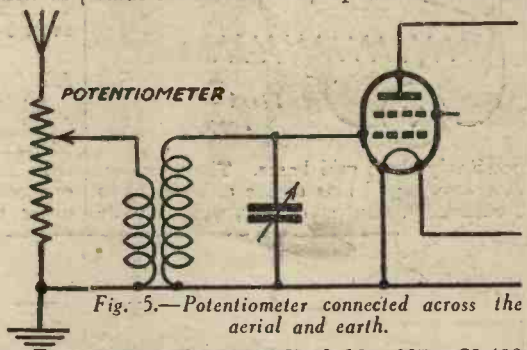
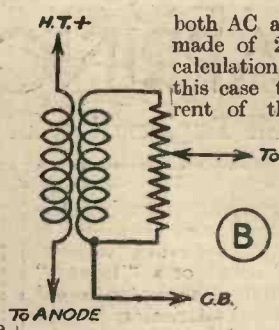


Fig. 5.—Potentiometer connected across the aerial and earth.

As critical accuracy is not essential, both AC and CB would be made of 20,000 ohms and calculation will show that in this case the standing current of the potentiometer will be rather more than 5 milliamperes and the screen voltage a little higher than 100 volts—in actual fact about 105 volts.



Tapped Resistances as Volume Controls

Because the volume of sound, obtained from a radio set or amplifier, depends upon the voltage of the signal applied to the grid of the output valve, a potentiometer or tapped resistance forms a convenient device for varying this voltage and hence for controlling volume. In a radio set a potentiometer may be connected across the aerial and earth, the tapping being taken to the aerial terminal of the set as indicated in Fig. 5. In this arrangement the input to the set is varied, and the method is employed not only for controlling volume, but also for limiting the input signal to a value which can be handled without distortion by the first valve. Low-frequency volume control, as is necessary when reproducing gramophone records, or say, in order to prevent overloading of a pentode valve on strong signals, is best performed by a potentiometer connected across the secondary of one of the inter-valve transformers, or across the terminals of the gramophone pick-up as indicated in Fig. 6, A and B.

Tapped resistances have other uses in radio. They are incorporated in many eliminators to provide one or more intermediate voltages, and are also used in a similar way in some automatic grid-bias circuits. Other pieces of radio apparatus which are frequently provided with tappings are coils, transformers and chokes.

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which transmissions enjoyed a full 9 kilocycle separation, the broadcasts were received without any trace of interference. Background, except in such instances where signals had to be unduly forced to full volume, was exceptionally silent, and mains hum in the D.C. model was never insistent. During daylight hours with the outdoor aerial, over twenty foreign stations were logged.

On the long-wave band, no difficulty was found in tuning in Königs Wusterhausen without any trace of twitter from Daventry National or Radio-Paris, and this transmission could be received at any time of the day or evening without interference when these neighbouring stations were operating. In the same way, Warsaw was clear of Motala, but slightly marred by a broadcast from Eiffel Tower. (In this case, however, there is only a separation of 5 kilocycles between the transmissions, and consequently, a perfectly clear reception of the Polish concerts could not be expected.) Lahti could be heard faintly, and Kaunas at readable strength; concerts from Motala, Oslo, and Kalundborg, although somewhat marred by atmospherics, were well received. On medium waves, the receiver gave an excellent all-round performance. Notwithstanding the fact that it was tested at no great distance from the London stations, broadcasts from Gleiwitz, Toulouse PTT, and Horby were heard whilst the National programme was being radiated; Leipzig, however, was swamped. No difficulty was experienced in separating Mühlacker from London Regional, and although Graz could not be tuned-in clearly, Barcelona provided a satisfactory signal. Again, Scottish Regional, Hamburg, Lwów, Toulouse, Frankfurt-am-Main, Bucharest, Midland Regional, Sottens, and Dublin, were easily logged, and most of them could be received at full volume. On the shorter wavelengths, the Faraday Superhet. showed its usefulness, inasmuch as Rome, Moscow, Lisbon, HVJ, Vatican, G5SW, EAQ, Madrid, and three American broadcasts were found in a very short space of time, and there appears little doubt that given favourable atmospheric conditions a large log of transmissions under 60 metres could be compiled.

Although comprising all the attributes of the most modern type of Superhets., the Faraday All-Electric, All-Wave Receiver possesses the qualities of a musical instrument capable of giving genuine entertainment, even when handled by the greenest of tyros. It does not require an expert to manipulate such simple controls; their use can be mastered in a few minutes. It is made in both A.C. and D.C. models, and its price, considering its all-round utility, namely, twenty-seven guineas, is a reasonable one. We can recommend it to our readers.

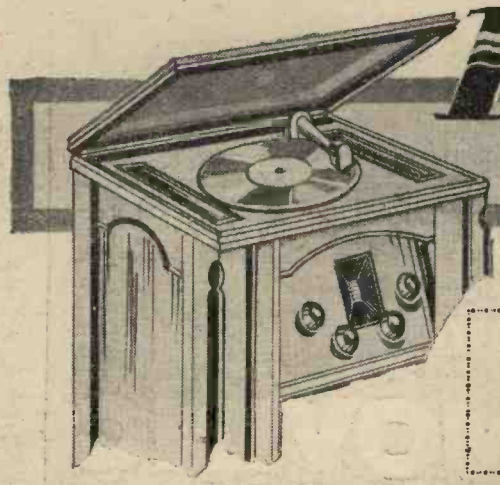
RECEIVERS AND THEIR RECORDS

The Faraday All-electric, All-wave Super-het. Model S620

(Continued from page 382.)

"Detectortips"

WHEN you wish to make fixed condensers of your own—a job that doesn't pay, but is sometimes done—the drilling of the mica sheets will present something of a problem. If you clamp the mica between two pieces of wood and drill through the wood as well, a perfect hole results which has no frayed edges. The same tip applies to hard, or common ebonite. If you disconnect the loud-speaker from your set while it is working—a bad practice if you use a pentode, because of the peak voltage rise on open circuit—you will perhaps hear the phenomenon of the singing choke, presuming you use choke-filter output. This is very interesting, but see that the core of your L.F. choke and the core of your L.F. transformer are at right-angles, or interaction will take place.



RADIOGRAM RECEIVERS

A RADIOGRAM CONVERSION

By S. J. GARRATT

THERE must be a great number of listeners whose station has grown by the addition of accessories from time to time, until it has become a collection of units, which together give perfectly satisfactory results although the *tout ensemble* presents a somewhat untidy appearance. Every addition or modification, although improving performance, usually has an adverse effect on appearance.

The writer's set being at this stage, and the household powers having expressed a desire for a "nice radio gramophone like Mr. So-and-so has," it became a matter for consideration whether the family gramophone and the wireless "paraphernalia" could be combined into a satisfactory instrument, thus avoiding the construction or purchase of a new one. The wireless outfit consisted of a 3-valve set in a plain box case, an H.T. battery eliminator, an accumulator with trickle charger and a moving coil speaker. The gramophone was of the type shown in the illustration, the right-hand half holding the gramophone with the trumpet below, the mouth of the latter being fitted with louvres and a door; the left-hand half held a nest of cells for storing records. When the gramophone trumpet and louvres were removed there was found to be just sufficient room for the set in this position. The ebonite panel was about ¼in. too wide and left about 1in. of space at the top; the panel and baseboard were reduced to the required amount in width, and the space at the top of the panel filled in with a piece of ¼in. fretwood, French polished to match the cabinet. The set simply slides into position, and is kept in place by small blocks of wood screwed to the floor of the cabinet.

Fitting the Pick-up.

The gramophone tone arm was removed and a "pick-up" fitted in its place, this being wired to the grid of the detector valve, as shown in Fig. 2. The two-way switch with a dial plate marked "Radio" and "Gramo," also the potentiometer were both mounted on the panel of the set. It is necessary to provide a special grid bias battery for the pick-up, because when working on "Radio" the valve is a detector and is fitted with a grid leak, but when working on "Gramo" the valve is used as an amplifier and therefore requires grid bias to give good results.

The object of the potentiometer is to provide a volume control for the gramophone, and it should have a resistance of from 50,000 to 100,000 ohms, depending upon the characteristics of the pick-up, and the maker's instructions should, of course, be followed on this point. The record storage cells being removed from the cabinet, a compartment was exposed large enough to accommodate the H.T. unit, trickle charger and the accumulator. It would, of course, be simpler to use a combined H.T. unit, instead of a separate L.T. accumulator and charger, but this improvement may materialise at a later date.

Access to this compartment was obtained from the top, and a polished mahogany cover was made to form a removable lid.

(*Continued on page 418.*)

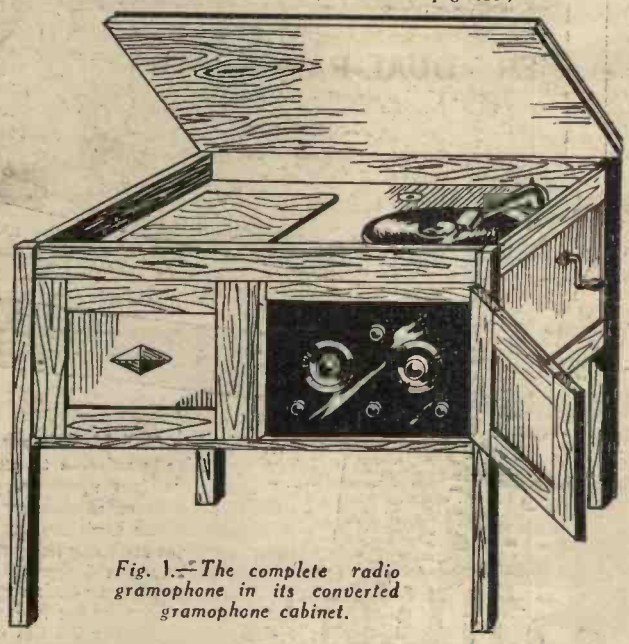


Fig. 1.—The complete radio gramophone in its converted gramophone cabinet.

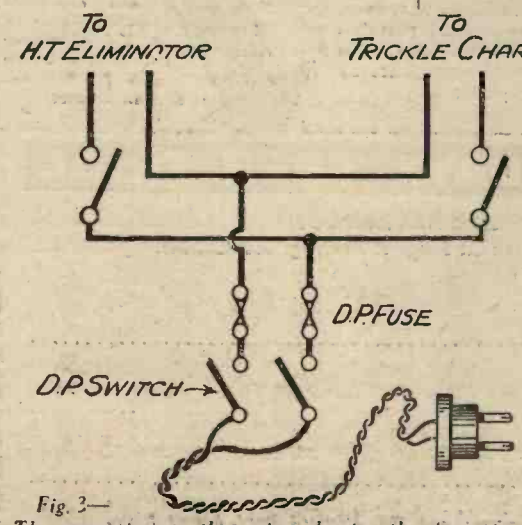


Fig. 3—The connections to the mains, showing the fuses inserted in both mains leads.

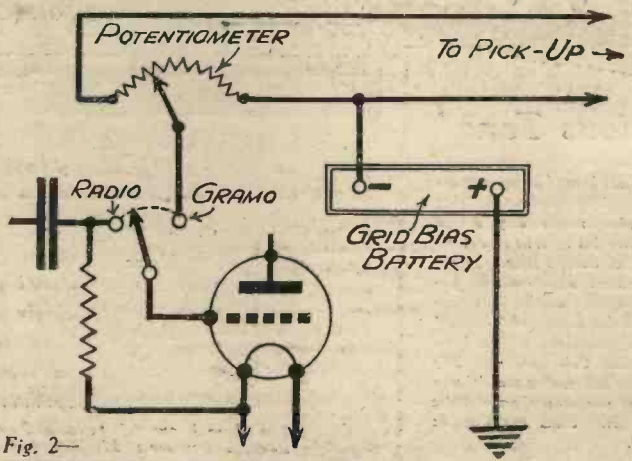
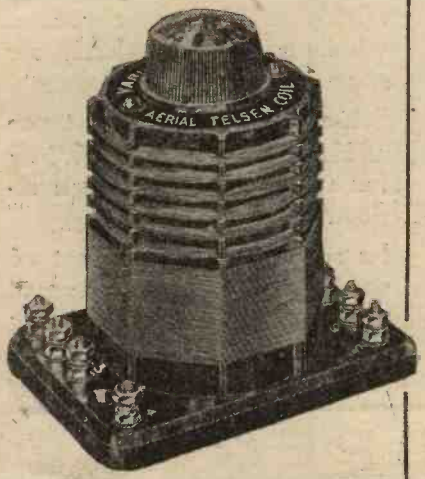


Fig. 2—Diagram of connections of the pick-up, volume control, etc.

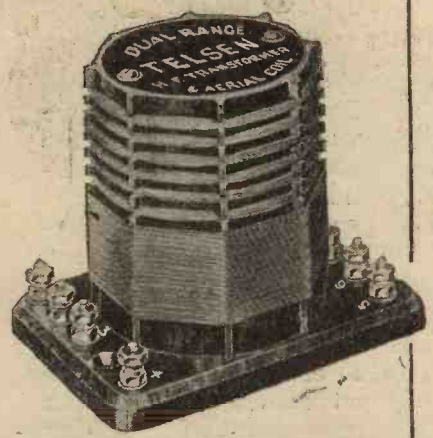
TELSEN

DUAL-RANGE COILS



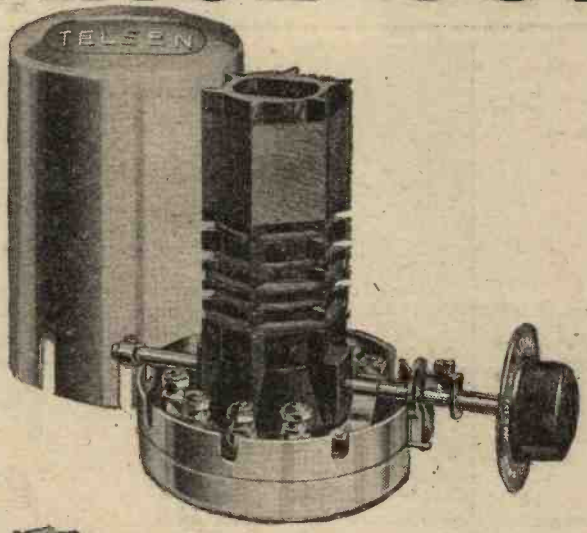
TELSEN DUAL-RANGE AERIAL COIL

Incorporates a variable selectivity device, making the coil suitable for widely varying reception conditions. This adjustment also acts as an excellent volume control, and is equally effective on long and short waves. The wave-band change is effected by means of a three-point switch, and a reaction winding is included **7/6**

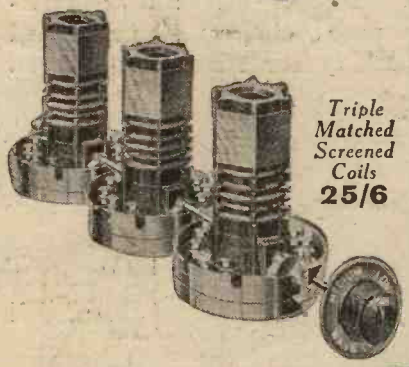


TELSEN H.F. COIL

May be used for H.F. amplification with Screened-Grid Valve, either as an H.F. Transformer or, alternatively, as a tuned grid or tuned anode coil. It also makes a highly efficient Aerial Coil where the adjustable selectivity feature is not required **5/6**



Twin Matched Screened Coils **17/-**



Triple Matched Screened Coils **25/6**

TELSEN SCREENED COILS

The result of much research and experiment, these coils embody the ultimate efficiency attainable in a perfectly shielded inductance of moderate dimensions. Provided with separate coupling coils for medium and long waves, they are suitable for use as aerial coils or as anode coils following a screened-grid valve, giving selectivity comparable only with a well-designed band-pass filter. The coils are fitted with cam-operated rotary switches with definite contacts and click mechanism, and are supplied complete with aluminium screening cans, bakelite knob, and handsome "Wave Change" escutcheon plate, finished in oxidised silver **8/6**

Full instructions are supplied with every Telsen Screened Tuning Coil, showing you the alternative methods of mounting the coils, either singly or in twin-matched or triple-matched form as required.

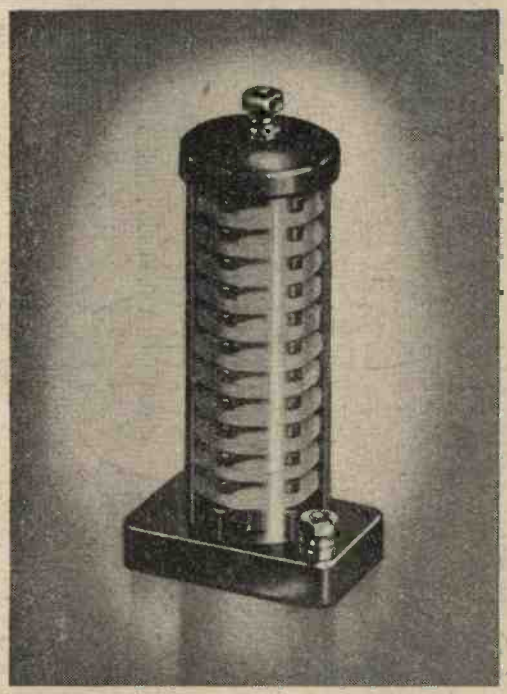
TELSEN

RADIO COMPONENTS

TELSEN RADIO COMPONENTS ARE 100% BRITISH

ANNOUNCEMENT OF THE TELSEN ELECTRIC CO., LTD., ASTON, BIRMINGHAM

READY RADIO S.G. CHOKE



A new H.F. Choke specially designed for screened-grid sets. Highly efficient sectionalised windings almost entirely air spaced.

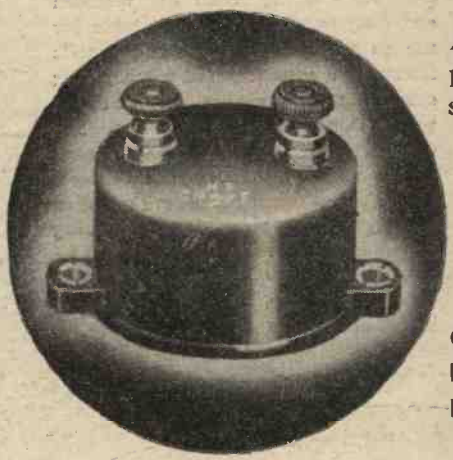
Self-capacity, D.C. resistance and losses are exceptionally low for a choke of such high inductance.

Its specification for a set of so high a calibre as the "Argus", is sure proof of its outstanding quality.

5/6

SPECIFIED for the "ARGUS"

READY RADIO STANDARD H.F. CHOKE



A highly efficient general-purpose choke recommended specially for reaction purposes.

1/6

GO TO YOUR RADIO DEALER FOR YOUR KENDALL-PRICE BOOK AND FOR ALL READY RADIO COMPONENTS

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Post Coupon now and we will send you **FREE** the Kendall-Price 36-page 1/- Book (the size of a normal issue of "Practical Wireless"). It shows you how, at the cost of a few shillings, you can bring your present set right up to date. It contains complete instructions, photographs and diagrams of ten modern circuits, both battery and mains-operated.

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If you wish to have, with your free book, ten full-sized blue prints, enclose 1/- in stamps with this coupon. Prac. W.8.

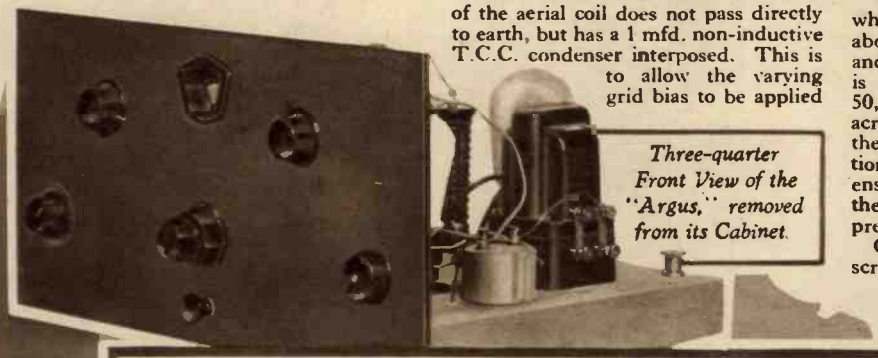
SEE PAGE VII (Supplement)

THE "ARGUS" THREE

A SUPER RECEIVER ON NEW LINES, EMPLOYING TWO SCREEN-GRID AND PENTODE VALVES

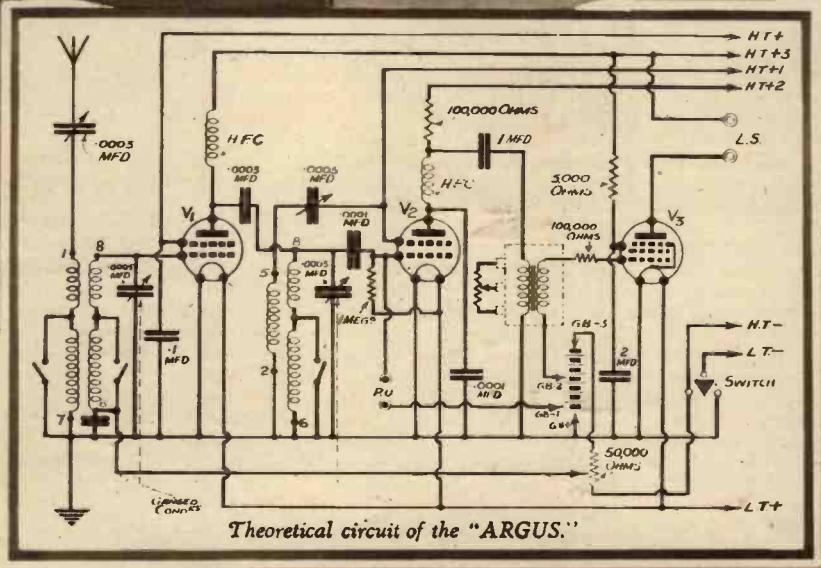
By H. J. Barton Chapple, Wh. Sch., B.Sc. (Hons.), D.I.C., A.M.I.E.E.

I HEAR from the Editor that further details of the "Argus," briefly described last week, are being awaited with great interest, so without further ado let us get down to basic facts.



Three-quarter Front View of the "Argus," removed from its Cabinet.

To appreciate fully all the salient points associated with the Argus, undoubtedly the best plan is to first of all devote a little time to the study of the theoretical diagram. There is nothing really difficult about this task, and even if you are a novitiate to the joys of wireless and not fully cognisant with the component symbols and their meaning, make an effort straight away to master this little circuit.



Theoretical circuit of the "ARGUS."

The Circuit Explained.

Starting at the left we have our aerial lead-in connected to a .0003 mfd. variable condenser, and from here we pass to earth through the primary winding of the first of a pair of Telsen matched coils—both these coils, by the way, being screened. Very complete instructions are issued by the makers concerning these coils, and I must say that in this set they have proved very efficient in performance.

The wavelength ranges covered are 200-550 and 800-2,000 metres respectively, and all the wave-change switching is included in the coil bases, being operated by a knob on the front panel connected to a rod passing through the coils.

The secondary of the aerial coil is tuned by one .0005 mfd. section of the twin-gang Jackson condenser. This condenser is completely shielded in a metal case, and it is a very easy matter to match up the tuned circuits quite accurately.

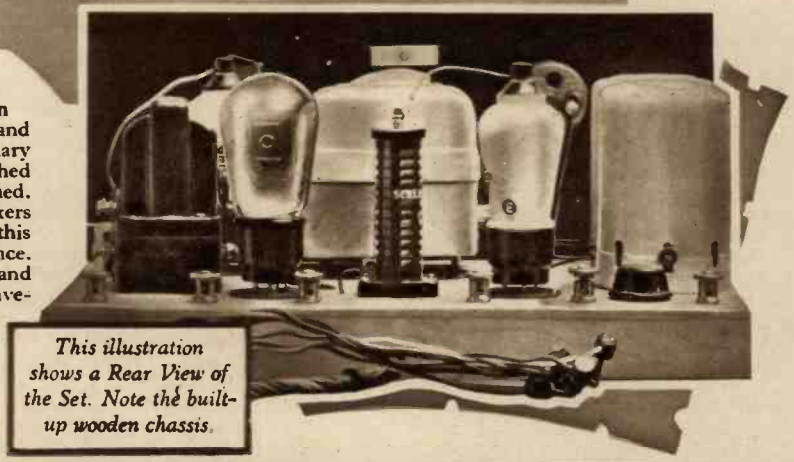
It will be noted that terminal No. 6 of the aerial coil does not pass directly to earth, but has a 1 mfd. non-inductive T.C.C. condenser interposed. This is to allow the varying grid bias to be applied to the variable mu valve—a Cossor 220VSG. As the negative bias is increased there is a progressive decrease in the mutual conductance of the valve and hence in the amplification furnished.

This gives a form of volume control which does not affect tuning, and brings about a minimum of H.F. distortion and cross modulation. The bias control is obtained through the medium of 50,000 ohm potentiometer shunted across the 16.5 volt grid bias battery, the three-point on-off switch connections indicated on the right of the diagram ensuring that the circuit is broken when the set is not in use, thus preventing a premature demise of the G.B. battery.

Our screened grid H.F. valve has its screening potential applied from the H.T.+ lead, a .1 mfd. decoupling condenser being added as shown. Choke feeding to a tuned detector grid coil is the method of coupling adopted for the "Argus," an arrangement which, in my opinion, always lends itself to good results and greater stability. Nothing more need be said about the tuned circuit here, for it forms the counterpart of the gang switched and ganged tuned arrangement we met on the aerial side.

The Detector Stage.

Coming to the detector stage, however, we see straight away a departure from common practice. A screened grid valve is used and this not only results in an improvement of the selectivity of the set, but also brings about an improvement in the ganging of the tuned circuits. The former is due to the great reduction in



This illustration shows a Rear View of the Set. Note the built-up wooden chassis.

The ARGUS THREE

the damping of the tuned circuit immediately in front of it owing to the very high impedance of the valve. With the ordinary detector valve, unless special precautions are taken, not only is the tuning flat, but the circuit often fails to develop its full voltage.

On the other hand, with a screened grid valve as a detector the handling input power is lower than would be obtained with a three-electrode valve of relatively low impedance. After all, one cannot expect to have all the advantages without an accompanying disadvantage, that is a law of nature. However, to counter any possibility of the valve overloading and in consequence distorting, we have already arranged our pre-detector volume control, that is, the variable mu S.G. valve, so all is well.

Reaction.

For reaction we take our "feed back" circuit, consisting of a .0005 mfd. variable condenser and the reaction winding between terminals 5 and 2 of the Telsen coil, from the screening grid of the valve. Once the correct value of the screening voltage has been determined, as will be indicated later in the operating instructions, the control will be found to eschew completely any fierceness or ploppiness which so often is a bugbear in many sets, and makes station searching difficult.

While discussing the detector stage it is as well to indicate that at this point we have included a pair of pick-up terminals, one terminal passing to the grid of the valve and the other to a G.B. plug for applying the appropriate bias. In the plate circuit of our screened grid valve we have our conventional H.F. choke and small by-pass condenser to earth.

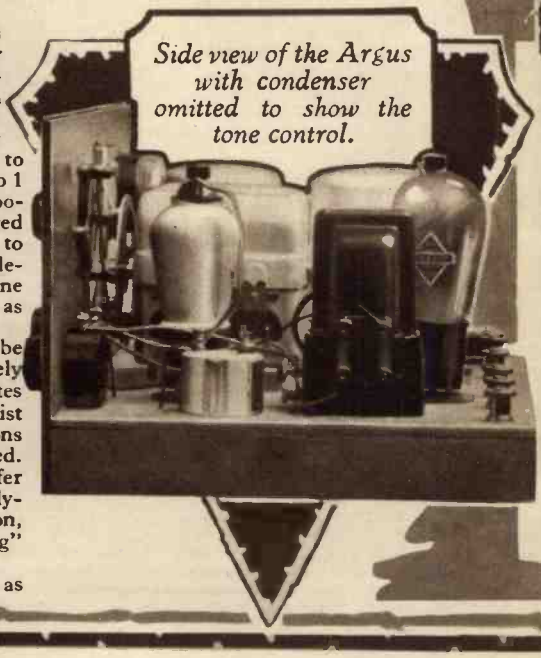
Comes now the low-frequency coupling between the detector stage and the pentode output stage. A moment's thought will show that it is impossible to put the primary of a low-frequency transformer direct in the anode circuit when that primary has been designed to suit the average detector impedance of about 20,000 ohms. The Cossor 220SG valve specified has an impedance of 200,000 ohms, ten times as great, and our resultant amplification would be reduced in proportion.

Volume Control.

The best method of meeting this is to adopt the policy I have used for the "Argus," namely, a resistance-fed transformer. A 100,000-ohm resistance has its low potential end connected to a 1 mfd. coupling condenser, which in turn passes to the primary winding of a Lissen 4 to 1 Hypernik transformer. This component is extremely good when judged by its quality of reproduction, but to meet modern conditions which demand something more, a Lissen tone compensator has been incorporated as well.

Quite frankly I am sure you will be surprised at the way this relatively new Lissen component compensates for any imperfections that may exist in a circuit owing to the conditions under which it has to be operated. The imperfections to which I refer particularly are the effects of sharply-tuned circuits and the use of reaction, and coupled with this the "balancing" of response from the loud-speaker.

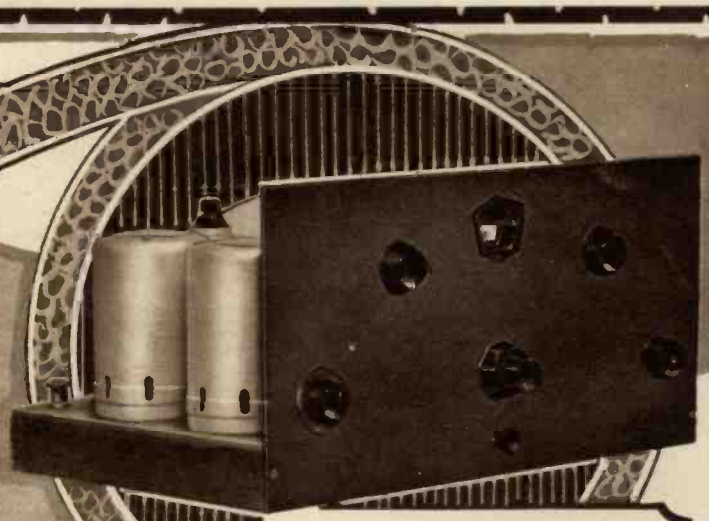
Highly selective circuits, such as are demanded by modern conditions arising from high-powered broadcasting stations, result in a cutting off of the side bands and a diminution of the upper musical register. The same effect is produced by reaction, and the tone compensator corrects this by over-emphasizing the top register. The complete component consists of a moulded base



Side view of the Argus with condenser omitted to show the tone control.

SPECIAL POINTS:

TONE CONTROL
EXTREME SELECTIVITY
POWER WITHOUT DISTORTION
SIMPLE TO OPERATE
LONG REACH
EASY TO MAKE
COMPACT



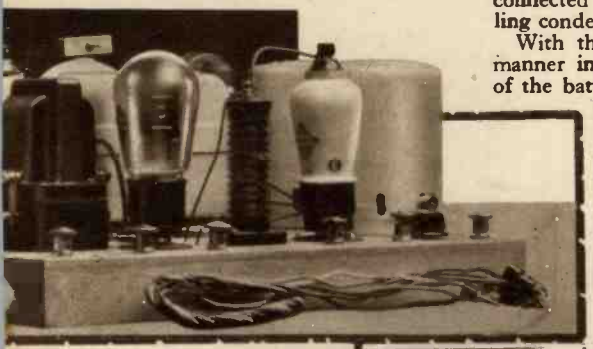
Three-quarter front view of the Argus, showing the neat lay-out of the controls.

on which is mounted the Hypernik transformer and a potentiometer joined by three leads to terminals provided. All the control is effected simply by adjusting the potentiometer knob position, and it works most effectively.

Coming now to the final considerations of our "Argus" circuit, note the inclusion of a grid-stopper resistance in the lead to the grid of the Cossor 230HPT pentode output valve. The voltage to the screen is applied via a 5,000-ohm resistance connected to H.T. +3, with a 2 mfd. decoupling condenser as shown.

With the three-point switch joined in the manner indicated, there is complete isolation of the batteries when the set is not in use, a most important point.

Having completed our critical survey of the circuit used in the "Argus" three-valve receiver, I am sure the appetite of the potential constructor is sufficiently whetted to make him want to make a start on construction, so that must be the next stage.



Three-quarter rear view of the Argus.

Constructional Details.

As will be seen from the photographs and accompanying diagrams this part of the work is in no way difficult. Just exercise a little care and patience and follow the drawings and all will be well.

In order to avoid congestion of components, a sub-baseboard wiring scheme was decided upon. The main baseboard is made of five-ply being 14 inches long and 9 inches deep. The *top edge* of this is raised 1½ inches from the bottom edge of the panel by three wooden battens screwed to the underside of the baseboard along the two shorter sides and along the back edge.

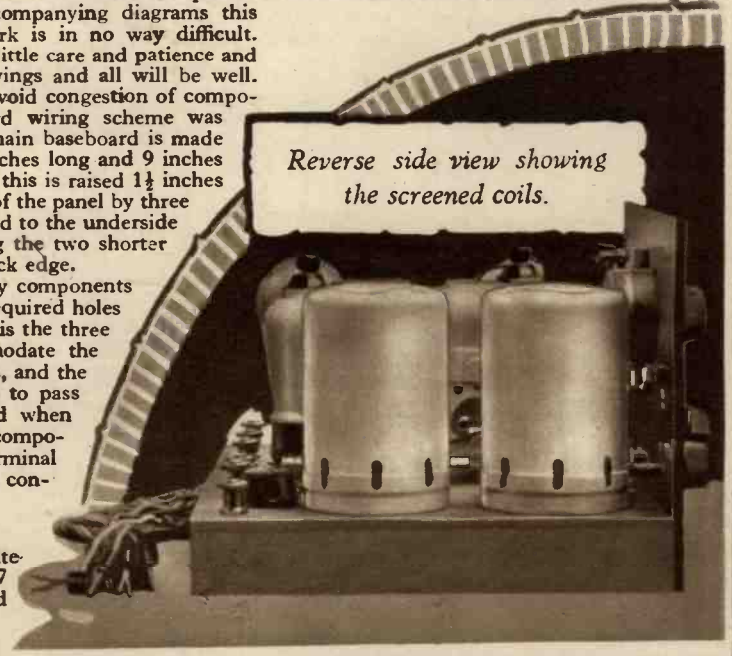
Before mounting any components in place, drill all the required holes in the baseboard, that is the three large ones to accommodate the three Clix valveholders, and the smaller ones for leads to pass through the baseboard when connecting up the components, and also the terminal holes, and series aerial condenser hole.

The Panel.

Now take the ebonite panel 14 inches by 7 inches by ⅛ inch, and drill the appropriate holes exactly as given in the panel-drilling diagram. Remember that in the case of the variable condenser there is a template supplied and this will help you for this part of the work. Now mount all the panel components in place and lay this on one side for the moment.

Mounting the Components.

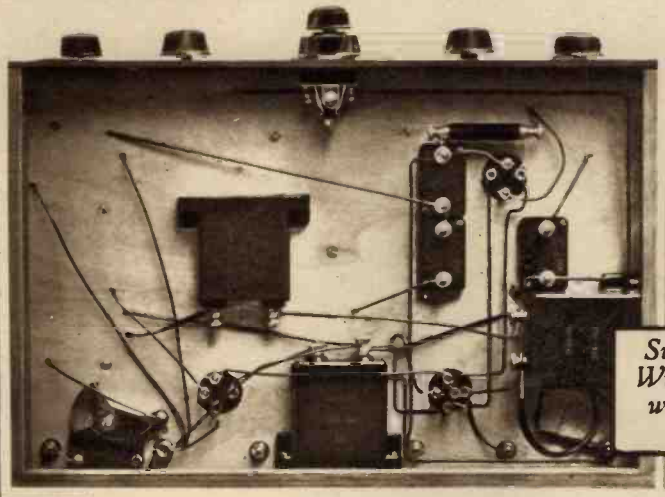
In mounting the components above and below the baseboard there are one or two points which need to be watched by the constructor in order to simplify the work. First of all the variable condenser. Remove the terminal just below the trimming wheel and screw it on the opposite side of the front



Reverse side view showing the screened coils.

LIST OF COMPONENTS

Panel: Ebonite, 14in. x 7in. x ⅛ in.
1 Pair Telsen Twin matched coils.
1 J.B. 2-gang .0005 mfd. variable condenser.
1 Lissen Hypernik 4-1 L.F. Transformer, with Lissen tone Compensator.
1 Ready Radio S.G. Choke.
1 Bulgin Midget H.F.8. Choke.
2 Polar "Compax" condensers, .0003 mfd. & .0005 mfd.
1 Lewcos 50,000 ohms Potentiometer.
1 T. C.C. .0003 mds. Fixed Condenser type S.
1 T.C.C. 2 mfd. Fixed Condenser type 50.
2 T.C.C. .0001 mfd. Fixed Condenser type S.
1 T.C.C. 1 mfd. Fixed Condenser type 50.
1 T.C.C. .1 mfd. Mansbridge Condenser type No. 50.
1 Graham Farish 1 meg. Ohmite Resistance.
Bulgin Spaghetti Resistances, one 5,000, one 20,000 and two 100,000 ohms.
1 Ready Radio 3-point Switch.
2 Clix 4-pin Chassis Mounting Valve Holders.
1 Clix 5-pin Chassis Mounting Valve Holder.
6 Eelex Terminals: L.S. positive, L.S.—, Two Pick-up, Aerial, Earth.
4 Eelex Wander Plugs: G.B.—1, G.B.—2, G.B.—3, G.B. plus.
1 Belling Lee 7-way Battery Cord, with terminals, marked H.T. plus, H.T. plus 1, H.T. plus 2, H.T. plus 3, H.T.—, L.T. plus, L.T.—.
2 Coils, Lewcos, Glazite.
1 W.B. Senior Model 4-pole Balanced Armature Speaker in oak cabinet.
3 Cossor Valves: 230 V.S.G., 220 S.G., 230 H.P.T.
2 Ediswan Batteries, 16.5-v. and 120-v. H.T.
1 Ediswan 2-v. L.T. Accumulator.
1 Tin of Filt for Earth (Graham Farish).
1 Clarion "Argus" Cabinet and Baseboard.

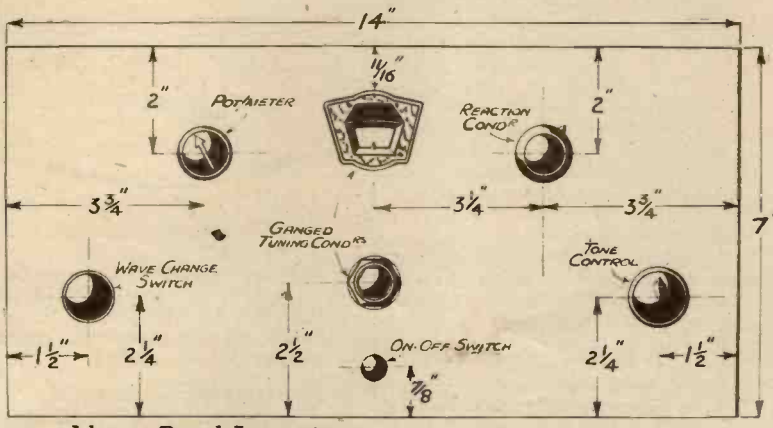


Sub-Baseboard Wiring, compare with Diagram on p. VIII.

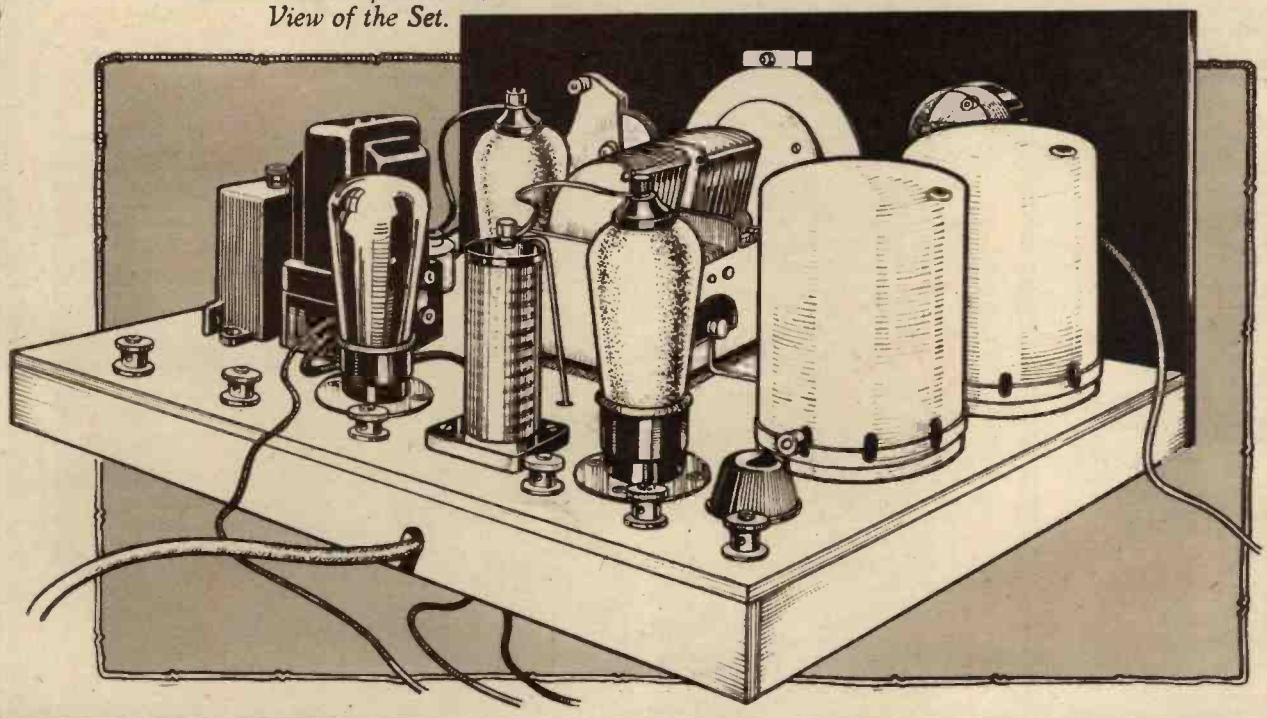
section of the dual condenser. One of the small screws should be removed from the bakelite strip and the two changed round.

Three bolts—4BA and ⅝ inch long, will be required to attach the condenser to the baseboard, it being raised from the wooden surface with the three distance pieces provided. In addition, one of the bolts supplied with the condenser must be screwed into one of the holes on the right-hand side (facing back) for the attachment of the earthing lead.

Coming now to the Telsen coils, remove the two bolts and put on one side each aluminium plinth, as these are not required. Use the aluminium base of the coils to mark out the holes for the leads and, if you can, it is really better to obtain long bolts to hold down the base. On the other hand, wood screws are almost as efficient and will save drilling the holes to accommodate the bolts. The makers of these coils issue very complete instructions for attaching the gang switching rod and it is therefore unnecessary to set this down here. Just follow the details given and notice from the photographs how the switch stop, spacing collar and washer are fitted. It is really better to leave the question of attaching the coils until the last to avoid any possibility of damage.



Above: Panel Layout.
Below: Three-quarter Rear View of the Set.



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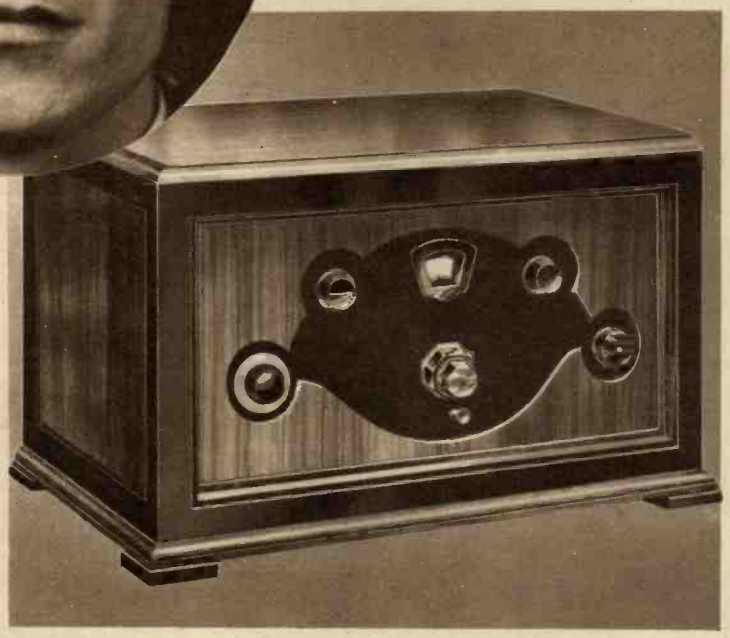
CASH : C.O.D.
EASY PAYMENTS

	£ s. d.
1 Pair Telsen twin matched coils	17 0
1 J.B. Unitune 2-gang ·0005 mfd. variable condenser. 2069	18 6
1 Lissen Hypernik 4-1 L.F. Transformer with Lissen tone Compensator	1 2 6
1 Ready Radio S.G. Choke	5 6
1 Kinva Standard Screened Choke	2 9
1 Ready Radio Bakelite condenser ·0005 mfd.	2 6
1 Ready Radio Bakelite condenser ·0003 mfd.	2 3
1 Lewcos 50,000 ohms. Potentiometer	3 0
2 T.C.C. ·0003 mfd. fixed condensers type S	2 6
1 T.C.C. ·0001 mfd. fixed condenser type S	1 3
1 T.C.C. 1 mfd. Mansbridge condenser type No. 50	2 10
1 T.C.C. 2 mfd. Mansbridge condenser type No. 50	3 10
1 T.C.C. ·1 mfd. Mansbridge condenser type No. 50	1 10
1 Dubilier 1 meg. resistance	1 0
1 Lewcos Spaghetti resistance 5,000 ohms.	1 0
1 Lewcos Spaghetti resistance 20,000 ohms.	1 6
1 Lewcos Spaghetti resistance 100,000 ohms.	1 6
1 Ready Radio 3-point switch	1 6
2 Clix 4-pin chassis mounting valve holders (with terminals)	1 4
1 Clix 5-pin chassis mounting valve holder (with terminals)	9
6 Belling Lee terminals LS : LS—; two Pickup; Aerial; Earth	1 3
4 Belling Lee Wander Plugs. GB—1; GB—2; GB—3; GB	6
1 Belling Lee 5-way battery cord with plugs marked HT+; HT - 1; HT - 2; HT - 3; HT—; LT—; LT	2 0
2 coils Lewcos connecting wire	8
Mullard valves :—PM12V; PM12; PM22A	2 10 6
1 "159" Cabinet	1 0 0
1 Easyfix Baseboard and special Panel drilled to specification	2 9
Flex, screws, etc.	6
1 Calibrator Easy Station Finder (no charge)	
	£8 13 0

RECOMMENDED ACCESSORIES

Siemens H.T. Battery	13 6
Oldham 0·50 Accumulator	9 0
Siemens G.B. Battery	1 0
"Cop" Aerial and lead-in tube	2 6
Selectant Indoor Aerial	2 6
Selectant Earth	1 6
Epoch 20th Century Permanent Magnet Moving Coil Speaker	1 15 0
Atlas A.C. 244 Eliminator	2 19 6
Atlas A.K. 260 Eliminator	4 10 0

	£ s. d.
KIT No. 1 (less valves and cabinet)	5.2.6
or 12 monthly instalments of	9.6
KIT No. 2 (with valves less cabinet)	7.13.0
or 12 monthly instalments of	14.0
KIT No. 3 (with valves and cabinet)	8.13.0
or 12 monthly instalments of	16.0



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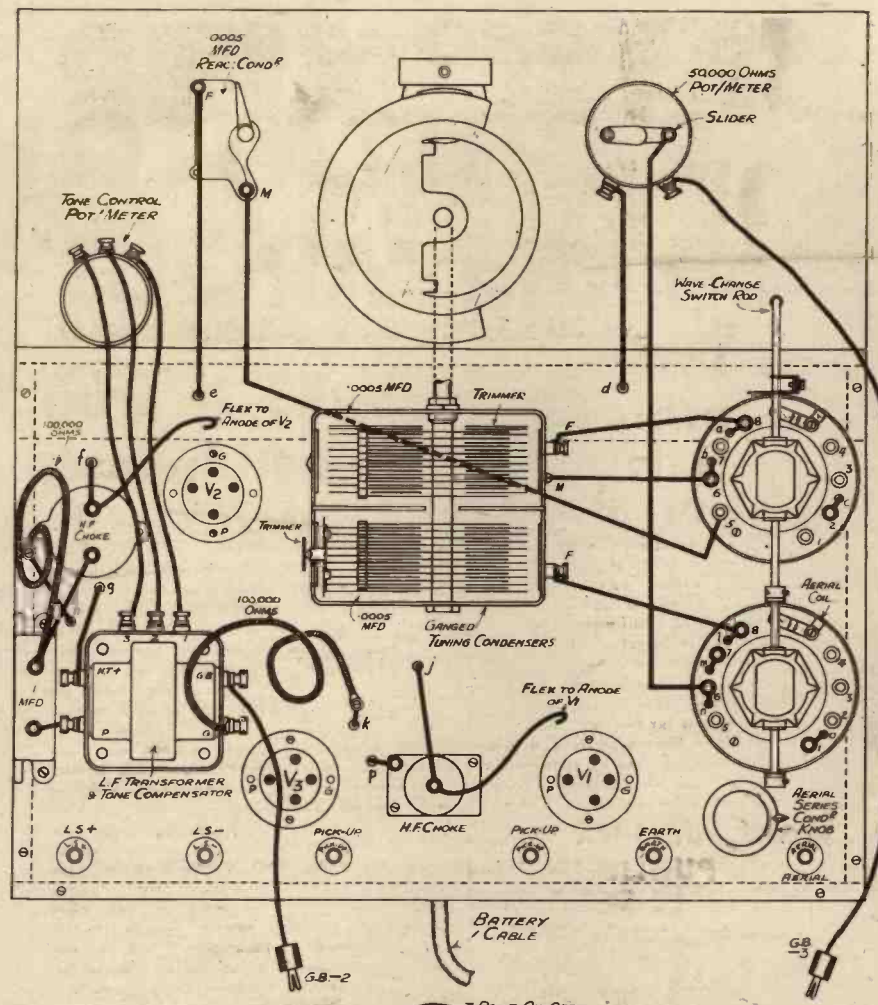
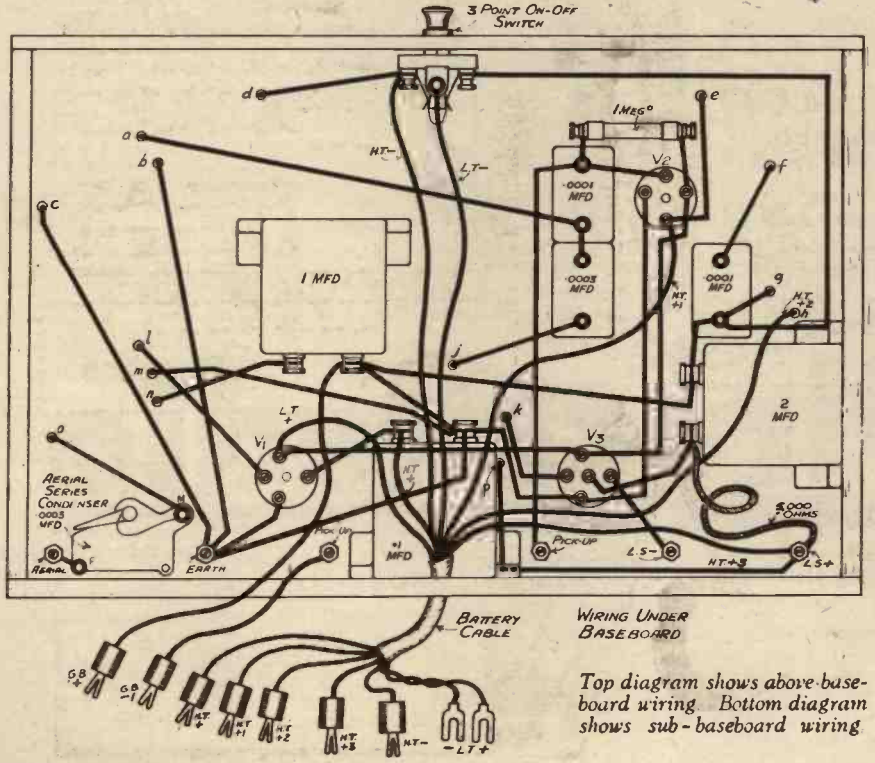
NAME.....

ADDRESS..... *Practical Wireless.* 12/11/32

159 BORO HIGH STREET LONDON BRIDGE





WIRING UNDER BASEBOARD

Top diagram shows above-baseboard wiring. Bottom diagram shows sub-baseboard wiring.

Screw every other component in place, mounting the Lissen Hypernik transformer on the tone compensator base. This is an easy matter if the wiring plan is followed exactly, and be sure to leave clear the holes passing through the baseboard for wiring.

Wiring.

Everything is now ready for the last lap—the wiring. Here, again, make full use of the wiring diagrams and photographs and carry out as much of the wiring as is possible before attaching the panel. Make all your leads straight wherever you can, and use neat right-angled bends when changing wire direction.

Do not attempt to accommodate two Lewcos wires in the valveholder slots—pass the wire right through and just bare it where connection is made. It is really advisable to follow carefully each wire which passes through a valveholder slot, cut off the length required, bare where connection is to be made, and in this way save any junctions.

It will be noticed in the under baseboard wiring diagram that one terminal of the by-pass condenser is used as a junction point for a few of the earth leads. This will save long wires running all over the baseboard.

Anchoring the Leads.

A small round-head screw with a washer (or a soldering tag removed from one of the components, since no single soldered connection is made) will serve to anchor the spaghetti and H.T. lead in each case.

Now attach the panel and complete the wiring, drilling a hole in the centre of the wooden strip at the back so as to pass through the battery cord. Make sure you connect the right coloured lead to the appropriate points so as to correspond with the plugs at the other end of the cord. Since the grid bias battery is to be accommodated in the top of the wireless cabinet, make your G.B. leads of sufficient length for this.

All should now be complete, but I strongly advise you to re-check each wire to insure you are quite immune from sins of omission or commission. Once satisfied that you have an exact replica of the original set, prepare for an aerial test, and full instructions for this, together with detailed operating instructions, will appear in the next issue.

SIMPLE APPARATUS FOR MEASURING RESISTANCES

How to Test Home-made Resistances by Means of an Easy-to-make Arrangement. By W. NEWBY

THE small instrument described in this article can be used for measuring resistances. The components required can be found in most wireless junk boxes, or purchased second-hand. It is needless to stress the importance of resistances, and this easily-constructed instrument, based on strictly scientific principles, is capable of measuring them quickly and cheaply. Not only can resistances now be checked, but home-made ones can be made and tested, which will considerably cut down wireless expenses.

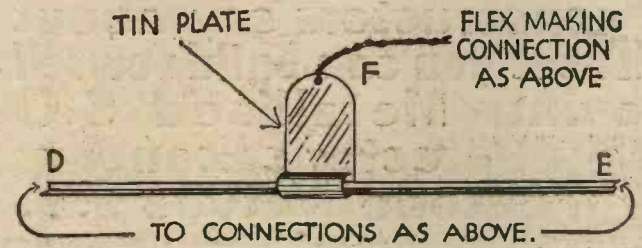


Fig. 2.—How to use a straight length of wire and a clip instead of the potentiometer shown in Fig. 1.

The essential part of the apparatus consists of a potentiometer and two holders, mounted on a wooden baseboard. One holder takes a standard resistance, and the other takes the unknown resistance. Of course, the holders, clips, terminals, etc., will be modified according to the nature of the resistance. The baseboard is then wired up as shown in Fig. 1, ordinary copper wire being used. The moveable arm of the potentiometer is made to move over a circular scale, which is divided up into a convenient number of units, say fifty.

Using the Instrument

The instrument is now ready for use, and is connected up as indicated in Fig. 1, an accumulator being used for the battery. The known resistance is placed at A and the unknown at B, and the headphones put on. Upon breaking any part of the circuit a clicking will be heard; the best part of the circuit to break is the battery circuit, as a saving in current will result. By tapping the wire on the battery terminal, a loud clicking will be heard. The object of the experimenter is now to move the arm of the potentiometer until the clicking cannot be heard. If the resistances are high, this may cover an area of about a quarter of an inch, but by taking the average of the extremes, this difficulty can be overcome. By noticing the reading of the scale, we are in a position to calculate the number of units to the right and to the left of the arm, and by substituting these in the given formula, the value of the unknown resistance is found.

A Modified Arrangement

The apparatus can, of course, be modified, for if a potentiometer is not available, a straight length of wire will do. Then the arm of the potentiometer is replaced by a "jockey" (see Fig. 2), and the measurements made directly with a ruler. The method of procedure is the same, except that instead of moving the arm of the potentiometer, the jockey is tapped along the wire until no tappings are heard. The resistance of the wire must, of course, be comparable with that of the potentiometer, so that copper wire is useless. German silver wire is admirable for the purpose.

With a little experimenting, resistances ranging from 20 to 3,000,000 ohms can be made and tested. This, of course, is a great boon to the wireless experimenter. The lower resistances are made of coarsely grounded carbon and copper sleevings, while the higher ones consist of heavily scribbled pencil lines, about a quarter of an inch in length and width.

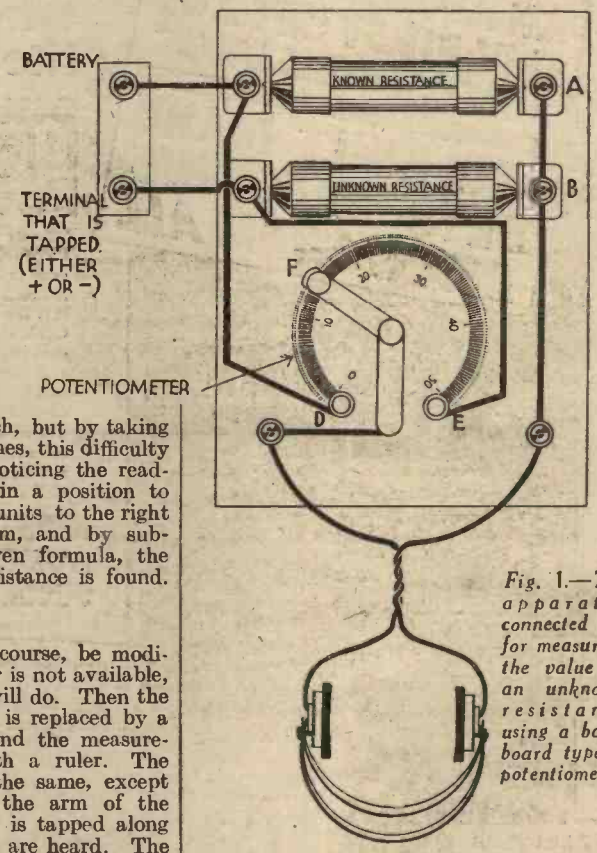
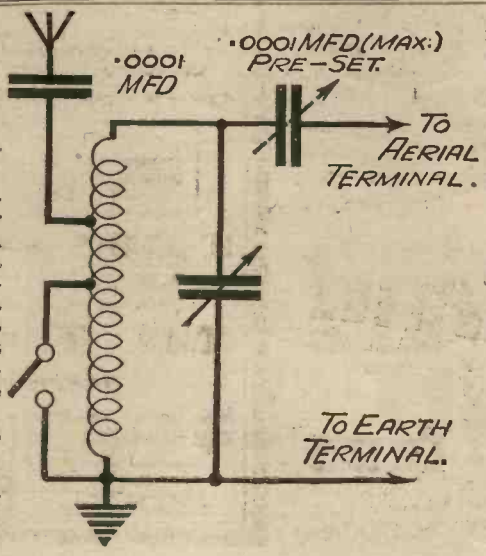


Fig. 1.—The apparatus connected up for measuring the value of an unknown resistance using a baseboard type of potentiometer.

A BAND-PASS CONVERSION SCHEME

IF you have a receiver which is not sufficiently selective for the excellent winter reception conditions now prevailing, and you do not wish entirely to re-design it, a great improvement can be effected by converting the single circuit aerial tuner into a band-pass filter. The conversion need not make it necessary to scrap the present tuner, but merely to add another one consisting of a coil and tuning condenser. The circuit arrangement is shown herewith, where it will be seen that band-pass coupling is on the top-capacity principle, the capacity being provided by a small pre-set condenser. When the latter condenser is set to its minimum position, tuning will probably be so sharp as to mar high-note reproduction, but by slightly increasing the capacity it will be possible to find a position which gives the true band-pass effect. It will be seen that it is only necessary to transfer the aerial and earth leads from the set to the extra tuner, and to connect the output from the latter to the usual aerial and earth terminals.



Tuning will be a little more difficult, because both condensers will have to be operated more or less simultaneously, but the conversion is well worth while. Any kind of dual-range tuner will do for the additional circuit, but if one is chosen similar to that in the set, both condensers will work more accurately in step.

Use Once Only

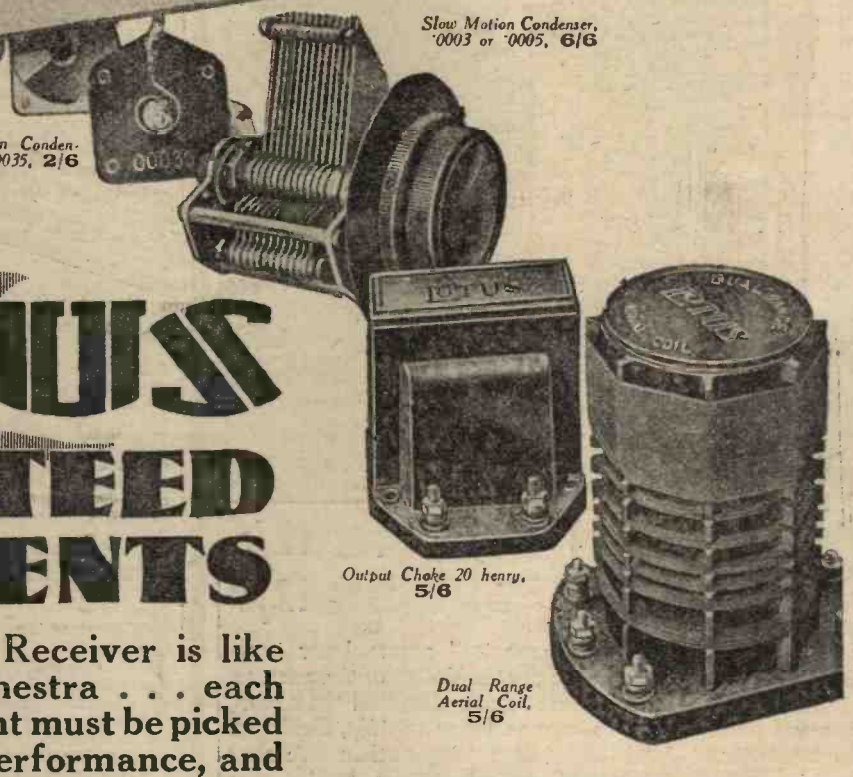
I WONDER how many gramophone records become "scratchy" prematurely? In many cases the reason is that the user ignores the "use each needle once only" warning. The "once" means *one side*, not one record.

NO GUESSWORK!

LOTUS Guaranteed Components, specified by all the leading designers of the day, represent a short cut to certain success in set building. They are matched to work in perfect unity and the result is absolute fidelity and balance.

Slow Motion Condenser, ·0003 or ·0005, **6/6**

Miniature Reaction Condenser, ·00015 or ·00035, **2/6**



Output Choke 20 henry, **5/6**

Dual Range Aerial Coil, **5/6**

with LOTUS GUARANTEED COMPONENTS

Building a modern Radio Receiver is like forming a Symphony Orchestra . . . each member and each instrument must be picked separately for individual performance, and the whole must work in complete harmony and under perfect control. When you build with LOTUS Components you guarantee the performance of the completed set

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Please send illustrated lists of LOTUS GUARANTEED COMPONENTS and "Landmark 3" Kit. I enclose 6d. for Wiring Chart. (Strike out if not required.)

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The Wonder KIT SET *of* 1932

"LANDMARK 3"

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Build it in an hour with only Screwdriver and Pliers . . . then switch on . . . and the kaleidoscope of programmes, rich in variety and interest, is yours to command! NOW . . . this very moment . . . get to know more of this amazing Kit Set!

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The BEGINNER'S SUPPLEMENT

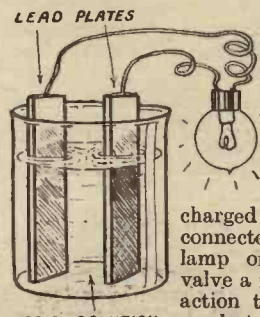
Conducted by
F. J. CAMM

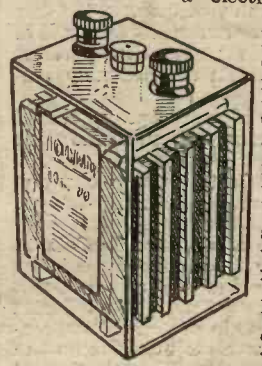
THE BEGINNERS ABC OF WIRELESS TERMS

This special beginner's supplement has been introduced in response to a general request from hundreds of readers who have only just commenced to take an interest in wireless construction. In it we propose to explain, week by week, in very simple language, facts about the various aspects of the practical side of wireless. To the many thousands who cannot yet understand the circuits or terms used in connection with wireless we extend a cordial helping hand.

Accumulator

IN its simplest form consists of two lead plates immersed in a weak solution of sulphuric acid. When the two lead plates are connected by wires to a dynamo or other source of electricity, a chemical action takes place. When this is complete the accumulator is said to be "charged" and is disconnected from the supply of electricity. If the charged accumulator is connected to an electric lamp or to a wireless valve a reverse chemical action takes place, and a electrical current is produced which lights the lamp or heats the filament of the wireless valve. This lasts until the accumulator is "discharged," when it must be charged again before it will give any more current. Accumulators used in wireless often have more than two plates. These are specially constructed in order to hold a large charge. An accumulator is often wrongly termed a storage battery, but it does not really store electricity. It is the chemical action which produces the current.





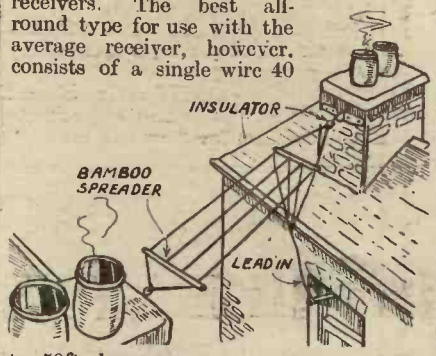
The filaments of valves in wireless receivers are heated by the current from what is called the low-tension battery. This is usually a single accumulator. A number of very small accumulators joined together are sometimes used to form a "high-tension battery," which is used in place of the more usual high-tension battery composed of dry cells.

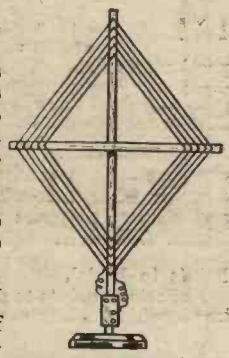
Acoustics

The science of sound. A loud-speaker with good acoustical properties is one which responds well to all sounds.

Aerial

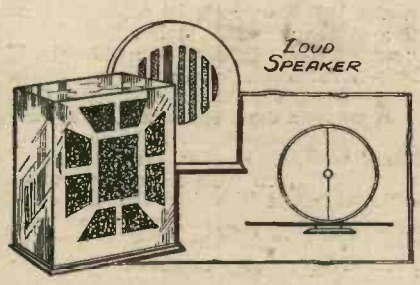
A wire or wires, usually suspended as high above the ground as possible, which is used to radiate or receive wireless waves. The aerial is insulated from the earth except for the connection to the transmitting or receiving station. There are many different types, from the huge broadcasting aerials, sometimes as high as 800ft. and supported by eight or ten masts, down to the small frame aerial used with super-heterodyne and similar receivers. The best all-round type for use with the average receiver, however, consists of a single wire 40 to 50ft. long, parallel with the ground, and suspended as high as possible. If it is not possible to erect a single-strand aerial as long as this, more than one strand may be used, as shown in the illustration. The wires are joined together at one end to form the lead-in. Other types of aerials are: umbrella aerial, beverage aerial, "T" aerial, loop aerial for direction finding, and mains aerial, etc.

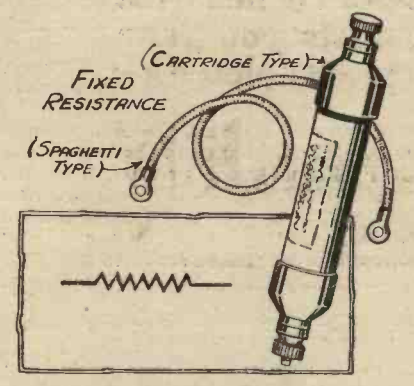




Wireless Shorthand—3

The beginner in wirelesss soon encounters difficulty in reading the mystic symbols which the set designer uses in combination to form the circuit. The circuit consists of a number of conventional signs linked together, and this short series of pictoriol diagrams will enable the beginner to recognise what they mean.





Alternating Current

Abbreviated as "A.C." An alternating current is a current of electricity which flows first in one direction and then in the opposite direction. It starts in one direction from zero and gradually increases to its maximum value. It then dies down to nothing again. After this it starts in the opposite direction, reaches its maximum value, and once more subsides, and so on, rising and falling first in one direction and then in the other. One complete change is called a *cycle*, and the number of complete cycles which occur in a second is called the *frequency*. The alternating current from the ordinary electric light mains changes its direction at the rate of about fifty cycles per second.

You cannot measure an alternating current by means of an ordinary ammeter, like you can a direct current. You know, for instance, that when measuring a direct current, say from the battery of a

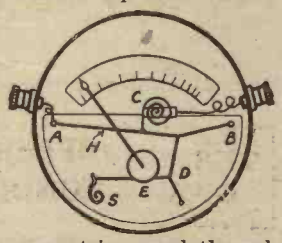
motor-car, that if you change the direction of the current going through the meter, the needle will swing in the opposite direction. With an alternating current its direction changes so rapidly that the needle cannot follow it, and so remains stationary. What is done, therefore, is to make use of a certain property which both direct and alternating currents have in common, and that is that they heat a conductor when passing through it. This principle is used in what is known as a Hot Wire Ammeter. This instrument contains a small piece of special resistance wire through which the current passes. The wire becomes hot with the passage of the current and naturally expands. In expanding it sags, and a small spring, "S," which is indirectly attached to it, takes up the slack and in doing so works a pointer. (See Fig. 1.)

Alternator

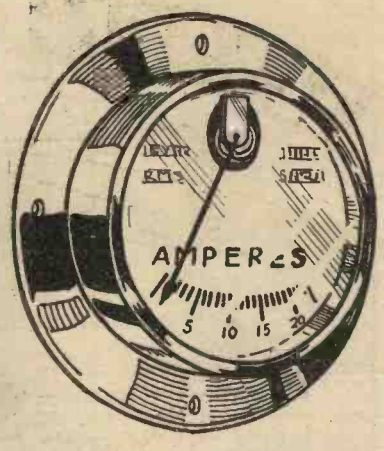
A dynamo which produces alternating current.

Ammeter

An abbreviation for "ampere meter." It is an instrument for measuring current in "amperes." There are several types. One, known as a *moving coil* ammeter, has a small coil of wire suspended between the poles of a powerful permanent magnet. When the current passes through this coil, which is on pivots, it swings round in the magnetic field. The heavier the current the greater is the movement, and this is recorded on the scale by means of a light aluminium pointer carried by the coil.



Another form has a small iron armature in place of the coil, and this revolves between the poles of an *electro* magnet. When a current is passed through the coils of the electro magnet it becomes energized and attracts the iron armature. On disconnecting the instrument, the armature is returned to its normal position by a spring. A pointer is carried by the armature and records its movement on a suitable scale. This type of meter is called a *moving iron* instrument. A third form is designed specially for measuring alternating currents, and is known as a *hot wire* ammeter. (See "Alternating Current.")



HOW TO CHOOSE A SUITABLE L.T. BATTERY FOR YOUR SET

MUCH confusion exists regarding the choice of a low tension battery of the right capacity to suit any particular radio set. A large number of wireless users think more of the price they pay than of the cost of charging and upkeep, or of the suitability of the battery to their radio set. A visit to any battery charging station confirms this, as on the charging table there will be found all sorts and sizes of batteries which are used on similar radio sets.

Points to Watch

Important points to observe in buying a low tension battery are :—

(1) First in importance is the capacity of the battery required. Every battery is used as a storage for the electric current required to work the radio set. Each battery is marked by the makers, giving its storage capacity; this may be 14, 40 or 100 ampere hours. Practically speaking, this means that if the discharge from these batteries is 1 ampere, then these batteries would run 14, 40 or 100 hours when in use. The capacity necessary for any particular radio set will depend on the current required for the valves and the length of time the battery is to run between charges; the latter will, of course, depend on the facilities there are available for charging.

Rate of Discharge

As to the current necessary for the valves, on referring to the notes sent out with the valves by the makers, it will be found that the filament current is clearly stated. If reference is made to the data given with the Mullard P.M.2, it will be noted that the filament current required for this valve is 0.2 amperes.

One well known S.G.4 portable receiver has four valves and the filament current of these valves total approximately 0.65 amperes. If the accumulator or battery is

Some Points to Watch when Purchasing an Accumulator and Hints on Maintenance

16 ampere hours capacity and is fully charged, the battery should give, say, twenty-four hours' service. The Fuller Accumulator Co. (1926), Ltd., in their catalogue W 2, give a very useful table showing at a glance which of their accumulators is suitable for the various currents required by any radio set. As an example, if a radio set in use required to draw 0.75 amperes from the accumulator, then their SW13 accumulator would give eighty hours' service. In the Exide Battery catalogue W, on page 10, a very useful table is given showing the discharge currents recommended for series "D" cells when used for wireless receiving sets. Even if facilities for charging seem to favour small capacity batteries, yet on the score of cost it will, in most cases, pay the user to have batteries of a high capacity.

(2) A large number of radio sets use a 2 volt battery, but reference must be made to the data given with the valves by the makers. For instance, the Mullard PM2 has a maximum filament voltage of 2 volts, the PM4 has a filament voltage of 4 volts, and the DO25 requires the maximum filament voltage of 6 volts. When the voltage is above 2 volts, then further 2 volt cells are connected in series to make up the necessary voltage.

Looking After the Accumulator

Other points to note are :—

(*a*) Terminals. These should be coloured differently, and be non-interchangeable, immune from creeping acid, and the metal parts of the terminals should be protected from corrosion. All battery terminals should be kept well vaselined.

(*b*) Most cases or containers are made of celluloid or glass, for other than portable sets, glass containers are generally preferable.

(*c*) The owner of every battery should have his name clearly written on the name slot.

(*d*) Send your batteries to a charging station where you are certain they will get proper treatment.

There are also a number of points to watch in placing the accumulator in its "home." Remember first and foremost that dangerous fumes are given off from the cell whilst it is in use. By "dangerous" we do not mean injurious to human life—although an excess of sulphuric acid is fatal—but dangerous to certain vital parts of a wireless receiver. For instance, copper and ebonite are both affected by accumulator fumes. Copper becomes eaten away after a lengthy exposure to these fumes, and ebonite becomes discoloured. Therefore, if you value tuning coils wound with fine wire, or are proud of a nice black ebonite panel, take care that the accumulator is stood in a position where there is nothing directly above it.

Use a Tray

As spilt acid can also have a deleterious effect upon most substances, it is also worth while purchasing a rubber tray—a photographer's porcelain dish would also serve—and keep the accumulator standing in this tray or dish as a further safeguard. If you are extremely precautious and believe in being forearmed, perhaps it is as well to keep a quantity of ordinary washing soda handy, so that it may be rubbed into any fabric, etc., upon which acid may get spilt. The soda will neutralise the acid.

Radio Ramblings

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

Music Industries Council

IN connection with the newly-formed Music Industries Council I see that Sir Henry Wood, the veteran conductor of the Promenade Concerts, has agreed to become the first president. The Council will represent every section of the musical community. Makers of music and makers of music-producing instruments will co-operate, and musicians, professors, radio and gramophone manufacturers, musical journalists and printers will work together in the Council for the encouragement of adequate recognition of the cultural and educational value of music in all its forms. Sir Henry Wood is an untiring worker, and will give his fullest support to the wide range of musical activities covered. A Music Trades School is already in existence, where apprentices are taught the craft of instrument-making, and radio and radio-gramophone reproduction is to become an important branch. This is a step in the right direction, and the inclusion of representatives of the radio industry on the Council gives an official status to the position of wireless in musical circles. This is due in no small measure to the vast strides made by manufacturers, amateurs, and the wireless press in the interests of quality of reproduction. Gone are the days when radio was considered an electrical novelty and when the constructor of a wireless set was regarded as being a little out of the ordinary, and it should be the aim of every reader of this journal when demonstrating his set to put out the best quality it is capable of. Never mind getting stations running into three figures or shivering the ornaments on the family "what-not" with the tremendous volume you can obtain *with reaction*. The ornaments may be your pet aversion, but your set will soon be somebody else's pet aversion after a little of this sort of thing.

Heterodyning Troubles with European Transmissions

AN American inventor has made a radio set that has the additional luxury of a map of his country mounted on the top of it with most of the important broadcasting stations marked thereon. The map is fixed to a glass panel, and when a station is tuned in a light appears behind the stations being received, showing at a glance the identity of the signal. The invention is said to be working perfectly, and there is no need to wait for the announcer to come on in order to ascertain from whence the transmission originates. It is not revealed how this happy state of affairs is brought about, but I do think the apparatus should be given a thorough testing in Europe. With the ether in the state it is nowadays, most of the lights would be lit at once, and the current taken by the little lamps would be more than that of the whole set. Seriously, though, the problem is becoming more and more acute. Even with the very best sets there are places on the dials where heterodyning becomes unbearable, which fact testifies that with the huge power of some of our modern stations the official nine-kilocycles separation is insufficient. The result is that in an average household the stations consistently listened to, apart from the British transmissions, could be counted on one hand, and in many cases one may see really powerful sets continually tuned in to the local station or Daventry with the volume control working at the wrong end of the scale.

It may sound retrograde, but I think that it is time a limit was put to the power of our stations until some revolutionary method of transmission or reception is evolved which will give knife-edge selectivity without loss of the side-bands from which real quality is built up. High power was very well when large areas had to be covered, but it becomes a nuisance when stations are springing up next door to one another. You can carry out tests in this direction on your own PRACTICAL WIRELESS set, for you will find that when you accurately tune in a station that is worth getting at all, the volume builds up to an extent altogether too loud for the average house. The result is a rush for the volume control, since de-tuning is no longer possible if only one station at a time is required, and somehow, even with a variable-mu, volume-controlled reproduction seems to me to have lost something by the way.

Radio and the Stratosphere

YOU already know how Professor Piccard used wireless in his journey to the stratosphere, and I understand further tests are being carried out by other observers with captive balloons to obtain true readings of meteorological and other conditions prevailing in the upper atmosphere. The latest type of captive balloon is fitted with a midget transmitting set which continually sends out on a fixed wavelength readings of temperature and other information. These automatic messages are received by observers on terra firma and information recorded. Incidentally, the actual balloon car and the wireless apparatus used by Professor Piccard were recently on view in an unusual radio exhibition held at Copenhagen. Also to be seen was the wireless installation that saved the lives of the flying Hutchinson family.

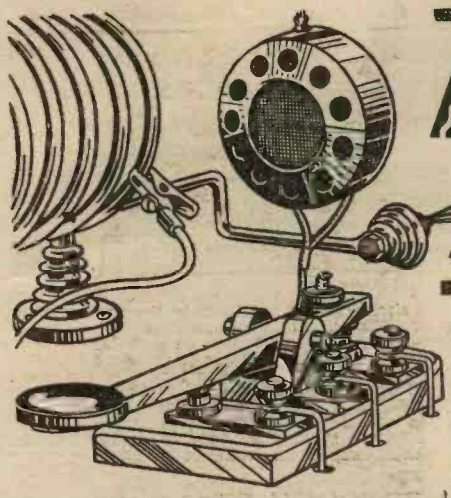
Pick-up Alignment

HOW many gramophone records are ruined by bad alignment of the pick-up? If you use one of the older type of units, which plugs into the gramophone tone-arm, it is well to take some care to see that the needle meets the record at the proper angle — generally about 60 degrees. Of course, it is much better to employ specially made track-arm, but much can be done to improve the tone-arm system by arranging a spring or counter-balance so as to reduce the weight applied to the record through the needle. An adjustable weight on a threaded arm will prove most useful.

(Continued on page 415.)

PIRATES, BEWARE!

An interior view of the latest type of Radio Detecting Van used by the G.P.O. for discovering wireless pirates.



BELOW 100 METRES

HOW TO IDENTIFY SHORT-WAVE STATIONS

By ALF. W. MANN

HOW many new and enthusiastic short-wave listeners find it necessary at times to correct the entries made previously in the Log-book, owing to being unfamiliar with foreign languages? As a rule, it is often the beginner's experience, and quite apart from that, station identification is indeed a problem owing to the increasing number of short-wave transmitters on the air. Several of them make announcements before the microphone in two or more languages, but there are others from which announcements are only made in the language of the country where the transmitter is located, and the fact that listeners in other lands receive the programmes is not taken into account.

One peculiarity familiar to most short-wave listeners is fading, and due to this and changes in the conditions of skip distances, there are certain stations, and in some cases, groups of stations located in different parts of the world, which, during one period of the year, are received at a strength great enough to allow reception through the loud speaker to be accomplished, but during the following period are only to be received at weak head-phone strength.

Data Books Necessary

If the new hand commences short-wave reception during one of the latter periods, he is apt to find station identification a problem, and owing to the difficulties experienced under such conditions, may receive the impression that listening on the short waves is a very much over-rated pastime. Speaking from years of experience, I can definitely state that under average conditions it will be found to be well worth the time and expense devoted to it. Like several other old hands, the writer has—so to speak—grown up with the pastime, and in doing so, has gained a considerable amount of experience, and at the same time, kept pace with the developments of the science. In order to do so, it was found necessary to keep different forms of data books. One of these is devoted solely to data concerning new stations which came on the air from time to time. By concentrated listening, call signs and station announcements are obtained and entered in the data book for future reference, or in order to pass on the information to fellow enthusiasts overseas.

A few extracts from my data book will doubtless assist new enthusiasts to identify some of the better known and most frequently heard transmitters located in different parts of the world. The wavelengths given in all cases are those which the stations concerned are transmitting on during the period in which this article was written. As changes of wavelength take place at intervals, in order to carry out experiments with a view to increasing the range and improving the service of a particular station, it is advisable to check the wavelength given by reference to an up-to-date time schedule and wavelength list.

Station Announcements

ITALY

Call sign: I-2RO Prato Smeraldo Rome.
Wavelength: 25.4 m. or 80 m.

The announcement given out from this station is made by a lady announcer as follows: Radio Roma Napoli, only when the programme of the Naples main station is being relayed. If the relay is taken from the Milan main station, the announcement is: Radio Roma Milano—the closing announcement being: Fine Della Transmissione—Signoir Buona Notte.

Call sign: HVJ Vatican City.
Wavelengths: 19.84 m. and 50.26 m.
Announcement: Pronto Pronto Pronto. HVJ Radio Vaticano.

This station, it will be noticed, keeps a metronome ticking as a background to the transmission. Transmissions in English and other European languages are scheduled from this station, but no musical or entertainment programmes matter.

PORTUGAL

Call CT-1AA.
Wavelength: 31.25 m.

Announcements are made from this station in several European languages; the English announcement being: "Good evening, ladies and gentlemen of the English speaking audience. Here is station CT-1 AA Radio Colonial of Lisbon, Portugal." A cuckoo call is given three times during intervals.

SPAIN

Call Sign: EAQ, Madrid.
Wavelength: 30.4 m.
Announcements: EAQ Trans Radio Madrid, in English, Spanish, etc.

SWITZERLAND

Call Sign: HB-9OC.
Wavelength: 32.85 m.
Announcement: "Hier Radio Zurich."
Interval Signal: Gong.

RUSSIA

Call Sign: RW59.

Announcement between items of programme intended for British and English speaking listeners: "Hello' Hello' This is Moscow calling from the Trade Union Station of the USSR and transmitting on a wavelength of 1,304 metres, or 230.1 kilocycles, and 50 metres or 6,000 kilocycles." Closes down by playing the "Red Flag." Other languages are used, a special evening being scheduled for programmes devoted to individual European countries.

GERMANY

Zeesen DJA, 31.38 m.

Call: "Achtung Achtung—Here the Deutchlandsender Koenigs Wusterhausen, or, Here Berlin und Kusswellendsender Koenigs Wusterhausen." This form of announcement is more or less common to station DJB, announced "day yot bay," and DHC, announced "day hah say" respectively in German.

The foregoing stations relay programmes from Berlin for American reception, which are often re-broadcast by the U.S. main stations.

FRANCE

Call Sign: FYA.
Wavelength: 24.4 m. 19.68 m. 25.63 m.
Announcement: "Ici Radio Colonial Pontoise Paris."

A news bulletin is given in English daily (afternoons).

SOUTH AMERICA

Call Sign: LSX.
Wavelength: 28.98 m.

The announcement in Spanish from this station when on the air for broadcast purposes is as follows: Trans Radio Buenos-Aires. The call letters given in Spanish being: L (ai'ley), S (ai'ssey), X (ai'kecs).

Call Sign: PRDA.

Announcements in English and Spanish, PRDA. Companhia Radio International of Brazil and Radio Club of Brazil, Rio de Janerio Brazil—special test programmes being radiated in co-operation with the above club at irregular intervals.

CANADA

Call: VE-9DR.
Wavelength: 49.96 m.

"This is the Marconi Beam Station, VE-9DR, Montreal, relaying the programme of station CFCF."

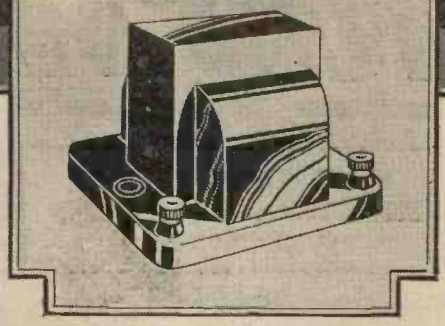
Call Sign: HRB. Honduras.

"This is station HRB. The voice of the Tropics. TEGUCIGALPA, Honduras, Central America, owned and operated by the Tropical Radio Telegraph Company of Boston, Mass., U.S.A."

This station is not listed in current wavelength lists and time schedules.

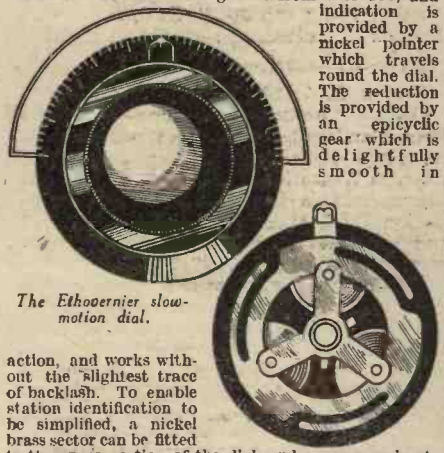
In addition to the foreign stations listed above, there is of course, our own G5SW which broadcasts from Chelmsford on a wavelength of 25.53 m. and forms a very useful test transmission for the newcomer. It is on the air from 6.30 to midnight, every night except Sundays.

CHATS ON COMPONENTS



SLOW-MOTION DIAL

THERE are a large number of fine tuning devices available to the home-constructor, and there is no doubt that a modern selective receiver demands some sort of slow-motion device. The Ethovernier Dial is an example of a combined coarse and fine tuning control, which will make tuning a pleasure. The dial is fixed, and the knob is in two sections, the lower portion giving a direct drive, and the upper section driving the condenser with a reduction of 18 to 1. The scale is engraved from 0 to 100, and indication is provided by a nickel pointer which travels round the dial. The reduction is provided by an epicyclic gear which is delightfully smooth in action, and works without the slightest trace of backlash. To enable station identification to be simplified, a nickel brass sector can be fitted to the upper portion of the dial, and a paper scale attached, to enable station names to be written at the actual reading. The price of this dial, complete with Etholog scale, is 6s.



The Ethovernier slow-motion dial.

LOTUS COMPONENTS

From the earliest days of broadcasting, Lotus components have been noted for reliability, finish, and efficiency. A glance through the catalogue of this Company shows that practically every component necessary for the home construction of a wireless set is manufactured under the Lotus trade-mark. Low-frequency transformers are made in three types, ranging in price from 5s. 6d. to 10s. 6d. Power transformers, power chokes, and other mains apparatus are well represented, and as an example of the value given, the power transformer, type A.M.20, has an output of 250 volts at 60 milliamps, 5 amps at 4 volts for I.H. valves, as well as a rectifier winding, and costs only 32s. 6d. Variable condensers are represented by a comprehensive range of air dielectric and solid dielectric models; reaction condensers being made in both standard types and miniature types. A differential reaction condenser, with all brass vanes and endplates, costs 4s. 6d., whilst a miniature differential with flexible brass vanes and bakelite spacing discs can be had for 3s. In addition to this range of condensers, heavily-shielded ganged condensers are supplied with drum or disc drive.

Plugs and jacks are valuable accessories for the keen experimenter, and will even be found of use in the household receiver for such purposes as extending the loud-speaker, or for providing remote control. A most exhaustive range of plugs and jacks, which have none of the defects of the old type jack in that they are extremely small, only taking a back of panel space of about 1in., can be fitted to any receiver to enable valves to be cut out of circuit, loud-speaker, or 'phones, to be included in any stage, or the complete receiver to be switched on and off. The Lotus Jack Plug costs 2s., whilst the jacks cost from 2s. to 3s., according to type. Moulded on exactly the same lines as the jacks is a range of jack switches which may be used for a variety of purposes. All interested listeners should obtain a copy of the Lotus catalogue, and we shall be pleased to see that a copy is dispatched to any reader who sends us a postcard in accordance with our Catalogue Service.

IMPROVED COIL CHARACTERISTICS

THE most efficient coil for tuning purposes should have a large diameter, and this gives rise to troubles due to the large external field. When the coil is reduced in size, and enclosed in a screening can, this source of trouble is removed, but efficiency is reduced. A famous German experimenter has evolved a material known as Ferrocart, which is a substance containing iron. It is well known that iron inside a solenoid increases its inductance, but for tuning purposes, there are certain difficulties in the way of its use. Ferrocart does away with these difficulties and enables small compact tuning coils to be designed, and so will enable a departure to be made from the orthodox type of receiver. We understand that Messrs. Colvern Ltd. have obtained an exclusive licence for the manufacture of coils, chokes, etc., using this Ferrocart. Details are not yet available, but will be announced in these pages as soon as they are received.

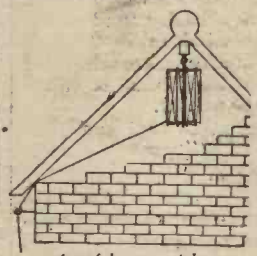
A NEW TERMINAL

WE have received from S. Lilley & Son, Ltd., of 80, Alcester Street, Birmingham, samples of completely new design in terminals. As will be seen from the illustration, the head of the terminal is moulded in an unconventional shape, which is very easy to grip, and has a very large contacting surface. The shank of the terminal is slotted, and therefore any gauge or number of wires may be accommodated under the terminal head. The base of the terminal is about half an inch in diameter, and is recessed to take a metal washer (to ensure good contact), and the edge is bevelled and embossed with an identifying name. The terminals may thus be fixed in position with the names always fully visible. These terminals are 2½d. each, and will be found extremely useful.

The B.B.C. terminal.

USEFUL CAGE AERIAL

THERE are many users of wireless sets who cannot erect a good outdoor aerial. Before erecting an indoor aerial they should consider the claims of the Ashton Cage Aerial, which the makers state gives critical selectivity, may be hidden in the roof, assembled on a broomstick, and provides volume and clarity. The set, complete with spreaders, costs 6s. 6d.



A useful cage aerial.

ERIE RESISTORS

THE Radio Resistor Co., of 1, Golden Square, Piccadilly, London, W.1, have submitted samples of their Erie Resistors. These are manufactured from a combination of carbon and rare earth and are quite small. Under a special process, all loose gases and moisture are removed and the resultant resistance is therefore perfectly stable. Substantially soldered wire ends are fitted to these Resistors for connection purposes, and an ingenious system of identification by means of colours is adopted. These Resistors are manufactured in three ratings, 1, 2 and 3 watts, and the price is 1s. per watt. The makers give an unqualified guarantee against open-circuiting.

A TIME SWITCH

THERE are many uses for a time-operated switch, not only for switching on your receiver at a prearranged time, but for switching on the electric kettle for an early-morning cup of tea, and many other uses to which the handyman will readily be able to adapt such a device. The Utex Time Switch is made in two types—L.T. and H.T. The L.T. type is a small device which has to be mounted on the back of an alarm clock in proximity to the alarm winding key. Two terminals are provided for L.T. connections, and it may be used on clocks in which the alarm key unwinds clockwise or anti-clockwise. The key, as it rotates, presses the contact on the switch and so completes the circuit. The unit works extremely well in practice, and will be found very useful. The L.T. model costs 3s. 6d., and the H.T. model 5s. 6d. In addition the Utex Mfg. Co. also supply a clock, complete with switch at 10s. 6d.

WIRELESS SAFETY-SWITCH

The Eclex Safety-Switch made by Messrs. J. J. Eastick and Sons is one of the latest developments in safety-first devices which enables the owner of a wireless set to earth the aerial outside the house. By pushing the knob the set is at once connected to the aerial and a pull instantly disconnects the set from the aerial system, automatically earthing it. The spark gap provides ample means of by-passing any electrical discharge which may occur while the set is in operation. Messrs. Eastick inform us also that their T.2.L.C. terminal has been reduced from 4½d. to 3d., and that they are bringing out an improved type of terminal which will be known as the T.2.L.C. improved type. In this latter form the head of the terminal, though free to rotate, is non-detachable; additionally, it will be provided with a removable name-plate enabling the user to alter the wording at will.

SLEKTUN MAINS TRANSFORMER

THIS component is a very sturdy article, employing a novel method of make-up. In place of the customary brass clamping strips and feet, a die-cast aluminium framework is fitted. This has lugs at the lower end for mounting purposes, and the top is finished at an angle. Across this is fitted a one-inch strip of ebonite upon which the terminals are mounted—one strip on each side. The result of this method of construction is a terminal strip which is really get-at-able, and upon which the markings are readily discernible. The model submitted to us had a primary tapped at 20-volt intervals, suitable for mains voltages from 200 to 240. Secondaries of 250 volts, 4 volts 1 amp., and 4 volts 3/4 amp, with centre-taps, complete the range of this component.

A VALVE TESTER

IT is often essential to take readings of the actua voltages, currents, etc., of a valve under its working conditions in a receiver, and this often means cutting or unsoldering wires in order to interpose the necessary meter. The Avodapter is a piece of apparatus designed to enable the valve to be tested under working conditions. It consists of an ebonite base containing a valve-holder (for 4- or 5-pin valves), terminals and switch. A flexible lead carries a plug fitting with 4 pins and a sliding pin to convert to a 5-pin base. The plug is inserted in place of a valve in a set, and the valve plugged into the Avodapter. All voltages, etc., can then be read. For S.G. valves, short flexible leads and crocodile clips are fitted. The price of this Adapter is 25s., and we can recommend this as being a valuable adjunct to the keen experimenter or handyman. For those who wish to make up an Adapter on some particular individual lines, the combined plug and cord may be obtained for 7s. 6d.

The Avodapter valve-tester and Avodapter plug.

TELSEN L.F. TRANSFORMERS COUPLING UNITS and OUTPUT CHOKES

TELSEN "RADIOGRAND" L.F. TRANSFORMERS

Typical of all that is finest in British Radio craftsmanship. Designed in accordance with recent research, constructed on the soundest engineering principles and tested rigorously for immaculate performance and enduring efficiency.

Ratio 3-1 *Ratio 5-1* **7/6**

TELSEN "RADIOGRAND" (Ratio 1.75-1) TRANSFORMER

For use in high-class receivers employing two stages of L.F. amplification. When used following an L.F. stage employing choke or resistance coupling, it gives ample volume with remarkable reproduction. **10/6**

TELSEN "RADIOGRAND" (Ratio 7-1) TRANSFORMER

Gives extra high amplification on receivers employing only one stage of L.F. amplification. Not recommended for use with two L.F. stages, as overloading is likely to occur. **10/6**

TELSEN POWER PENTODE OUTPUT CHOKE

For mains operated pentodes taking an anode current of up to 40 m.a. Serves both to prevent direct current passing through the speaker and to match the speaker to the pentode valve, with the choice of three ratios —1-1, 1.3-1, 1.7-1. Used with a 1-mfd. condenser it gives a great increase in both quality and volume. **10/6**

TELSEN TAPPED PENTODE OUTPUT CHOKE

For mains and battery operated pentodes taking an anode current of up to 20 m.a. The single tapping provides (by reversing) ratios of 1-1, 1.6-1, 2.5-1, ensuring perfect matching under widely varying conditions. Also suitable for matching a low-impedance speaker with an ordinary power valve, a 1-mfd. coupling condenser being recommended for this purpose. **7/6**

TELSEN INTERVALVE L.F. COUPLING CHOKES

Primarily designed for use as coupling chokes but may be used in any circuit carrying not more than the stipulated maximum current. The 100H type is for H. or H.L. type valves and the 40H for L. types.

	Normal Current.	Max. Current.
40 H.—	5 m.a.	10 m.a.
100 H.—	3 m.a.	8 m.a.

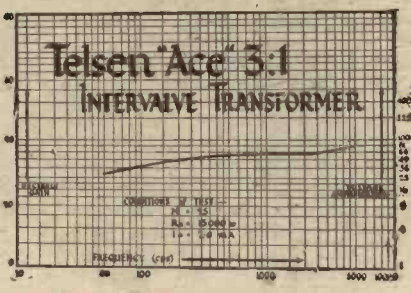
5/-

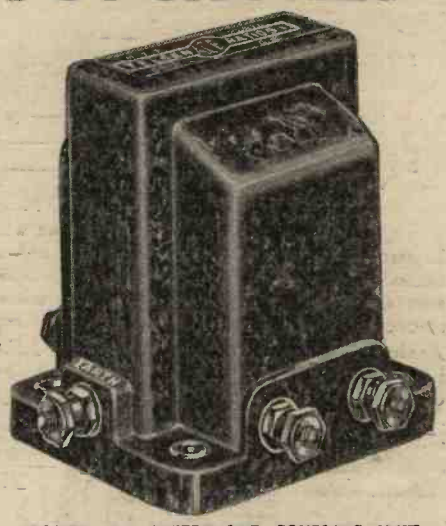
TELSEN OUTPUT CHOKE

Designed for use with power or super-power valves taking an anode current of up to 40 m.a., this output filter provides an ideal response curve under all conditions. For use with a condenser of not less than 1 mfd. capacity. **7/-**

THE TELSEN "ACE"

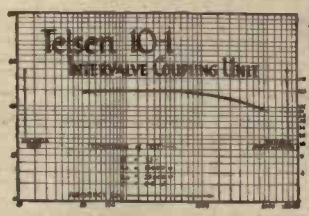
The Telsen "Ace" is eminently suitable for Receivers where highest efficiency is required at low cost and where space is limited. As its characteristic curve will show, it gives a performance equal to that of the most costly transformers. Ratio 3-1. Ratio 5-1. **5/6**





TELSEN 10-1 INTERVALVE COUPLING UNIT

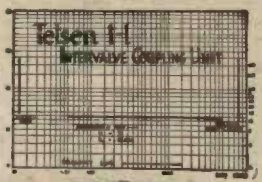
A filter-fed transformer using a high permeability nickel alloy core, securing a 10-1 voltage step-up while preserving an exceptionally good frequency characteristic. The response is compensated in the higher frequencies for use with a pentode valve giving an amplification greater than anything previously achieved, equal to two ordinary L. F. stages but with better quality of reproduction.



12/6

TELSEN 1-1 INTERVALVE COUPLING UNIT

A modern development of the deservedly popular R.C. unit incorporating a low pass filter feed in its anode circuit, thus preventing "motor-boating," "threshold howl" and other instability due to common couplings in eliminator and battery circuits. Used with an H.L. type valve it gives an amplification of about 20 and a perfect frequency response on a negligible consumption of H. T. current. **7/6**



TELSEN MULTI-RATIO OUTPUT TRANSFORMER

For use with moving-coil speakers, having a low-impedance speech coil winding, and suitable for anode currents of up to 40 m.a. Three ratios— 9-1, 15-1, 22.5-1—allow for correct matching of speakers of widely varying characteristics. **10/6**

TELSEN OUTPUT TRANSFORMER (Ratio 1-1)

For connecting the speaker to the output stage, using a triode valve. Avoids saturation by isolating the D.C. from the speaker windings. Also keeps H.T. voltage from the speaker and its lead, which is especially important where a D.C. eliminator is being used. Suitable for anode currents of up to 40 m.a. **10/6**

TELSEN
RADIO COMPONENTS

TELSEN RADIO COMPONENTS ARE 100% BRITISH

ANNOUNCEMENT OF THE TELSEN ELECTRIC CO., LTD., ASTON. BIRMINGHAM.

Practical Letters FROM OUR READERS

All letters intended for publication must bear the name and address of the sender, not necessarily for publication.

The Editor does not necessarily agree with opinions expressed by his Correspondents

A Satisfied Reader

SIR,—I have just had the pleasure of having three numbers of PRACTICAL WIRELESS handed to me by a friend. I must say this is the most interesting book for the wireless enthusiast, especially the amateur, that has been published. I am sorry I did not know of its publication before, as I would certainly have entered for your "Wireless Constructors' Encyclopædia." I shall place an order for PRACTICAL WIRELESS from the first issue. Wishing you success.—F. W. GRIFFIN (Mitcham Junction).

Special Articles Wanted

SIR,—I am very much interested in your new paper, PRACTICAL WIRELESS. Already it has contained quite a number of useful articles. I am writing to suggest an early article describing the Stenode principle, and one on Tone Control and the connection between the two. Nobody seems to have more than a very hazy idea of this principle, or whether it is a success or a failure, although some time ago we were led to believe it would perform wonders. Please give us enlightening articles on these topics. Thanking you in anticipation.—W. ROWE (Scunthorpe).

Prices of Components Wanted

SIR,—PRACTICAL WIRELESS has my support, because it is full of useful information and contains no padding. But why don't you quote the prices of the components used in the various sets you describe, as very few of your readers have a comprehensive wireless catalogue before them? Take the case of the A.C. eliminator described in October 22nd issue. You quote no prices, and I have never seen the make of transformer and choke you use advertised.—F. N. P. (Reading).

Congratulations and Suggestions

SIR,—Congratulations for PRACTICAL WIRELESS, which is a long-felt want supplied. As I anticipate having my copies bound up in volumes, it is with this end in view that I beg to make the following suggestions:—

(1) That the advertisement pages should be printed both sides and inserted without the folios (so that they may be removed prior to binding).

(2) That a small margin should be allowed between the centre pages so that they could be stitched without destroying the "text." And—

(3) Instead of the weekly index, as suggested, that an index should be included with the last issue of each volume.

Then wireless enthusiasts will have what has been lacking during the past ten years—a 100 per cent. "*Practical* Wireless" weekly.—W. THOMAS (Helston).

Keeping Track of Facts

SIR,—No doubt many of your readers have had the trouble and brain fag of looking up and reading through back numbers to find some particular data necessary to the job in hand. I have eliminated this process by buying a memo. book of the exercise type, stiff backed, and each week, after reading through PRACTICAL WIRELESS, I jot down the chief points of interest, thus:—

OHMS' LAW AND APPLICATION.

$$C=\frac{V}{R}, \text{ etc.}$$

Example— VOL. I, No. 3, p. 151.

You are thus able to find in a few minutes what otherwise would take you several hours. Should there not be enough information entered, then it acts as an index and the article in question is soon found. The above does not entail much work (a few minutes each week being all that is necessary), and writing anything down helps, I think, to impress same upon your memory.—J. STIRLING (Salford).

Some "Sonotone" Results

SIR,—I have built up your splendid set, the Sonotone, and I must admit that the results are *better* than you claimed for it. I have built up a large number of receivers, but must confess that this is the finest. I have already logged over 22 stations on the medium wavelength only, and the set has razor-edge selectivity. Stations come in at full strength, but can be cut out at the slightest move of the dial. I shall become a regular reader of your paper PRACTICAL WIRELESS, which is practical in every way, and I hope that in time it reaches every home that has a wireless set.—ERNEST PLUMPKINS (Putney).

Congratulations and Suggestions

SIR,—Allow me to congratulate you and your staff for producing such an excellent weekly. In the twelve years that I have been a radio fan, I have never read such an interesting book.

In October 22nd issue, I have read the article on an A.C. All-Mains Eliminator, and while this is all very nice for the person who has A.C. valves, how about those people who need an eliminator with trickle charger for accumulators? Perhaps in the near future you will publish details of the above.—SYD. HOWEY (Abbey Wood).

A Criticism

SIR,—You ask for criticism and I offer the following:—

(1) It is very confusing when reading, say page 219, to be referred to a figure located amongst the tag ends of other articles on page 263, and again, when reading the tag end on page 263 to find reference to figures back on page 219. Why not carry through with an article on the *next* page?

(2) Nearly as confusing is the arrangement of the figures illustrating articles. Have a look at pages 238 and 239 and see how long it takes to locate a particular figure. Then where are the Figures 7 and 8 referred to on page 234? Why not place the figures in their proper sequence and number them clearly.

(3) It is often necessary to show several similar diagrams to illustrate minor differences. To make it easy, the differences should leap to the eye, but it is a common practice to introduce other meaningless differences that only serve to obscure the points at issue. Reference is invited to the two diagrams on page 224. Apart from the differences which do *not* leap to the eye, there are differences in the layout and proportions that make the whole circuit look different, though they are actually almost identical. There are several ways in which the real differences could be made obvious, but at least the parts of the diagram which are common to both circuits should be shown exactly the same.

(4) One final suggestion is that writers of articles should be encouraged to keep in view the sort of person they are writing for, and to avoid casual reference to the Z of the subject when writing about the A B C, and, what is almost as bad, going into the details of A B C when writing rather learnedly about X Y Z. For example, in your issue No. 3, there is an excellent article on coupling and decoupling which is really a bit advanced for an absolute beginner, and yet at the very end of the article the writer assumes that the reader doesn't know Ohms' Law. My point is that the person who doesn't know Ohms' Law will never read through the article, and the one who understands what it is all about is merely irritated by the assumption that he does not know the A of the A B C of wireless.—E. PARBURY, Lt.-Col. (Tenby).

(*Whilst agreeing in some measure with the correspondent, most of the points raised are occasioned on technical grounds and are unavoidable.*—ED.)

A Reader's Views

SIR,—It was with pleasure that I read Mr. Hopkin's (Peterboro') letter, as it raises a question that has long been in my mind. Too many papers devote their space to promoting sales for the benefit of advertisers, to the detriment of readers.

(*Continued on page 412.*)

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—That a band of frequencies from 50 to 6,000 is sufficient for normal broadcast reception.
—That an ordinary valve may be used in emergency as a half-wave rectifier.
—That the electrolytic type of condenser is preferable for mains smoothing purposes.
—That holes in ebonite panels may be filled with heel-ball, sealing wax or Glitterwax so as to be invisible.
—That broken ebonite components may be repaired satisfactorily with Chatterton's Compound.
—That a fuse should be used in both mains leads of a D.C. mains-operated set.
—That the long lead to the Detector valve grid in a Radio Gram should be sheathed in an earthed metal lead to avoid hum.
—That the best "Earth" is one that is continuously moist.

Practical Letters from Readers

(Continued from page 411.)

This is all very well within reason, but we are not millionaires. My own experience has been costly, and the heap of "junk" is not a small pile. Paragraph three is very interesting to me. I wish to add a "band-pass" to my H.F., but am deterred by costs; I wish for a mains transformer, with a higher voltage than the one in use. Your contributor in this week's issue seems to have no idea that there is such a thing as decoupling. I already use 200 volts—my output valve takes this. As a newsagent I notice that people who want a wireless set just buy a paper now and again, constructors all the time; and every issue, but they do not want a new set every week. I have kept a copy of your paper every week because it seems a Proposition for Constructors to help them to understand the theory of wireless, and to get the best out of their sets.—HORACE WALKER (Breaston).

Testing the Polarity of the Mains

SIR,—It has been brought to my notice that in your issue of October 15th (last paragraph of page 210) you give support to one I.E.E. rule. At top of centre column, page 209, I am surprised to note that you, in effect, ridicule another equally important one (Rule No. 101 C.) My experience is that observance of this rule is of great importance, and that no encouragement should be given to anyone to take unnecessary risks.—P. J. ROBINSON, City Electrical Engineer (Liverpool).

[*Elsewhere on this page we publish another letter from an electrical undertaking suggesting that the method we gave on page 245 of our issue dated October 22nd, 1932, is dangerous.*

PRACTICAL WIRELESS *cannot subscribe to the policy which is advocated by the electrical, gas and water undertakings of the country that it is dangerous to use a gas-pipe as an earth, the water-pipe as an earth, or to test the polarity of the mains by the water method already referred to.*

It is not in the best interests of the electrical industry to surround experiments necessitating the use of the mains with an atmosphere of danger. Every practical operation demands a certain amount of care, and we repeat with emphasis that the time has now passed when polarity and similar tests are sacrosanct to a few members of a particular industry. It has been seriously suggested that it is dangerous to use a gas-pipe earth, and that electrolysis will take place in a lead water-pipe if a copper wire is attached to it!

The risk of using a gas-pipe as an earth is practically nil. Certainly the risk is beyond computation. There is a slight risk that you may short a mains should the two wires touch when determining mains polarity by the method we described. All that could possibly happen in that eventuality is that the fuse would be blown, and this cannot be attended by serious consequences. If such objections are pursued to a logical conclusion, we shall have the plumbers and their mates expressing the same solicitude for the welfare of our readers by objecting that it is dangerous for us to give instructions on soldering, lest the reader in his technical juvenescence drinks the hydrochloric acid sometimes recommended as flux, or spreads fluxite on his bread in mistake for butter; also that it is dangerous for our readers to use a drill, lest they develop the proclivities of the ostrich and swallow the drill.

We have accorded space in our columns to these letters, merely to show the absurdity of the matter.—ED.]

Finding Polarity of Mains

SIR,—I would like to protest against the method of finding the polarity of the mains recommended in the current issue of PRACTICAL WIRELESS, page 245, under the heading, "Simple Tests Without Instruments." The method suggested would no doubt be useful in the hands of a practical electrician, but as a municipal electrical engineer, I have experienced considerable trouble due to experiments carried out by amateurs, and I consider that there are other and safer methods of finding polarity without the risk of short-circuiting the mains.—W. E. RICHARDSON, General Manager (Urban District Council of Aberdare).

[*Whilst agreeing that it is possible to short-circuit the mains by carelessly carrying out the test described, the use of any mains apparatus presupposes the exercise of a certain amount of care. It is surely just as easy to short the mains when connecting up a home-made eliminator or mains operated receiver.* —ED.]

Short-Wave Section

SIR,—Altogether the paper is good value for money and I, in my opinion, feel sure that it will appeal to the wireless constructor for the articles *re* "How a Valve Works," and also the general theory of the working of a radio receiver are indeed just what the serious constructor needs.

Also the articles on Decoupling, Variable Condensers, Care and Upkeep, The Arithmetic of Wireless, etc., are highly commendable and are well written and I may say that if the present standard is kept up, then you will be assured of success.

One other observation—I should like to see a real hot-stuff short-wave section—for the short waves are indeed the coming thing—and not *too* much cabinet-making. —A. H. BRUCE, (G-2AXA) (Stamford Hill).

From a Radiogram Fan

SIR,—I wish to heartily congratulate you and your staff for such an excellent publication. Since reading Vol. I, No. 1 to No. 4, I am convinced that there is no other wireless paper that can compare with yours. Being one of the old school who began in 1922, the days of large drum coils and expensive valves and headphones, when 2MT gave us a gramophone concert on Tuesdays, it is pleasing to note the improvement in radio and wireless publications all for the good of this most fascinating hobby. A word or two about the grouping and display of your various articles. They are excellent. You have made each one clear and deeply interesting without being too technical, and this is an excellent achievement in view of the fact that there must be still some hundreds of listeners who are not at all familiar with the integral parts of a wireless set. May you keep up this standard of excellence. In spite of all the present day circuits (and I have built scores of different ones for purely personal test), I am still a staunch believer in Magnetic Reaction with straight High Ratio transformer coupling with matched valves. I am at present confining my studies to *home recording* on my Radio Gram, and I find it a very fascinating pastime. If you could give an article now and then on this subject I am sure it would be appreciated.

Wishing you and your staff the best of luck and excellent sales.—FREDERICK PARKER (Rainham).

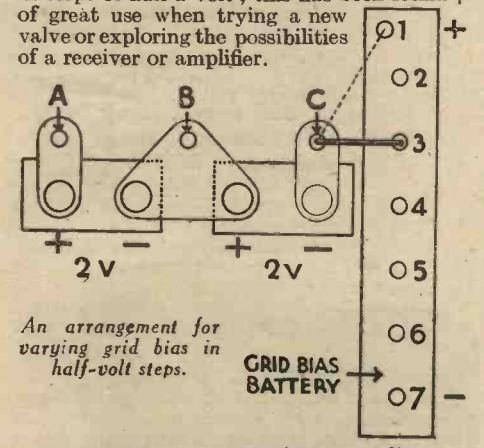
FROM THE FLASH-LAMP

By "PHOTON"

Grid Bias

FOR those who wish to get the best out of a set or amplifier, the ordinary grid-bias battery does not give a fine enough means of adjustment; this is especially the case when applied to the detector, but it also applies more generally; steps of 1½ volts are altogether too coarse. With a mains set having automatic grid-bias, the regulation is by a resistance or potentiometer, and the difficulty does not arise. For purely experimental purposes, a battery set may have its grid-bias furnished by similar means, but this necessitates the grid connection being unhitched whenever the set is left, or the penalty is a run-down battery.

The accompanying illustration shows a convenient combination by means of which the grid-bias potential may be varied in steps of half a volt; this has been found of great use when trying a new valve or exploring the possibilities of a receiver or amplifier.



An arrangement for varying grid bias in half-volt steps.

The combination comprises an ordinary 9 v. grid-bias battery, and two 2 v. accumulators; the latter may be of the smallest denomination procurable. Arrange the batteries as shown in the illustration, in which the plug-in holes are numbered 1 to 7 in the 9 v. battery and A, B, C in the accumulator battery; we couple C to 3 as a permanent connection; then :—

Connecting between

B & 2	gives ½ volt.	1 & 3	gives	3	volts.
A & 1	„ 1 „	B & 4	„	3½	„
1 & 2	„ 1½ „	A & C	„	4	„
A & B	„ 2 „	1 & 4	„	4½	„
A & 2	„ 2½ „	B & 5	„	5	„

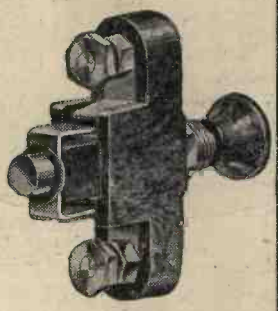
A & 4 gives 5½ volts.

And so on up to 9 volts. By changing the fixed coupling from C3 to C1 (shown by dotted line) the further values, 9½, 10, 11, 11½, and 13 volts are at command.

TELSEN

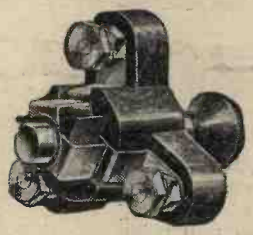
H.F. CHOKES, PUSH-PULL SWITCHES & VALVE HOLDERS

TELSEN TWO-POINT SWITCH



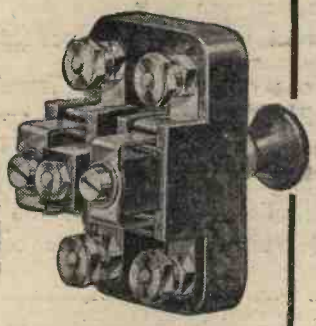
For use as battery switch, or as wave-change switch, with the dual-range S.W. Coil unit. Employs a "knife" type self-cleaning contact, and a positive snap action, a series gap reducing self-capacity to a minimum. **1/-**

TELSEN THREE-POINT SWITCH



The perfect wave-change switch for use with a dual-range aerial coil or for breaking L.T. and H.T. currents simultaneously. **1/3**

TELSEN FOUR-POINT SWITCH



Highly suitable for use in wave-changing on two coils or an H.F. Transformer, or for switching pick-up leads or an additional speaker. **1/6**

TELSEN VALVE HOLDERS

An improved range of valve holders in both solid and anti-microphonic types. Employ special contact sockets of one-piece design with neat soldering tag ends and terminals. Extremely low self-capacity.

Solid type 4 pin	*9d.*
Solid type 5 pin	*1/-*
Anti-Microphonic 4 pin	*1/-*
Anti-Microphonic 5 pin	*1/3*

TELSEN STANDARD H.F. CHOKE

Covering the entire broadcast band, and occupying only the minimum of baseboard space, the Telsen Standard H.F. Choke has proved deservedly popular ever since its introduction. With an inductance of 150,000 microhenrys, a resistance of 400 ohms, and an extremely low self-capacity, it is highly suitable for use in reaction circuits, and is constantly being specified in this respect by the leading set designers. **2/-**

TELSEN BINOCULAR H.F. CHOKE

In H.F. amplification, the performance of a choke is of supreme importance. Where the very highest efficiency is the primary requisite, the Telsen Binocular H.F. Choke is the inevitable choice. It has a high inductance of 250,000 microhenrys, with a very low self-capacity and a practically negligible external field (due to its binocular formation). It is from every point of view the *ideal* choke—and where high-class circuits are concerned definitely the *essential* choke. **5/-**

TELSEN
RADIO COMPONENTS

TELSEN RADIO COMPONENTS ARE 100% BRITISH

ANNOUNCEMENT OF THE TELSEN ELECTRIC CO., LTD., ASTON, BIRMINGHAM.

Radio Ramblings

(Continued from page 404)

An Extra Loud-speaker

THE modern tendency in receiver design is to make the whole instrument self-contained by housing the loud-speaker in the same cabinet as the set. This is all very well if the speaker is required for use in a single room, but rather complicates matters when one wishes to listen in a different room to that in which the set is installed. Assuming that one is prepared to buy a second speaker, the difficulty can be surmounted, but even so there are two or three precautions which must be observed. If the set is fitted with a moving-coil speaker with step-down transformer, and it is proposed to use a cheaper balanced armature in addition, it will not be sufficient to connect the extra speaker to the terminals of the built-in one, because the transformer ratio would be unsuitable. On the other hand, it would be unwise to put the new speaker in series with the primary winding of the step-down transformer, because the anode current would probably be too great. The best way of all is to connect the speaker on the choke-capacity principle, using the primary winding of the output transformer as a coupling choke. The only extra component required is a 1 mfd. condenser, whilst all necessary connections are shown in Fig. 1. Even if the extra speaker is of the moving-coil type, it will be better to connect it as explained above rather than to wire it in series or parallel with the original one, since it will then be less liable to spoil the matching of the power valve.

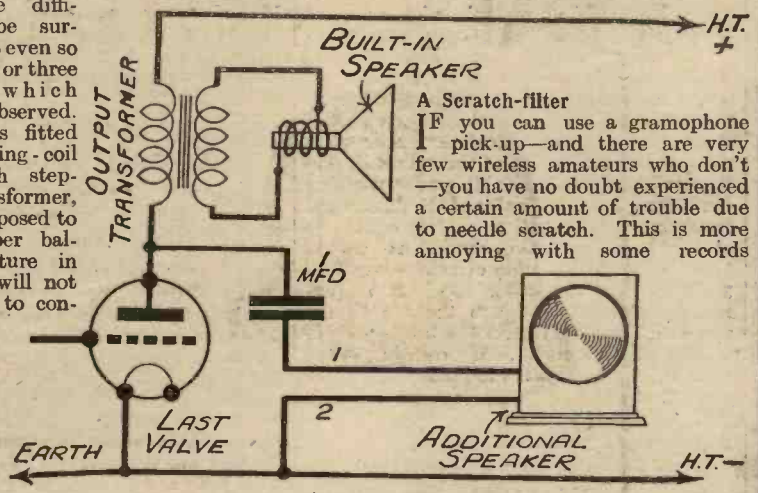


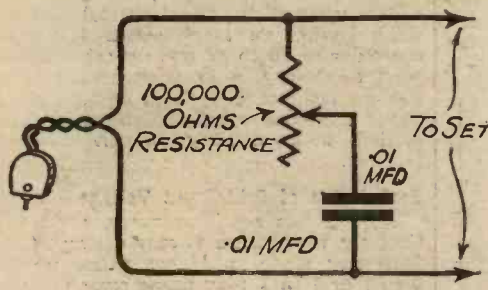
Fig. 1.—Using two loud-speakers.

Save a Wire

THINKING of loud-speaker extensions reminds me of another great advantage of choke-capacity output feed. When the speaker is situated some distance from the set, the capacity between the leads is often sufficiently high to affect the quality of high-note reproduction. It will be seen, however, that one loud-speaker lead (marked "2" on Fig. 1) is connected to earth when a choke-capacity filter is employed. Thus, instead of running wire Number 2 right back to the receiver, it can be connected to any convenient earthing point, such as a water-pipe or—dare I say it?—a gas-bracket. The latter is not always so efficient, because the white lead used to seal joints in the feed piping is liable to act as an insulator (*This is not so.—Ed.*). If the speaker is used out-of-doors, a sufficiently good earth connection can be obtained from a short iron spike driven into the ground.

A Scratch-filter

IF you can use a gramophone pick-up—and there are very few wireless amateurs who don't—you have no doubt experienced a certain amount of trouble due to needle scratch. This is more annoying with some records than others, and, peculiarly enough, is often more noticeable with a good amplifier than with a poor one. The scratch appears in the speaker as a "hiss"; it does not form what is known as a pure note, being, in fact, a "mixture" of various frequencies. But, fortunately for us, the hiss consists principally of frequencies higher than those of most musical instruments, and we can, therefore, make provision for eliminating it without spoiling the normal reproduction. There are three different places in which the scratch can be cut out. The first is between the pick-up and set, the second in the set itself, and the third between the set and speaker. In most cases the first-mentioned is the simplest, and a suitable scratch filter can be made from a 100,000 ohms variable resistance and a .01 mfd. fixed condenser. The two components are connected in series across the pick-up leads, as shown in the accompanying sketches. By adjusting the resistance a position will be found at which the "hiss" disappears.



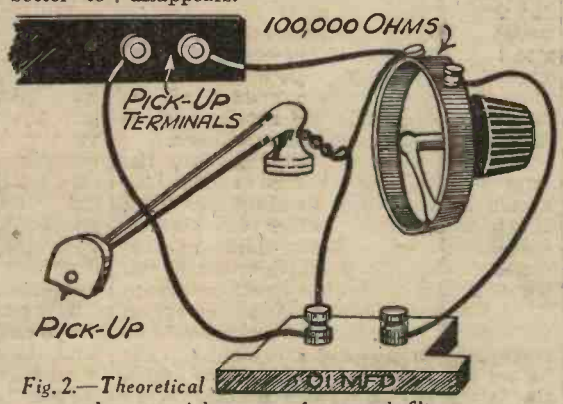


Fig. 2.—Theoretical and practical diagrams of a scratch-filter.

THE ARITHMETIC OF WIRELESS—2

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

A FAMILIAR example of the necessity of observing due proportionality between the different components in a radio circuit is presented in the resistance-capacity method of low-frequency coupling. Most listeners understand that the amplification factor of a valve is not a measure of the actual degree of amplification obtainable under working conditions, but is the value of the theoretical maximum amplification which could be obtained under ideal conditions which, however, are impossible of achievement in practice. On the other hand, it is perfectly correct to compare the amplifying powers of two valves on the basis of their amplification factors, if certain other constants of the valves are also taken into consideration.

Degree of Amplification

Being, for the moment, arithmetically minded, however, we may ask ourselves what is the actual degree of amplification to be obtained from a valve stage. To answer this question it is necessary to realize that in an amplifying valve the overall amplification is to be measured by comparing the signal voltage applied to the grid of the valve with the voltage developed across some piece of apparatus, termed the "load," included in the anode circuit of the valve. From what was said in the previous article of this series, you will have gathered that, for a given value of anode current, the voltage drop across the load will be proportional to the impedance of the load. It would therefore appear that the higher the load impedance the greater the voltage drop across it, and hence the greater the degree of amplification.

To an extent this is correct for the actual formula for the total stage gain in a resistance-capacity coupled stage:

$$\text{Gain} = \frac{\text{Resistance of load} \times \text{amplification factor of valve}}{\text{Anode resistance of valve} + \text{resistance of load}}$$

Resistance Values in Anode Circuit

There is, however, another factor to be taken into consideration—namely, the working voltage applied to the anode of the valve. If the value of the load resistance is made too great, the drop in voltage due to the passage of the standing anode current will be very great, with the result that the working anode voltage will be small, and the valve will not be working under the most favourable conditions.

For low-frequency amplification, the impedance of the external anode load should be from twice to about five times the valve resistance, which will give an overall gain of from two-thirds to five-sixths of the valve's amplification factor. Thus, if a valve has an anode resistance of 50,000 ohms, the resistance employed for a resistance-capacity circuit should be from 100,000 to 250,000 ohms. The higher the resistance, within these limits, the larger the percentage of the valve's amplification factor which can be utilized. If, however, a resistance greater than the maximum recommended be used, it is probable that the diminution in working anode voltage would seriously reduce the efficiency of the stage.

Transformer Ratios

"What is the best ratio for a step-up audio-frequency transformer?" is another question which the arithmetic of radio can answer quite simply. It will be understood that the primary winding of the transformer forms the "load" in the anode circuit of the valve; and that the secondary winding forms the grid circuit of the following valve. As the secondary winding has more turns than the primary winding, the voltage developed across the secondary winding will be greater than that applied across the primary in the ratio of the numbers of turns. Thus you may have a transformer with a 3 to 1, or a 3½ to 1, or a 4 to 1 or a 6 to 1 ratio, and so on. On what does the choice of ratios depend? Like so many other ratio problems, this is one in which the solution depends upon a great many factors, the discussion of which would require at least one article in itself. In redemption of the promise already made to avoid complicated mathematics and advanced technical matters, the more simple and practical points only are dealt with here. In the first place, then, it may be said that, in conjunction with a valve of the usual general purpose class, having an amplification factor of the order of 20 to 30 and operated under good conditions, a transformer having a step-up ratio of 3 to 1 or 3½ to 1 gives about as much amplification as can be carried with stability in the average receiver.

Peak Value of Grid Input Voltage

With a less sensitive valve, and particularly when there is only a single low-frequency stage, a higher ratio, up to 6 to 1 or 7 to 1, may under some circumstances be employed. The final factor, however, lies not in the first valve, but in the valve which follows it. In order to achieve undistorted amplification, the signal voltage applied to the grid of any valve must not exceed a certain value, sometimes called the "acceptance" of the valve. The peak value of this maximum grid input voltage is approximately half the recommended grid bias of the valve. It is clear, therefore, that if the overall gain in any stage—that is to say, the amplification due to the valve and that due to the transformer—produces a signal greater than the acceptance of the following valve, there is the risk that serious distortion will be introduced owing to overloading of the next valve.

It is particularly when two low-frequency stages are employed that it is necessary to limit the gain in individual stages to avoid overloading the next valve. The type of output valve employed is another important factor. If the output valve is a small

power valve, or a small pentode, both of which are intended to give the greatest output reasonably possible from comparatively small grid inputs, the previous stage or stages of amplification must be kept within bounds. Generally speaking, a modern detector stage followed by a 3½ to 1 transformer is quite adequate to load fully the average small power or pentode valve. If the detector is preceded by one or more high-frequency stages, it will probably also be able to load a super-power valve, if coupled by a 3½ to 1 transformer. If no high-frequency stage is employed, the detector can be coupled to a super-power valve through a high-ratio transformer, or a further low-frequency stage may be interposed between the detector and the super-power valve, the coupling in each case being a low-ratio transformer.

Of course, much depends upon the working conditions, and the degree of "quality," as opposed to mere volume, which the listener desires. On a poor aerial, for instance, a greater degree of overall amplification will be necessary, while, for the sake of economy, it is sometimes decided to sacrifice in tonal purity in order to obtain the required volume from the minimum number of valves.

Ratio Between Load and Valve Impedance

While on the subject of the anode load of valves, arithmetic has something to teach concerning the ratio between the load in the anode circuit of an output valve and the valve impedance. In the case of an output valve, it is not merely a voltage drop in the anode circuit which is required, but an appreciable amount of power which can be used to operate the loud-speaker. This amount of power can be measured by multiplying the *alternating* voltage drop across the load by the *alternating* component of the anode current. The load in this case is, of course, the speaker winding, or the primary winding of the output transformer, if one is used, or by the combined circuit provided by the output choke and the speaker winding in the case of a choke output circuit.

As the result of numerous careful calculations, confirmed by actual measurements, it has been established that, for most three-electrode output valves of the types chiefly used by amateur listeners, the optimum (or best) value of the load impedance is of the order of twice the valve resistance. The value is not very critical, and the usual range of speaker impedances covers most practical requirements. An exception must be made in the case of pentode output valves, the optimum loads for which are usually considerably higher than those for triodes of equivalent output. For most types, loads of approximately 8,000 ohms are recommended, but some of the new low-consumption pentodes work economically with still bigger load impedances, of the order of 15,000 ohms.

Some of the larger "high-voltage" output valves, also, give their best performance with loads very much greater than twice the valve resistance. In every instance the recommendations given by the valve-maker should be followed. As already mentioned, the value of the load is not very critical, and a departure of 10 per cent. or even 20 per cent. is not likely seriously to affect either output or quality.

Matching the Speaker with Output Valve

It will be clear from the foregoing, that for any given output valve there are certain limits within which the load of the speaker

(*Continued on page 418*)

ARITHMETIC OF WIRELESS

(*Continued from page* 417.)

must fall if the full output of the valve and good-quality reproduction are to be obtained. But suppose that we have a pentode, requiring an anode load of 8,000 ohms, and a speaker the impedance of which is only 2,000 ohms. Or, again, suppose we have a valve the optimum load of which is 2,000 ohms and a moving-coil speaker of low resistance—say, 6 ohms only. What can the arithmetic of radio do to help us to solve this problem ?

Obviously, it will not do to connect the speaker direct in the anode circuit of the valve, as its impedance is far too low. What we must do is to employ an output transformer, so designed that the impedance of the primary (which is connected in the anode circuit of the valve) matches the valve resistance, while the secondary is wound to match the speaker impedance. The correct ratio for such a speaker is found by dividing the optimum value of the load, as recommended by the valve-maker, by the impedance of the speaker, and extracting the square root of the answer. The proof of this formula does not come within the scope of this article, and it must, therefore, be taken on trust.

It should be noted that it is the *impedance* of the speaker, and not its *resistance*, which should be used in this calculation. The majority of modern speaker manufacturers quote in their lists the actual impedance of their instruments—usually at a frequency of 1,000 cycles per second. If, however, this figure is not stated, a fairly accurate approximation can be obtained by using the resistance figure in the case of a moving iron instrument, or one-and-a-half times the resistance in the case of a moving-coil speaker. Here, again, the actual value of the ratio is not very critical, and it is usually quite satisfactory to take the nearest standard commercial ratio, even if this means a departure of as much as 20 or 25 per cent. from the ideal ratio as determined from the calculation.

RADIOGRAM RECEIVERS

(*Continued from page* 386.)

All the accessories were located by strips of wood screwed to the floor of the cabinet. The loud-speaker was retained as a separate unit. For one reason, there was no room for it in the cabinet, also the set always seemed to work better when not too close to the speaker.

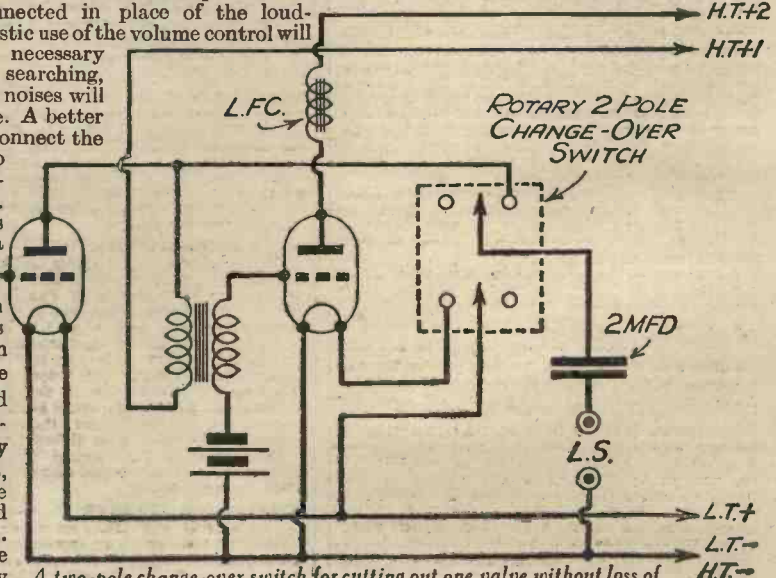
Wiring Connections

The aerial and earth wires were simply led through holes in the back of the cabinet, and connected to the usual terminals at the back of the set; the wires to the speaker being similarly dealt with. The only other wires to the set were the mains, and these were connected as shown in Fig. 3. The double-pole switch is turned "off" before anything is done in the way of alterations or adjustments to the set; the fuses can be lighter than those on the house circuit. When either gramophone or radio is in operation the D.P. switch is, of course, "on," the H.T. switch "on" and the charger "off"; and on closing down for the night the charger is switched "on" and the H.T. "off." The switches and fuses are outside the cabinet, near the back corner at one end.

The clockwork motor for the gramophone is retained for the present, but it is intended to fit an electric turntable motor as a future improvement. This, in addition to a combined H.T. and L.T. eliminator, will make the instrument in all respects the equivalent of an expensive radio gramophone.

SWITCH FOR 'PHONES AND LOUD-SPEAKER

IT is often an advantage, especially in short-wave work, to search for stations with headphones. Also, there are occasions when one member of the family may wish to listen to an item without disturbing the rest. If the headphones are merely connected in place of the loud-speaker, drastic use of the volume control will usually be necessary and, in searching, background noises will be excessive. A better way is to connect the 'phones to the preceding valve. In cases where a choke output filter system is used, this operation may be performed without altering any connections, by the method shown. When the two-way change-over switch is to the left, all the valves are in operation, when to the right, the filament circuit to the last valve is broken, and the output comes from the I.P. terminal through the 2 mfd. condenser, the primary acting as L.F. choke.—F. B. Cope (Kirton.)



A two-pole change-over switch for cutting out one valve without loss of efficiency.

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 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.

L.T. FROM H.T.

"Could you please send me a practical drawing of an arrangement for taking low tension for 2-volt valves from 140-volt wet H.T. battery, as I am using a six-valve sup.-het., with two valves in push-pull?" (G. W., Ilkeston.)

We would advise you most strongly to refrain from taking filament current for two two-volt valves from H.T. accumulator, as the cells are of small capacity and would have a very short life. It will be far more satisfactory, and considerably cheaper in the long run, to buy a small separate two-volt accumulator for the purpose.

ELIMINATOR TAPPING

"I am using an —— elliminator with my set. It has a tapping marked 'S.G.' Must this be used only when an S.G. valve is employed in a set, or can I use it for any valve? Also I have within the last week added another valve to the set; previously it was a two-valve using a pentode. I find on trying same that there is a considerable amount of distortion. I should be pleased if you could give me some idea to get over the trouble."—(A. W. E., Taunton.)

The tapping marked "S.G." on an H.T. eliminator is designed to give 75-80 volts, therefore this could be used with satisfactory results for supplying the detector valve. The distortion you experienced on fitting a further valve to your receiver is due to the fact that you are now overloading the pentode valve. Some form of volume control (see page 7 of PRACTICAL WIRELESS, No. 1) should be employed.

TWO TRANSFORMERS

"I enclose a circuit diagram of the output stage of my set—det., L.F. and push-pull A.C. mains receiver. I am employing two output transformers, as the one already built in the speaker (25:1) will only carry a plate current of 50 m/A. I would welcome very much your opinion of this method of output, as I wish to obtain the best quality of reproduction possible with my output valves and speaker."—(W. H., Wigan.)

The best method for you to employ in your output stage is to acquire a transformer of 25:1, capable of carrying 80 m/A, which has a centre-tapped primary, and use this in place of your present push-pull output transformer. You will then be able to discard the 25:1 transformer already on the speaker and connect the speaker direct to the secondary of the new 25:1 transformer. This will eliminate any undue resonances caused by having two transformers in cascade.

AERIAL TROUBLE

"I have a new 3-valve set, which gives excellent results in the daytime, but at night I can't get some English stations without foreign stations butting in. I have been told that this is the fault of my aerial, which is 80ft. long, including lead-in. Will that affect my results? If I have to shorten it, will it do off the same pole (which is fixed) by having a longer wire to the insulator?"—(J. F., Camb.)

The length of your aerial would certainly acconnt for much of the foreign interference. Eighty feet is much too great a length for modern conditions. Try cutting it down to at least half its present length, or even less.

By all means use the existing pole with, as you suggest, a longer wire between the pole and the insulator at the open end of the aerial.

MORE VOLUME WANTED

"I have a 3-valve set with built-in lond-speaker. As one of the members of the family is rather deaf, I should be glad to know if it is possible to fit any gadget to make it a little louder, or any other way you can suggest."—(W. J. A., near Brecon.)

To get more volume from your set yon might try fitting a bigger output valve—a pentode for preference. Presumably your present output valve-holder is of the four-pin type, in which case you should use a four-pin pentode, with a lead from the terminal on the valve to the H.T. positive. It will be in order to plug in this lead to the same point on the battery as that to which the anode lead is connected; in other words, the anode and terminal leads may be joined together.

SHORT-WAVE COIL

"I have just made a short-wave set (circuit enclosed) but am unable to obtain any reaction above 50 degrees on the tuning condenser. The coil is a commercial article, and cannot be wrong, so I should be glad of your advice."—(J. L., Bury St. Edmunds.)

This trouble is most likely due to the fact that you are using a .0005 tuning condenser, which on the short waves covers a large range of wavelengths, thus rendering the reaction winding inefficient on the higher end of this range. Most short-wave coils are designed to be tuned with a condenser not larger than .00025 mfd., and you will see that, if your receiver works efficiently over half the scale of a .0005 mfd. condenser, you are obtaining the full range of the coil.

PUSH-PULL OR PARALLEL?

"I am going to add an amplifier to my all-mains set, and want really good volume. My present output valve is fully loaded now, and I am therefore doubtful whether to employ two valves in parallel in the new amplifier, or the push-pull principle. Can you explain the differences to me?"—(A. J. B., Hounslow.)

The push-pull method is certainly the method to employ to overcome overloading, but the parallel method will give you a larger undistorted output for a given signal. Thus, you will be able to cut down volume before the last stage and still have the same volume output, but undistorted owing to the smaller input. The essential difference between the two arrangements is this: With push-pull a larger *input* is permissible owing to the fact that you double the "grid swing," but you do not enlarge the amplification factor. With paralleling the grid swing remains the same as for one valve, but the amplification factor is theoretically doubled.

DATA SHEET No. 8

FREQUENCY BANDS

Cut this out each week and paste it in a notebook.

Instrument.	Lowest Frequency.	Highest Frequency.	Total Band covered.
Pianoforte ..	26	4096	4070
Human Voice..	64	1024	960
'Cello	72	853	781
Viola	128	1706	1578
Cornet ..	170	1152	982
Clarionet ..	170	2730	2560
Violin	192	2730	2538
Flute	256	2048	1792

The above table shows the musical frequencies covered by the most popular musical instruments, giving the lowest and the highest note, and the total band of frequencies covered.

OUTPUT TRANSFORMER

"I am using a —— 3-valver, and a cone speaker, and was interested in the article 'The Voice of the Set' in the current issne of PRACTICAL WIRELESS. Would yon please say what type of output transformer would be suitable. I have an L.F. transformer ratio 3—1, would this answer the purpose?

"Should I decide to bny an M.C. speaker I understand these are fitted with output transformers. Is this correct, please?"—(M. F., Southsea.)

Your L.F. transformer would hardly be suitable for use as an output transformer; the latter type of component usually has a much different ratio.

The answer to your second query is that some moving-coil speakers are sold with transformers already fitted and some are not.

MAINS-DRIVEN SPEAKER

"I am using an all-mains set which is supplied with an external speaker. This appears to be rather a poor article, and I therefore wish to purchase a new one, but I want a powerful moving-coil speaker. I don't want a permanent magnet, but I believe the other types of M.-C. speaker require accumulators or something to drive them. Can you let me know about this, and give me any hints?"—(J. F. V., Leeds.)

The simplest solution is to purchase a mains-driven speaker of the self-contained type. If for A.C. mains, the rectifier and associated equipment should be included in the loud-speaker. If D.C. operated, the necessary smoothing apparatus will be enclosed. The speaker will thus only need connecting to a mains socket, and the output from your set joined to the input terminals of the speaker.

L.F. AMPLIFIER

"I have just finished making a powerful L.F. amplifier, incorporating two low-gain R.C. stages coupled to a push-pull stage. Efficient decoupling is fitted, but on switching on there is a very high-pitched whistle. Can you let me know what this is, and perhaps suggest a remedy?"—(A. S. P., Belfast.)

The whistle is probably due to H.F. oscillation of the push-pull stage. To prevent this, grid and anode H.F. stoppers should be inserted. In each grid lead insert a non-inductive resistance of .1 megohms, and in each anode lead a similar resistance of 100 ohms. Endeavour also to arrange the valves so that all wiring and leads are balanced—in other words, try and arrange the stage as it is shown in the theoretical circuit diagram.

SUPER.-HET. OR 2 S.G.'s?

"I am anxious to make up a new set—in more or less experimental form. Expense is no object, but the receiver must have range and volume. I do not particularly require one-knob control, and the receiver is for my own use—not a household set. What do you recommend, a 5-valve Sup.-Het., or 2 S.G.'s, det. and 2 L.F.'s."—(A. P., Sheffield.)

Both types of receiver have their advantages and disadvantages. The Sup.-Het. will have the advantage of being able to have one-knob control, with good range, whilst the two S.G. receiver will require more careful arranging. The range of a two S.G. det. and 2 L.F. receiver will be as great as a 5-valve Sup.-Het., but will require more careful arrangement and handling. As the receiver is for your own "experimental" use, we would advise you to build the S.G. receiver.

REACTION DIFFICULTY

"I have just made a dual range coil, with a reaction winding fitted in between the long and short wave windings. The winding in question is common to both long and short waves, but does not work efficiently. For instance, on short waves (by which I refer to the 250 and 500 metre-band), reaction is nice and smooth from zero to 180 on the dial. On long waves, however, reaction is only obtainable from 0 to 10 on the dial, and then even with the reaction condenser (.0003) all in no oscillation is obtainable. Can you tell me how I can alter this, as I realise that a larger condenser would result in uncontrollable reaction on the short band. Can you suggest a remedy for me, please?"—(A. R. V. de P., Boston.)

The remedy shonld not be difficult, and would consist simply of varying the position of the reaction winding. It would be best to slide it along the former and by trial and error find the position that gives an even control on both bands. By carrying out this idea you will not have to strip off or add any turns to the coil.

FUSE FOR ELIMINATOR

"I am just building an A.C. mains battery eliminator, and have a point I should like yon to elucidate. The mains transformer has cost me over £2, and I want to safeguard this against burn-out, in the event of a short-circuit, either in the eliminator or set. What type of fuse should be fitted, and where should I fix it?"—(W. F., Watford.)

A simple flash-lamp bulb type of fuse will be good enough—say, 300 m/A. This should be interposed between the H.T. negative terminal of the mains transformer and the H.T. negative terminal of the eliminator.

FREE ADVICE BUREAU

COUPON

This coupon is available until Nov. 19th, 1932, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 12/11/32.

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.

MORLEY'S COILS

A RANGE of coils for all purposes is included in a folder just to hand from Messrs. Morleys, 5, Colin Parade, London, N.W.9. A three-range coil unit, mounted on an aluminium base, has silver-plated switch contacts, the connections being plainly marked and easy of access. Amongst the other coils listed are special short-wave three range; double-capacity, band-pass; and dual-range short-wave. Most of these are screened. Another well-finished component is an ultra short-wave coil with a range of 12—70 metres with an .00025 condenser. The unit incorporates a wave-change switch with silver contacts, and the former is wound with heavy-gauge silk-covered wire. For super-het. work there is a neat intermediate transformer for baseboard mounting, with built-in trimmers. The coils, which are completely screened, are adjustable for selectivity. Combined ganged condenser and coil units, matched to within one-half per cent., are also shown in this useful folder.

THE ORPHEUM S.G.P. THREE

IN a neat folder we have just received from Spiers and Browne, full particulars are given of the Orpheum Three, an all-electric receiver embodying several noteworthy features. Housed in an attractive cabinet of the console type, the receiver is designed to give tonal quality and a full range of stations. Simplicity of control, "knife-edge" tuning, illuminated dial and pick-up terminals are some of its important features. The valves used are screened-grid H.F., power detector and pentode output. Either A.C. or D.C. operated models are available, each incorporating a mains-energised moving-coil speaker. In the battery model a permanent magnet moving-coil speaker is used. This model is priced at 16 guineas and either of the all-electric models at 19 guineas. The address is Crown Works, Forest Hill, London, S.E.23.

R.K. REPRODUCERS

FROM the Ediswan Radio Co., comes a folder giving particulars of various R.K. reproducers which are improvements on the original Rice-Kellogg instruments. The R.K. range of speakers is well known for its high standard of workmanship and faithful reproduction. For those who require a combination of efficiency and good appearance there is the senior R. K. permanent magnet model, complete with multi-ratio transformer, and housed in a handsome fumed oak or walnut cabinet of modern design. Two other attractive cabinet models are the Senior "Warwick" and the Minor "Arundel." The latter instrument, complete with permanent magnet moving coil unit and fumed oak cabinet, is listed at the very moderate price of £2 17s. 6d. Separate units for either A.C. or D.C. are also listed. These do not embody an output transformer, but suitable transformers for use with these, and other moving-coil speakers are listed separately.

BELLING-LEE TERMINALS

TO some constructors, terminals may seem to be of little importance, but there is a big difference between a poor terminal and a good one. Messrs. Belling-Lee specialise in terminals for every purpose, and a neat booklet we have just received from this firm gives particulars of a comprehensive range of indicating termiuals, plugs and sockets, mains input connectors, battery cords, fuses and fuseholders. All the terminals and plugs are of the indicating type, and one series has a non-rotating name and is bakelite insulated. Readers who require robust and well-finished terminals or other connections for their sets should write for a copy of this booklet. The address is Cambridge Arterial Road, Enfield, Middlesex.

POWER TRANSFORMERS AND CHOKES

A COMPREHENSIVE range of high-class transformers and chokes is given in a brochure to hand from Messrs. Rich and Bundy, Ltd. This firm have been manufacturing transformers since 1916, and the instruments listed are standardised goods which are particularly suited to the radio needs of to-day. Full particulars are given of various types of mains transformers for valve rectifiers and Westinghouse metal rectifiers, output and filter chokes, and special output transformers. The cores of all Rich and Bundy power transformers are entirely constructed of Stalloy-alloyed high-resistance steel, and the windings have an ample cross-sectional area. All windings are well insulated and each instrument is subjected to a high voltage test. Primary connections are brought out to insulated terminals mounted on strong Bakelite terminal strips.

"CLIX" PLUGS AND SOCKETS

A LARGE percentage of reception troubles are traceable to faulty connections in a set, often through the use of inferior plugs and sockets or similar fittings. By the use of "Clix" fittings this sort of trouble is avoided, and the latest list issued by Lectro Linx, Ltd., gives particulars of several "Clix" terminals, plugs, sockets and connectors which are well known for ensuring good contact. A recent addition to the "Clix" range is a neat chassis-mounting valveholder fitted with resilient helically-slotted sockets with terminal ends. Another efficient "Clix" fitment is the "Master" plug with specially made prongs which are adaptable to different sizes of sockets.

Broadcast Query Corner

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

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

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

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

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

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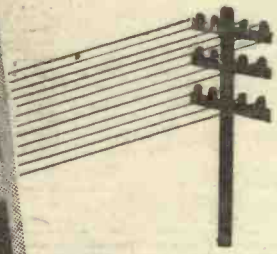

When You Switch on Your Radio Do You Get Crossed Lines?

When you get crossed lines on the 'phone you can cut off and ring up your number again, but on your radio only a PIX will cut out the unwanted interferer. Nothing is more annoying when you want to enjoy your favourite item to have other music and speech butting in or a permanent background of another programme. A PIX fitted in the aerial lead-in will increase the selectivity of every set, whether crystal, valve, battery or all-mains. Fix a PIX in your aerial and cut out powerful and local stations and enjoy foreign concerts without interference. **TO GET BETTER RADIO**—just undo the aerial wire from the aerial terminal on your set and fix it to one end of the PIX and join the other end with a small piece of wire to your aerial terminal. Close the PIX up, tune in the powerful or local station you are trying to cut out, as loud as possible, then open the PIX until this station disappears (a ¼-in. is generally sufficient), then re-tune your set, bringing in those stations on either side which hitherto were being "swamped."

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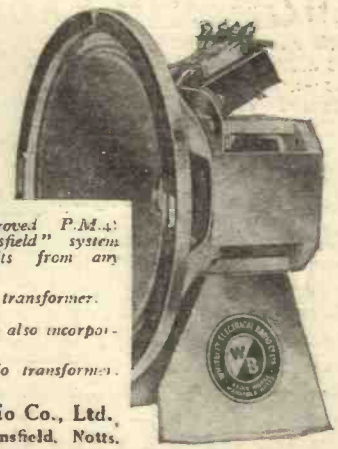
A momentous discovery by the 'W.B.' research engineers .....

The new (patented) "Mansfield" Magnetic System lifts the whole subject of popular moving-coil speakers on to a higher plane. It makes possible a magnet 30% more efficient than the *best cobalt steel magnet of the same weight* and 10% more efficient than a *chrome steel magnet of three times the weight.* It enables a steel chassis to be used without magnetic loss. It eliminates the bug-bear of loss of magnetism.

There is nothing like it in the world. A magnet made on this principle comprises two steel alloys so arranged that the magnetic flux is concentrated in the small area where the work is done instead of being distributed over the whole system. Thus without extra weight or cost sensitivity is materially increased and the range of reproduction improved.

This secret, *now revealed,* accounts for the colossal demand for the new "Mansfield" permanent magnet moving-coil speakers (Senior and Junior) ever since we introduced them at Olympia. We have had to make repeated large extensions to our works and engage and train hundreds of additional workers—*and we can now meet demands for delivery.* Write for booklet then.

Ask your dealer for a demonstration: You will be AMAZED



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42/- *complete with 3-ratio transformer.*

"Mansfield" Junior (P.M.5) also incorporates the above.
27/6 *complete with 3-ratio transformer.*

Whiteley Electrical Radio Co., Ltd.
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A revolutionary development!

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INSIDE! MAKING AN A.C.—D.C. ELIMINATOR

Practical Wireless

3D

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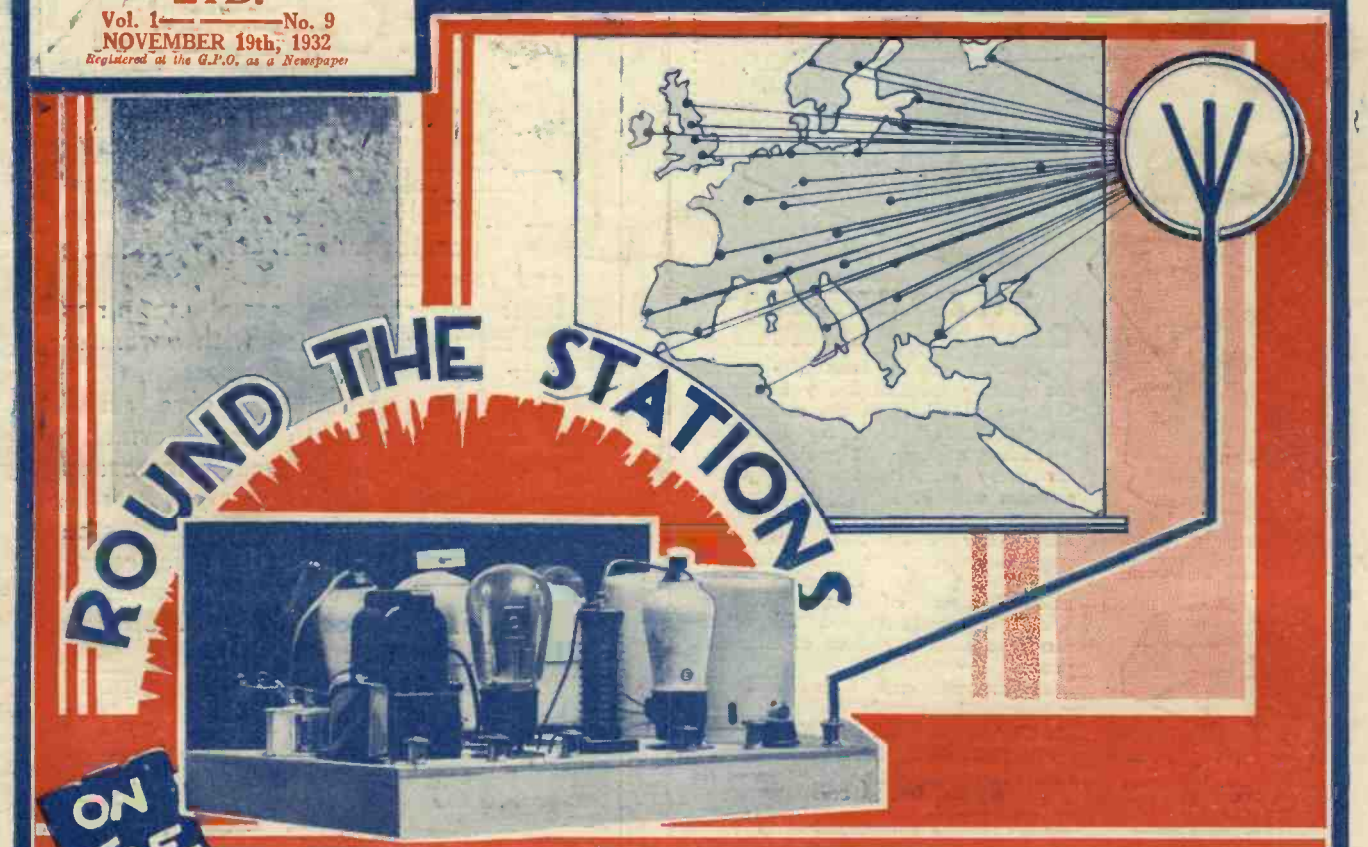

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SLEKTUN SCOUT S.G.3. S.G. detector, and power. "A" (less valves and cabinet). Reduced Price, Cash or C.O.D., £3/19/6. Carriage Paid. Balance in 11 monthly payments of 7/3. — Send 7/3 only

R & A "VICTOR" MOVING-COIL SPEAKER DE LUXE. With 6-ratio input transformer and protecting grill. Cash Price £3/10/0. Carriage Paid. Balance in 11 monthly payments of 6/5. — With 6/5 order

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EPOCH "20 C" PERMANENT MAGNET MOVING-COIL SPEAKER. With 3-ratio input transformer. Cash Price £1/15/0. Carriage Paid. Balance in 5 monthly payments of 6/6. — Send 6/6 only

CELESTION P.P.M. MOVING-COIL SPEAKER. For Standard or Pentode Output Valves. Cash or C.O.D. £2/7/6. Carriage Paid. Balance in 11 monthly payments of 4/5. — Send 4/5 only

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BLUE SPOT UNIT AND CHASSIS TYPE 99 PP.M. Including matched Transformer. Cash Price £2/19/6. Balance in 11 monthly payments of 5/6. — Send 5/6 only

ATLAS ELIMINATOR. Type A.C.244. Three tappings. S.G., detector and power. Output: 120 volts at 20 m/a. Cash Price £2/19/6. Carriage Paid. Balance in 11 monthly payments of 5/6. — Send 5/6 only

HEAYBERD H.T. UNIT D.150. Tapped variable 60/120 v., variable 0/150 fixed. Max., 25 m/a at 150 v., 20 m/a at 120 v. Cash Price £4/6/-. Carriage Paid. Balance in 11 monthly payments of 8/10. — Send 8/10 only

GARRARD INDUCTION GRAMOPHONE MOTOR. For A.C. mains. Model 202. Mounted on 12-inch nickel motor plate with fully automatic electric starting and stopping switch. Cash Price £2/10/0. Carriage Paid. Balance in 11 monthly payments of 4/7. — Send 4/7 only

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BLUE SPOT PICK-UP and TONE ARM. Cash or C.O.D. £3/3/0. Carriage Paid. Balance in 11 monthly payments of 5/9. — Send 5/9 only

ARGUS 3

As described in last week's issue

KIT "A" Author's kit of specified components with ready-drilled panel, less valves and cabinet.

Delivered CARRIAGE PAID on FIRST PAYMENT OF **10/3**

Balance in 11 monthly payments of 10/3.

CASH or C.O.D Carriage Paid £5 : 12 : 0

Specified Valves £2: 10: 6. Specified Cabinet 15/-

KIT "B." As Kit "A," but with Valves, less Cabinet. Cash or C.O.D. Carriage Paid, £8/2/6, or 12 monthly payments of 14/11.

KIT "C." As Kit "A," but with Valves and Cabinet. Cash or C.O.D. Carriage Paid, £8/17/6, or 12 monthly payments of 16/3.

KIT-BITS

Selected C.O.D. Items. You pay the postman. Orders over 10/- all Post Charges Paid.

	£	s.	d.
1 Red Triangle panel, 14in. x 7in. Ready Drilled		3	6
1 Baseboard 14in. x 9in. Chassis Type 1 1in. Deep		2	6
1 pr. Telsen twin matched coils		17	0
1 J.B. Type No. 2069 2-gang .0005mfd. variable condenser with dial		18	6
1 Lissen Hypernik 4-1 L.F. Transformer with Lissen tone compensator	1	2	6

SONOTONE 4

Described in issue of October 22nd.

KIT "A" Author's Kit of specified components with ready-drilled Panel but less valves and cabinet.

Delivered CARRIAGE PAID on FIRST PAYMENT OF **11/1**

Balance in 11 monthly payments of 11/1.

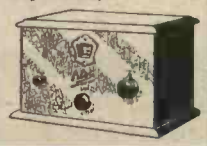
CASH or C.O.D. Carriage Paid £6/1/0.

Specified Valves £2/2/6. Cabinet £1/15/0.

PILOT BAND-PASS UNIT

Whether your set is Mains or Battery operated, the PILOT BAND-PASS UNIT cuts out programme interference effectively and sharpens tuning to needle-point selectivity. It is simple to attach and can be operated by anyone without technical knowledge. No valves or extras required.

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



25/- CASH or C.O.D Or 6 monthly payments of 4/6

1933 KELSEY SHORT-WAVE ADAPTOR

Tune-in the Short-Wave Stations on your present set. Plug the Kelsey Short-wave Adaptor—it fits without any alteration. No extra valve required, no extra apparatus. Ready for immediate use and sold complete with Dial Calibration Chart and simple Tuning Notes by our Short-Wave Expert.

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

45/- CASH or C.O.D. or 9 monthly payments of 5/6

PETO-SCOTT WALNUT CONSOLE

Constructed in Walnut with contrasting inlaid Walnut Veneers.

Comes to you with vignetted front, as illustrated, ready to take your own Set. No skill or expensive tools are required to transform your Radio into a beautiful Console instrument, presenting the professionally finished appearance of the most luxurious Radio Receiver money can buy. Or 12 monthly payments of **62/-**

Baffle Board Ready Drilled, 3/6 extra.

Carriage and Packing 2/6 extra England and Wales.

Dimensions: 36in. high; 21¼in. wide; 15¼in. deep. Panel 18in by 8in. Baseboard, 14in. deep. With lift-up lid.

STOP PRESS OFFERS

R & A "CHALLENGER" P.M. MOVING-COIL SPEAKER. Cash or C.O.D. £1/15/0. Carriage Paid. Balance in 5 monthly payments of 6/6. — Send 6/6 only

BLUE SPOT SPEAKER UNIT, Type 100U, AND CHASSIS. Cash Price £1/12/6. Carriage Paid. Balance in 6 monthly payments of 5/2. — Send 5/2 only

BLUE SPOT 66R UNIT AND MAJOR CHASSIS. Cash or C.O.D. £2/10/0. Carriage Paid. Balance in 11 monthly payments of 4/7. — Send 4/7 only

TELSEN "JUPITER" S.G.3. Complete kit, less valves and cabinet. Cash Price £3/17/0. Balance in 11 monthly payments of 7/-. — Send 7/- only

GARRARD JUNIOR "B" SPRING MOTOR Complete with turntable. Cash Price £1/13/0. Carriage Paid. Balance in 5 monthly payments of 6/1. — Send 6/1 only

W.B. P.M.4. PERMANENT-MAGNET MOVING-COIL SPEAKER. Complete with transformer. Cash Price £2/2/0. Carriage Paid. Balance in 7 monthly payments of 5/9. — Send 5/9 only

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If you have an Original Notion, Turn it into Half-a-Guinea! See page 437.

ROUND THE WORLD OF WIRELESS

Our Photogravure Supplement—A Sensational Development

AT the moment of going to press, letters are pouring into these offices congratulating us upon the eight-page photogravure supplement which appeared in last week's issue. That photogravure supplement was a sensational development, for it was the *first time in the whole history of wireless journalism* that a photogravure supplement has been given. PRACTICAL WIRELESS will continue to lead the way!

A Terrific Fillip to Home Construction

ON one thing there can be absolutely no doubt whatever, and that is that the publication of PRACTICAL WIRELESS has given a terrific fillip to home construction. The home constructor had reached the stage of stalemate, and we feel that we have performed an immense service to the wireless industry in reviving the waning interest in home construction. Dozens of periodicals are published on Wednesday of each week, but for the wireless constructor *the* publication on that day is PRACTICAL WIRELESS.

German Ultra S.W. Transmissions

HAVE you heard the new Berlin ultra-short-wave station yet? It commenced its test transmissions on 6–7 metres early on in October. A power of 4 kilowatts (in the aerial) is used and tests take place from 10 p.m. to 11 p.m. on Mondays and Thursdays, and from 7 p.m. to 8 p.m. on Wednesdays and Saturdays. In each case the hours are G.M.T. Theoretically, of course, this station should not be heard in this country due to the short-distance nature of these very short waves, but one can never quite tell what will happen in wireless. It would be interesting to hear of any reception of the new station—either freak or otherwise.

Hier Ist

TALKING of the German stations, you have no doubt noticed the much-abbreviated call, since the centralization of broadcasting in that country, when an S.B. is being put out. Instead of the long list of names given hitherto we now hear the less tiring "Hier ist der deutche Rundfunk."

The Vienna Radio Show

WE understand that the Vienna Show was excellent from the point of view of up-to-date sets and components besides being excellently staged. But the disappointing part is that sales were slow and poor, presumably due to shortage of money.

Heterodyning in North of England

OUR North of England Correspondent writes to say, although reception conditions in his part of the country are now very good indeed, heterodyning is fairly bad on two or three parts of the medium waveband. The North National (301.5 metres) is so badly heterodyned by Hilversum that at times good reception of either station is impossible. Round about the wavelengths of the Scottish Regional and London Regional heterodyning is very troublesome and in both cases a number of stations are affected.

MAKING AN A.C.—D.C. ELIMINATOR
See Page 431
+ + +
TUNING AND ADJUSTING THE "ARGUS"
See Page 433

Above 480 Metres

OUR correspondent goes on to say that reception of those stations above the North Regional, such as Prague, Florence, Brussels No. 1, and Vienna, is now very reliable and better than it has ever been before.

100 kW. for I.F.S.

WE wonder what will happen when the new 100 kW. Irish Free State Transmitter takes over Dublin's wavelength of 413 metres. This station, situated at Athlone, as you probably know, will have more power than any other in the British Isles and will indeed rank among the most powerful in Europe. Some of the Midland Regional listeners look like having a bad time, especially those with unselective sets. The Athlone Station is expected to be "on the air" a few days from the time I write these notes, so you will probably have heard it before reading them.

Radio Emergency Corps

YOU probably remember the excellent service rendered to their country by New Zealand transmitting amateurs during the unfortunate earthquake a year or two ago. These same amateurs have now banded themselves together as a Radio Emergency Corps. The corps already consists of nearly 300 members who are divided into about 15 regional sections. It is their object to be of national assistance in maintaining communication in the event of similar earthquakes, floods, or other crises.

American Reception

I MENTIONED in these columns last week that the time is now ripe for attempting reception of American medium-wave stations. Although I have been too busy to sit up until the "wee small" hours myself, I have received one or two reports of good reception of these stations. In one case no fewer than four stations were well received on a standard S.G.—D.—P. set between 1.30 a.m. and 3 a.m., when my informant went to bed. At the latter time reception conditions were gradually improving.

Licences by Instalments

LATELY there was a renewed appeal for wireless licences by instalments. It is proposed that the licences should be obtainable by paying a shilling per week at the nearest Post Office. Apparently the P.O. authorities do not approve of the scheme because of the additional clerical work which it would involve. But why not arrange it on the same basis as motor taxation so that payment could be made in a lump sum or by quarterly instalments. In the latter case an additional ten per cent would be charged to cover clerical expenses.

"Break-through"

IF you are troubled by nearby medium-wave stations breaking through when receiving Daventry and Radio Paris, you

Round the World of Wireless (continued)

should insert an Anti-Break-through Choke in series with the aerial lead. This will effectively cure the trouble. It must be remembered that the choke must be short-circuited when medium-wave reception is required; a simple push-pull switch can be employed for this purpose. Incidentally, a suitable choke is made by Messrs. Lissen and costs only 4s.

Fécamp very Popular

JUST lately we have received numerous queries from listeners who wish to receive Fécamp, or by its other name Radio Normandie, which operates on 223 metres. This station has long working hours, and gives some excellent programmes in both French and English. Unfortunately for some, its wavelength is pretty low down on the scale, and consequently very many sets cannot be tuned down to it. Several readers have expressed surprise that they cannot get below 250 metres or so even though the coils they use have an advertised range of from 220 to 550 metres. I am sorry to say that in the case of some coils the ranges quoted by their makers could not be covered by any means whatever. In other cases, however, the difference in actual and stated tuning ranges is accounted for by the fact that an unsuitable tuning condenser is used. If the condenser is a poor one, having a high minimum capacity, it will considerably reduce the possible wavelength range of *any* coil. When it is impossible to "get down" to Fécamp by any other means a few turns must be removed from one end of the medium-wave winding. The exact number of turns to be removed will depend upon individual circumstances, but if they are removed one by one, no difficulty should be experienced. It should be remembered that the removal of turns, though increasing the wavelength range at the lower end, will cause a corresponding reduction at the upper one.

Grid Emission

I RAN across a rather peculiar fault in an all A.C. receiver the other day. This particular set was a home-made one, but looked a splendid job. The constructor had obviously expended much care on it, and had enclosed both set and power unit in a beautiful combined book-case and cabinet. When the set was first switched on it gave a very fine account of itself, both as regards quality and "quantity"; in fact, it at first struck me as an almost ideal instrument. All went well for twenty minutes or so, and I began to be really impressed by this fine set. But, after that, reproduction gradually began to fall off; first it weakened, and then the quality went entirely. After a few more minutes the sound from the loud-speaker became more like what one would expect from a pack of wild animals, than from a symphony orchestra. My friend explained that the same sequence of events happened every time the set was put into use, and, although he had carefully checked everything he had been unable to trace any fault. After switching off the set I immediately felt the valves and, as I expected, found they were extremely hot. This was due to the fact that no ventilation was provided in the set. I suggested that the set should be removed from the cabinet and tested again. This was done, and it worked perfectly for the whole evening. The trouble at first experienced was due to the valves heating up until the grids became incandescent so that they began to act in the same way as the cathodes and emit an electron stream. The moral to be drawn from the above incident is, that a free circulation of air should always be allowed for round indirectly-heated valves.

INTERESTING & TOPICAL PARAGRAPHS

THE NEW WIRELESS TELEPHONE

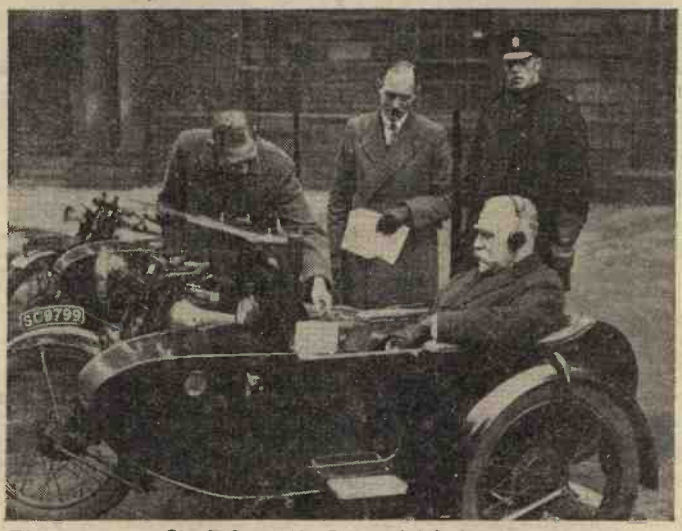


Photo shows :—Chief Constable Ross, of Edinburgh, testing the new radio telephone which is being tried out by the Edinburgh "speed cops." Mr. Forsyth, of the Standard Telephone and Cable Co., is seen pointing out details in the set, which is placed in the side-car. The aerial is mounted on the carrier of the motor-cycle as seen in picture. Superintendent Berry, of the Edinburgh Traffic Police, is seen standing behind.

Another Valve Problem

ANOTHER rather baffling valve problem came my way recently, and, peculiarly enough, the valve concerned was also of the A.C. mains type. I was asked to look at a D.—2 L.F. A.C. receiver, which I was told was playing some funny tricks. I listened for a quarter of an hour, but nothing unusual happened. I noticed that the volume was tremendous and much too loud for my liking, but otherwise I had no legitimate complaint. Just as we had decided that the set was not going to "perform" a loud hum started and this soon developed into a "growl," and then an indescribable din. The set was quickly switched off and an examination of its "innards" commenced. No fault could be found, so we switched on again—everything all right. But after a short time the trouble recurred. Every wire and every component was carefully tested without result. In the end I became so bold as to examine the interior of the set whilst it was in operation. My idea was that by carefully prodding (with my fountain pen as an insulator) various wires and components, I might be able to create the disturbance and so locate its source. And what do you think I found? On tapping the detector valve in one direction, the noise started, and by tapping it in another, it ceased. I am not sure even now what was wrong, for the valve was "silvered," of course, but I imagine that there was either a break in the cathode or heater leads. It was replaced immediately on returning it to the makers.

Aerial Circus for South Africa

ON November 4th, Sir Alan Cobham left for South Africa upon an organized tour, visiting over seventy centres with a fleet of aeroplanes. The object of the tour is to popularize aviation. Broadcasting from a public address van to an aeroplane in the air and at the same time transmitting the messages to the public by the special public address apparatus will play an important part in these aerial demonstrations. One of the most novel items on the programme is the dancing aeroplane, which literally dances in the air to music broadcast to it by the public address apparatus on the ground. Thus the public are able to hear music and see the machine perform to it.

Lotus Competition

COINCIDENT with the B.B.C. Birthday Week Celebrations, the Lotus Radio Company are announcing a very interesting competition under the name The Lotus XI. This competition will prove to be very popular and consists of choosing sets for a range of eleven people. The competition will be advertised in the Daily Press, and £500 in cash prizes are offered.

Continued on page 434)

SOLVE THIS!

Problem No. 9

Jones built a one-valve set from spare parts. Every component was tested before being used, and was found perfect. When completed, however, the set only worked for a few seconds, and then signals ceased with a click. The set was switched off, all leads checked, nothing found wrong, and so Jones switched on again. The same thing happened—signals for about 30 seconds only. What was the cause of this trouble? Three books will be awarded for the first three correct solutions opened. Mark envelopes Problem No. 9, and send to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2, to reach us not later than November 21st.

SOLUTION TO PROBLEM NO. 8

The coupling condenser and resistance were not non-inductive.

The following three readers receive books in connection with Problem No. 7:—

C. D. Pope, 90, Mount Pleasant, Road, Lewisham, S.E.13; C. Duell, A.B., 7 Mess, H.M.S. *Iron Duke*, Weymouth; J. E. Tucker, The Cottage, Baglan Nurseries Port Talbot, Glam.

SIMPLE POINTS ABOUT TUNING

The Principles of Tuning Simply Explained

By GILBERT E. TWINING

THOSE desirous of listening to wireless programmes erect an aerial and make connection to earth, either by sunken plate or tube, or to a convenient water pipe. The leads from the aerial and earth are taken to the A. and E. terminals of the set respectively. The set is then ready to be tuned, that is, of course, after it is switched on.

The actual handling of the tuning dials of a set appears to some people to be confusing, but most of the controls, if treated in a systematic manner, are very simple, and the difficulties vanish with experience. It is futile to twiddle the dials aimlessly in one direction, and then in another, expecting to receive numerous stations; they must be turned slowly or stations will be missed. Where an ordinary single-tuned circuit is used, it is a simple matter to tune from one station to another, using a certain amount of skill with the reaction control; the difficulty arises when there is more than one tuning control. When two tuning dials have to be operated together they must be kept in step. Some practice is essential before successful control can be accomplished, for as soon as the dials get out of step the circuits are not in tune, and the chances of receiving all but the very powerful local station becomes very remote. When commencing tuning, the reaction knob should be placed at zero, and the tuning dials adjusted to the wavelength of the station; the reaction is then advanced just sufficiently to maintain the set in a really sensitive condition. If the two circuits are in step, a certain liveliness is noticeable, together with a slight breathing or rustling sound.

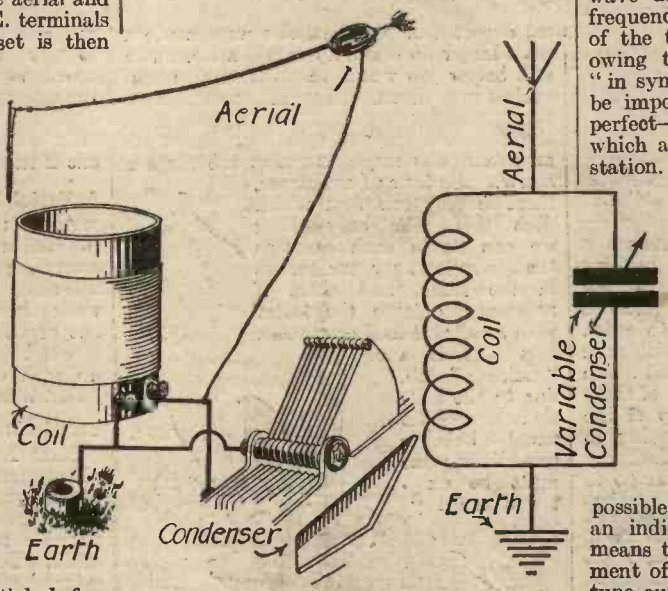


Fig. 1.—A theoretical and pictorial diagram of a simple tuned circuit to cover the normal band of frequencies.

The Transmitting Station

The transmitting station sends out on an aerial electro-magnetic, or wireless waves, of very high frequency, travelling at the speed of light, that is to say 186,000 feet per second; these electro-magnetic frequencies are known as the carrier waves, the sound waves of speech or music—of a much lower frequency—are modulated or mixed with the carrier waves. The combined waves disperse from the aerial in all directions, gradually becoming weaker; this is partly due to the earthing effects of buried metal, and also to their absorption and conductance to earth by buildings, trees, etc. A transmitter can be simply explained by saying that it has an aerial which radiates the signals, associated with which aerial is a coil and condenser. The wavelength or frequency of the station—and every station is allotted a wavelength—depends upon the setting of these two pieces of apparatus. For instance, a station which is allotted a wavelength of 400 metres, adjusts its coil and condenser to this wavelength; it then fixes it, permanently, enabling it always to transmit at 400 metres. If the transmitting station broadcasts at a certain known frequency and it is desired to receive this station, the receiving set must be tuned to respond to the same frequency. This is carried out by a tuning circuit similar to that of the transmitter. It is made up of an inductance coil and a variable condenser. In Fig. 1 is shown a simple aerial tuning-circuit.

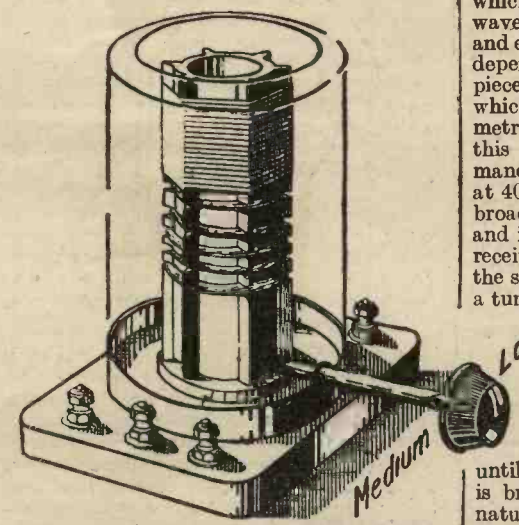


Fig. 3.—A commerical form of the coil shown in Fig. 2, showing the metal screening cover.

Wireless Waves

Wireless waves are inaudible until resonance, or, as we know it, tuning, is brought into action. Everything has a natural period of vibration. It is possible for a gong yielding a note of certain pitch to be struck, and so cause a nearby hollow vessel of suitable shape and material to vibrate in sympathy, the two objects can then be said to be in tune. In the case of wireless tuning it is possible to select any wave desired from these many inaudible frequencies, because the increase in strength of the tuned station is so considerable—owing to the receiver being in tune or "in sympathy" with it—that it ought to be impossible, if the sets of to-day were perfect—to hear any of the other stations which are broadcasting around this tuned station. The great difficulty concerning the present-day broadcasting system is, however, that owing to the number of stations and the close proximity of the wavelengths, the ether is becoming very overcrowded, consequently, when a station is tuned in, others are likely to be heard as a background, by reason of their being in partial resonance with the receiving set. This is the reason why it is so necessary at the present time to make sets as selective as possible. Sharp tuning can be taken as an indication of good selectivity, which means that only a small amount of movement of the tuning condenser is needed to tune out one and bring in another station. The opposite, of course, to sharp tuning is flat tuning; this is when a powerful station occupies a large proportion of the tuning dial.

The tuning is varied by altering the capacity of the variable condenser, although the inductance of the coil, if altered, will also vary the tuning, but it is more practical to move the condenser vanes. A very important point to be remembered about coils and condensers is that several different proportions of inductance and capacity may be used, that is to say, a small amount of inductance in a coil and a large capacity of condenser, can produce the same wavelength as a large amount of inductance and a small amount of capacity. This is partly the reason why two sets with identical calibrations on the dials may not give the same dial readings for the same wavelength; this means that on

(Continued on page 436.)

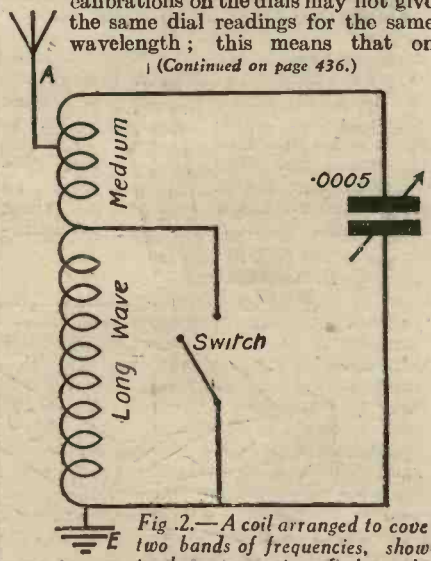


Fig. 2.—A coil arranged to cover two bands of frequencies, showing how one section of the coil is short circuited.

OVERCOMING LITTLE MANUFACTURERS AND

Component Design has Undergone Vast Improvements in Remain, and this Article Explains How to

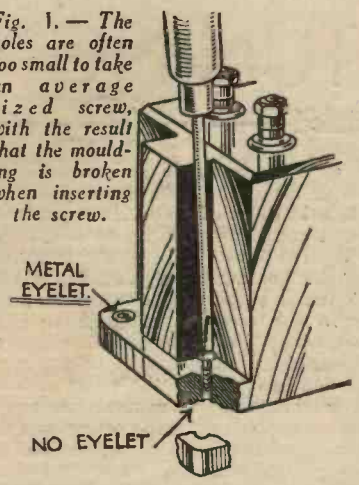


Fig. 1. — The holes are often too small to take an average sized screw, with the result that the moulding is broken when inserting the screw.

ALTHOUGH we radio enthusiasts are in a much more fortunate position to-day than we were only a few years ago, there are still several difficulties in our path which ought never to exist. I refer principally to difficulties which arise due to causes beyond our control, and which result from lack of care on the part of those responsible for the design of many of the components we use. I am not going to condemn every component manufacturer, because I know that most of them go to infinite trouble to satisfy our every requirement, and they do succeed in simplifying the task of both designer and constructor in no small measure. But there are a few manufacturers who do not give sufficient attention to some of the minor points of design which would save us a good deal of time and trouble. Such people cause us much unnecessary annoyance due to nothing else but lack of foresight, and lack of sympathy with the average constructor's limitations. Lest I be misunderstood I would like to say at once that many of the improvements which I shall suggest have already been adopted by certain manufacturers, and in those cases my criticisms will not apply.

Screw Holes

The first point which comes to my mind is in respect to screw holes in the bakelite mouldings of L.F. transformers, fixed condensers, valve holders, and the like. These are often too small to take any average-sized screw, with a result that the moulding is broken immediately an attempt is made to insert the screw with a screwdriver. One might say that it is rather "ham-handed" to attempt to put a screw in a hole which is too small; but wireless constructors are drawn from all classes, and not a few of them are without previous mechanical experience. If the holes were made a little larger no difficulty would arise, but a still better job would result if small metal eyelets were fitted. These latter strengthen the moulding very much in the region of the hole and prevent splitting even when an attempt is made to insert too large a screw. So far as I am aware, there is only one firm which does this. The only thing we can do in such cases as the above is to try our screws in the holes, and then, if necessary, enlarge the latter with a suitable drill or reamer. But this is a "ticklish" job, due to the brittle nature of the usual bakelite mouldings. One must be extremely careful that only a small pressure is applied whilst the drill is turned at high speed.

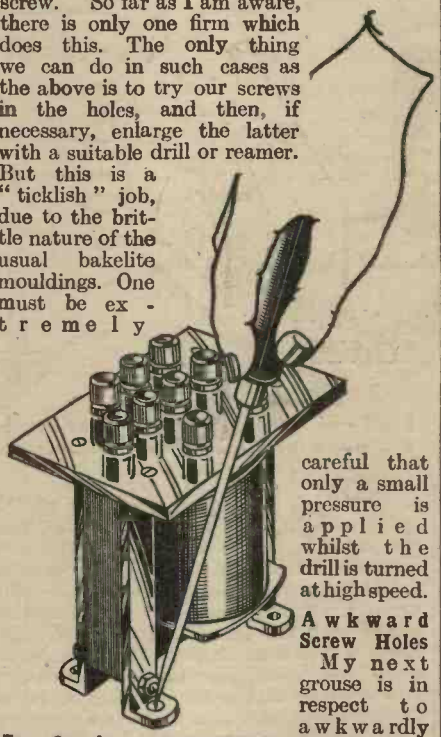


Fig. 2.—It is impossible to hold the screwdriver upright due to the position of the holes.

Awkward Screw Holes

My next grouse is in respect to awkwardly placed screw holes that one sometimes finds in the feet of components such as metal-shrouded mains transformers. Due to the positions of the holes, it is impossible to hold the screwdriver upright whilst putting in the screws (see Fig. 2). In consequence, unless great care is exercised the screw enters the wood at a slanting angle and wobbles from side to side as it is driven home. Not infrequently it becomes bent, and then breaks off. The solution from the manufacturer's standpoint would be to increase the length of the feet so as to bring the hole further out, or to arrange the feet to project from the ends instead of the sides of the component. The best way that we can avoid trouble in a case like this is to lay the component on the baseboard, carefully mark off the positions of the screw holes, and make small holes with a bradawl to receive the screws. Even after doing all this our task is not an easy one if the baseboard is at all crowded.

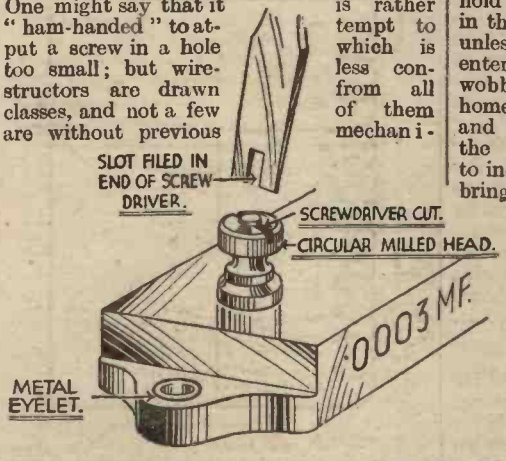


Fig. 4.—Terminals should be increased in size and provided with screwdriver slots.

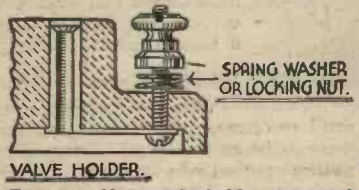


Fig. 5.—How valveholder terminals could be made firmer.

A Useful Tip

At this juncture may I offer a little suggestion? When mounting, say, fixed condensers of the type built in a tin case it is often difficult to hold the screw upright whilst inserting it. A fairly simple way out of this difficulty is shown in Fig. 3; it will be seen that the condenser is lifted up with one hand to support the screw whilst it is being driven in.

Terminals

Next I am going to make a complaint about many of the terminals fitted to some of the smaller parts like fixed condensers, valve holders, high-frequency chokes, and variable condensers; they are much too small. Being so small they cannot be gripped sufficiently well with the fingers, and are easily damaged if turned too forcibly with pliers. I would like to suggest that no terminals should be less than 4 B.A. (equivalent to about ¼in. diameter), and that they should be fitted with nuts at least 5/16 in. diameter. Regarding the latter, they should be circular and well milled, so that they can easily be gripped between the finger and thumb—that would avoid breakages due to the necessity for using pliers. The terminal nuts would also be

Fig. 3.—The condenser should be lifted with one hand to support the screw.

DIFFICULTIES THAT DESIGNERS SET US!

the Past Three Years. Some Petty Annoyances Still Obviate Them!—By FRANK PRESTON, F.R.A.

greatly improved if provided with a screwdriver cut on their upper surface, as shown in Fig. 4. This would make it a simple matter to screw down the nuts firmly when they were in positions inaccessible to the hand. A slotted screwdriver like that shown in Fig. 4 would be required, but the necessary slot can easily be made in any ordinary screwdriver with a small file.

Spring Washers and Locking Nuts

Whilst on the subject of terminals I am reminded of the trouble which often arises with components such as valve holders when the terminal nuts are being screwed down. First the terminal moves bodily and then becomes loose. To tighten it up again involves the removal of the valve holder from the set to get a grip on the lower end of the terminal with a screwdriver. All this could be avoided if the makers would fit a spring washer, or better still, a lock-nut as shown in the sketch of Figure 5.

Panel Mounting Bushes

It is surprising to find that many manufacturers make the bushes of panel mounting components so short that they can only be fixed on the thinnest of panels. There is no objection to having bushes on the long side because the extra length can always be filled up with one or two washers. Again, why can't insulating washers be supplied with panel mounting components? They are often wanted in these days of metal chassis. When insulating washers are required they can be made quite easily from a piece of ebonite rod—if a lathe is available. But most often it is not, so another method must be adopted. It is illustrated in Figure 6 and consists of binding a length of insulating tape round the screwed bush and placing a washer made of fibre, paxolin or thin ebonite on each side of the panel. The holes in both panel and washers must be large enough to take the full diameter formed by the bush and insulating tape.

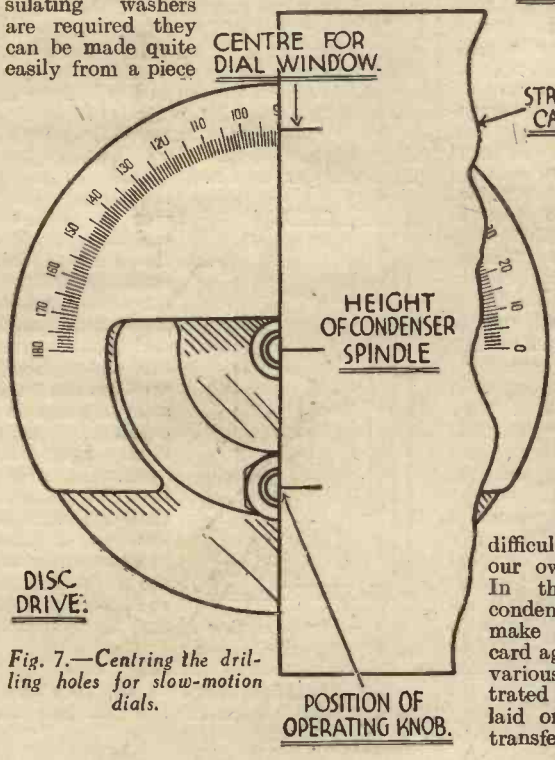


Fig. 7.—Centring the drilling holes for slow-motion dials.

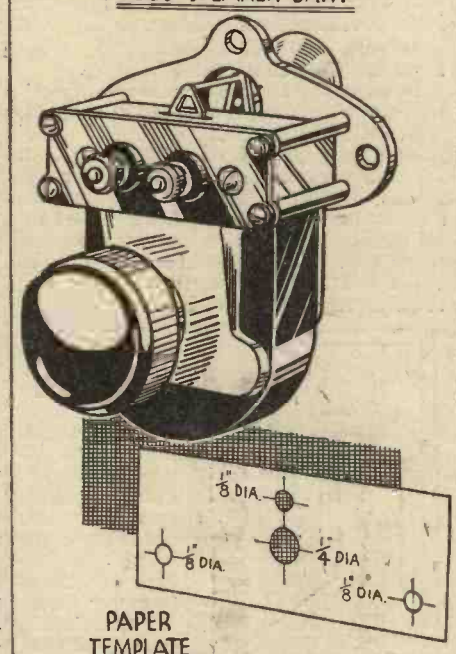


Fig. 8.—A template for loudspeaker unit.

Give Us Templates

Very few manufacturers, even among those who are otherwise blameless, supply templates with their components. These could be made in paper or thin card and would cost next to nothing, but they would be appreciated. I find it very annoying to have to mount such parts as condenser drives, loud-speaker units, gramophone motors, etc., without being given a template. Of course, the difficulty can be overcome by making our own, but we shouldn't have to. In the case of components like condenser drives the easiest way to make a template is to hold a piece of card against the centre and mark off the various heights with pencil lines as illustrated in Figure 7. The card can then be laid on the panel and the distances transferred.

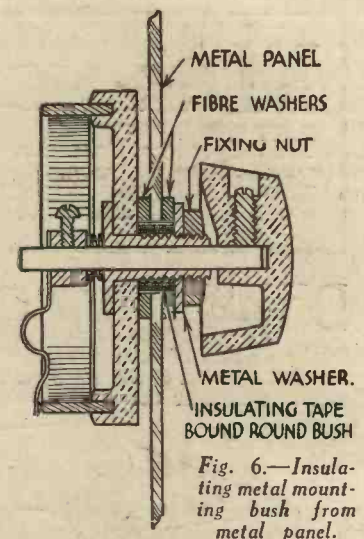


Fig. 6.—Insulating metal mounting bush from metal panel.

When dealing with such parts as loudspeaker units and gramophone motors where the positions of holes are required the simplest method is to use a piece of thin paper. Make a hole to fit over the projecting spindle and scribble over the paper with a pencil the region of the holes; impressions of the holes will be left on the paper. By laying the template on the fret or motor board the centres can accurately be pricked through (see Figure 8).

A few years ago one or two valve manufacturers used to put a label, giving the principal characteristics, round the valve cap. But this system has now been abandoned, although I don't know why. I should like to see it started again, because it really is very convenient to have necessary data ready to hand.

What Manufacturers Ought to Tell Us.

A few of the things which I suggest the manufacturers ought to tell us in respect of various components are:—

Tuning Coils: Accurate maximum and minimum capacities, or at least the ratio, of maximum to minimum. These figures would enable us to tell what wavelength range could be covered with any particular coil.

Fixed and Variable Resistances: Safe current carrying capacity; we should then know not to overload them.

H.F. Chokes: Inductance and self-capacity, so that we could tell at a glance if suitable for any particular circuit.

L.F. Transformers and L.F. Chokes: Inductance and impedance of primary winding at various frequencies and when carrying specified values of anode current—for purposes of matching. Also the maximum safe current carrying capacity.

Fig. 9.—A label on the valve base giving its characteristics.

Power and Pentode Valves: Optimum Load, so that we could accurately match them with a suitable loud-speaker.

Loud-speakers: Impedance at a frequency of, say, 300 cycles, to assist in matching output valves.

H.T. Batteries: Economic current load; the battery could then be chosen according to the type of set in use.

MAKING A DUAL CONE SPEAKER

This Speaker Possesses Merits which will Appeal to the Majority of Cone Experimenters. It Embraces the Principles of Fixed and Floating Cones, which enable it to handle with Remarkable Fidelity and Volume, the Full Range of Responses

By T. STEPHENS

DURING the past few years, thousands, probably tens of thousands, of wireless enthusiasts have experimented in the making of cone speakers since the first introduction of the balanced-armature units. One after the other, designs have

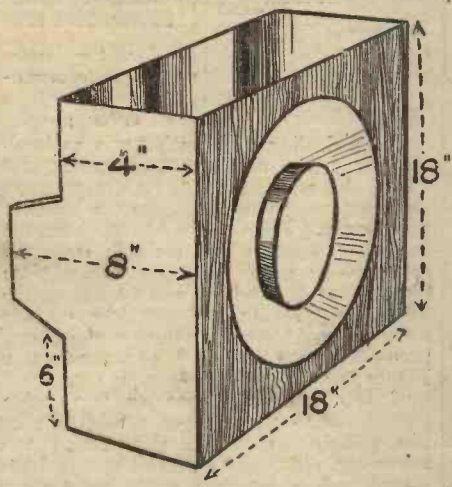


Fig. 1.—Shows completed speaker without fret front. In use the shoulder piece is used as a base.

appeared in various publications, and each claimed some particular advantage over its predecessor which would bring it into the quality class of the moving coil. There have been the fixed cone, the floating or free-edge cone, the single and double diaphragms, the rubber-mounted, the round, the square, and the oblong. Last of all, there has come the approved B.B.C. type of box speaker with its special woollen packing. Yes, everyone possessed definite points of value and such improved characteristics that one was certainly intrigued.

With the exception of the latter type, which, incidentally, seems expensive to make, and therefore outside the orbit of the general experimenter, I have tried them all, and have achieved varying degrees of success, but I must confess there was never that pleasant "up to expectation" feeling with the finished job. Whether there was something radically wrong in actual craftsmanship, or faults in the materials used—and I admit the feasibility of such in both instances—results did not reach the heights the originator claimed.

In addition to these I have attempted numerous experiments of my own. My latest achievement is the result of a constructional error which, when perceived, caused the usual type of lamentation. Then, as if in consolation for wasted effort, I stumbled on a new line of reasoning which induced me to carry on. I had aimed high. I desired that deep register usually obtained by a large fixed cone and extreme baffle, together with that excellent and natural response on the upper scale more successfully produced by the floating cone arrangement.

The combination of these two requisites has been accomplished with, I genuinely believe, better results than any other cone model yet designed, and now I recline in my armchair of an evening with a complacent smile listening to moving-coil output. In fact I might say for a normal-sized room it is more pleasing than a moving coil.

Satisfying Test Results

Perhaps there are a number of experimenters who, reading the last paragraph, will mutter "Bunk," or "Bosh," or something equally forceful. But wait a moment. I frankly admit being astonished by the results obtained. When I hooked up the speaker leads and switched on, I realized for the first time what a symphony concert really was. Those graceful cadences of the violin and the deep slur of the bass viol came through clear and balanced. In the exuberance of my feelings I rushed to a friendly wireless dealer and borrowed a P.M. unit, a good one retailed at 50s. without cabinet. I tested this until I got the correct matching of transformer with output valve. I then induced two neighbours, both keen speaker experimenters, to spare me an hour. I accommodated them in an adjoining room. Neither of them knew exactly what lay behind such an invitation. All they were asked to do was to listen for a period, and select what they considered the best speaker. Tuning various stations in order to obtain both music and speech, I repeatedly changed speakers, thus affording each a fair test. They were unanimous in their selection, which proved to be the dual cone assembly. And this from a three-year-old unit of a well-known make and material which cost less than sixpence to buy. And having made this assertion, I now provide all the necessary details of construction so that those not too sceptical may try out this assembly. These details are so simple that experimenters should find no obstacle in producing a first-rate job.

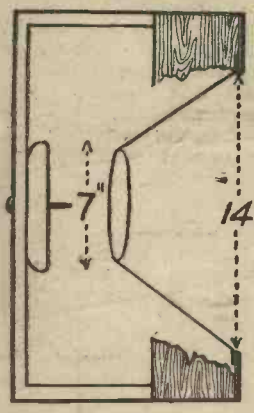


Fig. 2—Sectional view showing larger cone cut ready to accommodate the smaller cone.

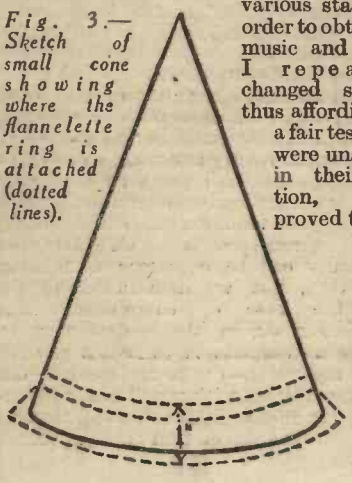


Fig. 3.—Sketch of small cone showing where the flannelette ring is attached (dotted lines).

Details of Construction

First of all, get five pieces of wood; rough box wood will do admirably. Cut four of these so that when joined they will form a square with an inside measurement of 18in. Two pieces should be 4in. wide and two 8in., the latter pair being shaped so as to form 4in. shoulders on which the fifth piece, 2in. wide and forming the unit cross-piece, can be attached. Nail or screw the four pieces together (see Fig. 1). Now get a piece of thin brown wrapping paper 24in. square. Hold this up to the light and see that it is free from blemish and that no cracks or hard folds appear on the surface. Wet well—but do not soak this under the water tap—and spread on a wood table. Place the wood square upon this face downward. Glue the outer face of the frame and fold up the paper edges. A few drawing pins pressed along the top edge will ensure the paper sticking. Once the glue is holding firmly, the newly-made baffle can be placed in front of the fire to dry. In a very short time it will be found that the paper has shrunk tight and when tapped will produce a sound like a side-drum.

Whilst this baffle is drying the experimenter can be busily employed in the making of two cones of different sizes. I will deal with the larger first; though I might add that both may be constructed of similar paper, preferably medium-weight lampshade or art, which can be obtained at any stationer's for 3d. per sheet.

This cone should measure 15in. across. When completed, carefully snip with a pair of scissors ½in. cuts every ½in. or so round the edge. Well glue the inside of the cone up to the limit of the cuts. Now turn the baffle upside down once more and place it on the table. Take up the cone, and after finding the centre, press lightly upon the apex. In doing this be careful that the cone is not bulged. The pressure will cause the snipped edges to spread outward and flat on the brown paper. Keep one finger on the apex until the glue has set.

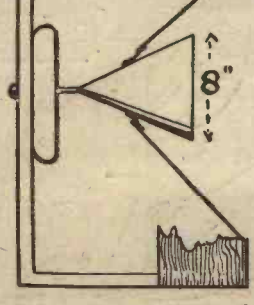
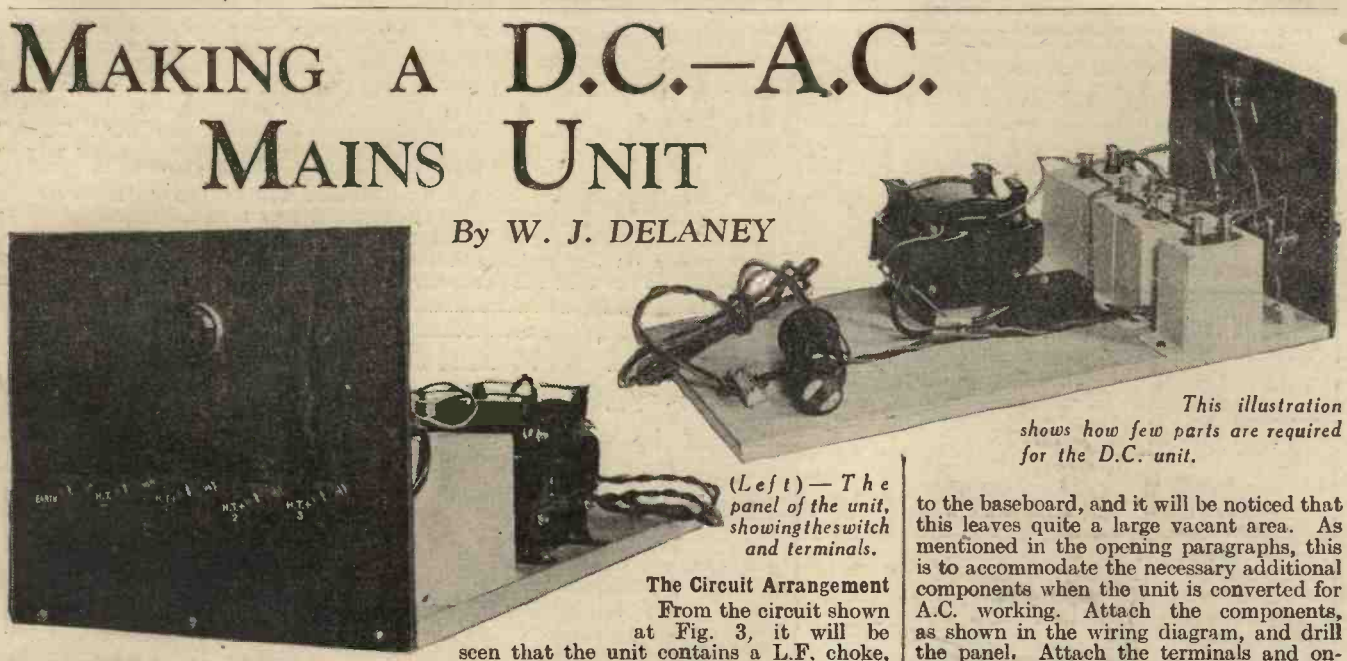


Fig. 4.—Sectional view of completed speaker. To show method of attaching the cones they have been drawn out of actual proportion.

(Continued on page 444.)

MAKING A D.C.—A.C. MAINS UNIT

By W. J. DELANEY



This illustration shows how few parts are required for the D.C. unit.

(Left)—The panel of the unit, showing the switch and terminals.

LISTENERS who have access to D.C. mains are fortunate in one respect—the construction of a mains unit is a cheap proposition. They are, of course, extremely unlucky in another respect—they are unable to increase the voltage of the mains supply. With A.C. a transformer can be used to increase the voltage to practically any value, so that where the mains supply is 200 volts, it is possible to use valves which require an anode voltage of 500 volts by simply using a suitable transformer between the mains and the receiver. Unfortunately, the D.C. supply cannot be increased, and, therefore, it is restricted in its use, and is rapidly becoming obsolete for commercial purposes. Those towns and villages which are at present on the D.C. supply are being changed as quickly as the work can be carried out, and the time will come when there will be no D.C. in the country. Until that time, however, the listener with D.C. mains need not go on using H.T. batteries under the impression that a battery eliminator will become obsolete when the mains change-over comes. Fig. 1 shows an A.C. mains unit, and Fig. 2 shows a D.C. unit, and it is quite obvious that the latter is that part of Fig. 1 which is drawn in heavy lines. The "Alpha" D.C. unit, described in this article, is, therefore, designed in such a manner that as soon as your mains are changed over it will only be necessary to buy one or two parts and *add them* to the present unit to convert it to an A.C. battery eliminator. The advantages of such a unit are obvious.

The Circuit Arrangement

From the circuit shown at Fig. 3, it will be seen that the unit contains a L.F. choke, various by-pass condensers and resistances, and a double fuse. The latter component inserts a fuse in each lead from the mains, so making the unit quite safe. It will be noticed that there is a terminal marked EARTH, and that this is joined to the H.T. negative terminal through a 2 mfd. condenser. This is one of the most essential points in the unit, as it must be used to isolate the mains from earth. When the unit is used, therefore, the earth lead *must* be removed from the earth terminal of the receiving set and connected, instead, to the earth terminal on this unit. The values of the resistances have been so chosen that any D.C. mains having voltages between 200 and 250 may be used, to deliver between 120 and 150 volts H.T. for power valves; 60 to 80 volts for S.G., and detector valves, and 80 to 100 volts for L.F. valves. The unit is, therefore, admirably suited for two- or three-valve sets, employing either screen grid, or detector and L.F. stages.

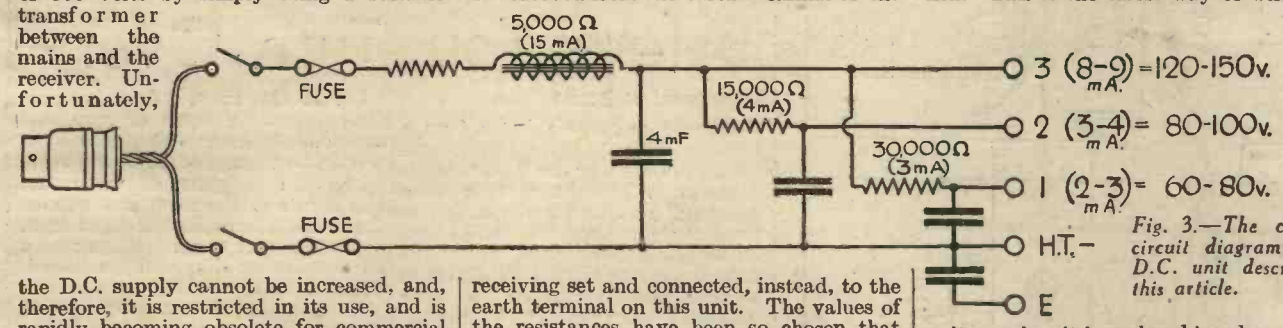


Fig. 3.—The complete circuit diagram of the D.C. unit described in this article.

Constructing the Unit

There are only six components to attach to the baseboard, and it will be noticed that this leaves quite a large vacant area. As mentioned in the opening paragraphs, this is to accommodate the necessary additional components when the unit is converted for A.C. working. Attach the components, as shown in the wiring diagram, and drill the panel. Attach the terminals and on-off switch, and then screw the panel into position. Ordinary twin lighting flex must be used to join the switch to the small fuse box, and also to join the switch to the mains. This latter flexible lead must be chosen so that it will reach from the unit to the requisite mains socket, as there is no additional external plug-in connection provided. To keep the flex in its position, a knot is tied and a small strip of ebonite or wood screwed to the baseboard across the flex. This is the safest way of wiring the unit, as when it is enclosed in a box there is no possibility of shocks due to exposed plugs or sockets. To wire the remainder of the unit use good, thick Glazite, only baring the covering where contact is made. The Spaghetti resistances have been chosen to give the voltages previously mentioned with currents of 4 mA and 3 mA. These are correct for the average valves, but may be modified to suit different types of valve by dividing the anode current into the voltage which has to be dropped.

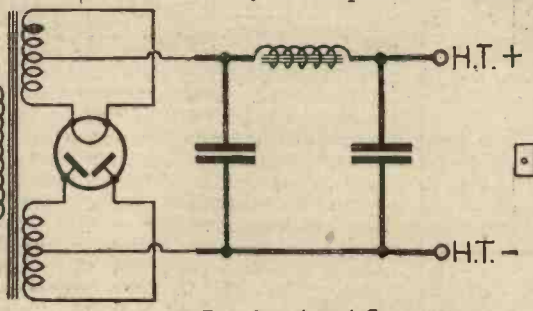


Fig. 1.—An A.C. mains unit in its simplest form.

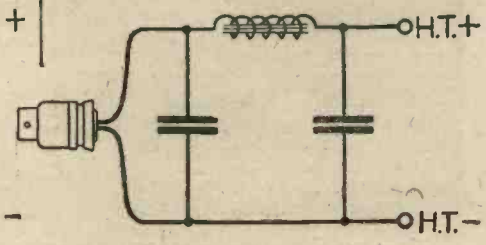
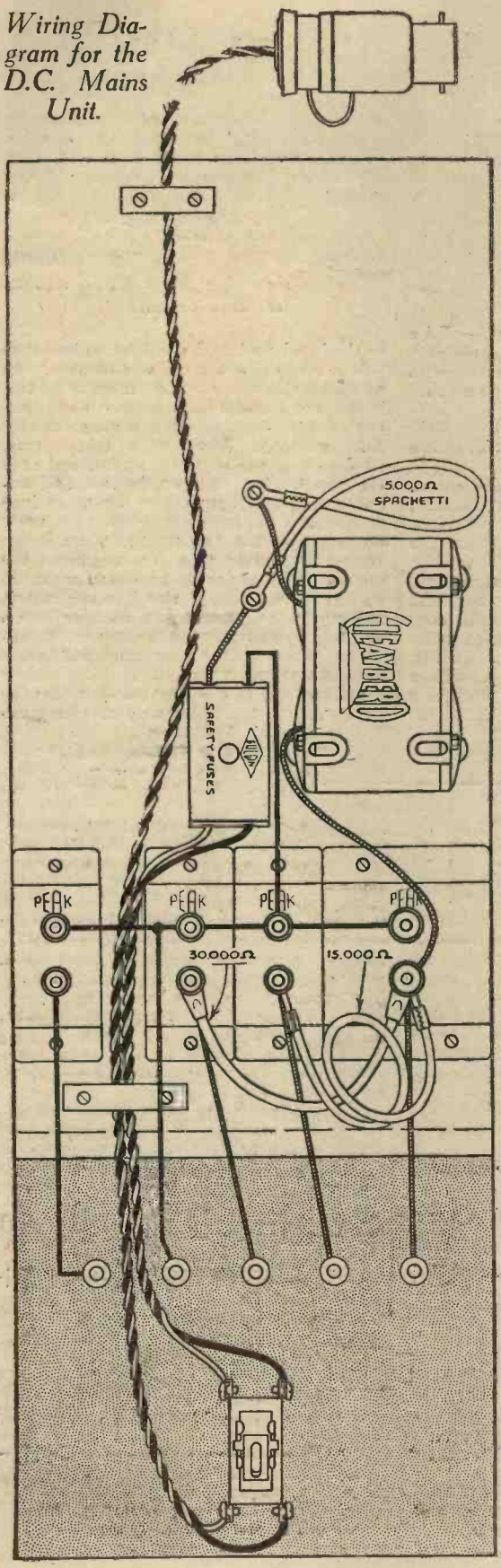


Fig. 2.—A D.C. mains unit. The first condenser is generally omitted.

MAKING A D.C.—A.C. MAINS UNIT

(Continued from page 431.)

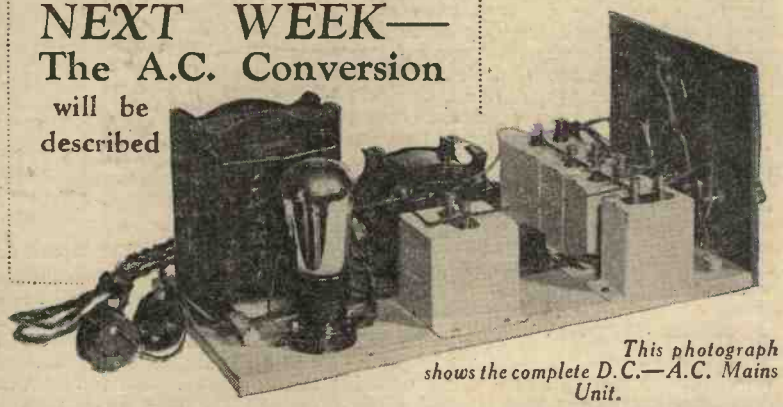
Wiring Diagram for the D.C. Mains Unit.



How to Use the Unit

When wiring is completed, replace the fuses, and insert the plug into a convenient mains socket. Join the H.T. terminals to your receiver, and change over the earth lead as mentioned before, and, for safety's sake, also put a fairly substantial condenser in the aerial lead. This will remove all possibility of shorting the mains. Now switch on the mains and then the switch on the unit, and the receiver should work straight away. If nothing happens, reverse the plug in the mains socket, as this must be connected up so that the mains negative lead coincides with the negative lead of the unit. When the correct way round has been found for the plug, it is preferable to mark the plug, either by means of a piece of paper stuck on, and bearing the word "Top," for instance, or in some other way to ensure that the plug, when it is removed, will always be replaced the correct way round. The unit will be found absolutely trouble-free in use, and we shall describe next week how to convert it for A.C. working. It is hardly necessary to add that the unit must be enclosed in a box to avoid danger, and this should preferably be of iron, with an earthing screw attached.

NEXT WEEK—
The A.C. Conversion
will be described



This photograph shows the complete D.C.—A.C. Mains Unit.

Before You Turn Over—

Department of Deceit

When I received a letter from a Great Western Railway driver, complaining of the way the B.B.C. effects department brought a train to a standstill by allowing the engine to "puff" right up to the moment of its stopping, it occurred to me the B.B.C. was conducting its effects in a very similar manner to some American film producers, who introduce twentieth century appliances in eighteenth century stories. I thought this was sufficient reason to find out what takes place in studio 6D of Broadcasting House. Some people think the room looks like the interior of a mausoleum; to me it has the appearance of a secondhand junk shop, gymnasium and operating theatre combined, in which every conceivable kind of noise is manufactured, from a synthetic kiss to a cannon's roar. Every bit of junk is an essential ingredient for concocting descriptive noises for background work. In barnstormer days, when the noise of falling rain was required, dried peas were turned in a large drum, but things are modernized in this studio of art; now the sound is produced by dropping rice on brown paper. Our old friends caused a gale by rubbing coarse sandpaper on wood and blowing a small siren. Up-to-date methods demand the shuffling of torn paper in a bowler hat when you hear the wind in the trees. Just imagine, that appetizing sizzle of eggs and bacon being fried is produced by a well-known brand of fruit salts being stirred in a glass of water. In one corner of the room is a wooden bath which provides all manner of aquatic sounds, from a storm at sea to a morning dip. On its side is fitted a small rowlock, in which is placed a small oar for rowing scenes, and the climax of illusions is the scratching of tinfoil with rubber to represent approaching footsteps.

Radio Herrings

An English radio fan, resident in Norway, has written to me saying how well the new Scottish Regional station is received there. He goes on to tell me how radio is used to assist fishermen during the herring season. The authorities have fitted aeroplanes with radio transmitting apparatus, and instead of the fishing fleet going out to search for the schools of fish, the 'planes are employed. When the herrings are sighted the fact is "radioed" to a land station, which in turn passes on the directions to the fleet. In this way, what has in the past been a very precarious livelihood, has changed to a most profitable one and saved thousands of people from privation. The B.B.C. broadcasts the price of herrings from Aberdeen.

OPERATING THE "ARGUS" THREE

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

The neat appearance of the "Argus" Three, when fitted intothe "Clarion" Cabinet, is apparent from this illustration.

"WELL and that's that, now what am I to do?" I can quite imagine that this was the remark of each constructor of the "Argus" Three, as he contemplated the results of his handiwork, after following carefully the instructions given for building the set in last week's issue of PRACTICAL WIRELESS. Justifiably proud of his work (after checking over to see that no errors have been made in wiring, of course) it is natural that he awaits quite eagerly the final instructions pointing out how to join up and operate his set. Well, here they are:

First of all the valves. Place a Cossor 220 V.S.G. in the valve socket V (the one just by the aerial and earth terminals). By the way, I notice that in the list of components given in PRACTICAL WIRELESS, dated November 5th, this valve was designated the 230 V.S.G., but, naturally, you all appreciated that this was a small printer's error—in any case, just alter it on your copy straight away. Join the short flex lead from the top of the screened grid choke to the top of this metallized valve, making sure that a good screw contact results. Next place a Cossor 220 S.G. in the V_2 socket—that on the right of the set just behind the reaction-condenser, and, as before, join your flex lead from the terminal of the screened-grid choke to the terminal on the top of this metallized valve. Finally insert your pentode valve, the Cossor 230 H.P.T., in the remaining valve socket. This, of course, is all done with the set outside its cabinet, for the first test on the aerial is best carried out in this semi-experimental manner.

Connecting Up

Join your aerial and earth leads to the terminals so marked and also your loudspeaker. Comes now the question of connecting up the three battery supplies. First of all take the seven-way battery cord and connect the L.T.— and L.T.+ spade tags respectively to the negative (black) and positive (red) terminals of the two-volt L.T. accumulator. Then, after placing the H.T.— plug into the negative socket of the 120 volt high tension battery place the remaining plugs in the following marked socket positions:—

H.T. +	.. ..	60 volts.
H.T. + 1	.. ..	42 volts.
H.T. + 2	.. ..	117 volts.
H.T. + 3	.. ..	120 volts.

The first plug on this list supplies voltage to the screening grid of the valve V, the second plug to the screening grid of the valve V^2, the third plug to the anode of V^2, and the fourth plug to both the screening grid and anode of the pentode valve V^3. I shall have more to say about this voltage question later, but the values suggested will be suitable for the initial tests.

For grid bias, insert the G.B.+ plug into the correct socket of this battery, G.B.— 2 into 6 volts negative, and the plug from the bias potentiometer of the variable mu screened-grid valve (top left-hand control facing panel front) into 9 volts negative. The G.B.—1 plug can be neglected for the moment as this only comes into operation when using the pick-up. (By the way, in the November 5th issue this G.B. battery was designated an H.T. battery; another small printer's error you must correct.)

Tuning In

All is now in readiness for switching on, so, after setting the wave-change switch to "medium" so as to tune the 250 to 550 metre waveband, turning the volume-control knob (top left-hand) as far as possible in a clockwise direction, and the reaction control knob (top right-hand) as far as possible in an anti-clockwise direction, pull out the filament switch knob (bottom centre). The set is now "alive" and by turning the main tuning knob (larger of the double centre knobs) you can tune in your "local" station on this waveband. If there is an excess of volume, with a possible tendency to overloading, just tone down this by turning the volume control knob in an anti-clockwise direction. This will increase the negative bias to the variable mu valve, and reduce the signal input to the detector valve.

The smoothness of this control will immediately impress itself on the constructor, and there is another point which must be looked into with this first station tuned in. refer to the tone compensator. I spoke about this in the preceding articles and now you will be able to test its effect. In the carton housing the original component will be found complete and detailed information and, according to the numbers, correction is given to unequal response of loudspeakers, cut off due to selective circuits and cut off due to narrow base note grooves on gramophone records. The value of the control is soon made evident when you have tuned in your station. Just turn the knob to left or right until the reproduction is to your own taste. Different settings will be found to suit best the individual items of speech, song, light orchestra, band, and so on, and the effect of the control is most marked.

Adjusting the Controls

Now let me pass on a few remarks with reference to the controls in general. First of all the "ganging" of the condenser. This should be done before attempting any real searching. Tune in a fairly weak station at about the middle of the dial with the pre-detector volume control full on. Then, rotating slightly the "star" wheel on the right of the condenser chassis, move the larger of the two tuning knobs backwards and forwards a few degrees until this signal is heard at its maximum strength. Do not touch the "star" wheel again, but repeat the process just described with the small tuning knob in place of the "star" wheel. This is the knob in front of the main tuning knob.

Further adjustment should then, strictly speaking, not be necessary, but I have found it a good plan to manipulate this front-knob trimmer when tuning in any particular station. This will ensure that you have got the station required at just its correct setting.

As far as the reaction control is concerned, the smoothness of working depends upon the correct adjustment of the voltage applied to the screening grid of the detector valve via the tapping H.T. +1. It is therefore necessary to find this on the set with the set in use. I recommended earlier that for a starting point H.T. +1 could be about 42 volts, and the set has worked quite satisfactorily with that value. However, I advise you to try out a few other voltages either side of this value, keeping the screening voltage as low as possible consistent with smooth reaction—that is, no ploppiness or fierceness.

I mentioned in the other issues how the use of the screened-grid valve as a detector produced a sharper tuning in the detector circuit, owing to the reduction in damping

Three-quarter rear view of the "Argus".

in this circuit. An additional selectivity control is given by the series aerial condenser situated on the baseboard between the aerial and earth terminals. You must adjust this to suit your own local conditions, bearing in mind that the smaller the amount of capacity included (knob turned in anti-clockwise direction) the greater the selectivity and the smaller the volume. This loss of volume, however, is easily taken care of by the reserve of power in the set itself. Include as much capacity in circuit as possible for the best results.

In *extreme* cases on the long waves it may be found desirable to cut this condenser out of circuit altogether. Should this be found necessary, the following little dodge will be found helpful. Just drill a small hole in the wooden batten at the back, and connect a short piece of wire to the moving-plate terminal of the series aerial condenser. The aerial lead can then be connected direct to this if ever required, and the condenser will automatically be cut out of circuit, the aerial in this way passing direct to the aerial coil.

Avoiding "Break-through"

When one is situated very close to a high-powered broadcasting station working on the medium waves, there is sometimes a tendency for a "break-through" at the lower end of the tuning scale on the long waves. If this should by chance occur, one way of avoiding it is to connect a fixed condenser of .003 mfd. capacity between the terminals marked 4 and 7 on the aerial coil. In normal situations, however, this point will not arise, but it is worth noting.

I think this covers most of the "hints" that have occurred to me while operating the set. A few slight adjustments in H.T. and G.B. values may be found necessary—except for H.T. +1 these are not very critical—and the amateur is well advised to try any small alterations himself, always switching off, however, before touching any of the plugs. As a general rule, H.T. +2 and H.T. +3 should be as near 120 volts as possible, H.T. + of the order of 60 volts, G.B. —1 6 to 9 volts, and G.B.— about 9 volts.

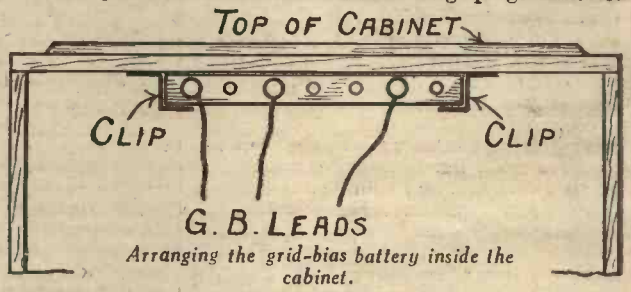
Having become thoroughly accustomed to handling the controls and the ordinary tuning operations, the reader can proceed to house the set in its cabinet. Make a note on a piece of paper of all the voltages which on test have been found to give the best results, and then remove all your plugs and leads. Now slide the set in from the back, and house the grid-bias battery inside the cabinet by accommodating it on the underside of the cabinet top. Pieces of thin aluminium or brass can be bent up as clips if you do not happen to have any G.B. battery clips by you, laying the battery with its sockets facing towards the back edge somewhat as shown in the sketch of Fig. 1. Now replace all your plugs and leads in their correct positions and all is well.

Using a Pick-up

I have not mentioned anything about the use of a pick-up. G.B. —1 plug comes into play here and should be inserted in three volts negative. Since the screened grid valve will not handle a large input signal, I very strongly advise you to use a volume control in conjunction with your pick-up. An ordinary potentiometer joined up as has been shown before in these columns (for example, on page 321 of the November 5th issue) will do quite well, and this will ensure that there is a pleasant volume level maintained and no risk of overloading and consequent distortion. The leads are joined to the pick-up terminals in the usual manner.

In conclusion let me say that I am sure readers will be delighted with the results they obtain with the "Argus" Three.

I am content, therefore, to say that the set, once the reader has become thoroughly "at home" with it, will bring in all the principal broadcasting stations. I have heard all the familiar foreign programmes on it at comfortable loud-speaker strength, and on a large number of the transmissions both the pre-detector and reaction control have had to be "cut down" considerably so that the volume is not above normal room level.



Arranging the grid-bias battery inside the cabinet.

Round the World of Wireless

(Continued from page 426)

Whiteman's Band Broadcast from U.S.A.

DURING "Birthday Week," in addition to the many attractions and surprise items already arranged for the celebrations of the tenth anniversary of broadcasting in the British Isles, the B.B.C. will relay a performance of Paul Whiteman's Band from the United States on Saturday, November 19th.

Heavy Penalties for Wireless Pirates

PIRATES, beware! Clause 3, Section 1 of the Wireless Telegraphy Act (1904) reads as follows: "If any person establishes a wireless telegraph station without a licence in that behalf, or installs or works any apparatus for wireless telegraphy without a licence in that behalf, he shall be guilty of a misdemeanour, and be liable, on conviction under the Summary Jurisdiction Acts, to a penalty not exceeding ten pounds, and on conviction on indictment to a fine not exceeding one hundred pounds, or to imprisonment, with or without hard labour, for a term not exceeding twelve months, and in either case be liable to forfeit any apparatus for wireless telegraphy installed or worked without a licence, but no proceedings shall be taken against any person under this Act except by order of the *Postmaster-General*, the Admiralty, the Army Council, or the Board of Trade." Confiscation of apparatus was recently ordered by the Bench in a recent case at Wrexham. This law applies to both transmitting and receiving apparatus.

Frankfurt and Leipzig

ON October 28th two German high-power stations were brought into operation, and simultaneously an exchange of wavelength was carried out. The 17-kilowatt Frankfurt-am-Main transmitter now works on 259.3 metres (1,157 kc/s), or immediately below the channel used by London National. The wavelength of the Leipzig 75-kilowatt station has been raised to 389.6 metres (770 kc/s), thus placing the transmission between those from Radio-Toulouse and Midland Regional.

Falling Off of German Licences

FAR from increasing its number of licence holders, during the period July to September, Germany lost over 42,000 registered listeners. From investigations carried out by the authorities it was found that over 60 per cent. of these cancellations was due to economic conditions, and only 2 per cent. influenced by dissatisfaction with the class of programmes broadcast. The German listening licence is paid monthly to the Post Office authorities, and only a thirty-days' notice is required.

Milan's High-Power Transmitter

ON October 26th Signor Mussolini officially inaugurated the recently-completed 50 kilowatt Milan transmitter, and from that date the station may be heard on the air nightly on 331.4 metres. Although the power at present is only equal to that of Rome, the plant has been so designed that its energy can be increased to 200 kilowatts.

CHARGE YOUR ACCUMULATOR FROM THE MAINS

Practical Details of Trickle Charging from A.C. and D.C. Mains.

By FRANK PRESTON, F.R.A.

IF you have any kind of electric light mains in your house, you have available a very convenient and cheap means of keeping your wireless accumulators in a fully charged state. By making suitable arrangements you can control things so that the battery is charged overnight by the same amount as the discharge occurs during the day. Needless to say, this is the ideal state because it makes for a long accumulator life and overcomes the necessity for keeping more than a single accumulator in service. The actual methods of charging depend upon whether the supply is A.C. or D.C., but in either case the job is perfectly simple and quite safe, so long as reasonable care is taken. Moreover, the apparatus required is not by any means expensive, and the cost of installation will quickly be repaid, not only in £ s. d., but in convenience and reliability.

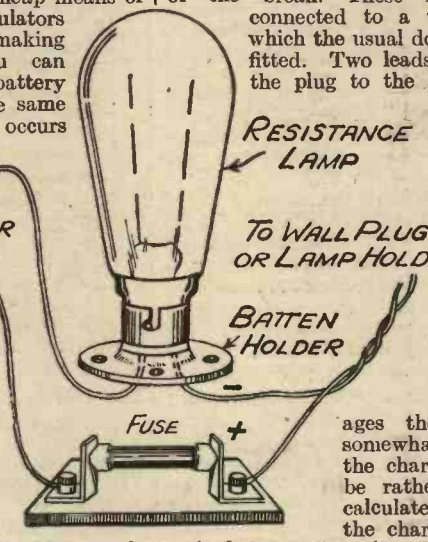


Fig. 1.—The simple arrangement required for charging accumulators from D.C. mains.

Charging from D.C. Mains

When the mains supply is D.C. it is only necessary to connect the two wires to the accumulator through a suitable resistance which serves to regulate the charging current. The most convenient form of resistance is an ordinary electric lamp, and by choosing an appropriate one any desired charging current can be obtained. The current which any lamp will pass depends upon its working voltage and power consumption (in watts), and is found by dividing the wattage by the voltage. For instance, a 60 watt 240 volt lamp will pass a current of 60/240=¼ ampere, whilst a 120 watt lamp will pass ½ ampere. The method of connecting the lamp to a convenient wall plug or lamp holder is shown in Fig. 1. It will be seen that a fuse is inserted in the positive lead as a safeguard against shorts. This latter is not by any means essential, but it does ease the mind of the nervous. When a fuse is employed it should have a current rating of twice that of the lamp, and should be inserted in the mains lead which is not earthed. This is generally the positive one, but the supply company will always advise on this point.

The method of charging just described is not an economical one unless the lamp can be employed for some useful purpose, but that shown in Fig. 2 overcomes the question of cost by making use of a lamp normally employed for lighting. The lead from the switch to the lamp is broken and a short length of wire attached to each side of the break. These latter are then connected to a wall socket into which the usual double plug can be fitted. Two leads are taken from the plug to the accumulator. It will be seen that the accumulator is put on charge immediately the lamp is switched on. As in the previous method, the accumulator may be of 2, 4 or 6 volts, but with the higher voltages the light will be somewhat dimmed and the charging current will be rather less than the calculated figure. When the charging current required is greater than that provided by any convenient lamp the accumulator can often be wired in series with some other electric appliance such as a small fire or immersion heater, the appliance replacing the lamp as regulating resistance.

Correct Polarity

It is absolutely essential that the positive terminal of the accumulator should be connected to the positive mains lead and the negative to the negative, for if the accumulator were left wrongly connected for any length of time it would be damaged. There are two simple ways of distinguishing the correct polarity, the first being by noticing the brilliance of the lamp; it will give a brighter light when the accumulator is wrongly connected. If both connections are tried it is thus usually fairly easy to recognize the correct one. Another, and perhaps more definite test, is actually to test the mains leads for polarity. This can be done by using a leaf of pole-finding paper, or a specially made polarity indicator. It can also be done by dipping the bared ends of the mains leads in a tumbler containing water made slightly acid by the addition of a few drops of vinegar. A profusion of bubbles will be liberated by the negative wire and very few from the positive. (See Fig. 3.)

Once the polarity of the leads has been established, the wires should be marked in some way to facilitate future recognition. It is also well to mark the plug and socket if there is any likelihood of their being disconnected.

Rectification of A.C.

When the supply is alternating current (A.C.) the charging apparatus is a little more involved because the voltage must be reduced to a suitable figure and the current rectified. A general idea of the processes involved is given by Fig. 4. The A.C. leads are connected to the primary terminals of a step-down transformer which gives secondary voltages of approximately 7, 5, 9 and 11. The secondary output is still A.C., so the appropriate voltage is applied to the rectifier which converts it to D.C. The rectified current is then fed to the accumulator through a 2-5 ohm "ballast" resistance. By the time the current arrives at the accumulator the voltage has been reduced to about 2.7, 5.4, or 8.1 respectively, depending upon the transformer tapping employed. These latter voltages are the correct ones for charging 2, 4 or 6 volt accumulators since we allow 2.7 volts for every 2-volt cell. The purpose of the ballast resistance is to

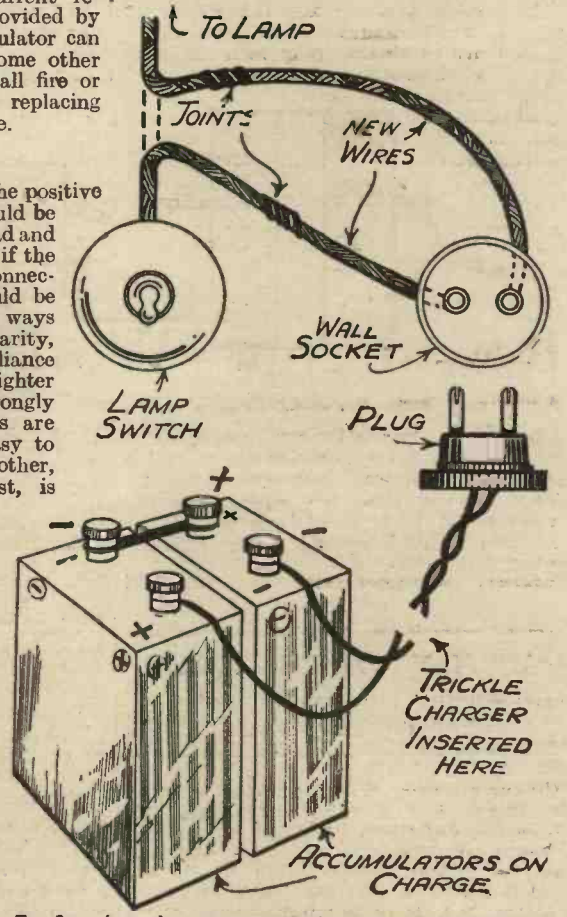


Fig. 2.—A similar arrangement, but a more economical one, using the ordinary lamp for current regulation purposes.

regulate the charging current to a reasonably constant value, but it also proves useful in preventing serious damage should the accumulator be wrongly connected.

An A.C. Trickle Charger

The following instructions will enable the A.C. trickle charger shown in Fig. 4 to be easily and cheaply constructed. The components employed are:

- 1 Baseboard, 8in. by 6in. by ½in.
- 1 Westinghouse Style L.T.2 Metal Rectifier.
- 1 Heayberd Type W.36 Transformer.
- 1 Lissen 5 ohm Baseboard—Mounting Rheostat.
- 2 Belling Lee Type B Terminals, marked L.T.+ and L.T.—.
- 1 Belling Lee Terminal Mount.
- 1 Wall or Lamp plug with length of good twin flex.

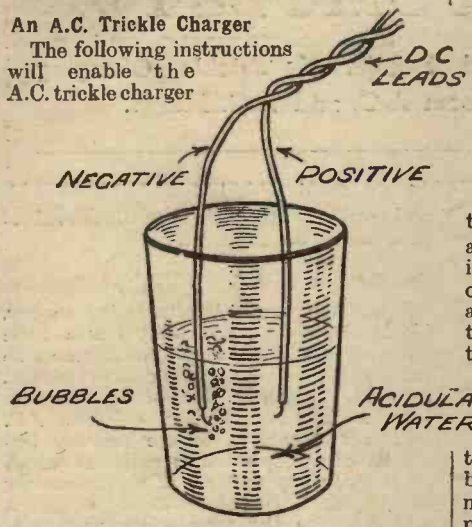


Fig. 3.—A simple method of ascertaining the polarity of D.C. mains.

The charger will give a maximum current of .5 amp., but this latter can be reduced to about .25 amp by adjusting the rheostat. If a maximum charging current of only .25 amp. were required the style L.T.2 rectifier might be replaced by a style L.T.1 without making any other alteration.

Constructional Details

The construction of the charger is extremely simple and can be carried out in less than half an hour. Mount the transformer, rectifier and rheostat on the baseboard and connect the flex to the primary terminals appropriate to the supply voltage. Take wires from the two secondary terminals giving the correct voltage for the accumulator to be charged to the two rectifier terminals marked "~." These are the two lower ones, and the marks will be found on the soldering tags held under the terminal nuts. It does not matter in the least which way round these connections are made because the current at this point is A.C. Next connect the "+" terminal on the rectifier to one terminal on rheostat, and connect the second rheostat terminal to terminal "L.T.+." A wire is then taken from the "—" terminal of rectifier to terminal "L.T.—." That completes the wiring and the charger is ready for use. Before connecting the accumulator and switching on the mains, the slider of the rheostat should be set to its midway position. It should never be moved in a clockwise direction past this point, but it might be turned anti-clockwise when a reduction in charging current is required.

General Notes on Trickle Charging

It is fairly obvious that the amount of current "put into" the accumulator should be equal to the amount "taken out" and, therefore, the charging current and length of charge will depend entirely on the consumption of the set. As an example, we will assume that the set has three valves, the first an S.G. 215 taking .15 amp., the second an H.L. 210 taking .1 amp., and the third a P. 220 taking .2 amp. The total current consumption will thus be .45 amp. or, approximately, half an amp. If, therefore, the set is used for six hours a day the current consumed will be about 3 ampere-hours. This could be replaced by charging for six hours a day at .5 amp. or for twelve hours a day at .25 amp. Alternatively, the same result could be achieved by charging for twelve hours every other day at .5 amp. or every third day for eighteen hours at .5 amp. This rule applies whether the charger operates on A.C. or D.C.

To be on the safe side it is as well to charge for a little longer than the calculated time; this cannot possibly have any bad effect, but it does ensure that the accumulator is kept in a fully charged state. Very little attention is necessary to accumulators on charge at the low rates under consideration, but there are one or two points which should be borne in mind. These can be stated briefly as follows:—

1. Keep the accumulator on charge well away from any fabrics or metal parts, because it is liable to emit a small amount of fine acid spray as it nears "full charge."
2. Remove or loosen the vent caps before charging, to allow easy exit of gases.
3. Keep naked lights away from accumulators on charge; the gas given off is *not* explosive or dangerous but *will* burn.
4. Keep the acid up to the level indicated on the case by occasionally adding distilled water—obtainable cheaply from any chemist.
5. Do not allow terminals to become corroded, but smear with vaseline once in a while.

The Cost of Charging

In the case of A.C., the cost of charging is absolutely negligible even in districts where current is comparatively expensive. The actual running expenses will amount to a matter of pence per month. With D.C. the cost will be greater when using the method shown in Fig. 1, if the lamp cannot be used for some purpose or other. With current at 6d. a unit the cost works out at a penny for every three hours on charge, allowing for a charging current of .25 amp. and a supply voltage of 240. The cost will be correspondingly lower for lower supply voltages because there will then be less voltage drop across the lamp. If the method shown at Fig. 2 can be adopted the charging current will be obtained absolutely gratis, and it is obvious, therefore, that this method should be used where possible.

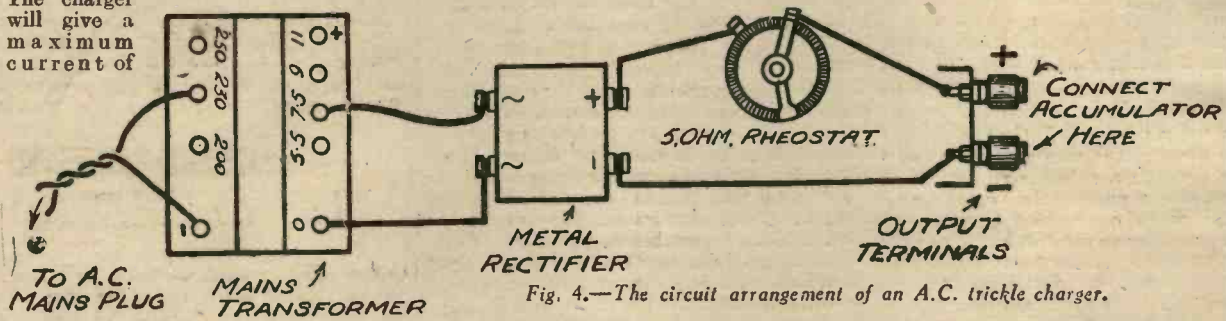


Fig. 4.—The circuit arrangement of an A.C. trickle charger.

SIMPLE POINTS ABOUT TUNING

(Continued from page 427)

the one set, more capacity on the variable condenser has to be given because the inductance of the coil is less.

One coil, as illustrated in Fig. 1, is unable to cover both long and medium wavelengths if coupled to the normal variation of condenser capacity. A variable condenser having a maximum capacity of .0005 microfarads will not tune from 200 to 2,000 metres, therefore a coil has to be designed that will have the ability to cover two distinct wavelengths.

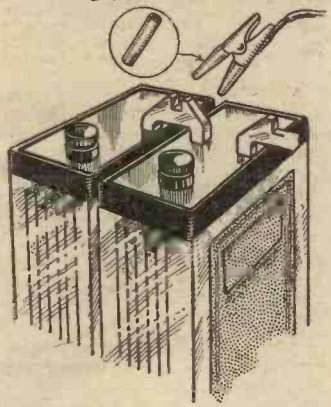
The Dual-Range coil in Fig. 2, has a continuous length of winding, it being arranged to short-circuit a section when on the medium wavelength of 200 to 550 metres. A two-point switch is inserted in the windings, one terminal going to the earth end of the coil, and the other switch terminal going to a tapping on the coil. When the switch is in contact the coil is used for medium waves, and when the switch is out of action the whole coil is in circuit, and the set is on the long wavelength of 1,000 to 2,000 metres. Reaction winding is applied to the coil separately, or it can be arranged as a continuation of the original winding. The reaction winding has a .0002 or .0003 maximum variable condenser in circuit with it; this is not a tuning condenser, but serves to vary the amount of reaction generated by the detector valve, that is to say, it feeds back magnified impulses from the plate to the grid circuit. In Fig. 3 is illustrated a modern dual-range coil shielded with an aluminium cover.

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

Non-Corroding Battery Clips

DURING the last two years this dodge has saved me a lot of trouble with corroded battery connections, also saving the cost of clips, as these were eaten away

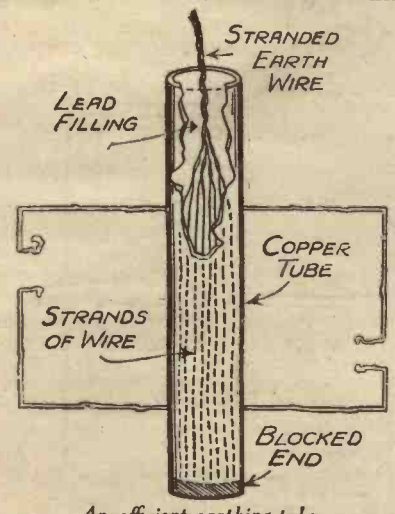


Non-corroding battery clips can be made by slipping pieces of lead tubing over the ends of the clips as shown.

in a few months and needed renewing. I cut off short lengths of lead-covered bell wire, took out the wire, leaving a hollow tube of lead, which I then slipped over the clips, and pressed into the shape of the jaws, thus making a clean and trouble-free job of my H.T. battery.—G. E. GOLDING (Bristol).

An Efficient Earth Tube

I HAVE used an earth of this type for the last two years, and find it very satisfactory, as there are no terminals or connections to become corroded, as with ordinary earth tubes. I obtained a 3ft. length of copper tube and blocked up one end with wood. I also obtained a suitable length of heavy duty stranded wire (8 to 10 strands), and bared 3ft. of the wire, opened out the strands, and placed same into the tube. Some molten lead was next



An efficient earthing tube.

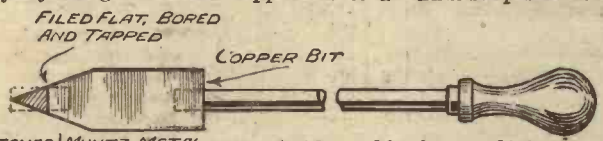
poured into the tube, and when cold, the lead had semi-soldered all the strands of wire, making a solid and efficient earth tube.—B. HOUGHTON (Preston).

THAT DODGE OF YOURS!

Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? For every item published on this page we will pay half a guinea. The latest batch is published below. 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 Wrinkle."

A Soldering Tip

MOST wireless enthusiasts who take a pride in their work sometimes find it very annoying when soldering, as the copper bit is apt to become dirty, making a neat job almost impossible. I myself have found it very trying having to clean the bit frequently by filing the surfaces, and re-tinning. I have got over this difficulty by filing down the copper bit to a

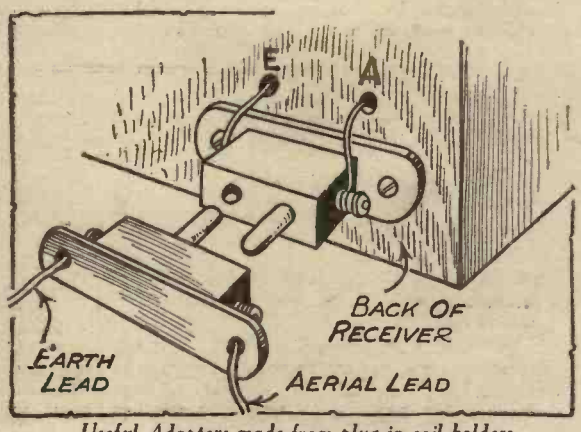


A Muntz Metal tip, added to a soldering iron, facilitates soldering.

flat point, boring and tapping same to suit a piece of Muntz Metal, about 5-15in. diameter, which is threaded to suit, and screwed into the bit for a distance of ¼in. or so. The Muntz Metal is then filed down to a point to same plane as the sides of the bit. The accompanying sketch will make this clear. When this bit is now "tinned" in the same manner as an ordinary soldering iron bit, there will be no further fear of making a bad job, as the Muntz Metal will retain the tinning indefinitely. I have been using a bit of this description for some considerable time with absolute success.—GERALD H. COLHOUN (Londonderry).

Improvised Adapters

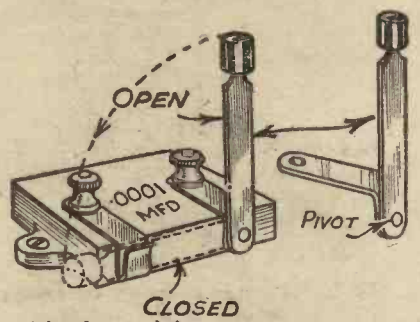
NO doubt there are quite a number of readers who have coil-holders of the plug-in type on their hands. Two such holders make a very useful adapter, as shown in the accompanying diagram. If three spare holders are available, the adapter can be inserted in the loud-speaker circuit, and when required, the speaker can be carried to another room and be plugged into the remaining holder, which is, of course, connected to the speaker terminals on the receiver. This adapter cannot be connected the wrong way round, and it is always out of sight, being fixed in the most convenient place behind the loud-speaker or receiver.—GEORGE WREN (New Cross).



Useful Adapters made from plug-in coil holders.

A Neat Condenser Switch

A SIMPLE knife switch fitted to an aerial series condenser, as shown in the sketch, will be found very convenient



A handy switch for cutting out an aerial series condenser can be arranged as shown.

for a quick change over, when necessary. Thin strip brass can be used for the switch clip and lever, while a small knob, made from a piece of ebonite or rubber can be pressed on the end of the lever.—C. B. SENIOR (Bristol).

Making Extension Rods

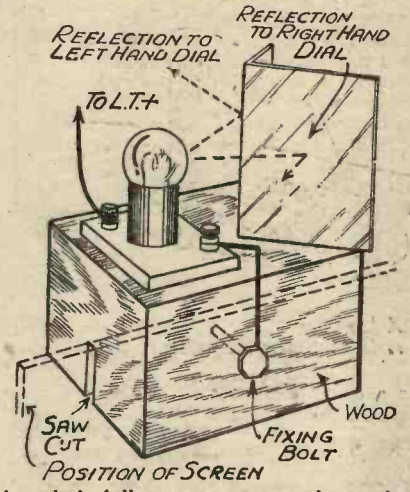
A SPARE lead-in tube makes a couple of useful extension rods for short-wave sets, and adapters. Cut the ebonite tube to required lengths; tap a small hole at each end of the tube, and fit with screws.

Method of making extension rods.

Cut a short length of brass rod, and fit in one end of the tube. (The dial of the variable condenser is fitted to this.) The other end of the tube is slipped over the spindle of the condenser and tightened up.—H. E. WINTER (Liverpool).

A Novel Dial-lighting Device

MY receiver is fitted with two illuminated disc drives, and I found that the necessary two bulbs took an appreciable current from the low-tension accumulator, so I fixed up the following gadget to enable one bulb to illuminate the two dials. I obtained a small block of wood about 2in. long by 1in. wide by 1in. thick, and made a saw-cut ¼in. deep along the middle of the bottom. A bulb-holder is fixed to the top of the block, and a reflector cut out of a piece of tin is bent to a V-shape, and fitted behind the bulb-holder, with the

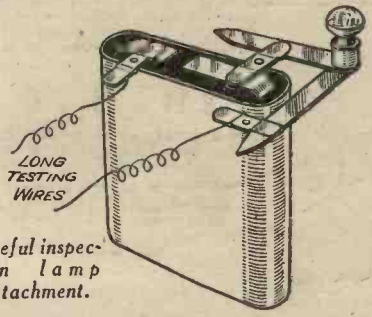


A method of illuminating two condenser dials with one bulb.

point to the front, as shown in the accompanying sketch. The gadget is fixed on top of the screeen dividing the S.G. and detector portions of the set by means of the saw-cut, and may be placed in any position along the screen. The light from the bulb can be reflected on to the two dials by bending the sides of the reflector to the necessary angle. If a hole is tapped through the side of the block, and a small bolt screwed through so that it touches the metal screen, it will hold the gadget firm when the best position has been found for it, and a connection can also be taken from the bolt to one side of the bulb-holder, the other side of which should be wired to the filament plus-terminal of the nearest valve-holder. I think the sketch will make the idea quite plain.—C. C. ALGAR (Forest Gate).

A Handy Inspection Lamp

THIS novel inspection lamp is very simple to make, and consists of a small fuse-holder, an ordinary spring

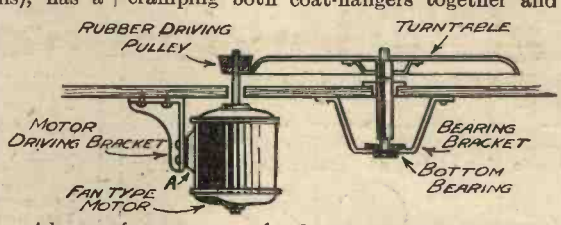


A useful inspection lamp attachment.

clothes-peg, and a length of twin flex. This little device, details of which will be clear from the sketch, is very useful, as it can be clipped almost anywhere in the set, and so leaves both hands free to work.—J. H. FLETCHER (Malton).

Electric Drive for Gramo. Turntable

THE accompanying sketch shows a very cheap and quite effective electric drive for a gramo. turntable. A small fan-type motor, of the induction type for preference (if for A.C. mains), has a rubber pulley on its driving spindle which bears against the turntable edge. If the turntable is 12in. diameter and the motor speed is, say, 1,200 r.p.m., then this pulley should be $\frac{.78}{1,200}$ x 12 or .78in. diameter. Actually, if this is made ¾in. it will allow for a little compression of the rubber. If a soft rubber block is fitted behind the motor, *i.e.* clamped between the supporting bracket and the motor, it will serve a dual purpose of damping down vibration and imparting a greater degree of flexibility to the drive. The rubber driving pulley may, with advantage, be slightly tapered so that the meshing pressure of the driving and driven members may be altered at will. Once this arrangement has been successfully constructed, it is amazing how such a simple device will continue to function for very long periods without the slightest attention. If a brush-type motor is used, it is advisable to fit an earthed screen around it to prevent interference.—F. BATE (Handsworth).



Adapting fan-type motor for driving a gramo. turntable.

Automatic Lighting for Motor-board

IT is generally appreciated that most radio-gram motor-boards are, by virtue of the sound-proof lid, in a state of semi-darkness if the room does not happen to be lighted up. This automatic light is designed to help those battery radio-gram owners who sometimes scratch a record, or perhaps let the pick-up fall, through fumbling with the needles, etc., in the dark, and yet do not want the trouble of switching a motor-board light on and off with every record, always remembering that to keep a light burning all the time is going to waste the attendant battery, or the L.T. accumulator, if this is used. It will be seen from the accompanying sketch how the motor governors are made to switch the light on and off, by means of the up-and-down movement of the governor brake-disc as the motor starts and stops. The contact here is made by a slender strip of springy brass, and if fitted as shown in the diagram it should be found that the lamp lights just as the record finishes playing and the motor stops, and remains alight until the next record is started. The spring-brass holds the contact just long enough for the needle to be placed on the record. Thus it will be seen that this simple automatic light which switches itself off when not in use will make a battery last for weeks which would otherwise be spent in a few hours. A switch is included in the circuit, of course, to switch off the light when the radio-gram is finished with altogether.—F. E. ROGERS (Bedminster).

TO HAVE *BEEN* FIRST MERELY PROVES ANTIQUITY.
TO HAVE *BECOME* FIRST SHOWS PROGRESS!

A Non-sag Indoor Aerial

TO make this handy aerial, obtain two coat-hangers, two springs of the coil type, a few washers, and a quantity of wire suitable for indoor aerials. Start by cramping both coat-hangers together and drilling a number of holes through the flat side of each, as in Fig. 1. Having done this, remove the hooks from the woodwork, drilling the hook holes right through a shade larger. Replace the hooks,

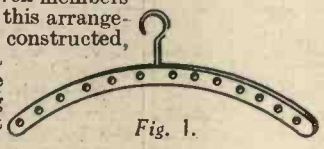


Fig. 1.

Fig. 2.

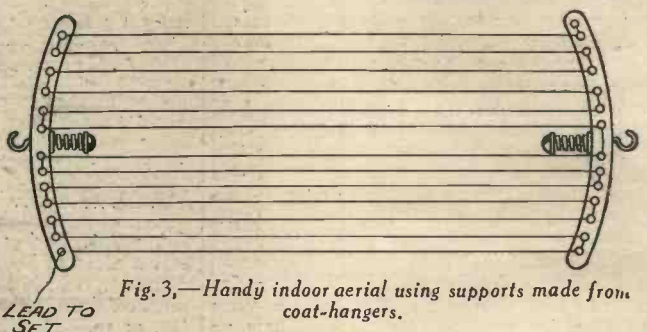
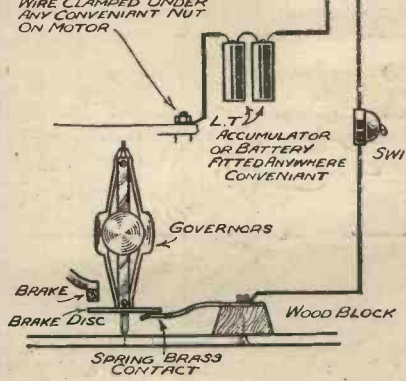


Fig. 3.—Handy indoor aerial using supports made from coat-hangers.

pushing them through for the shanks to protrude far enough for a couple of washers and a spring to be put on each. Rivet the end of each shank enough to hold the springs and washers on, as shown in Fig. 2. Complete the job by threading the aerial wire backwards and forwards through the holes in each hanger, leaving enough at the starting or finishing end to lead down to set, as indicated in Fig. 3.—L. A. COOKE (Hereford).



Using a gramophone governor gear for automatically switching a motor-board light on or off.

"Stations all round the dial... at full loudspeaker strength"

Yorkshire owner's tribute to efficiency of the Cossor Melody Maker

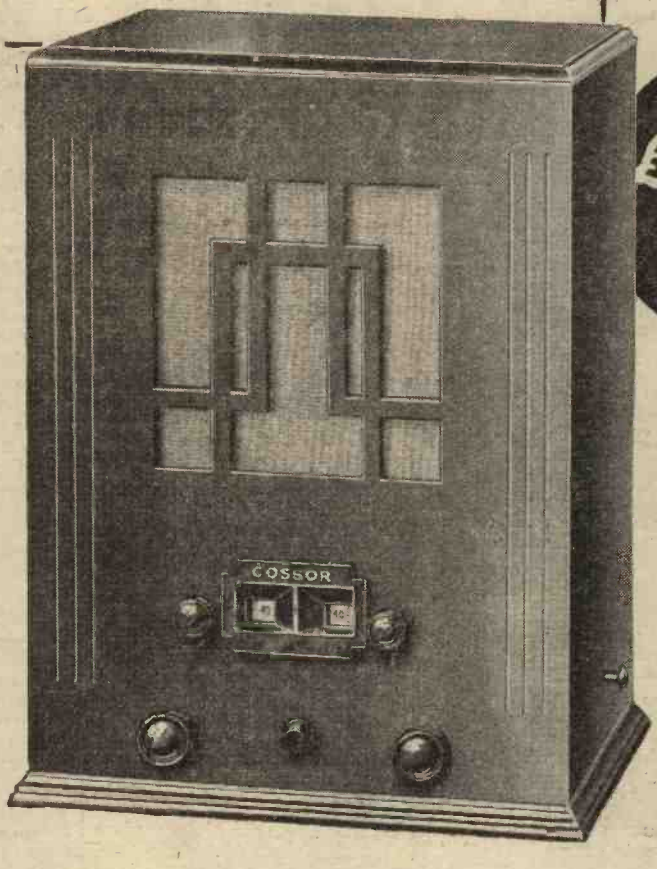
DONCASTER
1st October, 1932

Dear Sirs,

"I cannot say how pleased I am with the performance of your Model 335—range, volume, tone, selectivity are all that can be desired. Rome, Radio Paris, Berlin and stations all round the dial come in at full loud speaker strength. I have had more expensive radio but my 335 is the best I have had yet. Without doubt it is the finest value for money radio on the market."

Yours truly,
Signed.....

The original of the above letter may be inspected at our Head Office: Cossor House, Highbury Grove, London, N.5.



PRICE £7.17.6

SCREENED GRID CIRCUIT

ALL-METAL CHASSIS

SELF-CONTAINED LOUD SPEAKER

BY every post, from all over the country, we receive letters like this—definite proof of the outstanding performance of the Cossor Melody Maker. This remarkable receiver is definitely to-day's greatest value in Screened Grid Radio—it is right up-to-date in design, it uses Cossor Variable-Mu Screened Grid Valves, individually Shielded Coils, All-Metal chassis, etc., etc. Send at once for a free Constructional Chart which tells you how to save money by assembling the Cossor Melody Maker at home—*no wireless knowledge is necessary*—please use the coupon.

COSSOR MELODY MAKER

BATTERY MODEL 335

with Self-Contained Loud Speaker

Kit of Parts includes Cossor 220 V.S.G. Variable-Mu Metallised Screened Grid, Cossor 210 H.L. Metallised Detector and Cossor 220P. Output Valves; Individually Shielded Coils, Cossor L.F. Transformer: All-Metal Chassis and all parts for assembling the Receiver as illustrated; handsomely finished cabinet 18½ in. high, 13½ in. wide, 10½ in. deep and 10 in. Balanced-Armature Loud Speaker with rear adjustment. Provision is made for fitting Gramophone Pick-up Socket and Plug. **Price**

£7.17.6

Hire Purchase Terms: 17/6 deposit and 9 monthly payments of 17/6

ALL-ELECTRIC MODEL 337

with Self-Contained Loud Speaker

Kit of Parts includes Cossor M.V.S.G. Variable-Mu Metallised Screened Grid, Cossor 41 M.H. Metallised Detector, Cossor 41 M.P. Output and Cossor 442 B.U. Rectifier Valves; Individually-Shielded Coils; Cossor L.F. Transformer; All-Metal Chassis; Cossor Mains Transformer and all parts necessary for assembly. Handsomely finished cabinet 18½ in. x 17½ in. x 10½ in., Balanced-Armature Loud Speaker with rear adjustment. Provision for fitting Gramophone Pick-up Plug and Jack. **Price**

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Hire Purchase Terms: 25/- deposit and 11 monthly payments of 21/-.

All-Electric Models for A.C. Mains only. 200 to 250 volts (adjustable). 40-100 cycles.

Prices do not apply in I.F.S.

To A. C. Cossor Ltd., Melody Dept., Highbury Grove, London, N.5
Please send me, free of charge a full size Constructional Chart, that tells me how to build the Cossor *Battery/*All-Electric Melody Maker.
(*Strike out type not required.)
Name.....
Address.....
P.RAC. 19/11/32

BATTERY MODEL 334

Kit of Parts, similar to Battery Model 335 except that no loud speaker is supplied. Handsomely finished cabinet 9½ in. high, 13½ in. wide, 10½ in. deep. Price **£6.7.6**

Hire Purchase Terms: 14/- deposit and 9 monthly payments of 14/-

ALL-ELECTRIC MODEL 336

Kit of Parts, similar to All-Electric Model 337 except that no loud speaker is supplied. Handsomely finished cabinet 10½ in. high, 17½ in. wide and 10½ in. deep. Price **£9.15.0**

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A. C. COSSOR Ltd., Highbury Grove, London, N.5. Depots at Birmingham, Bristol, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Sheffield, Belfast and Dublin. ♡ 1693

Receivers and their Records

We shall be glad to advise readers regarding purchase of complete sets.

The New Lissen Three-valve Battery-operated Receiver

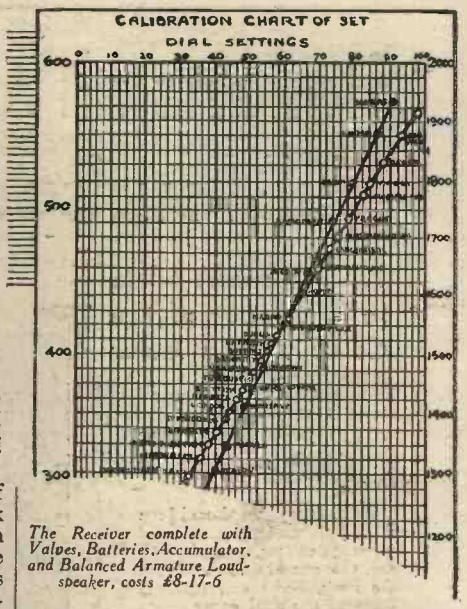
THIS is a battery-operated three-valve receiver employing a circuit which is now practically standard for three-valvers—namely, screen-grid, detector and pentode. The employment of three valves in this manner is, however, the only part of this interesting receiver which is what might be termed "standard." We have no hesitation in saying that this is one of the most ingenious and efficient self-contained three-valve sets which we have yet had the pleasure of examining. First of all, the cabinet. This is of the clock, or domed type, with a loud-speaker grille at the upper section. This cut-out has been designed from the point of view of harmony with the outline of the cabinet, and not just simply a hole cut in the front to accommodate the diaphragm of the loud-speaker. This point is one which could be attended to in many commercial receivers, where the manufacturers seem to think it is necessary to cut a hole of the same size as the loud-speaker. This results in a perfectly circuit opening which it is extremely difficult to camouflage, no matter what pattern is fretted in the opening, and many a good cabinet design is spoilt by this. In the Lissenola, however, the opening is beautifully balanced to the cabinet, and the silk material covering this cut-out matches perfectly the walnut front. The edges of the fret are dark tinted, and again this shows careful attention to detail, as it helps to match up the black escutcheon surrounding the opening for the tuning scale and avoid that look of oddness which would be present with black tuning controls and the remaining golden tint of the entire cabinet. The appearance of the cabinet, therefore, justifies its inclusion in any room, and it would harmonise with practically any furniture, and would take its place as part of the furnishing instead of having the appearance of a piece of electrical apparatus.

The back of the cabinet is open for two-thirds of its length and the appearance of the receiver proper is one of the first points upon which we must comment. At a first glance one would be justified in thinking that this was an "all-electric" receiver, as it is of the metal-chassis pattern, and the only components exposed to view are the tuning coils, each of which is screened. Not even the tuning condenser is visible, and small bakelite insets are provided for loud-speaker, pick-up and aerial plugs. The pig-tail for the screen-grid valve is metal-sheathed, and the valve-holders are sub-baseboard mounted, leaving simply a disc of bakelite exposed to view.

Note the attractive lines of the New Lissen Receiver

The Circuit Arrangement

Removal of the back aluminium plate revealed the working parts of the receiver, and here further evidence of the excellence of the design was forthcoming. For tuning purposes a substantial dual-gang tuning condenser, with die-cast framework, is employed, and this is provided with trimmers to both sections, one being of the small mica type, and the other a separate small vernier operated by a concentric knob on the panel front. The leads are all bunched and tied, in the manner of the mains receivers, and there are no points here which we can criticise. Tuned grid coupling is employed for the detector valve, and transformer coupling for the L.F. stage. The transformer primary is connected direct in the anode circuit of the detector valve, following an H.F. choke. The reaction control is perhaps the most interesting part of the circuit, as this performs a dual function. An ordinary bakelite-dielectric reaction condenser is mounted on a plate, and coupled to the moving plates is a flexible brass arm. As the plates are rotated this arm travels in an arc over a wire-wound resistance which is wired into the circuit in such a manner that it reduces the filament voltage of the screen-grid valve. At zero, or in other words, with no reaction, the H.F. valve is also at its lowest working point, and this reaction control is, therefore, a real volume control in that it reduces the overall sensitivity of the receiver to its lowest value when in one position, and as the control is rotated towards its maximum position, the actual signal pick up is increased at the beginning of the receiver, and, at the same time, the regeneration of the detector valve is employed. The value of this will be fully appreciated when employing the receiver for distant reception. To avoid risks of instability due to L.F. oscillation, a resistance is joined between the grid of the pentode valve and the L.F. transformer. The wave-change switch performs the dual function of on and off switch as well as to change from short to long waves, and this is a most substantial affair mounted on a plate 3ins. by 2ins., with splendid wiping contacts and a most definite positioning device consisting of a steel ball and a plate with radial holes. This device is so strong and certain in its action that it is almost impossible to turn the spindle by hand unless the knob is attached. There is only one other point which can be mentioned before passing on to the performance of the receiver, and that is the tuning scale. This is engraved in actual wavelengths (in metres), and is divided into bands of 25 metres on the normal waves, and into sections of 1,000 metres on the long waves. The dial is black with white markings, and we have found that this is a most satisfactory type of dial, adding greatly to the ease of tuning.



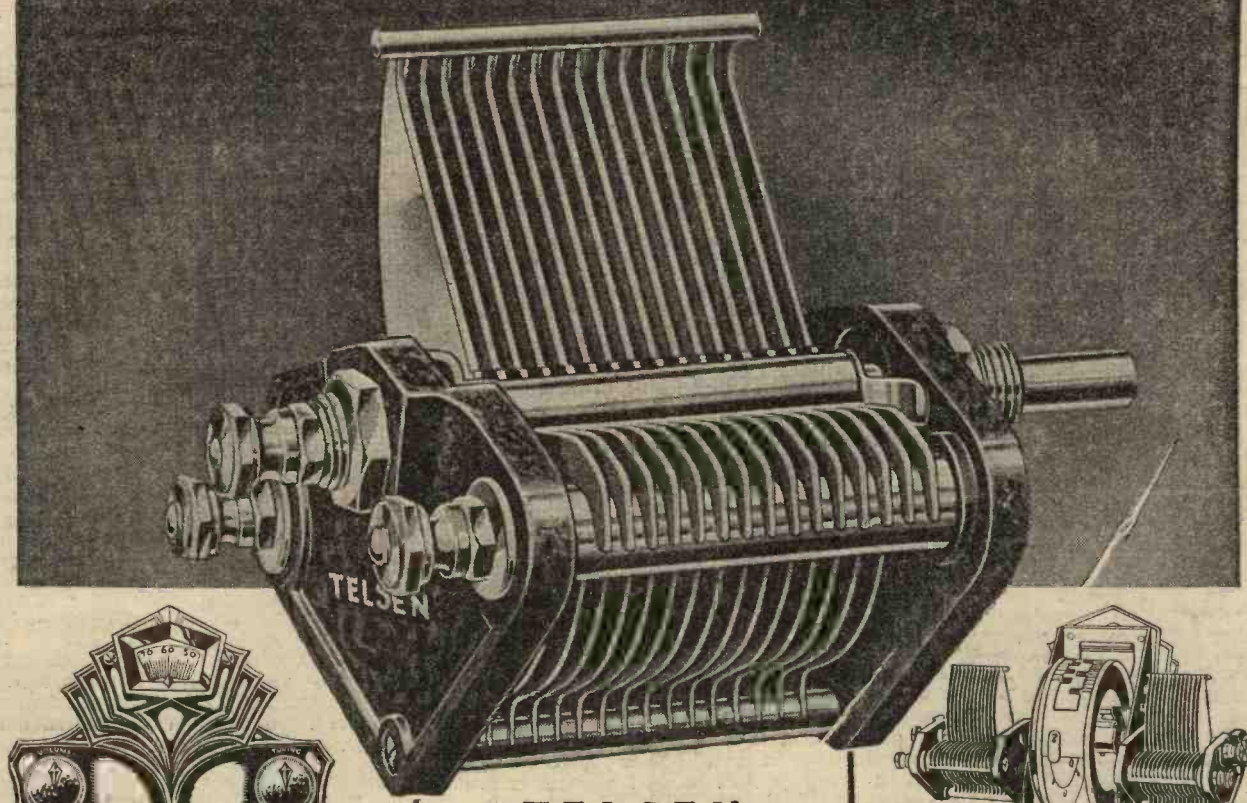
The Receiver complete with Valves, Batteries, Accumulator, and Balanced Armature Loud-speaker, costs £8-17-6

Performance

The quality of the reproduction is excellent, as would be expected from the heavy balanced armature type of loud-speaker which is fitted. The actual tests were carried out within a few miles of Brookmans Park, and various expedients were adopted in order to really put this set through its paces. We will not, therefore, discuss the reception of the London stations as these are obviously easily received, and with a Pentode output, would be more than sufficient for the average room. The first test was made on a Sunday morning, using the Radio-Paris gramophone transmissions which are now so popular. The tuning dial was set to the

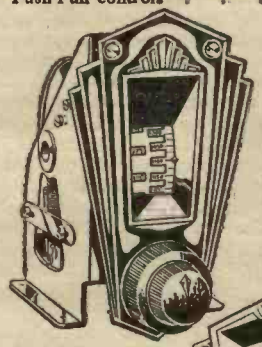
(Continued on page 462.)

PRECISION



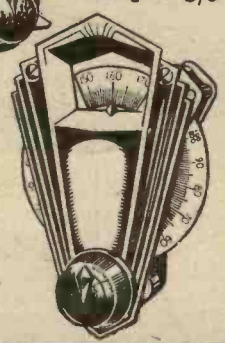
TELSEN TELORNOR

An illuminated Disc Drive embodied into an unusually handsome silver oxidised escutcheon plate, complete with artistically grouped Volume, Tuning, On-Off, and Push-Pull controls 7/6



TELSEN DRUM DRIVE

Embodies numerous refinements, including cord drive and rocking stator trimmer. An extra scale, graduated for wavelength tuning, is supplied free of charge . 3/6



TELSEN ILLUMINATED DISC DRIVE.

Fitted with handsome silver oxidised escutcheon plate and incorporating an improved movement, making for delightfully easy tuning . . . 3/6

TELSEN LOGARITHMIC CONDENSER

The Telsen Logarithmic Variable Condenser is a component whose precision, allied to its sturdy construction, ensures years of faithful service. The sturdy frame is braced by three solid pillars, and the vanes clamped at three points, making distortion impossible. The rotor is also built into a rigid unit and the vanes held at both ends, generous bearings preventing backlash or endplay.

Cap. .00025	4/6
Cap. .00035	4/6
Cap. .0005	4/6
Cap. .0005 (left-hand movement with trimmer) ...	5/-
Cap. .0005 (right-hand movement with trimmer) ...	5/-

TELSEN

RADIO COMPONENTS

TELSEN DRUM DRIVE AND CONDENSER ASSEMBLY.

A complete drum drive and ganged condensers tuning unit, with a handsome escutcheon finished in oxidised silver. An extra scale (marked in wavelengths) is supplied free 17/6

TELSEN SMALL FRICTION DISC DRIVE.

A low priced disc drive for auxiliary controls. It is extremely robust and may be used for main tuning condensers where considerations of space make it desirable . 2/6

TELSEN SLOW MOTION DIAL.

(Black or Brown Bakelite)

Made with a gear ratio of 8-1, the disc being graduated from 0-100 in both directions. Supplied complete with instructions for mounting on all panels up to 3/16" thick . 2/-

TELSEN RADIO COMPONENTS ARE 100% BRITISH

ANNOUNCEMENT OF THE TELSEN ELECTRIC CO., LTD., ASTON, BIRMINGHAM

PRACTICAL TIPS ON OPERATING MAINS SETS:

How to Get the Best From a Mains-operated Receiver, and Some Hints—by DETECTOR

WITH the acquisition of a set worked entirely, or in part, from the A.C. mains, there are several points likely to crop up that will puzzle the owner who hitherto has been used to a set deriving its power solely from batteries or accumulators. The chief difference between a mains valve and a battery operated one is that the valve filament is usually heated by a separate heating circuit comprising a spiral of high-resistance wire surrounding the electrode, which takes the place of the filament proper in a battery valve. The electrode that does duty as the filament in the mains valve is now known as the cathode and is not in direct connection with the source of current supply at all. It receives its heat from the heater coil and the valve is consequently known as an indirectly heated one. In certain output valves the filaments of cathodes are in direct circuit with the heating source of current, but this only occurs in valves designed for the output side of the receiver.

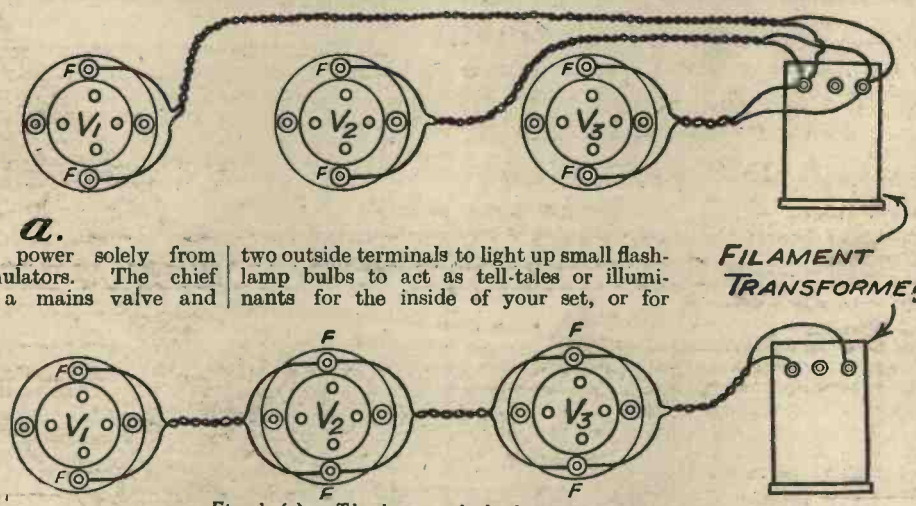


Fig. 1 (a).—The best method of wiring mains valves to avoid voltage differences, and (b) a bad method of wiring.

When making a set for all-mains use, or when converting a battery set into one of the latter type, it is often more profitable to purchase a mains unit complete. There are several makes regularly advertised in the pages of PRACTICAL WIRELESS and unless you build one like that described in our columns a few weeks back, it is safer to rely on the superior knowledge of the makers' of mains units. As you are already connected up to the mains, it is very unlikely that you will make another battery set, so that in purchasing your mains unit it is desirable that tappings be provided on the transformer for connection to the heating circuit of all-mains valves. By choosing a unit of this type you can still use your battery set and valves until their life is over, and when you make a completely all-mains set, you have not to go to the additional expense of a special transformer for obtaining the filament current.

Flash-Lamp Bulbs as Tell-Tales

If you do this there will be no need to touch the terminals of the filament tappings, of which there are sometimes two, and sometimes three. You can, however, use the two outside terminals to light up small flash-lamp bulbs to act as tell-tales or illuminants for the inside of your set, or for the tuning dials. You will find that if you connect up only one bulb to these terminals it will quickly burn out, owing to the high voltage given when only a small load is taken, so that unless you use a small resistor in circuit you will have sufficient low voltage A.C. to light about four ordinary 3.5 flash-lamp bulbs. If you arrange one or two of these behind the speaker fret they will serve as a tell-tale for when the set is switched on, and also give a very effective and pleasing appearance to the speaker front. One could also be used to light up the gramophone section if you own a radiogram, and to assist you in changing needles, and in placing the needle in the correct groove on the record.

A small bulb of this sort could also be used, if you are only working a two valve set from the mains, in place of a resistance. Most filament transformers are rated at 4 volts 4 amps., this being a good all-round figure for a three or four valve set. When working a two valver, however, the transformer tends to supply more current than the valves are taking, with the result that the voltage rises and there is a danger of considerably shortening the life of your valves through over-running them even though the stronger heater filaments give slightly more latitude in this direction than battery valves. A small resistor of about 4 ohms placed across the secondary of the transformer will remedy this, but as this will consume current in any case, it is as well to utilise the spare current with a flash-lamp bulb, and have the advantage of its illumination. The resistor or a 3.5-bulb should be connected across the two outside terminals of the transformer, this giving about 4 volts, but if you use a 1.5 or 2 volt bulb, this should be put across the centre terminal and either of the outside ones.

Preventing Voltage Drop in Leads

If, however, you are using your mains unit to drive a four or more valve set, it may be that the current given by the transformer is barely sufficient to work the valve filaments at their best temperature. In this case it is in your interest to prevent any loss of current in any way you can, and the best way to do this is to use heavy gauge wire to connect up the A.C. valve heater circuit. As a general rule, ordinary lighting flex is used, twisted as supplied, but choose a heavy grade of this wire when buying. It is a good plan to still further prevent voltage drop with long leads, to wire each valve separately to the filament transformer terminals. Reference to Fig. 1 will make this clear, it being evident that in (a) every valve will receive the same voltage, whereas in (b) the more usual way of wiring, the last valve away from the transformer is often worked at a much reduced voltage. As this is usually a screened-grid or H.F. valve, both quality and volume suffer, and a great improvement is noticeable by working as in (a).

Sometimes it is felt that the voltage on the anodes of your valves would be better if somewhat higher in value, but if your eliminator is going "all-out" it is difficult to see how this may be brought about. You could use a dry H.T. battery, used separately across, say, the first H.F. valve or

(Continued on page 444.)

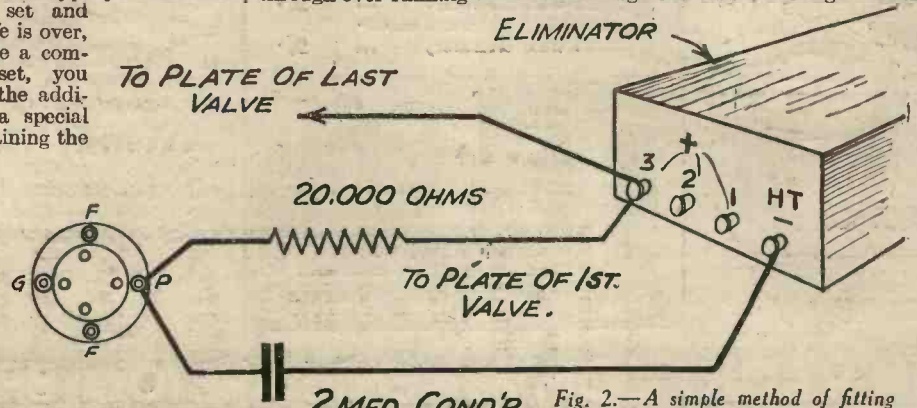


Fig. 2.—A simple method of fitting an external decoupling circuit.

ALL-WORLD ALL-WAVE RADIO

Build the Meteor S.G.3 and you are guaranteed at least thirty stations, many users get as many as sixty to one hundred. The design was based on the famous S.T.300 circuit and gives huge volume on home and foreign stations. In addition you have the fascination of receiving ultra-short wave stations from all over the World. HUNDREDS OF MARVELLOUS TESTIMONIALS ALREADY RECEIVED.

METEOR S.G.3 KIT
Complete Kit of Parts with full instructions.

£3-15-3

Or 9 monthly payments of 9/9.

METEOR S.G.3 MODEL 'A'
Complete Kit with set of three Mullard Valves and full instructions with *beautiful walnut cabinet fitted with new type moving-coil speaker giving superb reproduction.*

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Or 12 monthly payments of 17/-

METEOR S.G.3 MODEL 'B'
Complete Kit of Parts with set of three Mullard Valves (metallised Screened Grid, Detector & Power) with full instructions.

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QUALITY RADIO FOR ALL

OBTAINABLE FROM ALL LEADING RADIO DEALERS

303 MODEL 'A'
Complete Kit and Valves as above with beautiful walnut cabinet fitted with new type of moving-coil speaker.

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Or by 10 monthly payments of 16/-.

BUILT IN 20 MINUTES

'303' KIT
Complete Kit of Parts with full instructions.

47/3

Deposit of 9/6 and 5 monthly payments of 9/-.

'303' Model 'B'
Complete Kit of parts with set of 3 Mullard Valves, with full instructions.

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The simplest Detector-2 L.F. Set ever designed. Gives superb moving coil reproduction and an excellent choice of home and foreign programmes. Incorporates wonderfully efficient dual range coil fitted with the unique four-in-one-control On-Off, Wave-change, Selectivity and Volume Control all operated by one knob.

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To READY RADIO LTD. (Book Dept.), Eastnor House, Blackheath, S.E.3.

Please send me free copy of the Meteor S.G.3 and 303 Book containing full instructions, plans and photographs showing how to build these two wonderful sets. Also tell me about your REGISTERED USERS' SCHEME. I enclose 1½d. stamp to cover postage.

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Address .....

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READY RADIO

Announcement of Ready Radio Ltd., Eastnor House, Blackheath, S.E.3.

Practical Tips on Operating Mains Sets

(Continued from page 442.)

the detector; but an even better plan, if you use automatic grid bias, is to abandon this and substitute an ordinary dry grid-bias battery. The current taken from such a battery is so small as to make the cost of replacing this at intervals negligible, whereas automatic bias often takes quite a drain from the eliminator, and by throwing this overboard an appreciable rise in H.T. voltage can be gained. Any tendency to instability may be cured by the substitution of a grid battery.

Fitting a Mains Unit

When fitting a mains unit to your existing set it often happens that the unit has a tapping or two short of the number of H.T. terminals on your set. You can try bunching two of them together, so long as you bunch those supplying the same type of valve. That is, two L.F. valves could be run off the same tapping; and sometimes the anodes of the screened-grid valve and of the pentode can be coupled together without any ill effects. On the other hand, any attempt at joining valves together in this way may set up serious "motor-boating," and the only way out is to take two leads from one tapping on the eliminator, and decouple one or both in the manner shown. The calculation of the correct resistance to be used for a definite voltage drop could be given, but this is rather involved, and it is more practical to say that a suitable value lies between 20,000 and 50,000 ohms. The larger value resistance should be used for a detector tapping or for the control grid of an S.G. valve, but the smaller value would be ideal for taking a tapping to the first L.F. valve. In this connection it is advisable before purchasing a mains unit to choose one of the right capacity for your set. One giving too large an output will put you to unnecessary first cost, and will probably run your valves at a voltage too high to be desirable. Ask the dealer the output of the mains unit in milliamps, and find out from the valve boxes the consumption of H.T., also in milliamps, that your valves take. The sum of these will be the approximate H.T. consumption of your set, and if you allow from ten to twenty per cent. "safety factor" over this as the output of your mains unit, you will not go far wrong. If, however, you are contemplating going in for a larger set in the near future you may use a large unit with safety, providing you insert fairly heavy wire-wound resistances in series with some of the H.T. leads. If you are troubled with "motor-boating" in your set you may feel the need for decoupling, without the snag of reduced voltage that always follows to some extent when decoupling is resorted to. A good L.F. choke connected in series with a H.T. tapping often gives the advantages of decoupling without the voltage drop. (See Fig. 2.)

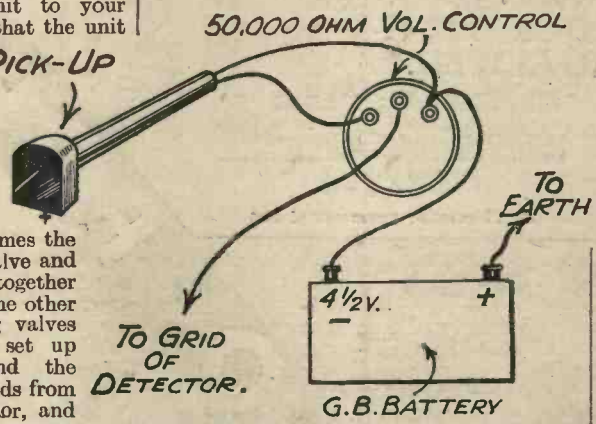


Fig. 3.—The method of connecting a pick-up and biasing battery to a mains set, which has not been provided for gramophone reproduction.

Using a Pick-up

A good many of the older all-mains commercial receivers were not fitted with an arrangement for inserting a pick-up, and the question is often asked as to the best way of doing this. One of the best ways is depicted in Fig. 3, it being only necessary to procure a small grid-bias battery of about 4.5 volts and a 50,000 ohm potentiometer or volume control. The positive end of the grid battery may be taken direct to the cathode of the detector; but as this is invariably connected to earth, the grid battery may be taken to earth also if shorter wiring results by so doing. If the set is constructed on the chassis system, even shorter wiring may be achieved by connecting the grid battery to the nearest terminal on the aluminium chassis. Finally, take care that as much "hum" is eliminated as possible. You will always get a certain amount of this with a mains set, but by carefully placing the mains' leads, or even shielding them with metal sheathing, much of it may be cut out. Remember that while a good earth connection is always desirable in any set, it is doubly so in a mains set, as a lot of humming troubles can be traced to poor earths.

It is, in fact, advisable always to screen the pick-up leads with metal sheathed leads, as the grid lead is the most common cause of induced hum, in both battery and mains receivers.

(To get the centre, simply measure 1½in. from two or more sides of the frame and mark lightly with a pencil. When the cone is fully flattened the edges should touch this line.) Any type of cutting instrument, such as a razor blade, can be employed in removing the circle of brown paper from the front of the cone. With this done, you have a completed single-cone speaker similar to those introduced last season.

Assembling the Cone

Now I come to the more intriguing part of the scheme. Measure the outside of the cone and mark the halfway distance. With a compass, or a pencil and string, draw a circle round the cone level with this mark, and then cut along this line with scissors. When this has been done it will be found that the half cone remaining on the baffle measures 7in. across. It is also ready to receive its companion. The smaller cone previously mentioned must now be made. It should be of reasonably good depth and have a base measurement of 8in. When completed, draw a circle round the lower edge 1in. in and on the outside. Now take a piece of used (washed) flannelette sufficiently large to cut an 8in. circle, which should again be cut 1in. smaller, so that you have a 1in. ring with a 7in. inside measurement. Glue the inner edge of this to a depth of ½in. and place over the cone along the line marked. It will then hang like a cape, the bottom touching the edge of the cone.

Once again the glue pot is in demand.

MAKING A DUAL CONE SPEAKER

(Continued from page 430).

Glue the outer side of this ring to a depth of ½in. What follows needs care because accuracy is essential to obtain best results. Take up the cone and pass it, apex first, through the baffle until the glued flannelette comes in contact with the inner edge of the larger cone. Steady pressure with one finger against the inner side of the apex should ensure exact fitting. See that the ring grips evenly and without pull or crease. When this is done you will find that the unglued portion of flannelette separates the two cones and that the smaller is perfectly floated.

Finishing Touches

The unit may now be screwed to the fifth piece of wood and attached to the shoulders at the back of the frame. Care should be taken to see that the rod is in direct line with the centre of the apex, and that the adjusting nuts so hold the cone that full and unrestricted movement is permissible. The very lightest of cone washers should be used, and between these and the cone small rings of flannelette can be inserted, thus avoiding any possible cause of rattle later. A very light dope such as turps and paint of a consistency hardly thicker than the neat spirit can be used to kill the colour of the cones and paper baffle; but better still, if you desire to complete the job in a workmanlike manner, fit a fretwork front. This, however, should be raised off the front ¼in. by the use of rubber stoppers.

In practice I find such an arrangement of two cones cures that general annoyance of rattle and false boom. The smaller cone carries the high notes and the larger portion with its baffle carries the low ones. The flannelette suspension apparently absorbing unwanted resonance, it is difficult to overload the speaker. In addition to such obvious advantages, clarity and balance of response is extremely good, whilst more than usual volume is obtainable, presumably as the larger cone, extending as it does beyond the limit of the smaller, does duty in a double capacity.

TEST YOUR COMPON BUILD

That Prevention is Better Than Cure is Describes Some Simple Tests Which You Receiver. They May Save Time an

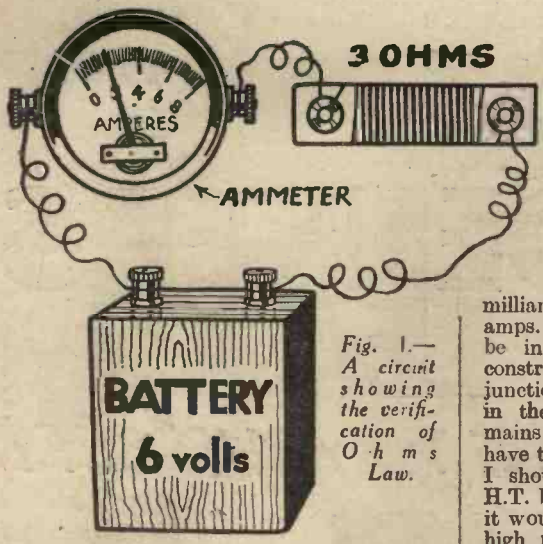


Fig. 1.—A circuit showing the verification of Ohms Law.

HAVE you ever carefully collected together all the parts for a new receiver, equally carefully assembled them according to plan, and then when you have completed the whole thing and switched on received—nothing? Hours of careful planning-out and wiring-up all resulting in a fine-looking receiver—which won't work! Well, if you have, you know what you feel like as you stare blankly at the mass of components and wiring, and then quietly sit down and prepare to test the set from end to end! You just haven't the heart for the job! Besides, you know quite well in your own mind that you've made no mistakes in the wiring or anything of that sort—you've been too careful. That's just the irony of the thing. You *may* have carried out the wiring and construction without a hitch, but are you sure there was no faulty component amongst the thirty or forty parts you may have used?

The Thousand-to-One Chance

Don't for one moment think I am suggesting that you may find two or three "duds" in the collection of new parts which you purchased to build the new receiver. Far from it! Nowadays, components are turned out with such precision, and are so carefully tested, that it is very rare that a faulty article reaches the constructor. Nevertheless there is that thousand-to-one chance that something may have happened, say, in transport from works to the retailer. Or, perhaps, some of the parts were not new, but came off an old receiver. You may for reasons of economy, or because they were of the same type as those specified for your new set, have decided to use them up instead of purchasing fresh ones. Here there is an even greater chance of striking a snag, especially if the old set was rather groggy before you dismantled it. Now the whole point is that, had you made a few simple tests of each component as it came out of the box, instead of screwing it in place right away, you might have saved yourself the much more tedious task of making tests when the receiver was complete.

If you go about it systematically it does not take many minutes to test each component sufficiently to tell whether it is "good" or "bad." For this you need one of the small pocket meters of the universal type, which combines a two range-voltmeter and milliammeter reading 0 to about 30 milliamps. One of these instruments should be in the possession of every wireless constructor. The meter is used in conjunction with the batteries to be used in the set, but in the case of an all-mains receiver, I am afraid you will have to borrow or buy a grid bias battery. I should hardly expect you to buy an H.T. battery, but if you have one by you, it would come in handy for checking very high resistances for which the grid bias battery is hardly suitable.

Checking Resistance Values

Let us start off by testing the various resistances. We will take these first because, with the exception of the grid leaks, it is possible to test these more completely than any of the other components. We can quite easily check their values as well as test for continuity. To do this we bring to our aid the ever useful Ohms Law. This states that Current equals E.M.F. (voltage) divided by Resistance. It is usually expressed thus: $C = \frac{E}{R}$. Without labouring the point it will be evident also that $R = \frac{E}{C}$ and $E = C \times R$. Thus you will see that when we know *two* of the values in a circuit we can soon find the third. For instance, if we take an unknown resistance and connect it to a battery giving 6 volts, also including in the circuit an ammeter as in Fig. 1, and the ammeter reads 2 amps, then we know the value of the resistance is 3 ohms, because $R = \frac{E}{C}$ or in other words the resistance =6 divided by 2.

You will, of course, be dealing with much higher resistances than this in your set and, therefore, with correspondingly small currents—hence the need for a milliammeter. Now how would you proceed to test, say, a thousand ohm Spaghetti resistance? Well, the quickest way is to assume that the value is correct and then work out what voltage would give you a working reading of say, 10 milliamps on your milliammeter. We know that $E = C \times R$, so then if we take the current "C" namely, 10 *thousandths* of an amp, and multiply it by the resistance "R," which we expect to be 1,000 ohms, then we shall see that the voltage required will be $1.000 \times .01$ that is 10 volts. What to do then is to connect up the resistance, the milliammeter and your grid bias battery as in Fig. 2. Start with one cell only in the circuit, that is, 1.5 volts, and gradually increase to the maximum of 9 volts when, if the resistance is of the value at which it is rated, you should get a reading of just under 10 milliamps on your meter. The reason for trying with small voltages first is in case the resistance under test is *less* than it is rated, in which case more current would flow than you had calculated. Should its resistance, by any chance, be very much lower than the stated value, it might damage the meter by passing a

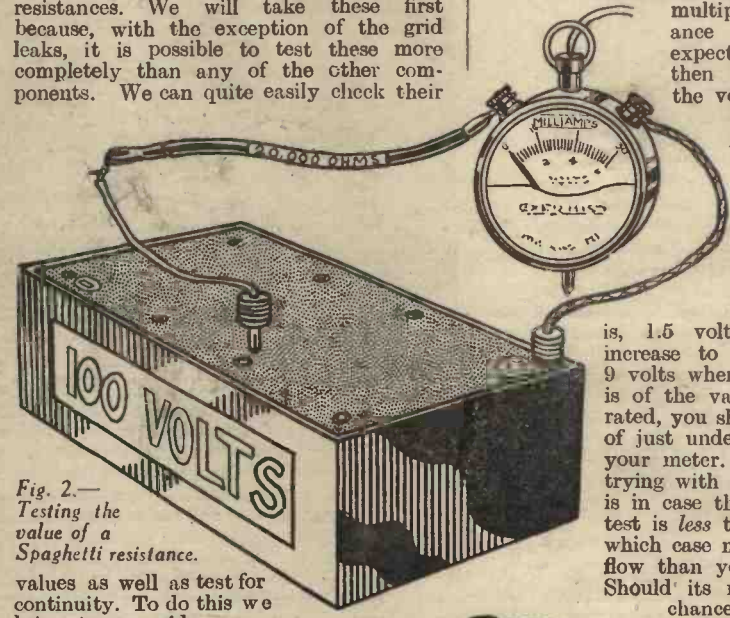


Fig. 2.—Testing the value of a Spaghetti resistance.

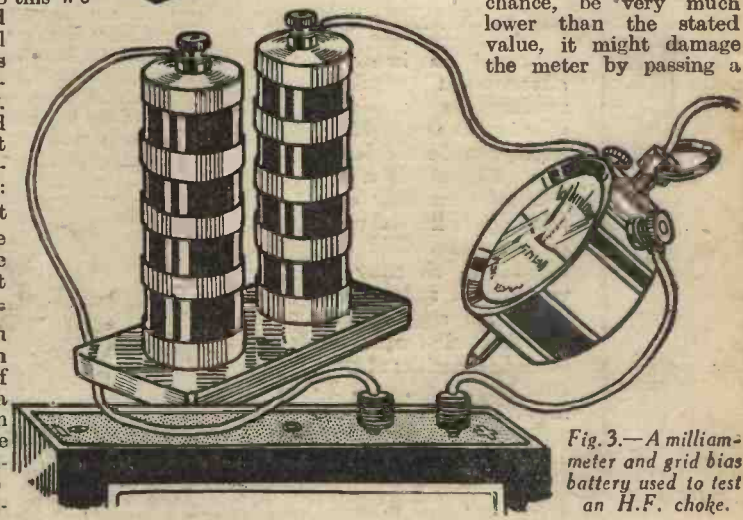


Fig. 3.—A milliammeter and grid bias battery used to test an H.F. choke.

ENTS BEFORE YOU

the Keynote of this Article in which the Author May Apply to Your Components Before Building a d Trouble Later On—*By W. B. RICHARDSON*

very large current if you plugged in at 9 volts right away. It is better to be on the safe side and start with a low voltage and then increase it until you can get a reading which will tell you near enough if the resistance is accurate. Now suppose, for the sake of illustration, you had just tested a Spaghetti resistance or metallised resistance marked "1,000 ohms" and had found that when you plugged in at 3 volts on your bias battery the milliammeter already showed 12 milliamps. What would be the value of the resistance? The answer is 250 ohms! (3 volts ÷ $\frac{12}{1,000}$ amp=250 ohms). In other words, it is only a quarter of its rated value.

When it comes to measuring high resistances as used for decoupling purposes etc., it will be necessary to employ your H.T. battery in order to get anything like a readable figure on the milliammeter. Take, for instance, a 20,000 ohm resistance. In order to show 5 milliamps you must use 100 volts (E=C×R ∴ $20,000 \times \frac{5}{1,000} = 100$). Nevertheless, don't plug in to 100 volts straight away. Be cautious and start low. Naturally, when it comes to still higher resistances your tests will not be quite so accurate, unless you have a very sensitive milliammeter, but they will serve to show if a resistance is very much *lower* than it is rated. Take the case of a resistance marked 100,000 ohms. If this passed 2 milliamps at 50 volts you would know it was actually only about 25,000 ohms, whereas if it were accurate it would only show 1 milliamp at 100 volts, that is to say, it would only just move the pointer of the milliammeter.

A Precaution

There is one precaution you should observe in making these tests, and that is to see that you do not pass too much current through the resistance under test. Usually the maximum safe current is indicated by the makers, but if in doubt the following figures may be taken as a rough guide in the case of Spaghettis and Metallised resistances: Up to 1,000 ohms, 30 milliamps; up to 10,000 ohms, 10 milliamps; up to 100,000, 5 milliamps. Non-wire-wound resistances do not usually stand quite so much. Many resistances nowadays are graded in watts. There are 1 watt, 2 watt and 3 watt types, and so on. With one of these you can soon calculate what current it will stand. A watt is a unit of power and is arrived at by multiplying volts by amps. Take our first example of the 1,000 ohm resistance. We proposed in testing it to use 9 or 10 volts so as to give a reading on the milliammeter of about 10 milliamps. Suppose this resistance was of the 1 watt type: Is a current of 10 milliamps more than it will safely stand? Well, let us see. Remember watts=volts×amps, therefore the power dissipated through the resistance is 10 volts × .01 amp = 1/10th watt. In other words, we are well within the limit of 1 watt.

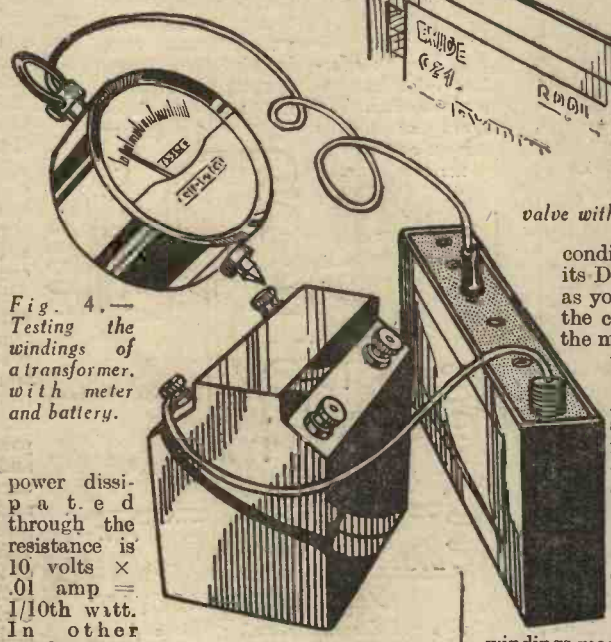


Fig. 4.—Testing the windings of a transformer, with meter and battery.

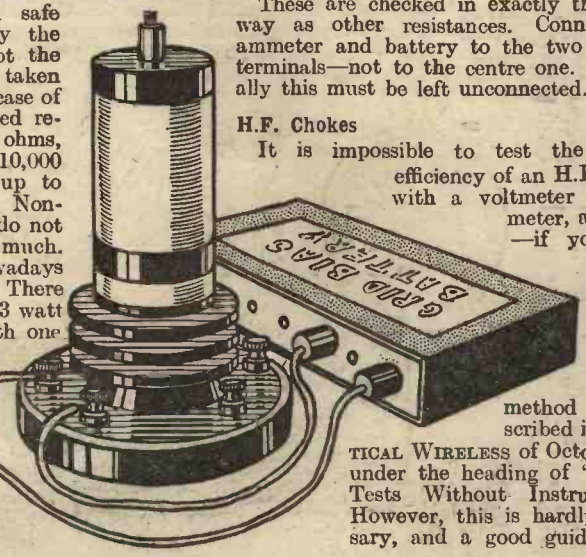


Fig. 6.—A simple method of testing a tuning coil for breakages in the windings.

Potentiometers

These are checked in exactly the same way as other resistances. Connect the ammeter and battery to the two outside terminals—not to the centre one. Naturally this must be left unconnected.

H.F. Chokes

It is impossible to test the actual efficiency of an H.F. choke with a voltmeter or ammeter, although—if you have another receiver in use you can use the absorption method as described in PRACTICAL WIRELESS of October 1st, under the heading of "Simple Tests Without Instruments." However, this is hardly necessary, and a good guide to its condition can be obtained by testing its D.C. resistance in the same way as you would a resistance. Connect the choke under test in series with the milliammeter and grid-bias battery, as in Fig. 3. Start with 1½ volts and then try 3 volts. At three volts you should get a reading of from about 4 milliamps to 10 milliamps if the choke is O.K. This would indicate that there were no breaks in the winding and that the D.C. resistance was somewhere between 900 and 400 ohms—as is usual.

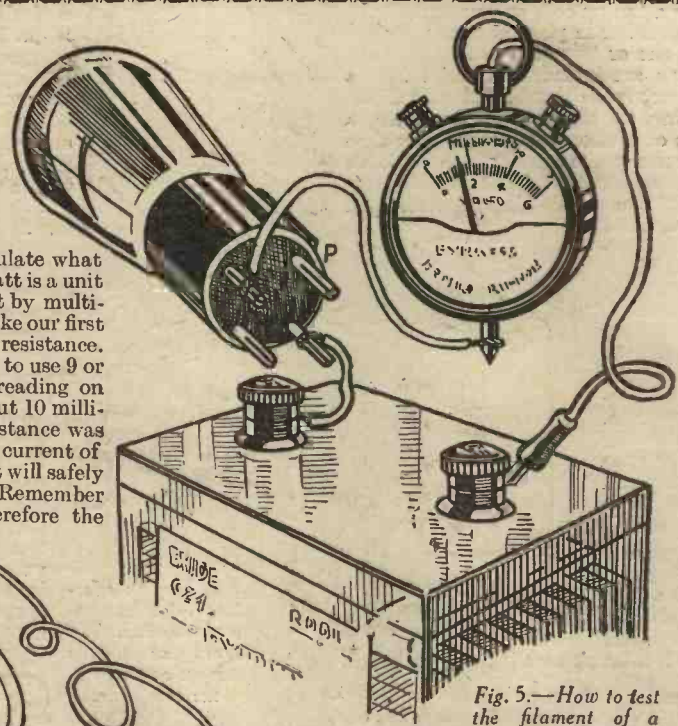


Fig. 5.—How to test the filament of a valve with a voltmeter and accumulator.

With L.F. transformers both the primary and the secondary windings may be tested in the same manner as the H.F. chokes. Do not use a higher voltage than will give you a reading of 5 milliamps or you may run the risk of damaging the windings. The voltage required is usually about 3 for the primary and rather more for the secondary. But here again start off with 1½ volts and work upwards. Fig. 4 illustrates a transformer being tested in this way. A break in the winding would give no reading at all even if higher-voltages were used.

Testing Valves and Coils

To test if the filament of a valve is intact, connect it to the accumulator to be used or to one grid bias cell and to your voltmeter as in Fig. 5. If the filament is unbroken, a reading of nearly 2 volts or 1½ volts as the case may be, will be obtained, the slight loss being due to the drop in voltage across the filament. Remember to use the *voltmeter* terminals of your universal meter, not the *ammeter* connections that have been used for each previous test. The valve would pass too much current for the ammeter.

The voltmeter can be used in the same manner for testing the continuity of wind-

ing in a tuning coil, or you can use the loud-speaker in place of it as in Fig. 6. Here one or two cells of the grid-bias battery are included in series with a high-resistance loud-speaker. If the windings of the coil are unbroken, a sharp click should be heard every time you connect the speaker. Do not leave it connected, of course. In making this test put the circuit diagram before you and observe which terminals of the coil should be joined to one another through the turns of the coil. For instance, Nos. 2 and 3 may be joined one to each end of the long-wave coil. On connecting them in circuit a click should be heard. If there is a break no click will be heard.

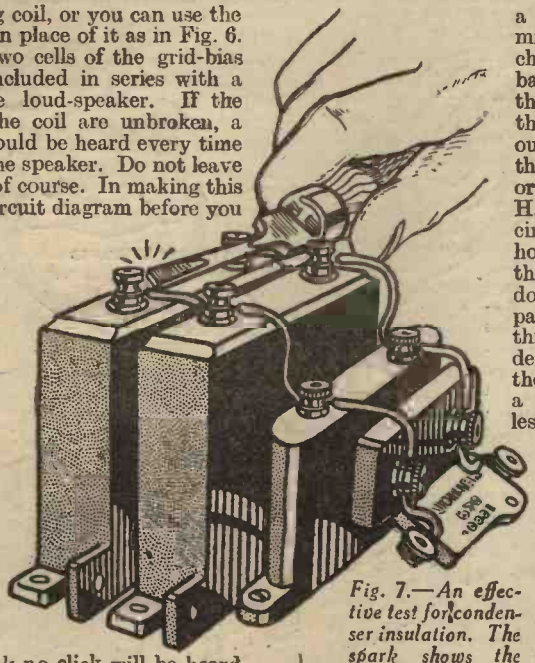


Fig. 7.—An effective test for condenser insulation. The spark shows the storage capacity of the condenser.

Condensers

With the simple apparatus at our disposal it is not, of course, possible to check the capacity of fixed condensers, but it is a very simple matter to see that there is no breakdown in the insulation. No doubt you have heard of charging up condensers of 1mfd. capacity and higher with an H.T. battery, and then seeing how long they retain their charge. Briefly, what you do is to momentarily connect two wires from the full voltage of the battery on to the two terminals of the condenser. Then take the wires away, taking care not to touch the condenser terminals in doing so, and the condenser will be in a charged state. To discharge it, connect a piece of wire or a screw-driver blade across the terminals, when a snappy spark will occur. If the condenser is left for a long time the charge gradually leaks away and you cannot get a spark from it. The longer it holds its charge, then, the better is its insulation. Now, with small condensers this test is no good, since they do not hold a big enough charge to give a spark. What to do in this case is to join all your small condensers together with the large ones as in Fig. 7, so as to form one extra-large condenser. Then charge this from a 100-volt H.T. battery. If after a few minutes' wait it will give a good fat spark on discharge there is nothing the matter with any of the condensers from the insulation point of view. One bad condenser in the pack would be sufficient to prevent a spark being obtained. If no spark is obtained, remove first one and then another until you come across the culprit. If you do not care to wire the condensers all together you should test the small ones one at a time in conjunction with a big one.

Variable condensers of the solid dielectric type are unlikely to "short," but it is possible, although unlikely, for the vanes of the air dielectric type to touch and so cause a direct path through the condenser. In the case of a tuning condenser, this is unlikely to do any actual damage, although signals would cut out at the position where the vanes touched one another, but with a reaction condenser a fault of this sort might lead to the discharge of the H.T. battery or damage to the mains unit besides the risk of burning out the primary of the L.F. transformer or the windings of the H.F. choke. The circuit in Fig. 8 shows how it is possible for this to happen; the dotted line shows the path of the current through the faulty condenser. Admittedly the possibility of such a fault is remote unless the condenser has been dropped, but it is because of the damage it may do that it is wise to make the simple test with your voltmeter, as shown in Fig. 9. There should, of course, be no reading with the condenser vanes in any position. Ganged condensers may be tested in the same way by taking each section in turn.

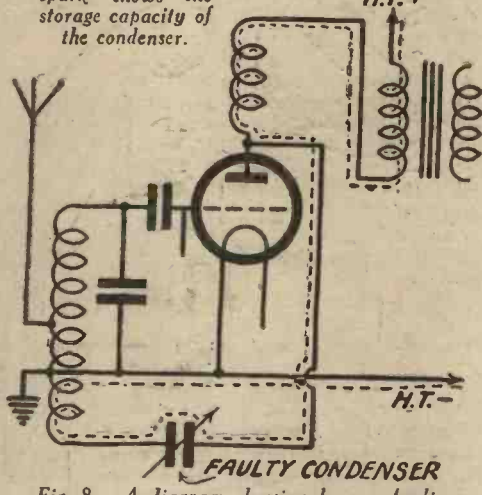


Fig. 8.—A diagram showing how a faulty reaction condenser can short-circuit an H.T. battery.

Tests for Continuity

Such small components as switches, especially the enclosed type, should be tested with the voltmeter in the same way as the variable condensers. The voltage used is not very important, although a low voltage will show up a poor contact in a filament switch better than a high one. Obviously, when the switch is in the "on" position the voltmeter should record the voltage of the battery. When it is "off" there should be no reading, and where there is imperfect contact it would show less than the full reading or even fluctuate. Don't forget to test the valve holders for continuity between each terminal and its corresponding socket. And at the same time test for short-circuits, or partial short-circuits between the various pins. Although an expensive instrument is required for accurately testing a valve-holder, a milliammeter will be found to give a good indication of the insulation, provided a high enough voltage is employed.

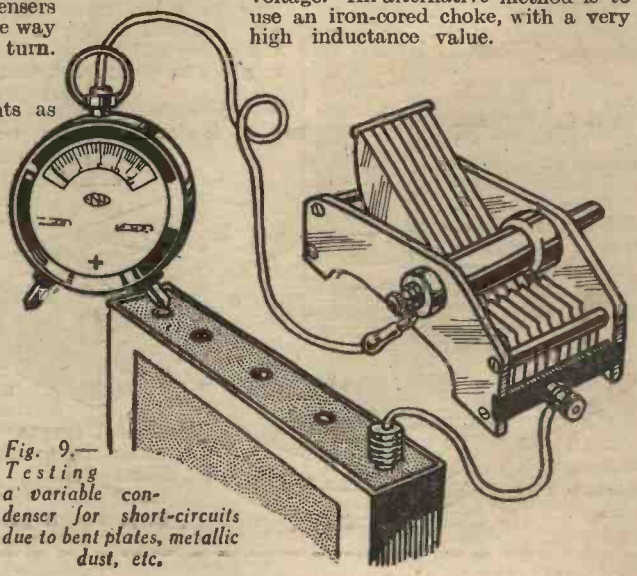


Fig. 9.—Testing a variable condenser for short-circuits due to bent plates, metallic dust, etc.

POWER GRID DETECTION

FROM the number of letters which have been received from readers on this particular method of rectification, it is clear that the idea is not fully understood. Some readers think that it is simply a matter of altering the value of the grid condenser; others that it is the grid leak which requires modifying; others that both must be changed, whilst there are some who are of the opinion that only the H.T. is the vital factor. Actually, all of the above items are bound up with the question of power grid detection.

The essential features of this method of detection are large-standing anode current, with a good, strong signal applied to the valve so as to produce a drop in current of about 15 per cent. Owing to this large anode current, it is necessary to use a valve with an impedance of between 10,000 and 25,000 ohms, and it is also impracticable to use the majority of L.F. transformers owing to saturation troubles. This means that either resistance-capacity coupling or a parallel-fed transformer must be used, and it is quite obvious that a large current through a resistance to match an impedance of the order stated will result in a very heavy voltage drop. This means that only H.T. batteries of the super type are of use, or, alternatively, mains valves must be used. Owing to the convenience of A.C. mains, it is possible to use 400 or 500 volts for H.T., and the drop through a suitable anode resistance still permits the valve to receive its maximum H.T. voltage. An alternative method is to use an iron-cored choke, with a very high inductance value.

Correct Tracking

THERE is an important point which should receive attention from radio-gramophone users, and that is what is known as "correct tracking." The majority of modern gramophones are provided with what is sometimes termed a "goose-neck" tone-arm, or the end which carries the sound-box is set off at an angle in order that a short tone-arm may be employed. The effect of this is to enable the stylus to be at the same relative position on every groove. If you examine one of the old-fashioned gramophones you will find that when the sound-box is placed on the first groove it has the plane of the sound-box at right angles to the groove, but as it travels across the record this angle gradually alters. The sound waves in the groove are from right to left, and if the diaphragm is at right-angles to the groove the stylus may be moved freely from side to side. If, however, the diaphragm is twisted, there will be a difficulty in moving it in a true piston movement, and the result will be a mutilation of the record. Unfortunately it is not possible in a small space to accommodate an arm long enough to enable a sound-box or pick-up to be at the correct angle on every groove, so that a compromise has to be arranged. There is, however, no need to have a greater tracking error than 2°. To test the angle the simplest method is to place the needle on the first groove of the record, and to place a straight-edge from the point of the needle to the spindle in the centre of the record. The armature should be at right-angles to the straight edge. Now place the needle a few grooves nearer the centre, and again place the straight-edge from needle point to spindle.

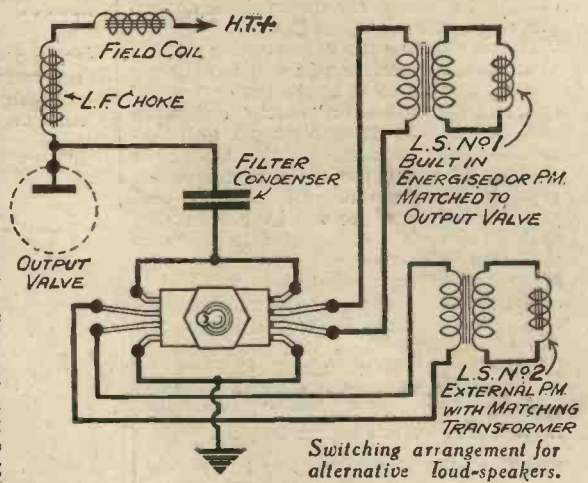
PRACTICAL PARS

Carry out this test at further points on the record right to the last groove, and if possible adjust the carrier arm so that at as many points as possible the correct angle is formed. If it is not possible to make your own tone arm track correctly, endeavour to get the correct angle at the centre of the record, as it is here that most wear takes place. Owing to the size of the first grooves it is not quite so important there, but of course, if possible, endeavour to get the angle as correct as possible at all parts of the record.

Finally, use only the needles recommended by the makers of the pick-up. If no special needle is mentioned, use a medium type in preference to a loud tone.

Switching Alternative Loud-speakers

MOST receivers with built-in loud-speakers provide for an *additional* loud-speaker, which imposes an extra load on the output valve, and quality suffers as a consequence. A *true alternative* speaker, however, is a different proposition, and would, no doubt, be welcomed by listeners who desire to switch from room to room without losing quality or volume. It will be seen from the accompanying sketch that this switching can be accomplished by using a double-pole double-throw switch, and by this means a built-in energized loud-speaker can be supplemented by an external P.M. moving-coil speaker to work separately, but never together, without interfering with the smoothing effect of the field coil when this is used as a choke. This scheme could also be adapted to switch two moving-coil type of loud-speakers. The best scheme would be to use a conventional choke condenser filter in the anode circuit of the output valve. The switch I have used for this purpose for some months past, with success, is the Bulgin S89 D.P.C.O. switch.—F. S. COOPER (Brixton).



Switching arrangement for alternative loud-speakers.

TAPPING AND ITS USES—2

A Full Explanation of the Reasons for Tapping Coils and other Components and the Methods Adopted

By
H. BEAT HEAVYCHURCH

A previous article on this subject appeared on pages 383 and 384 of last week's issue.

IN the first section of this article it was shown how a battery or a resistance was tapped in order to make full use of a portion of its properties. Now, among other components which are tapped may be mentioned coils, transformers and chokes, and we will deal with these in the order named, taking the tapped coil first, two examples of which are shown in the accompanying illustration (see Fig. 1).

If you examine the aerial tuning coil of your wireless receiver you will most likely find that, in addition to the top or "grid" end, and the bottom or "earth" end of the coil, there is a connection to an intermediate position, and that this tapping is the one to which the aerial is connected. Possibly there are several tappings, and you will have read, or will have been told, that if the aerial is connected to the tapping nearest to the earth connection, your set will be adjusted for greatest selectivity, and that the selectivity decreases as the connection is moved to positions nearer the top of the coil. You will possibly have learned by experience, also, that when the set is most selective the signal strength is considerably less than when the aerial connection is taken to a higher tapping.

Function of Tuning Coils

All these points call for some explanation, and yet comparatively little has been written on the subject. To examine the details thoroughly, it is necessary to draw

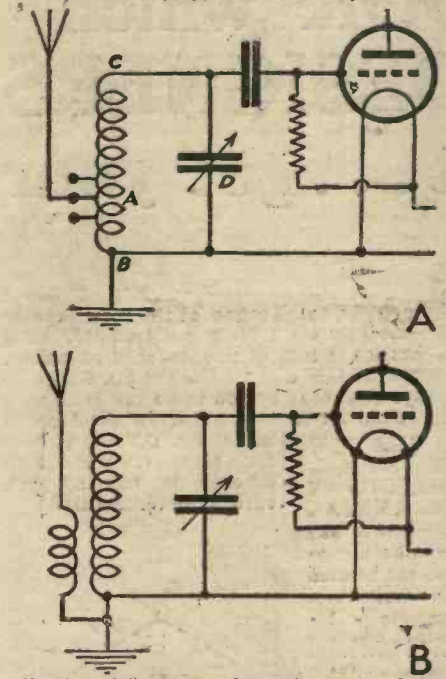


Fig. 1a.—(A) A tapped aerial tuning coil, and (B) a separate aerial coupling coil.

what radio engineers call the "equivalent circuit." In Fig. 1a is shown the actual connections to an aerial tuning circuit with the aerial connection taken to a tapping fairly near to the bottom of a tuning coil, and immediately below this sketch is indicated another circuit in which the aerial is not connected to the tuned circuit at all, but is joined to the top end of a small coil wound on the same former, the bottom end

Fig. 1.—Two examples of tapped coils; that on the left showing a plug-in coil with the taps brought out to terminals, and that on the right a long wave pyramidal winding and medium wave solenoidal winding with the tappings coming out as leads.

being taken to the earth end of the main tuning coil. This second drawing shows the "equivalent circuit" and is well worth a moment's study. Every listener knows that the aerial "picks up" signals from many stations at the same time, and that oscillating currents, corresponding to the frequencies of all these stations, are generated in the aerial circuit. It is the function of the tuning arrangement to make the receiver highly receptive to the signals of the "wanted" station and as unresponsive as possible to all other frequencies, and what we call the selectivity of the set is the extent to which we are successful in achieving this much desired condition.

Now consider what happens, taking first of all the equivalent circuit. Because the small aerial coil is not tuned to any particular station, it will have flowing in it currents corresponding to all sorts of frequencies, and the strength of the current due to any one station will depend upon the original strength of the signal intercepted, and upon the impedance of the coil at the frequency of that particular station. You know, of course, that the impedance of a coil to alternating currents is not constant, but is greater at the higher frequencies than it is at the lower frequencies; while, in addition, the coil resistance varies with the frequency. Owing to the aerial coil being coupled magnetically to the tuning coil, the combination of the two coils acts as a high-frequency transformer, and voltages are induced in the grid coil corresponding in frequency to the currents originally generated in the aerial. By means of the tuning condenser, however, we are able to tune the grid coil to the frequency of the "wanted" station, which means that the energy picked up from the wanted station is not "damped" or dissipated, but is retained in the tuned circuit across which a big signal voltage is built up.

The currents corresponding to the signals of all other stations, however, are somewhat rapidly dissipated, and the voltages of those frequencies are not so great. *If the tuning circuit is really efficient* the wanted signal voltage built up in this way is so large compared with the signal voltages corresponding to the other stations that the latter will not be heard in the receiver. Why is it that this coupled aerial coil gives a greater degree of selectivity than if the aerial was connected to the top end of the grid coil? The answer lies partly in the transformer effect, but chiefly in the fact that because the grid coil or "secondary" is tuned, and because there is a certain degree of coupling between the two coils, the small aerial coil is tuned by mutual induction, or, as it were, pulled into tune with the grid coil. Although, therefore, in actual fact the aerial coil is to all intents and purposes "aperiodic," that is to say, its natural oscillation frequency does not correspond to any of the frequencies it is required to receive, it is forced into re-

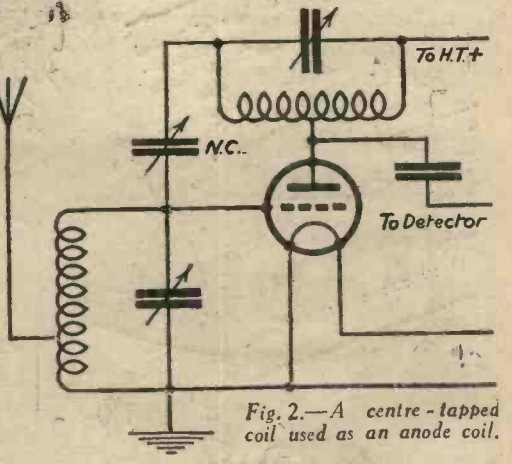


Fig. 2.—A centre-tapped coil used as an anode coil.

sonance with the wanted signal, or, in other words, the damping with respect to the frequency to which the grid coil is tuned is greatly reduced. Another point that should be noted is that the weaker the

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degree of coupling between the two coils, the smaller will be the amount of energy transference between the two coils, and the greater the degree of selectivity.

So far we have explained how the coupled coil in the equivalent circuit effects an improvement in selectivity, but it is now necessary to show how the equivalent circuit is, in effect, really identical to the tapped coil arrangement shown on the left-hand side of Fig. 1. It should be quite evident that in this arrangement the aerial circuit consists of a portion of the coil from A to B, while the grid coil is the whole of the winding from C to B, and that this latter coil is tuned by means of the variable condenser D. The only difference between the two circuits in actual fact is that as AB is a portion of CB, the coupling between the two circuits is even closer than in the case of the circuit B Fig. 1.

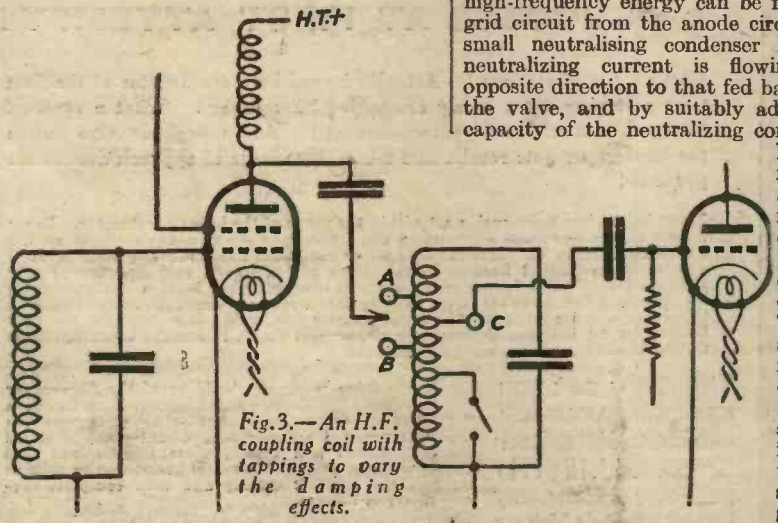


Fig. 3.—An H.F. coupling coil with tappings to vary the damping effects.

Auto-transformer Coupling

From the foregoing explanation it should also be clear why a tapping nearer to the top of the coil gives a less degree of selectivity but greater volume. The higher tapping brings the aerial portion of the coil nearer in natural frequency to the range of wavelengths it is desired to receive, and the signal voltages developed across it will be considerably greater than in the case of the smaller coil or lower tapping, and these greater signals will be passed on by induction to the grid coil. So, as the point of tapping rises nearer and nearer to the top of the coil we approach more nearly the position which obtains when the aerial is not "tapped in," but is connected to the top end of the grid coil itself.

In truth, our tapped coil which we have just described at length is an auto-transformer—that is, one winding with tappings instead of two separate and distinct primary and secondary windings—hence the name sometimes given as auto-transformer coupling. Before leaving this particular coil there is one other point which must not be overlooked, and that is by having two or three tappings on your aerial coil it facilitates the use of the same coil on different aerials not possessing similar constants or values. It enables the user on sight to ascertain for himself which is suited best to his own requirements and will bring about optimum results.

Centre-tapped Anode Coil

Another type of tapped coil which is not so frequently seen nowadays but was extensively used three or four seasons ago is the centre-tapped anode coil. This was employed in the tuned anode circuit of neutralized three-electrode high-frequency valves, and its purpose can be explained by a reference to Fig. 2. The trouble with the three-electrode valve when used as a high-frequency amplifier is that its electrodes act as the plates of a small condenser, so that amplified signals in the anode circuit can be fed back to the grid circuit. A kind of spurious reaction is thus developed, and the circuit becomes unstable and falls into oscillation. By connecting the anode of the valve to the centre point of the anode coil as shown in Fig. 2, however, it is possible to arrange that a controlled amount of high-frequency energy can be fed into the grid circuit from the anode circuit via the small neutralising condenser N.C. This neutralizing current is flowing in the opposite direction to that fed back through the valve, and by suitably adjusting the capacity of the neutralizing condenser the harmful feed-back, and the neutralizing current, can be made to cancel out each other. The necessity of the neutralized current has been obviated by the introduction of the screened-grid valve, but no doubt there are many old receivers still in service employing neutralized high-frequency stages, and this simple explanation will, therefore, be not only of general interest but helpful to the owners of such old sets.

Tapping the Grid Coil

Coming now to another case, an examination of the circuit diagrams for different wireless receivers will show the reader that in the case of the choke-fed tuned grid system of inter-valve coupling, especially between the high-frequency and detector stages, the grid coil is tapped. One such example is shown in Fig. 3. By joining the lead from the feed condenser to either of the points A and B (taps on the coil) it is possible to bring about the auto-transformer effect to which reference has been made earlier, and in this way increase the stage gain in amplification according to the degree of step-up given by the position of the tap. In addition, notice the farther tap C. It has been pointed out before in this journal that there is a very serious defect in the three-electrode detector valve owing to the damping effect which it introduces into the tuned circuit immediately preceding it. That is one of the main reasons why the detector circuit tunes a great deal more flatly than the high-frequency circuit, although the tuned circuits appear to be very similar. By having a tap on the coil, such as shown at C in Fig. 3, it is possible to reduce the detector loading and thus improve selectivity—hence another important reason for "tapping."

Transformer Tappings

As an example of a tapped low-frequency transformer we will refer to Fig. 4, which shows a conventional push-pull output stage. Here you will see that the input or inter-valve transformer has the usual primary winding which is included in the anode circuit of the previous valve, while the secondary winding is centre-tapped and supplies the grids of two output valves, the grid-bias connection being made to the centre tap. In the output transformer, however, the process is reversed, the anodes of the two valves being connected to the ends of the primary winding, which is centre-tapped, at which point the high-tension lead is connected. The secondary in this case is a single winding, the power in the circuit being the combined outputs of the two valves.

In the case of a pentode valve which requires a larger load impedance than most three-electrode output valves, the correct matching of speaker to valve can be attained by connecting a tapped choke as shown in Fig. 5. Here, for the sake of example, the choke is shown centre-tapped, and after having read the earlier portion of this article the reader will have no difficulty in realizing that a choke so connected acts not only as a filter, but also as an auto-transformer having a ratio of 2 to 1.

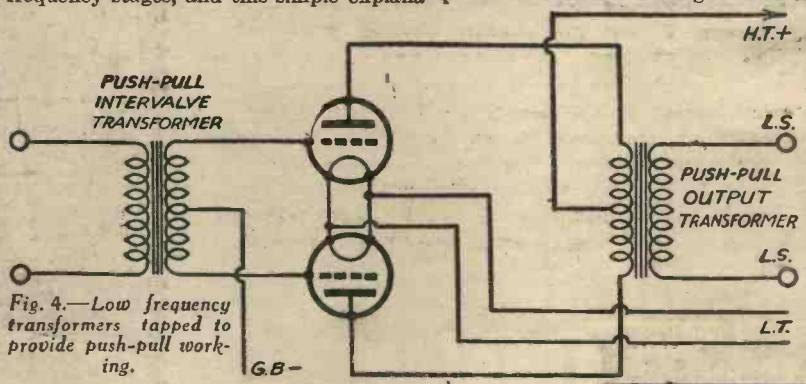


Fig. 4.—Low frequency transformers tapped to provide push-pull working.

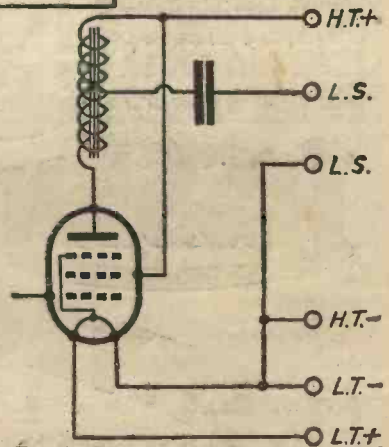
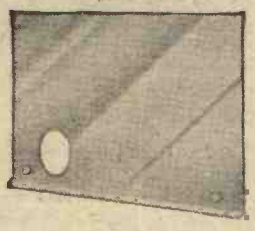


Fig. 5.—An iron-cored choke tapped to enable a loud-speaker to be matched to the output valve.

TELSEN COMPONENTS



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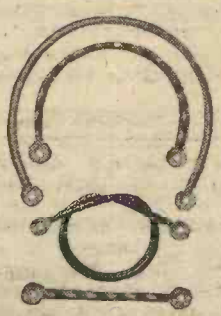

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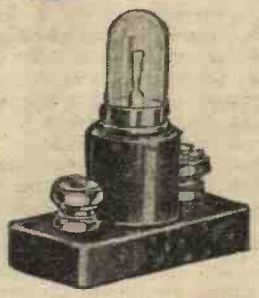

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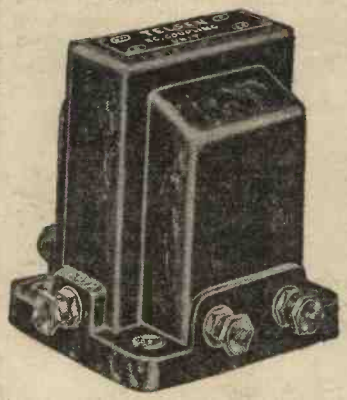

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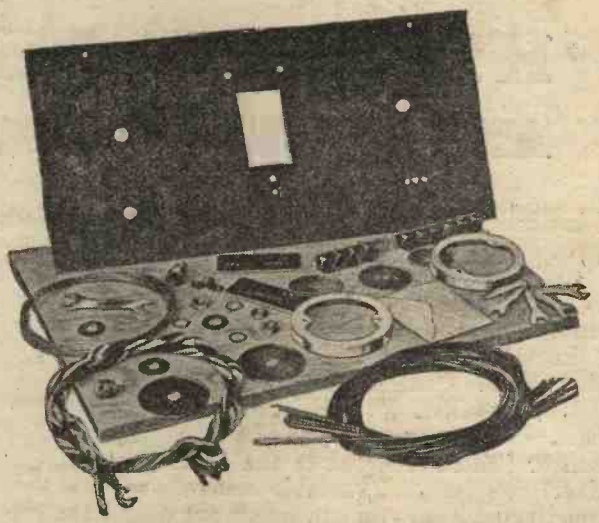

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These invaluable outfits contain all the necessary requirements (including baseboard, terminals, battery cords and all accessories) for the construction of any of the Telsen Receivers employing either the Telornor or Drum Drive and Condenser Assembly respectively—e.g. the Telsen Ajax 3, Triple 3 and Nimrod 2 (Telornor) and the Jupiter S.G. 3 (Drum Drive and Condenser Assembly). The various Components differ only very slightly in each outfit **3/6**

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Amperage
Refers to current in *amperes.*

Ampere
(Abbreviated to "amp."). The practical unit of electric *current*—that is, the *rate of flow* of electricity. It must not be confused with the unit of *quantity*, which is the coulomb. If one coulomb of electricity flows along a wire in one second, a current of one ampere is said to pass. In wireless and electrical engineering generally we are more often concerned with the rate of flow than the actual quantity of electricity. This is because a quantity of electricity which is *static*—that is to say, does not move—cannot do any work. It is only when it moves in the form of current (measured in amperes) that it develops any power. A quantity of electricity may be likened to a tank of water raised above the ground. As such it does no work, but as soon as a pipe is led from it to the ground the water will flow and can be used to drive machinery. The flow of water is equivalent to a current of electricity.

Ampere-hour
A unit of *quantity* of electricity. It means enough electricity to provide a current of 1 ampere for one hour, or alternatively the same quantity would give ½ an amp. for two hours, or again 2 amps. for half an hour and so on. When an accumulator is said to be of 40 amp.-hour capacity, it means that you can get from it 1 amp. for forty hours or its equivalent — say, 2 amps. for twenty hours. To calculate ampere-hours, multiply amps. (amperes) by the time in hours. An ampere-hour is equal to 3,600 coulombs.

Fig. 1.—Ampere-hours marked in an accumulator denote how much electricity it will hold. It will give 1 amp. for 20 hours, the capacity is thus 20 amp. hours.

Ampere Meter
(See "Ammeter")

Amplification Factor
This term is used in reference to valves. It is rather difficult to explain in non-technical language, but may be expressed as the maximum voltage amplification of which the valve is capable. A valve work by virtue of the fact that small changes of *voltage* applied to its grid—that is, where the signals enter the valve—cause corresponding changes in the plate or output *current*. Now, changes in the plate current can also be effected by changes in the plate *voltage*. This latter fact you may have had practical proof of if you have at any time increased the H.T. voltage of your set so as to get louder signals. You probably noticed that after doing this the H.T. battery has not lasted so long; in other words, an increase in plate *voltage* caused an increase in plate *current*.

You may wonder what all this has to do with the amplification factor. Well simply this, that in arriving at the amplification factor of a valve these relative changes in *grid voltage*, *plate current*, and *plate voltage* all enter into the calculation. It may be expressed as the ratio of change of plate voltage to change of grid voltage, which will give the same change in plate current.

It should be noted that the amplification factor of a valve is not in itself a sufficient guide to the practical amplification you may expect from it under working conditions, since other things, such as the impedance of the external circuit, must be taken into account. It suffices to say that a valve with a high amplification factor is not necessarily going to give higher magnification of signals than one with a lower amplification factor.

Amplifier
A device used to increase, or magnify, electrical impulses. A valve is the best-known form of amplifier used in wireless. It can be used to amplify the signals picked up by the aerial, in the form of high-frequency impulses and before they are "rectified," or it can be used after they are rectified by the crystal or valve detector and are in the form of low or audio-frequency impulses. In the former case the valve is called a *high-frequency amplifier*, and in the latter a *low-frequency amplifier*.

Valves are not the only amplifiers, however. A transformer may be considered as an amplifier, in that it can be designed to give an increase in voltage or in current, although it will not give both at the same time. In other words, it will not give an increase in *power* like the valve does. For instance, if the transformer is constructed to give an increase in voltage it will cause a decrease in current, so that the resulting output of watts, or power, is no greater than that put in. Now, a transformer used in conjunction with a microphone, battery, and a telephone receiver, as in Fig. 2, *can* be made to give an increase in power. This arrangement is known as a Microphone Amplifier, and the increase in power is derived from the battery. On speaking quietly in the microphone, thus causing small electrical impulses in the circuit, a loud response will come from the receiver due to the amplified impulses. An arrangement somewhat similar to this is used in some amplifiers for use with crystal sets.

In the case of valves the term "amplifier" is more often used to refer to the whole equipment employed—that is, the transformers, condensers, etc., employed in conjunction with the valves, besides the valves themselves. Sometimes "amplifiers" are made up as a separate unit, comprising the valve or valves, the necessary couplings, and even the batteries.

(Continued on page 456.)

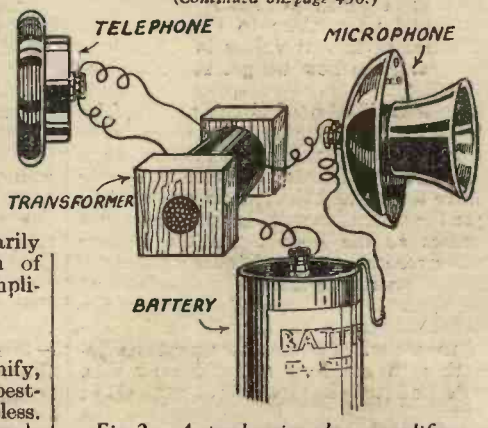


Fig. 2.—A simple microphone amplifier.

THE BEGINNERS A B C OF WIRELESS TERMS

This special beginner's supplement has been introduced in response to a general request from hundreds of readers who have only just commenced to take an interest in wireless construction. In it we propose to explain, week by week, in very simple language, facts about the various aspects of the practical side of wireless. To the many thousands who cannot yet understand the circuits or terms used in connection with wireless we extend a cordial helping hand.

BEGINNER'S SUPPLEMENT

(Continued from page 455.)

Non-Inductive Resistance

ALTHOUGH we are continually using the resistance, both in radio work and in common parlance, how many enthusiasts have pondered over its various arrangements, its arithmetical values and perhaps its actual meaning? Let us think for a moment what is meant by resistance in the electrical sense. All bodies which are set in motion, whether they be mechanical or otherwise, have to overcome friction, and it is a similar property, possessed by a conductor, of opposing the passing of electrons through it, that we know as resistance.

Specific Resistance

Every conductor has a specific resistance, which means its resistance per cubic centimetre between its opposite sides, although it varies with different temperatures. It therefore follows that we must have some sort of comparison whereby we can measure the resistance of any conductor, and thus the standard unit called the "ohm" has been chosen, which represents

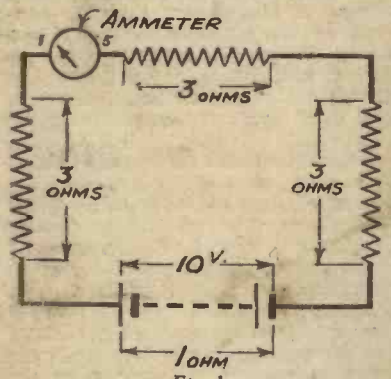


Fig. 1.

the resistance of a column of mercury of certain dimensions and temperature, and by which we determine our various calculations. We are not as a rule concerned so much with specific resistance, for you can guess that if we know the cross-sectional area (a), the length (l), and specific resistance (p) we can, by using the following equation:—(1) $R=\frac{pl}{a}$ arrive at the total resistance. But, of course, this is not necessary in practice, as it it is already nicely worked out for us when we purchase the component.

Resistance in Series

Having covered a little preliminary ground, let us venture to connect a few resistances of known values in series in a circuit, and see how we get at their total value.

Here is an illustrated circuit actuated by a 10 volt. accumulator with three resistances of equal value. What we have done in this particular instance is merely to have lengthened the circuit, and according to the above formula the total resistance increases as the length. As the voltage has to overcome each resistance separately, the total resistance is therefore the sum of their separate values—not forgetting the internal resistance of the cells, which are also in series. Perhaps it would be interesting to see how we arrive at this. Ohm's Law tells us that the current (I) in a circuit is directly proportional to the applied voltage (E) but inversely proportional to the resistance (R) of the circuit. So we can from this form an equation thus: $I=\frac{E}{R}$; where I equals amperes, E volts and R ohms. But if I equals $\frac{E}{R}$ E must equal I × R then R equals $\frac{E}{I}$; therefore $R=\frac{10}{I}=10$ ohms. We know the battery resistance is 1 ohm, the three remaining resistances must necessarily be 3 ohms each. Again $I=\frac{E}{R}=1=\frac{10}{10}=$ 1 ampere, or $E=I\times R=10=1+10=10$ volts. You see how nicely it works out when we apply Ohm's Law.

A TALK ABOUT RESISTANCES

Parallel Arrangement

Now let us turn our attention to a little more complicated arrangement, this time resistances in parallel as shown in Fig. 2.

Its first appearance seems to indicate a somewhat formidable aspect, but to the contrary, a little concentration, an algebraical equation, and it is all simplified. Perhaps at this point it is as well to recall formula 1, by which we observe that resistance varies inversely as the cross-sectional area. Although the formation appears to have a larger total than before, we have three parallel paths for the current and reverting to Ohm's Law again, we are reminded that the total current equals the applied voltage divided by the total resistance of the circuit, *i.e.*, $I=\frac{E}{R}$; but $\frac{E}{R}=\frac{E}{3}+\frac{E}{3}+\frac{E}{3}$, therefore by dividing both sides of the equation by E we get $\frac{1}{R}=\frac{1}{3}+\frac{1}{3}+\frac{1}{3}=3/3$; but as $\frac{1}{R}$ is the reciprocal of R therefore $R=3/3=1$ ohm. Now we have in addition 1 ohm internal resistance of the 10 volt. battery in series with the former, so the total resistance is $1+1=$ 2 ohms. $I=\frac{E}{R}=\frac{10}{2}=5$ amperes. Each branch will pass a certain proportion of current, depending of course upon the resistance of its conductor. So we have noticed that this method of connecting in parallel has the effect of reducing the total resistance to a value smaller than the smallest resistance, which is the reciprocal of the sum of their individual reciprocals. There are numerous applications where we can employ the resistance for radio purposes, one of the essentials being the grid leak usually connected between the detecting valve grid and positive end of the filament heating battery. This allows to drain away the negative charge, which would otherwise accumulate and impede the electron emission from the filament to the anode. Another, by using it as a coupling device between circuits, but this time in conjunction with a condenser. As already mentioned $E=I\times R$; so any change in anode current will cause a voltage or $I\times R$ drop across the resistance—this variation being communicated by the condenser, creates a change in grid potential of the next valves. A combination such as this is known as resistance capacity coupling. The values of the resistance in these cases are exceedingly higher than those we have been discussing, perhaps from 10,000 ohms to 3 megohms (3,000,000), but of course, it does not interfere with our method of calculation.

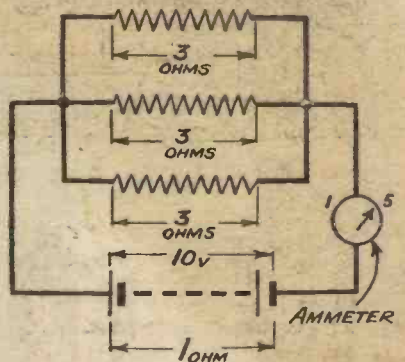


Fig. 2.

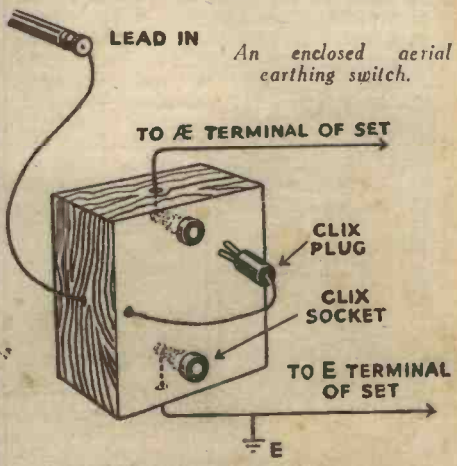
The Lamp Resistance

Last, but not least, comes the lamp resistance, usually of the carbon type, which we so often see on accumulator switch-boards for regulating the charging current. This, as well as the wire wound resistance, represents a definite expenditure of energy, but dissipates it in the form of heat and light. We can arrange them in any manner already described, and sum up their values accordingly. They are, of course, so constructed to withstand various specified voltages, or we would perhaps have no filament left!

AN ENCLOSED AERIAL-EARTH SWITCH

An Enclosed Aerial-Earth Switch

A NEAT substitute for the usual lightning and aerial-earth switch can be made, as shown in the sketch, with a small wooden box, two sockets and a plug. The sockets are mounted on the underside of the top of the box, and the connections made as indicated. The box, which should be made dustproof, can be fixed below the lead-in tube.—W. FREEMAN (Leeds).



An enclosed aerial earthing switch.

Direct Radio

159 BORO HIGH STREET LONDON BRIDGE

1 VARIABLE MU Screened Grid H.F. Amplifier for range and distortionless volume control. Mullard PM 12v.

2 SCREENED GRID DETECTOR for enormous amplification, with maximum selectivity and detection without overloading or distortion. Mullard PM 12.

3 DIRECT REASONS

3 LOW CONSUMPTION PENTODE output for quality with great volume. Mullard PM 22A.

WHY THE UNIQUE DIRECT RADIO "ARGUS 3" GIVES QUALITY SUPER-HET RESULTS

THE MOST MODERN CIRCUIT EVER PUBLISHED FOR THE AMATEUR SET CONSTRUCTOR.

"ARGUS 3"

GUARANTEED KIT with FREE CALIBRATOR

	£	s.	d.
1 Pair Telsen twin matched coils		17	0
1 J.B. Unitune 2-gang .0005 mfd. variable condenser, 2069 ..		18	6
1 Lissen Hypernik 4-1 L.F. Transformer with Lissentone Compensator	1	2	6
1 Ready Radio S.G. Choke ..		5	6
1 Kinva Standard Screened Choke		2	9
1 Ready Radio Bakelite condenser .0005 mfd.		2	6
1 Ready Radio Bakelite condenser .0003 mfd.		2	3
1 Lewcos 50,000 ohms. Potentiometer		3	0
2 T.C.C. .0003 mfd. fixed condensers type S		2	6
1 T.C.C. .0001 mfd. fixed condenser type S		1	3
1 T.C.C. 1 mfd. Mansbridge condenser type No. 50. ..		2	10
1 T.C.C. 2 mfd. Mansbridge condenser type No. 50.. ..		3	10
1 T.C.C. .1 mfd. Mansbridge condenser type No. 50		1	10
1 Dubilier 1 meg. resistance ..		1	0
1 Lewcos Spaghetti resistance 5,000 ohms		1	0
1 Lewcos Spaghetti resistance 20,000 ohms		1	6
1 Lewcos Spaghetti resistance 100,000 ohms.		1	6
1 Ready Radio 3-point switch..		1	6
2 Clix 4-pin chassis mounting valve holders (with terminals)		1	4
1 Clix 5-pin chassis mounting valve holder (with terminals)			9
6 Belling-Lee terminals, L.S.+; L.S.—; two Pick-up; Aerial; Earth		1	3
4 Belling-Lee Wander Plugs, G.B.—1; G.B.—2; G.B.—3; G.B.+			6
1 Belling-Lee 3-way Battery cord with plugs marked H.T.+; H.T.+1; H.T.+2; H.T.+3; H.T.—; L.T.—; L.T.+ ..		2	0
3 coils Lewcos connecting wire..			8
Mullard valves:—PM12V; PM12; PM22A	2	10	6
1 "159" Cabinet..	1	0	0
1 Easytix Baseboard and special Panel drilled to specification		2	9
Flex, screws, etc.			6
1 Calibrator Easy Station Finder (no charge)			
	£8	13	0

Kit No. 1 £5 2 6
(less valves and cabinet) or 12 monthly instalments of 9/6.

Kit No. 2 £7 13 0
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Kit No. 3 £8 13 0
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Kit No. 4 £11 5 0
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RECOMMENDED ACCESSORIES

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Oldham 0.30 Accumulator ..		9	0
Siemens G.B. Battery		1	0
"Cop" Aerial and lead-in tube..		3	6
Selectant Indoor Aerial		2	6
Selectant Earth		1	6
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Atlas A.C. 244 Eliminator ..	2	19	6
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THE "306" MODEL "A" (with Valves, Cabinet and Moving-Coil Speaker), £6/17/6. Or 12 monthly payments of 13/6.
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BOWYER LOWE A.E.D. Mark III pick-up. £1/10/0.

COLLARO B.30 automatic stop double spring gramomotor, £1/13/0.

COLLARO Induction gramo. motor for A.C. mains, £2/10/0.

COLLARO complete gramo. playing unit, incorporating induction motor, pick-up, volume-control and automatic stop, £4/0/. Or 10 monthly payments of 9/-.

ATLAS, A.C. 300 mains unit. Incorporating H.T. 150 volts, 25 M.A. L.T. charger and grid bias, 1½ to 10 volts. £6/10/0. or 12 monthly payments of 12/-.

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Kit No. 2 £7 11 6
(with valves less cabinet) or 12 monthly payments of 14/-.

Kit No. 3 £8 10 0
(with valves and cabinet) or 12 monthly payments of 15/6.

Kit No. 4 £13 10 0
or 12 monthly payments of 25/-. Complete Kit of Components as specified, with Valves, handsome Walnut Consolette Cabinet. Siemens Batteries, Oldham Accumulator and Epoch A2 Dance Orchestra Moving Coil Speaker.

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Please dispatch to me at once the following goods.....

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for which (a) I enclose (b) I will pay on delivery (c) I enclose first deposit of {cross out line not applicable} £.....

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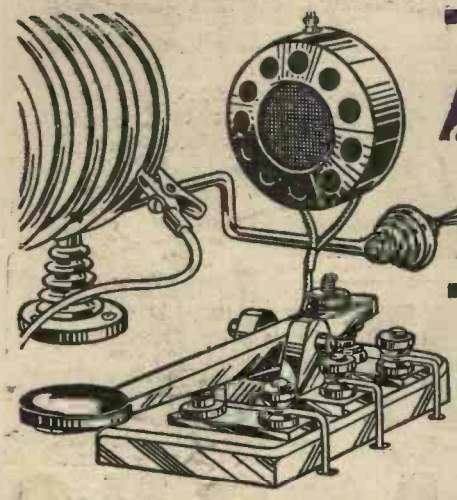
ADDRESS..... Practical Wireless 19/11/32



BELOW 100 METRES

THE ABC OF SHORT-WAVE RECEIVER DESIGN

By L. H. THOMAS

A FEW years ago the percentage of home-constructors interested in sets for the reception of wavelengths below 100 metres was very small indeed. To-day it certainly is not large. But the growing popularity of the short-wave receiver, and the growing number of short-wave stations, lead one to believe that in a year or two this branch of radio will have become very important indeed to the home-construction enthusiast.

The outstanding characteristic of the short waves is that they are almost useless for the reception of local stations, but invaluable for the reception of signals from great distances. During this summer there have been roughly one hundred stations, all over the world, broadcasting regular musical programmes on wavelengths between 10 and 80 metres; and, with a good receiver, most of them can be heard in this country during some part of the twenty-four hours. Various properties of "short waves" make it necessary to use a somewhat modified receiver for their reception. The ordinary broadcast receiver, particularly if it includes no H.F. amplification, may be made to function quite well on the shorter wavelengths, but, generally speaking, it is preferable to design a separate set for the purpose.

Short-Wave Frequencies

The chief reason for this is the extremely wide band of frequencies embraced by what we rather loosely agree to term "short waves." In the medium-wave broadcast band, between 200 and 600 metres, we have a frequency band 1,000 kilocycles in width—capable of accommodating 100 stations with a spacing of 10 kc/s between them. Between 20 and 30 metres only we have a frequency band five times as great in extent—5,000 kc/s wide. Between 20 and 10 metres we have a further 15,000 kc/s! The entire spectrum of "short waves" from 10 to 100 metres is 27,000 kc/s in width—27 times as spacious as the ordinary broadcast band, and necessitating 27 times the amount of care and skill in tuning! For this reason it is quite impracticable to handle it all in one sweep of the tuning condenser, and we adopt the compromise of sub-dividing it into four different bands, using, generally, four sets of plug-in coils for that purpose.

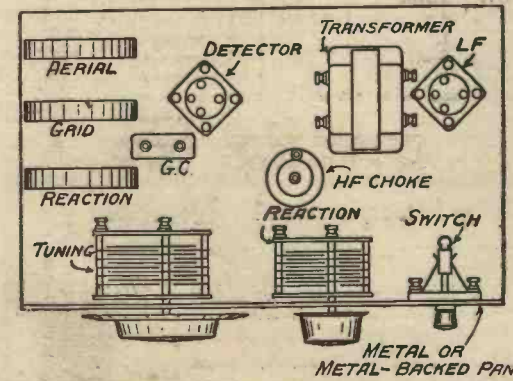


Fig. 2.—Layout of a two-valve receiver. Note the short wiring, and the layout of the components.

Coil Windings

Fig. 1 shows a typical short-wave receiver of the simplest kind. The particular charm of short-wave work, incidentally, is that the simplest apparatus is usually the most effective.

If the coils are carefully wound and equipped with plugs to make them readily interchangeable, only five will be required to cover the range from 10 to 100 metres. Wound on formers with a diameter of 2½ or 3 inches, the coils necessary will be two of three turns, two of six turns, and one each nine and fifteen turns. With a tuning condenser of .0001 or .00015 capacity, coils of these sizes should cover roughly the following bands:—

Aerial (L_1)	Grid (L_2)	Reaction (L_3)	Range (in metres)
6	15	9	55-100
	9	6	30-65
	6	3	19-30
	3	3	10-22

These ranges are, naturally, only approximate; but any deviations will be rather on the "wide" than the "narrow" side, so that there is no fear that the entire range will not be covered. Special points to watch in the operation of a short-wave receiver are these: First, there should be no "hand-capacity" effects. That is to say, that a signal should not disappear immediately the operator removes his hands from the tuning controls. Trouble of this kind is invariably due to instability, which, in turn, is usually due to a poor choice of layout.

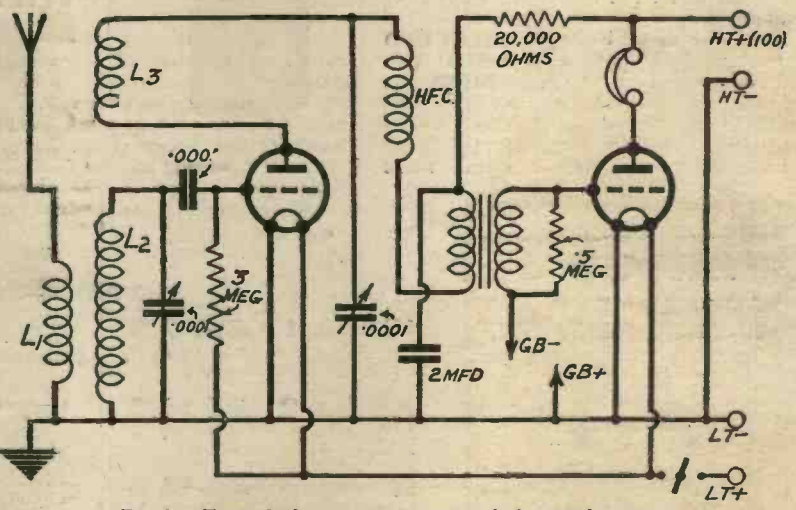


Fig. 1.—Typical short-wave receiver of the simplest type.

A Two-Valve Receiver

Fig 2. shows a layout for a two-valve receiver which makes possible the use of very short wiring. The front panel is either of metal, or of wood or ebonite backed with metal foil. The moving plates of both the tuning and reaction condensers may be directly connected to this metal, since both are at earth potential. This simple precaution, so often neglected, may prove to be the border-line between the success and failure of a short-wave receiver. Secondly, there should be no suspicion of "ploppy" reaction control. When the set goes in or out of oscillation it should do so *smoothly*, with neither a "plop" nor an audible howl. The latter effect, known as "threshold howl," causes considerable annoyance to novices handling a short-wave receiver for the first time, and may be due to a variety of causes. The use of a .5-megohm leak across the secondary of the L.F. transformer, as shown in Fig. 1, will generally prevent a set from showing this annoying habit.

Critical Tuning

Thirdly, the owner of a short-wave receiver must remember that, although

(Continued on page 459.)

Below 100 Meters

(Continued from page 458.)

the "spectrum" has been split up into four bands, the tuning on each of these will still be five or six times as critical as that of the average broadcast receiver. This may be counteracted to some extent by the use of a really good slow-motion dial on the tuning condenser; but even then the operator must not be heavy-handed. The golden rules are these—go round your dial *slowly*; and listen to everything that you hear.

The broadcast stations are grouped together in fairly narrow wave-bands on roughly 19, 25, 31 and 49 metres. Most of the space in between these bands is occupied by commercial stations using morse. This accounts for the usual complaint of the short-wave novice that he "can't hear anything but dots and dashes." If you cannot tell exactly where you are in wavelength, listen carefully until you find a broadcast station, and then, within five degrees or so on the dial, you should find half-a-dozen others. Once you have succeeded in identifying one of them you should have no trouble in spotting the rest.

Practically any aerial will give good results on the short waves, from the long outside wire to a short aerial across the room. The larger the aerial, the looser will the coupling of the aerial coil to the others need to be. An earth is not always necessary. The only rule that can safely be given is: "Use an earth if it improves your results. Otherwise, don't!"

Finally, it is as well to remember that those who expect consistent loud-speaker results from a two-valve receiver will generally be disappointed. There *will* be four or five stations that the average two-valver can handle on the speaker, but for consistent work three or four valves are necessary.

FROM THE FLASH-LAMP (2) By "PHOTON"

The Source of the A.C. Output Energy

THE A.C. component of the output of a valve is the only energy available for sound reproduction; the word *component* is used here, though it will be shown later that it is not strictly applicable. It is so often that in valve circuits of different kinds the valve is shown substituted by a diagrammatic A.C. generator, and this has the sanction of many leading authorities, that one very important aspect of the subject is lost sight of or glossed over.

If an A.C. current be superposed on a constant D.C. current, the energies of the two are added in summing the total energy. The mean current is not affected by the superposition of the A.C. current, but the root mean square is, and it is the square of this R.M.S., namely, the mean square which, multiplied by the resistance, is the measure of the energy, and this, as stated, is the sum of the D.C. and A.C. components taken separately. The resistance in question may include the motional impedance of the speaker, in addition to the copper ohms and the valve impedance, but we have not got to that yet; we are dealing with a simple circuit containing ordinary ohmic resistance. In such a circuit, it is correct to refer to the A.C. component of the energy or power (watts). But we cannot think of a valve circuit in quite the same manner. The only power available for both D.C. and A.C. comes from the H.T. battery; and so long as the valve is operating within the limits of undistorted output the milliammeter in the plate circuit stands steadily at the same reading, whether there is an A.C. component or not; that is to say, whether passing the normal steady plate current or whether a signal or broadcast is coming through, and the battery volts are unchanged. Hence the energy of the A.C. component cannot be considered as additional to the normal steady D.C. current energy, but rather as something taken from it. This looks like a paradox; it almost seems to upset the statement of the case and conclusion given in the preceding paragraph. We will examine the matter more closely.

Firstly, the fact that an A.C. current superimposed on a constant current in a given resistance means additional watts loss and therefore additional watts to be supplied cannot be doubted; that is so. Secondly, the fact that the energy per second (watts) consumed by the valve circuit is the same whether an A.C. component exists or not (so long as the ammeter is steady) is equally unquestionable. So we fall back on an examination of the nature of the resistance.

We cannot think of the A.C. working current in the case of a valve as being generated by a peculiar kind of A.C. motor producing a variable R.M.S. or vector potential; we must give full weight to the fact that the variations in the amplitude of the A.C. current are due to resistance or impedance changes in the circuit itself. Thus, if we denote the conductance of the circuit by σ ($=1/R$) and this be taken to vary, then the current (for given E.M.F.) i will vary with σ or $= k\,\sigma$ where k is a constant, and the "C^2R" loss will be $i^2/\sigma = i\,k\,\sigma/\sigma = i\,k$; in other words, it is the mean current and not the R.M.S. that determines the power expenditure, and this is in agreement with the obvious truth. The paradox is dissolved. To refer to the *dissipation* of a valve as being so many watts is misleading; it tempts one to believe that the useful work performed by the valve is *additional*. Actually, as will have been perceived, the *dissipation* may be either the whole *or part only* of what we may term the *input* to the valve, the balance being the (A.C.) output. There is no case for changing the accepted terminology, but it is important not to be confused into supposing that the dissipation is all *dissipated*, in the ordinary sense of the word.

Radio Ramblings

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

Output Transformers

A NOVICE friend asked me the other day a question concerning output transformers. "What," he said, "are they for, anyway?" I explained at great length that they allowed of matching the resistance of the loud-speaker with that of the valve, that they allowed of long leads being used without inconvenience, and that they protected the loud-speaker windings by diverting the high-tension current from them. Furthermore, I told him that with an output transformer it did not matter which way round the speaker was joined to the set, because, as there was no direct current passing, there was no fear of the magnets of the speaker being de-magnetised.

He then went on to ask what happened when the output transformer was fitted to the loud-speaker—as is the case with most modern moving-coils—and when he wanted to use the speaker in another room. That, of course, alters it, I told him, and it struck me that here was a point that has been neglected by some makers of moving-coils. It would be a great help if the output transformers were easily removable, because reception would be much better with speakers on long leads if the transformer could be fitted as near the set as possible. With long leads a considerable loss of high notes is noticeable unless precautions are taken, due to unwanted capacity of the leads themselves; and by placing this capacity across the primary this high-note loss is accentuated. This will be easily seen, for, by removing speaker and transformer to a distance, you are, by means of the double leads, adding wire to the primary and, incidentally, introducing unwanted capacity in a very undesirable place. By removing the transformer from the speaker chassis and fitting same in or near your set this unwanted capacity is placed across the secondary, in which position it cannot do much harm. The only snag that comes in is when the transformer is virtually part and parcel of the speaker and where it is almost necessary to wreck the whole job to separate them. In this case it is generally preferable to purchase a 1 : 1 output transformer, or else fit a choke filter output to your set. Either of these will result in much improved quality, apart from the fact that sending your H.T. through long leads is both a bad and uneconomic practice. In conclusion, it must be remembered that your quality can sometimes be improved if you feel you are losing some high notes by fitting a small fixed condenser across the primary of your L.F. transformer, and the addition of such a condenser will often do much to stabilize your set if you are troubled in this respect. It is across the primary of the output transformer that you do not want this capacity, and it is interesting to note that on some transformers a capacity of .005 is equivalent in value to one of 2 mfd. across the secondary.

Using a Scratch-filter

TALKING of high-note loss, I have found that, while the addition of a scratch-filter to a radiogram certainly removes the most objectionable scratch that some pick-ups seem to magnify to immense proportions, very often such a filter removes certain of the high notes as well. This seems to indicate that if the scratch-filter were wired up with a two-way switch so that it could be thrown out of circuit as desired, it would be a desirable thing. With organ records, baritone, speaking, and some orchestral recordings where the majority of the stuff is well down in the harmonic scale, the scratch-filter does good work, but records in which there is a good deal of clarionet, violin, flute and piccolo work in the upper register the scratch-filter could be conveniently cut out. Most filters cut in about 2,000 cycles per second, and, as a general rule, record scratch has a frequency of between 2,000 and 5,000 cycles per second. It is true that few instruments go above 2,000 cycles, but, in addition to those mentioned above, there are many pianoforte works that have passages exceeding this frequency.

S.G. Bias Values

DID you know that the insertion of a small bias in the control grid circuit of a S.G. valve often gives better selectivity, and increased sensitivity? Perhaps you did and, in any case, this provision is made in a great many of the modern set designs, but I would like to tell you not to take the value of the bias recommended too much for granted. Especially in the case of indirectly-heated valves is this bias critical, and can often exceed the usual value of 0.9 volts with advantage. It is a subject that will provide you with ample scope for experiment, and you will find that too much bias is as bad as too little. In fact, you will find that there is a peak point where an increase or decrease in bias value will result in a falling off in sensitivity and selectivity. When fitting a new S.G. valve, it is as well to experiment with various bias values.

About "Motor-boating"

I CAME across a set the other day that had suddenly developed the bad habit of violent motor-boating after working satisfactorily for over a year. It was a set worked from the mains, and the owner was completely at a loss, especially as it had previously given him such excellent results. I found that one of the decoupling resistances through which a H.T. tapping was taken from the eliminator was unduly hot and, of course, I immediately tumbled to the solution. The resistance had developed an internal "short," and this particular decoupling circuit has ceased to "decouple." In the same way, the failure of a decoupling by-pass condenser would cause sudden "motor-boating," and I have found that falling emission of one or more valves will also give rise to the same trouble. In the latter case, however, the trouble is rarely sudden. Instability and loss of power will have been noticeable over a fairly long period, so that when motor-boating is set up from this cause you will have had sufficient notice that it is time you treated your set to a new "set"—of valves! An old hint which does not lose in value by repetition is that valves can often be revived by disconnecting the H.T. and leaving the L.T. connected all night. This enhances the emission of old valves.

(*Continued on page* 462.)

A Young Inventor

KENNETH CHEESEMAN, with his invention for stopping would-be car thieves. It is operated by a hidden electric switch which, immediately the car thief puts his foot on the accelerator or takes off the brake, causes an electric syren to shriek, illuminates a flashing red light in the headlamps, and thus attracts the attention of police and passers by.

Radio Ramblings

(*Continued from page 460.*)

A New Mineral

X-RAYS, which are among those having the very shortest of known wavelengths, have been used to discover a new mineral known as braggite in honour of Sir William Bragg, whose work with X-rays and with the atom has been so successful. Its principal constituents appear to be platinum and palladium, and the ores from which it was discovered were given by a large concern of platinum producers. The discovery was made in the laboratory of the Natural History Museum, South Kensington.

Aerodrome Telephony

IF you are in the habit of listening to the telephony sent out from one or the other of our large aerodromes, you will be interested to learn that another such station will be working early in the New Year. The station will be erected at the municipal aerodrome at Manchester, and the Marconi Co. are doing the work. The transmitter will have sufficient range to communicate with aircraft on the Irish Sea crossing and proceeding through the Midlands and Wales, besides maintaining an inter-aerodrome communication. The Air Ministry is responsible for the installation, and weather reports and other matter will be regularly sent out. The station proper is situated nearly a mile from the landing-field, so that the two 100ft. masts used will not interfere with ascending and alighting aircraft. Transmissions will be made on 700 and 1,550 metres, so that if your sets will tune to either or both of these bands don't forget to listen.

Detector Hints

IF you are doubtful if the H.F. side of your set is working efficiently, disconnect the anode lead from the top of your S.G. valve, and connect it through a 0.0001 mfd. condenser to the aerial terminal. If signal strength does *not* appreciably alter, you were correct in the first place, and something is wrong with your H.F. amplifier.

If you try soldering a connection to the aluminium chassis or screen of your set you will find many difficulties. Years ago people said aluminium could not be soldered, but there are now many fluxes and patent solders on the market. Most fluxes can be eliminated, however, if you first of all "tin" the aluminium in the place to be soldered by getting a molten "pool" of solder at the spot and continually scraping through it with the point of an old knife. By this means the oxides are worked to the top of the "pool," and soon the tin in the solder will be found to be adhering to the aluminium. The wire to be soldered can then be inserted in the pool in the usual way after first of all cleaning it thoroughly. When making a connection to a screen by means of a terminal make sure that you have well scraped round the part where the terminal is to be placed. Some screens are sent out with a thin coat of lacquer on them to preserve their bright appearance, and to tighten a terminal on this will result in a very poor connection.

Wireless at the Wheel

AN entirely new built-in radio set which will enable motorists to enjoy programmes whilst actually driving was announced this week by Philco, who have recently established works in this country. These sets are a standard extra on many makes of American cars, and are widely used in an adapted form by the American police. They are entirely unobtrusive and take up no room in the car. The aerial is hidden in the roof; a 135-volt dry high-tension battery is fitted under the driver's seat, and both the receiver and the moving coil loud-speaker are placed under the scuttle. All that can be seen of the set is a neat illuminated tuning plate, fitted with a lock and key beneath the steering wheel. Built-in radio sets of various types have been tried out before in this country; but, owing to the noise generated by the electrical equipment and to constant variation in volume, they have usually only been playable when the engine is shut off. In the new Transitone, it is claimed, these difficulties are overcome. Special methods of insulation suppress electrical and engine noises, and volume is automatically controlled. The price of the new Philco Transitone is 33 guineas, plus the cost of installation.

THE NEW LISSEN 3-VALVER

(*Continued from page 440*).

approximate wavelength, and a good high aerial was used. With the volume control at its minimum setting the strength of signals was quite sufficient for ordinary listening purposes. The volume control could be rotated about two-thirds of the way round before the set burst into oscillation, and at this point the volume was too great for any but the "noise fans." Some of the dance music which was transmitted was almost sufficient for dancing in a small room, and the quality was really fine. Huizen was a good signal, although for this station the volume control had to be about one-third of the way round to provide normal room strength suitable for general listening. There were no other long-wave transmissions available at this particular time, so recourse was had to the normal wave-band. Here there were two stations working, Beromünster and Frankfurt. With the volume control about half-way round quite good signals were obtainable, although perhaps not sufficient for most people. It must be remembered, however, that this was in broad daylight. After darkness had fallen, dozens of stations could be heard upon setting the volume control about one-third one and rotating the tuning control. It would be useless to give a list of stations, as it would only take up a column which could be better devoted to talking about this neat little set, but it is sufficient to say that at least 20 stations provide a signal which would be more than enough for quite a number of people, and for the really interested listener this log could be easily doubled, although some of the weaker stations require careful tuning. For this latter range of stations use must be made of the selectivity plug situated inside the receiver, and the small knob which is concentric with the main tuning knob must also be employed to balance the two tuning circuits. There is not the slightest difficulty in finding the distant stations owing to the calibrated dial, and there is no doubt that this is the ideal receiver for the average listener, and the price—enables this little set to be placed in the hands of the ordinary man-in-the-street.

COMMENTS ON COMPONENTS

What we Found..

IGRANIC CANNED COIL

ONE of the screened dual-range coils manufactured by the Igranic Electric Co., Ltd., has been tested and examined by us, and proves to be a very efficient component. An eight-ribbed small-diameter former is used, and an eight-terminal base is fitted. An unusual method of construction is employed in this coil, the only windings on the former being the aerial coupling (or reaction) coil and the medium-wave coil. For the long waves a coil of the duolateral type is fitted inside the coil former. An efficient wave-change switch is fitted in the base, and a coupling rod through the mechanism may be ganged with any number of coils. The price of these coils is 12s. 6d.

PIX VALVES

THE British Pix Company, Ltd., well known as the makers of the famous Pix aerial attachment, have now turned their attention to the manufacture of valves. These employ a completely new type of filament which is triple-coated, and has as the active medium a deposit of neodymium and Mesothorium. The result of this type of filament, according to the makers, is a brilliancy and sensitivity above the usual. Ordinary reception tests were carried out with these valves, using them in a standard three-valve set. The results were certainly very satisfactory, and quality and distance-getting properties were very good indeed. The characteristics were compared, and the makers' ratings were found to be quite accurate. The valves are very cheap, ranging from 4s. 6d. for the detector type of valve to 11s. 6d. for the larger types of valve.

POLAR TWO GANG "UNI-KNOB" CONDENSER

PERHAPS the most popular of the well-known series of Polar Condensers, this model is a two-gang condenser, which is characterised by a particularly stiff and substantial construction. It has a die-cast frame with screening cover, disc drive, and illuminated dial. Trimmers are fitted to each condenser, the one on the rear section having a variation of 40 micro-microfarads. The trimmer fitted to the front section of the condenser has a capacity variation of 35 micro-microfarads and is operated by a small knob arranged concentrically with the main tuning knob, so as to enable a final tuning adjustment to be made and the utmost signal strength obtained. The capacity of each section is .0005 mfd. and the complete condenser is moderately priced at 19s. 6d.

BULGIN SIGNAL LAMPS

A RANGE of various patterns of signal lamps for mounting on the panel is made by the Bulgin Company. Outstanding among these is the Flush Signal Lamp No. D.9, which has been designed to have a minimum projection from the front of the panel. An ingenious spacing tube and spring throws the bulb forward when the screw cap is removed, permitting instant replacement. The neatness and effectiveness of the fitting will be evident from an inspection. Price is 2s. 6d.

PANEL MOUNTING DIALITE.

THIS very ingenious wireless accessory is manufactured by Messrs A. F. Bulgin and Co., and will be found a most useful addition to any set which has not illuminated dials. It answers the same purpose as a motor-car dashlight, and, although particularly small and neat, gives so wide a diffusion of light that it will, due to the powerful and specially-shaped reflector, illuminate panels up to 36in. long. It is finished in metal, and has one-hole fixing. It sells at 2s.

PANEL MOUNTING INSTRUMENTS

ONE can hardly overrate the convenience and importance of getting correct readings of the current consumption of your valves, condition of batteries, etc. The new miniature instruments made by Messrs. Bulgin are adapted for fitting to the panel, having an overall diameter of only 1¾in. and mounting practically flush with the panel. There are volt-meters, ammeters and milliammeters in a variety of ranges and also ammeters with a central zero for indicating accumulator charge and discharge. The cost of these instruments is variously 7s. 6d. and 8s. 6d. each. We are sure there must be thousands of radio enthusiasts who like to know what their set is doing, particularly in regard to H.T. consumption, and they will welcome the opportunity of acquiring a reliable instrument at so low a price.

GOLTONE COUPLING UNIT

IN addition to the choke used for H.F. coupling purposes, a condenser, and also decoupling components, are required for an efficient receiver. All these items have been included in one unit by Messrs. Ward and Goldstone, and this is known as the "Goltone" H.F. Coupling Unit. This has the appearance of an ordinary screened tuning coil—comprising an ebonite base and cylindrical aluminium cover. Mounted on the ebonite base is a slotted former containing a very efficient high-inductance choke, containing 6,000 turns of wire

The Goltone coupling unit.

with an inductance of approximately 300,000 micro-henries and a D.C. resistance of only 200 ohms. In series with this is a decoupling resistance of 600 ohms. Owing to the slotted former, the self capacity of this complete winding and decoupling resistances is extremely low.

For the decoupling condenser a tubular non-inductive condenser of .01 mfds. is employed, and for the coupling condenser a mica .0003 mfd. condenser is fitted. Where possible, the connections of these components are made on the actual unit, and external connections are made to terminals carried on extended metal arm projecting through ebonite bushed slots in the shielding can. As the unit is intended principally for S.G. valves, a pigtail is provided on top of the unit, and to ensure stability this is fitted with an "earthed" metal-braided covering. The price of this ingenious and efficient component is 9s.

"RADIO-OFF-GRAMO" SWITCH

IN these days, when everybody is linking up Radio with gramophone, this neat rotary switch is sure to be in great demand. It is of the double-pole type, with snap action and self-cleaning contacts. It may be used also as a wave-change switch, the indicating plate being reversible and engraved "*short-off-long*" on the reverse. The price is 2s. 6d., and it is made by A. F. Bulgin and Co., Ltd.

SENATOR NICKEL ALLOY TRANSFORMER

THE impulses which leave the plate of the detector valve are comparatively weak, and must be highly magnified before they will effectively operate the loud-speaker. And their characteristics must be carefully preserved throughout subsequent stages if distortion is to be avoided. Obviously, therefore, such a component as an L.F. transformer must be above reproach. The Bulgin Senator is up to the minute, with a core of nickel alloy, which, with general excellence of design, gives it a primary inductance of 80-100 henrys. Its amplification curve is straight between 50 and 6,000 cycles per sec., and it has a definite step-up of 1.3. It is designed for a parallel feed circuit, the direct H.T. current not being passed through the primary.

Apart from its use as an inter-valve coupling, this transformer is a splendid amplifier for a gramophone pick-up. Used for this purpose, the pick-up terminals are connected to the primary of transformer, while the secondary terminals go to the usual terminals provided on the set for attachment of pick-up leads. The secondary can be shunted with a volume control. The case is of the new universal mounting type, with frosted aluminium finish, and it sells at the modest price of 6s. 9d.

POLAR STAR GANG CONDENSERS

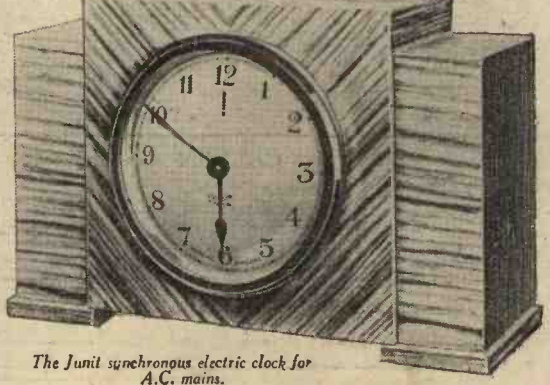
IT is hardly an over-statement to say that a set to be really up to date must employ ganged condensers. For modern conditions necessitate selectivity. To secure this, multiple tuned circuits are inevitable, and to tune each by means of a separate control is inconvenient and clumsy. So condensers must be gauged. But, and it's a very big "but," if each of three or four circuits are to be really correctly tuned at all points from zero to maximum, each condenser in the gang must be matched not merely as to minimum and maximum capacities, but throughout its range. And this is where the new Polar Star scores, for each one of these condensers is matched to an accuracy of one half of one per cent., plus or minus one micro-microfarad, at any position of the angular rotation of the shaft. Variable minimum trimmers are fitted to each section, operable without removing covers. The rotors have phosphor brouze bearings, and are spring coutrolled to prevent shake or end play. The sections are assembled on a base plate of U-steel construction, with flanged edges and of heavy section. Indeed, the mechanical construction is a sound engineering job, which will ensure permanent alignment, rigidity, and freedom from wear. The cost of the 3-gang .0005 type is 25s. 6d. *Polar* components, as most people know, are made by Wingrove and Rogers.

ELECTRIC CLOCKS

THE Junit Manufacturing Co. Ltd., are introducing a variety of attractive clock cases for the Junit Synchronous Electric Clock to go on top of A.C. Wireless Sets and Radiograms. The special models are designed to match the design of the set and are carried out in similar material and graining as the cabinet of the set. The clock and set can be run from the same mains, thus avoiding any further connections, and these models make very pleasing Christmas gifts and should be very popular for mains set owners.

The model illustrated is designed to match the Pye "K" receiver and the price is 42s.; other electric clocks in cases are supplied to match the leading Radio sets such as Lotus, Ultra, etc.

(*Continued on page 465.*)



The Junit synchronous electric clock for A.C. mains.

Comments on Components

(Continued from page 463.)

The "Megite" volume control—a wire-wound precision instrument for various purposes.

GRAHAM FARISH COMPONENTS

THE house of Graham Farish is associated with the "Gard" perhaps more than any other component. (The price of this component, by the way, is 1s. 6d.—not 1s., as erroneously stated in our issue dated Oct. 15, p. 206) This is an efficient, easy-to-fix lightning arrester which has to be attached to the lead-in *outside* the house, and thus provides adequate protection against damage from lightning, static, etc.

In addition to this item, however, Messrs. Graham Farish also make a number of interesting components, such as chokes, resistances, switches, volume controls, speakers, pick-ups, etc.

PICK-UP

THIS is made in two types, one of which is intended for attachment to an ordinary gramophone tone-arm, and the other is complete with carrier arm. The actual units are identical in both cases, having well proportioned magnets and a very efficient armature movement. These units are noted for their large output, and for the excellent response curve. The combined pick-up and carrier arm is of unique design, the pick-up lead being moulded direct on to the arm. This results in a rather unusual appearance, but in no way detracts from the performance. The arm is fitted with ball-race bearings, and is counter-balanced, so that wear due to weight and friction is reduced to a minimum. The pick-up alone costs 22s. 6d., and with the arm the cost is 32s. 6d.

The "Litlos" variable condenser for tuning or reaction control.

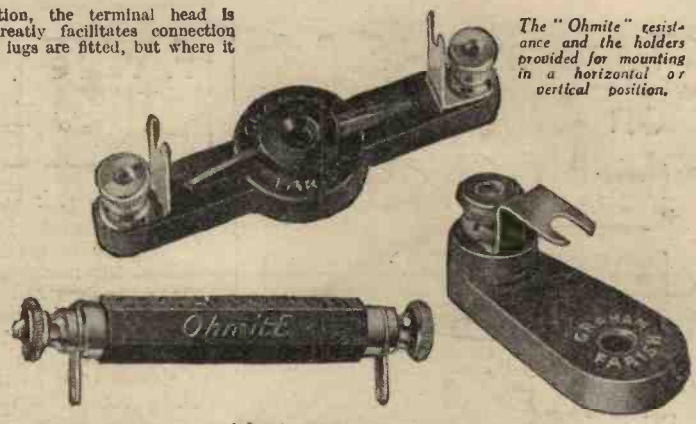
MEGITE POTENTIOMETER

THE Megite Wire-wound Potentiometer is a neat component, designed on very sound lines. A solid bakelite disc has a recess running round near the edge, and the wire resistance is fitted in this recess. For contact purposes the now familiar "swash-plate" principle is employed, a disc of metal over the wire being pressed into contact upon rotation of an arm. To ensure noiseless working, a non-metallic substance is used at the end of the arm, and this works very smoothly. The electrical contact is good, and proves quite noiseless in action. A bakelite cover is fitted over the component, so that it is protected from the atmosphere and dust. In values up to 25,000 ohms the price is 3s. 6d., and over 25,000 ohms the price is 4s. 6d.

OHMITE RESISTANCES

FOR various voltage dropping purposes—such, for instance, as decouplers, anode resistances, grid bias resistances, etc.—the "Ohmite" series of resistances will be found extremely useful. These are small, cartridge type resistances, fitted with most substantial terminal ends. The thread of these is very securely held, and it is almost impossible to loosen them. In addition, the terminal head is nice and large, and greatly facilitates connection in a receiver. Soldering lugs are fitted, but where it is desired to construct an experimental type of receiver, special holders are available. The "Ohmite" resistances fit into the clips provided on these, and may be securely locked into position, either horizontally or vertically. Where extra high currents have to be carried, a special heavy duty "Ohmite" is available. This costs 2s. 3d., and the ordinary "Ohmite" costs 1s. 6d.

For resistance capacity coupling, a special form of holder is employed. This consists of an ebonite base containing a fixed condenser, and two clips are mounted on either end of the base. Two "Ohmites" may thus be easily fitted. This unit costs 4s. 6d.



The "Ohmite" resistance and the holders provided for mounting in a horizontal or vertical position.

THE SNAP TRANSFORMER

FOR low-frequency coupling the "Snap" transformer provides a cheap, and at the same time efficient, component. Although small in size this gives results comparable to some of the larger and more expensive models. The overall reproduction is quite level, no undue resonances being noticeable anywhere in the scale. Two ratios are available, 3 to 1 or 5 to 1, and the price for either ratio is 5s. 6d.

LITLOS VARIABLE CONDENSERS

THE "Litlos" variable condensers are of the solid dielectric type, with log mid-line capacity variation. The vanes are of flexible metal, with bakelised separating plates, and connection to the moving vanes is made by means of a substantial pigtail soldered to the spindle, and to a strong metal strip anchored under a terminal. Stout bakelite end plates are attached, and the vanes, separators, and end-plates are firmly fixed by means of eyelets. The result of this method of construction is a sound and solid component, efficient both mechanically and electrically. This component is made in the ordinary two-terminal or three-terminal (differential) types, and costs 2s.

THE SNAP H.F. CHOKE

THE Snap H.F. Choke consists of a bobbin filled with very fine enamelled wire, having a D.C. resistance of about 400 ohms. The choke provides a high impedance on both normal wavebands, and the self-capacity is sufficiently low to make this a very sound component. A neat bakelite case protects the windings from damage, and the component takes up very little room on the baseboard. The price is 2s.

SPAGHETTI RESISTANCES

SPAGHETTI resistances are represented by a very novel line known as Flexible Resistance Links. These are wound with nickel chrome wire, and have good current-carrying capacity. The principal features of this particular item are the ends, which are provided with tags and rings (for soldering or terminal connections), and a thin bakelite tag, threaded on the resistance so that the value, which is stamped on the tag, may be easily determined, no matter where the resistance is fitted in the receiver. This is, in our opinion, a most valuable feature. The price of this component from 1,000 to 20,000 ohms, is 1s., and from 25,000 to 100,000 ohms., 1s. 6d.

H.F. CHOKE UNIT

THE "Multiwave" H.F. Choke Unit is a complete H.F. Coupling Unit consisting of condenser, choke, and grid leak. The condenser is moulded into the base, and four clips (with terminals) hold the leak and choke. The choke for this particular component is a specially wound coil, having sectionalised windings to reduce peak effects, and provides adequate choking effects from 50 to 3,000 metres. The price is 4s. 6d.

NEW CONDENSER ASSEMBLY

MESSRS. WILKINS AND WRIGHT are about to introduce a very interesting new condenser assembly for the home-constructor, and a sample has been sent to us for test. This consists of a Standard Utility Condenser, to which is fitted a new Straight Line Dial. This is one of the most ingenious dials we have yet seen, and is a departure from the usual circular arrangement. A friction drive of orthodox design is employed, but this is fitted with a cam operating between two parallel rods. These are pivoted at the base of the assembly, and rotation of the control causes the rods to travel through a short arc. To the top of the rods is fitted a crossbar carrying a pointer, and this travels in a practically straight line over a distance of 4 ins. or so. Behind the pointer is an ivorine box containing a lamp-holder for illumination purposes. A scale numbered from 0 to 100 completes the back of panel parts of this assembly, and it is finished off by a neat metal escutcheon with glass window, which will enhance the appearance of any receiver. The complete assembly can be fitted to existing sets.

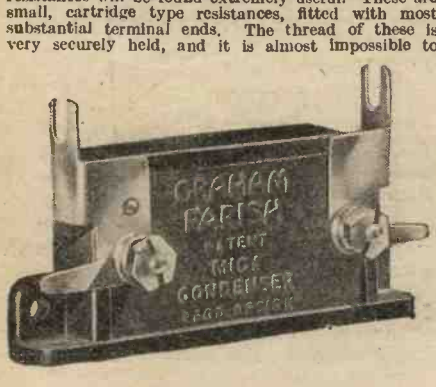
The flexible resistance leak—showing the identification tab.

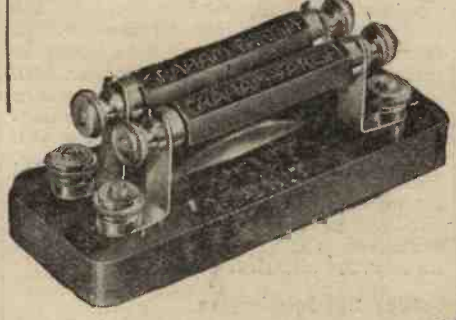
BROWN LOUD-SPEAKERS

MESSRS. S. G. BROWN LTD., the well-known manufacturers of 'phones and loud-speakers, have now ceased their activities in the Radio Trade. The P.M. Moving Coil Speaker, originally made to sell at £2 10s., is now offered to listeners at £1 19s. 6d. by Messrs. E. J. Heraud Ltd. This firm is now specialising in mail order business, and the address for this branch of their work is very easily remembered, namely, Number One, Edmonton, London, N.18.

MAINS CONDENSERS

FOR smoothing purposes in mains apparatus it is essential that a really good quality fixed condenser is employed. As probably the majority of our readers now know, on switching on such apparatus, rather large surges of current are quite common, and therefore there is risk of a badly made, or insufficiently insulated, condenser breaking down. The T.C.C. condensers have always had the name for reliable and high-class components, and we have just received samples of the Type 87. This is the metal-cased type, with soldering lugs instead of terminal connections, and is rated at a working voltage of 300 volts A.C. The 2 mfd. costs 4s. 9d., and 4 mfd. 8s.





The R.C.C. Unit (above), and on the left the fixed condenser. The 'Snap' choke is shown on the right.

FACTS ABOUT FRAME AERIALS

How They Work and Some Useful Applications

By ALBERT E. OAKLEY

WHAT is a Frame Aerial? I am not sure that the majority of radio users could answer this question, for many have never seen one, while others regard it as a laboratory instrument, or associate it solely with portable receivers. Actually the frame aerial is a most valuable piece of apparatus, and should be used more frequently than it is. Among its features may be named, first, its great value in avoiding interference from various sources, its ability to reduce or cut out atmospherics, and its selective capabilities. These merits are based largely, but not wholly, on the directional properties of a frame. Theoretically a frame will only accept a transmission from a direction lineable with the plane of its windings; at right angles to that plane, no signals are picked up. Refer to Fig. 1, and let us assume that a frame aerial is oriented so that its plane lies along the line west-east. The diagram shows, by means of a line forming roughly a figure eight, the comparative strength of the signals which will be received from any direction while the frame remains in that position. It will be seen that the signals will be at a maximum if from either east or west. Up to about 22½ degrees of that line the diminution of signal strength is not considerable. It then begins to fall off rapidly, and at 55 degrees is almost nil. At 90 degrees the point of zero signals is reached, and it will be noted that this is much more sharply marked than is the maximum point.

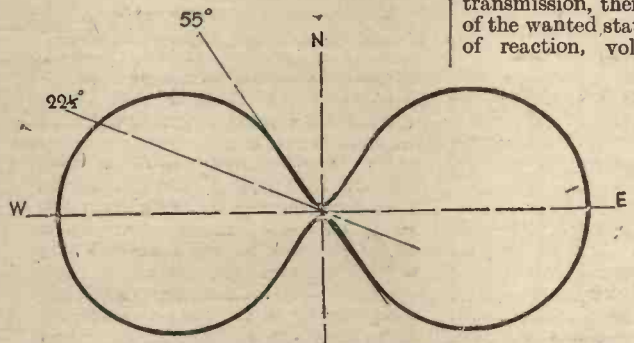


Fig. 1.—A diagram showing the comparative strength of signals received while the frame aerial is on the line W—E.

The reason for this phenomenon is that in the maximum position signals strike first one side of the winding and, later, the other side, each giving an impulse. If, however, the frame is at right angles to the direction of the arriving signals, then both sides are struck at the same instant, and as the two sides have necessarily windings which are opposed in direction, the two equal and opposite signals balance out. This effect is not quite perfect in practice for various reasons, principally because the windings have breadth, and the ends are connected to apparatus which upsets slightly the electrical balance.

Cutting Out Interference

Now, how does this help, practically, to cut out interference? Well, it is a question of direction, and of careful operation and tuning. Let us suppose that an interfering station lies to the north, and the one we are trying to get clear of lies to the north-west. There are two ways to proceed. First, to turn the frame so that the wanted station is in the strongest position, and tune it in; second, to turn it so that the *unwanted* station is in the *weakest* position, *i.e.*, at right angles to the frame. The latter is generally the better method; to concentrate on cutting out the interfering transmission, then to bring up the strength of the wanted station by careful adjustment of reaction, volume control, etc. Now about atmospherics—probably the most hopeless-sounding problem which faces the radio engineer. If an electric storm is occurring in the near vicinity, there is nothing to be done but switch off and pack up. But if, as more often happens, the static discharges are occurring at a distance, then one can turn the frame so that they are at a minimum, or disappear, and tune in such station as is available in or near that position.

Direction Finding

Another use, which is most valuable to ships, aeroplanes, etc., is the ability to tell within a degree or two the direction of a station from which signals are received, and, better still, the exact position of the ship if two stations can be heard. (See Fig. 2.) This is done by finding the direction of maximum signals, and, as a check, minimum or nil signals, which, of course, should be 90 degrees away from the maximum. A line AB is drawn on the chart in the direction indicated by the position of the frame. The ship is somewhere on this line. Then a station at another point is tuned in, and the line CD is drawn from it. The intersection of the two lines at X indicates the position of the ship. One of the "stations" heard may be another ship which is fitted with wireless, and able to give her position.

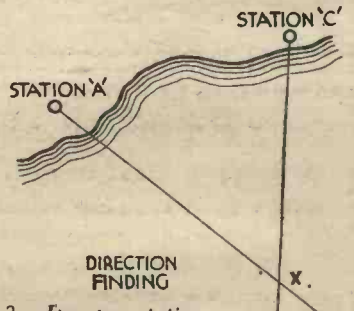


Fig. 2.—How two stations can ascertain the position of a transmitter by frame aerial reception.

Constructional Points

The construction of a frame is a fairly simple matter. The wires with which it

is wound should be well insulated with ebonite or porcelain insulators or plates at the corners, and spaced one-eighth inch or more apart according to the size of the frame. The wire is generally silk covered, though this is not important. A special wire of flexible nature is made for frame

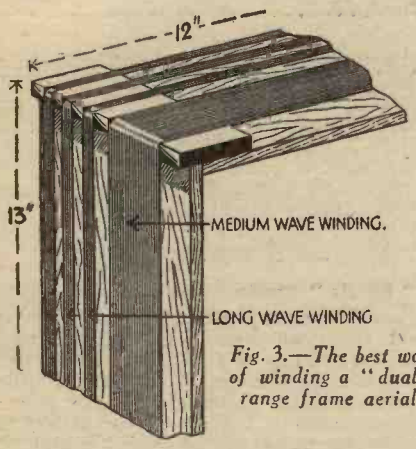


Fig. 3.—The best way of winding a "dual" range frame aerial.

aerials by the Lewcos people. The Litzendracht wire (a special "low loss" flexible) is favoured by some constructors, but the writer has found no advantage in this over a light flexible or even solid wire. The wire used should not be of too small a gauge, however. The medium and long wave sections are generally wound independently on the same frame. The length of the winding will vary independently on the same frame. The length of the winding will vary a little according to the shape of the frame, spacing between adjacent wires, etc., but it will usually be found that 75 to 80 feet are required to cover the medium waveband, and about 225 to 240 feet for the long waves, using, of course, the usual tuning condenser.

The amount of energy which a frame can pick up is of course small compared with the ordinary outdoor aerial, and it is necessary to conserve it by careful construction, good insulation, and the adoption of efficient circuits in connection with it. The most efficient frame, therefore, will be a mere skeleton, so that the windings will have a negligible capacity to earth, and internal losses and leakage will be practically nil.

Selectivity

The selectivity will be remarkably high, first, because of its small size and low capacity, and, second, because of its directional characteristics.

The frame for a portable necessarily differs from the open-room type, and because of its smallness the wires cannot be spaced, but are preferably wound in a single layer, supported at the corners but otherwise airspaced. The long wave portion may be sectionized.

The writer once made a very efficient aerial for a portable on the lines shown in Fig. 3. A light wooden frame had four ebonite strips mounted on its corners, with a wide shallow slot to retain the medium wave winding, and three one-eighth inch wide deeper slots, spaced one-eighth inch apart for the long wave. These were wound with No. 24 and No. 28 gauge cotton covered wire respectively of the lengths given above. The frame can, of course, with advantage be made larger if the size of the set permits, keeping the total length of wire the same.

Frame Aerial Circuits

Large frames are generally tapped at various points for adjustment purposes, and a portion of the winding is sometimes used for reaction. An effective method for a small set is the form of Reinartz circuit, shown in Fig. 4. The centre tapping is earthed (or connected to filament), the outer ends being treated as the ends of a tuning coil. A room frame aerial is usually connected to the aerial terminal on the set at one end only, but the opposite ends may be connected to aerial and earth respectively. If it is found that the latter plan alters the tuning of the set too much a small condenser may be interposed between the end of the frame winding and earth terminal. In the case of a portable with enclosed aerial, this usually forms the tuned circuit, there being no other aerial coil before the first H.F. valve. In this case, reaction is applied to the coupling preceding the detector valve by any of the usual methods. The Eelex frame aerial has its long wave winding centre tapped and includes a switch which connects it in parallel with the medium wave

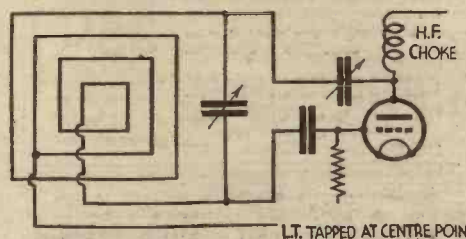


Fig. 4.—The centre-tapped frame aerial.

winding when the latter is in use. For long wave reception the long wave winding is used independently of the medium wave.

IN THE B.B.C. STUDIOS

A Visit to the Twenty-two Studios in the London Broadcasting House

COME with me on a trip in the London B.B.C. studios and see how the programmes are broadcast. There are twenty-two studios in Broadcasting House, as against the former nine at Savoy Hill. Studio No. 10, the converted wharf, may not be used when the concert hall at Broadcasting House is in full swing.

Not all of the twenty-two studios are in use at any one time, and the real reason for having so many is that each is allotted to a special broadcasting job. There is one for the Children's Hour, another for dance bands, another for religious services, another for military bands, and so on. To get to the Broadcasting House studios in the basement we can go down one floor in one of the express lifts, or by the broad, winding staircase. The big concert studio is the chief attraction on the lower ground floor. As it has been built in the heart of Broadcasting House, it is wedge-shaped, and the "splay" of the walls makes the hall appear longer than it really is. The ceiling walls are broken up by stonework and plaster mouldings, resulting in a pillar effect, and the idea is to prevent echo. The architect of Broadcasting House has designed this big studio, and we must remember that it is specially licensed by the L.C.C. for entertainment, and provided with a ventilating plant of its own; so that, no matter what goes on in the other studios above and below, the concert hall can carry on. Everything is quiet. It is entirely cut off from the outside world. All the lighting is artificial, and there is no sound-outlet to the street.

Vaudeville

We go a floor below to see studios BA and BB. BA is for vaudeville. Here a low stage has been fitted up at the far end, away from the gallery, and limelights throw a beam on to the artists on the stage. The big plaster discs over the ventilator openings strike a Futurist note. The second floor of Broadcasting House is taken up by offices and storerooms, so we are taken by the lift to the third floor. There are two double-deckers here: studios 3A and 3E. They take up the third and fourth floors. 3A, a plainly-decorated studio, is for the Children's Hour, and 3E is the religious studio. The feature of this is an illuminated alcove at the end, giving an impression of infinite distance. The three little single-height studios, 3B, 3C, and 3D, on this floor are for talks. As part of the fourth floor is taken up by the tops of the religious and Children's Hour studios, there are only two studios on the fourth floor: 4A and 4B.

S.O.S and News Studios

These are the "S.O.S" and News studios, a common anteroom of which is for the use of the News Editor while the news bulletins are being broadcast.

In each new studio there is a bench fitted with double gramophone turntables, so that the announcer can put on records to fill in programme gaps. The fifth floor is another "buffer" stage. Offices and music library help to insulate acoustically the studios above and below. The lift takes us up to the sixth floor, where the musical comedy and effects studios, 6A and 6D, are double-deckers, running up to the seventh floor. The effects studio is fitted out with a water-tank, special floors of wood, and stones for various concussion noises, and a rotating table on which the bells, clappers, and other noise-producing gadgets will be kept.

"Effects" Studio

At one end of the effects studio there are six electrically-driven gramophone turntables, and one or all of these can be used at once for "mixing" records for radio-plays effects. Above this is the gramophone studio. Up on the seventh floor are three talks studios, 7A, 7B and 7C. Studios 7E and 7D are also to be used by the gramophone and effects people, but these are only single-height rooms. On the eighth floor the military band studio, 8A, is the second largest in the building, after the concert hall in the basement. It is the only studio having connection with the outer world! Circular windows at the top, like great portholes, look out on to Portland Place. On one side of the military band studio is the small 8B studio for debates, and on the other, outside the studio well, the control-room, the electrical heart of all the twenty-two studios in the building. There are special rooms for wireless plays.

For Radio Plays and Dance Music

Studio 6A is the large production studio and the main one for radio-play work. It is the same size as the BB studio which Henry Hall regularly uses. This large studio will not be used if only two or three characters in a radio play are talking together. Either the 6B or 7B studios will be used for this work. These have about a third the cubic capacity of the large studio and the reverberation time is just over half a second. These are not designed for music; piano music can quite well be given in either of these studios on the sixth floor. The advantage from a radio-play point of view of using some rooms without echo is that, when speech is going on in a non-echo studio, it is easy to judge what artificial echo must be introduced into the transmission (*via* the echo room) to create any kind of effect, from talking in a padded cell to speech in the open air. Also, if there is a perfectly flat background, the man at the "effects" control can regulate the strength of the faked noises to a nicety.

Talks Studios

Three of the usual talks studios, which can also be used for radio plays, are very nicely graded in their amount of echo; 3B, the normal talks studio, has an echo of 0.35 seconds. 3C is absolutely dead, while 3A, which is sometimes used for the Children's Hour, has an echo period of just over half a second. The gramophone effects studios, which are in frequent use in radio-plays, are, of course, untreated acoustically.

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 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.

BREAK-THROUGH TROUBLES

"I have already fitted a series aerial condenser, but am troubled by break-through on the long wave section of my coil. Can you suggest any method of overcoming this trouble, which completely spoils my long wave reception? If possible, I should prefer not to have to purchase anything, but would like to make up some little gadget, if possible."—(C. F. B., Woking.)

What is known as an anti-break through choke would probably be the most suitable component to rectify your trouble. This should be connected between the aerial and the tapping on your long wave winding. Try different sized hanks of 36 gauge enamelled wire, wound to a diameter of about 1 inch. Try various values from 300 to 600 turns, and if you can obtain a small piece of ebouite you might prefer to sectionalise the winding.

LOUD-SPEAKER PROBLEM

"I have a 3-valve set with tone control across L.S. terminals. The L.S. is a . . . . . permanent magnet. Would it be an advantage or disadvantage to add an output transformer to the set, as I wish to have extended L.S. leads? Does the transformer on the speaker act as an output transformer?"—(L. K., Whitstable.)

It would be advantageous to use either an output transformer or a choke-capacity output filter.

Yes, the transformer on the loud-speaker *is* an output transformer. When extending the speaker leads the latter transformer should be removed from speaker and kept near to set.

REACTION CONTROL

"I have a three-valve set of the Det. and 2 L.F. style, and am quite satisfied except for one thing. When tuning a station in the reaction is smooth up to a point, and then it goes away with a plop, and everything is distorted. The condenser is a .0003, and I have a by-pass condenser of .0001. I also have tried putting a choke in the plate circuit of the Det.-valve but this does not help. The set is two transformer coupled, and a friend has just told me that if I fit an R.C.C. stage my troubles would be over. Also he says that better results in quality and volume will be achieved. Surely, however, there is a simpler way of curing my trouble, and I feel sure from the way you have helped others on your Queries page you will be able to help me."—K.O., Dorking.

If your grid leak in the detector valve circuit is taken to L.T. plus we advise you to try taking it to L.T. minus instead. If this is not successful in giving you smooth reaction control, we advise you to try different values of grid leaks. Perhaps a lower value, say, .0002mfd. or .0001mfd. reaction condenser may be necessary, and we would recommend you to keep the H.F. choke in the circuit.

CHOKE FOR MAINS

"I propose to build an A.C. mains set, and in the list of parts required is 1 output choke. I already have a new choke, 40 Henries 4 mA. Could I use this? If so, where would I connect the terminal marked earth?"—(A. G. B., Canonbury, N.1.)

The L.F. choke which you have is not suitable for smoothing purposes in an A.C. set since it will not carry sufficient H.T. current, without seriously losing inductance.

When using the choke for its legitimate purpose (L.F. coupling) the earth terminal should be joined to H.T.

OUTPUT FILTER

"I hope you will be able to show me how to connect an output filter circuit. I believe you have already given one, but I cannot find it, and I wish to fit one. I understand theoretical circuits, so perhaps you can give one."—(B. P., Fulham.)

An iron-core choke, capable of carrying the maximum current of your output valve, should be joined from anode to H.T. +. The loud-speaker should be joined from earth to anode *via* a 2mfd. condenser.

POTENTIOMETER FOR CENTRE-TAP

"I have a mains transformer, which, however, has no centre-tap on the L.T. 4-volt windings. As I wish to use this component, and believe that hum troubles occur unless a centre-tap is used, I should be glad if you would tell me what to do." (W. B., Blyth.)

A potentiometer with a value of about 30 ohms should be joined across the two 4-volt terminals, and the arm joined to earth. Adjustment of the arm will enable a point to be found where hum is reduced to a minimum.

DATA SHEET No. 9

TUNING COILS FOR SHORT WAVE RECEPTION.

Cut this out each week and paste it in a notebook.

Wave-length (metres).	Number of turns.	Spacing between turns.	Reaction Winding
8 to 20	5	5-16in.	3
20 to 50	7	¼in.	5
	5		
30 to 80	10	3-16in.	7

The wire should be 18 gauge bare copper, and a .0001 mfd. tuning condenser should be used. A tapping clip from the aerial terminal may be clipped on to various turns for aerial coupling purposes.

SHORT WAVES

"I have a commercial two-valve set, det. and one transformer. I am very keen on trying short wave work, and would like to try the following ideas out. First, remove the tuning condenser, and fit a .00025 in its place, with a .00025 fixed condenser across it to be connected with a switch for normal broadcast use. Remove coils, and fit plug-in socket arrangements for coil changing. Can you suggest whether the above ideas are all right?"—(B. F. J., Hounslow.)

Whilst the ideas you mention are in order, we would not advise you to carry them out. Firstly, the short waves are extremely critical, and as you are new to short waves, the use of a set converted in the manner you suggest would only lead to disappointment. Make up a reliable one-valve short-waver, and then when you have had some experience in handling short waves, you can convert it into a two-valve set, and perhaps try to make an adaptable set. Until you have experienced short-wave tuning, however, we do not advise you to try the conversion idea.

METALLISED VALVES

"I am desirous of fitting metallised valves in my S.G. and detector stages, owing to the present two valves being broken, and a desire to bring the set up-to-date. Will any alteration be necessary to the set, or can I just plug the new valves in place of the old ones?"—(F. R., Brighton.)

The only precaution you must take is to see that the metallic coating of the valves is earthed. You will see that a small disc and wire are attached to the bulb of the valve and this is immediately above one of the filament legs. This leg must be joined to earth. Sometimes the leg is marked E to indicate which filament terminal on the valve-holder should be joined to L.T. — (and to earth).

MAINS TRANSFORMER

"I have a home-made all-mains set, and am rather worried about a fault which has recently developed. When switched on signals are much weaker than they used to be, and a smell of burning rubber was noticed from the eliminator. I could not find any short-circuits, but I found the mains transformer was very hot. Can this be damaged in any way, without any damage being done to other parts of the receiver?"—(R. T. V., Peckham.)

We think you will find that some of the turns on the windings of the mains transformer are short-circuiting due to failure of the insulation. There is a possibility that the by-pass, or smoothing condenser, has broken down and is so putting a load on the transformer, but the former suggestion is the most likely cause of the trouble. Test the reading of the secondaries by means of a voltmeter, and you will find the winding which has broken down.

WET OR DRY H.T.

"I am very keen on getting the best from my set, and expense does not worry me very much. Unfortunately I live where there are no electric light mains. I realise that ordinary H.T. batteries discharge fairly rapidly, and so operate a receiver at a low voltage. My point is this—Should I get one of the wet, or Leclanche type batteries, or one of the accumulator batteries, so that I may have a good steady voltage and current supply. Your advice would be most appreciated."—(W. M., Watford.)

Whilst we agree that the accumulator gives the steadiest current, you must bear in mind that it will require recharging, and this may cause you some difficulty. The Leclanche type will prove, probably, troublesome to maintain, but the accumulator will be expensive to maintain. You will therefore be forced to decide between these two types, bearing in mind the charging difficulty of the accumulator.

EARTH CONNECTION

"I have a buried earth, and do not think this is very efficient. On removing the earth lead no difference in strength is noticeable on either the local or distant stations. The wire is heavy gauge, and the plate is two feet square, with soldered connections, and everything is apparently in order. Can I improve the earth in any way, as I am sure that this present arrangement is not efficient."—(H. V. R., York.)

It is quite possible to have a good lead, and good earth plate, and good connections, but inefficient in results owing to a "dry" earth. We would suggest that you thoroughly soak the earth, and if results are improved, then you should arrange that the earth is kept moist. A chemical preparation is obtainable which will maintain the earth in this condition.

INDEX TO "PRACTICAL WIRELESS"

"I note that many of your correspondents suggest a weekly or monthly index. Do you intend to issue a semi-annual index and binding case with title page? If so, I do not see why you should waste space with a weekly or monthly index as suggested."—O. B. (Darlington).

We shall certainly issue binding cases, title page and index for the half-yearly volumes of PRACTICAL WIRELESS, and when ready an announcement will be made in this journal. It is not practicable for us to issue a weekly or monthly index as has been suggested by several correspondents.

IDENTIFYING THE FOREIGNERS

"You would be supplying a much needed want by publishing a chart in PRACTICAL WIRELESS, by means of which readers could identify the principal broadcasting stations in Europe, in their numerical wavelength order."—J. J. (London, N.5).

This matter is now under consideration and an announcement will shortly be made concerning it.

FREE ADVICE BUREAU
COUPON

This coupon is available until Nov. 26th, 1932, and must be attached to all letters containing queries.
PRACTICAL WIRELESS, 19/11/32.

Practical Letters from Readers.

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

All Mains Receivers

SIR,—As a radio enthusiast since the earliest crystal-set days, I welcome the publication of your new paper, PRACTICAL WIRELESS, which seems to cover everything that the average home constructor wants or is likely to want, set forth in a practical way, without any "stunting" or re-hashing of old stuff in new guises. If I may offer a suggestion, I think that, with the increasing use of all-mains receivers, the practical information and construction side of this subject should be made a feature of, for the growing number of amateurs who are getting less scared of dabbling with mains apparatus. There are many of us, I know, who have not had any special electrical training, yet who would like to go into the theoretical and practical side of this subject which has revolutionized our radio and gramophone pleasures during the past three years. I would especially like to see a "small classified advertisements" section included in PRACTICAL WIRELESS, where home constructors as well as dealers would be able to advertise their surplus apparatus for sale or exchange, or their special wants. This, I think, would be much appreciated by a very large number of your readers. Simple competitions, with wireless apparatus as prizes (moving-coil loud-speaker, valves, transformers, etc.) would also be a great draw. In fact, I would even suggest that the receivers that are built and illustrated as PRACTICAL WIRELESS sets, such as the "Dolphin" and "Express" sets, be given as prizes after they have been finished with. Possibly my suggestions are impracticable, but I offer them with enthusiasm for the new radio weekly, which I hope will soon rank as the most outstanding journal of them all.—F. GORDON COOK (Southfields).

An Appreciation

SIR,—As an experimental wireless constructor of some years' standing I feel I must write in appreciation of PRACTICAL WIRELESS. I have taken the first six numbers to give it a fair trial and find that it is just what the vast number of home constructors want, *i.e.*, a paper that explains in plain everyday words what to do and how to do it. I cannot do better than advise all my friends who are interested in the practical side of wireless to place a standing order with their newsagent for your most excellent paper. I myself am looking forward to receiving my encyclopædia. Wishing your paper the best of luck.—WALTER W. BURGESS (Luton).

More Suggestions

SIR,—I have read with great interest the first six issues of PRACTICAL WIRELESS and can quite understand the great batch of enthusiastic letters you are receiving. I cannot, however, agree with your correspondent "Septimus" (Leyton) in his very narrow-minded criticisms which I trust you will ignore. We, and I think I am speaking for the majority of readers, not only want practical instructions, but also information as to the principles involved, and such information to be of a nature that any novice can understand it. Another point which has been raised in your correspondence columns is that of specifying one particular make of component in your circuits. I think your present policy is the best, because one particular component is obviously most suitable for a given purpose. A constructor who cannot afford to purchase the specified components can use his common sense in the choice of an alternative. On the contrary, however, I do not agree with the practice of specifying special coils in every important circuit you give, as there is plenty of scope for home construction in this direction. Perhaps I am a little too critical, considering the short existence of your publication, but I intend being a regular reader if the present high standard is maintained. I am employed in the electrical trade and I have been keen on wireless for several years. For the "not-too-clever" fellow it is fairly obvious that PRACTICAL WIRELESS is the journal. Wishing you every success.—"RADIOHM" (Consett).

A Constructor's Thanks

SIR,—May I add my little appreciation to the legions of readers who must have written you concerning your new weekly, PRACTICAL WIRELESS. The publication has been long overdue, and I only wish that you continue as you have began, that is, keep it a *practical* journal. I wholeheartedly support every word said by "Septimus" in your No. 6 issue. There are many journals which cater for the technician and the theoretical experts, but *we* want *practical* wireless.

What pleasure is there in buying a kit of parts—with each wire cut to size and every hole drilled ready—which can be rigged up in about twenty minutes? There is far more pleasure and satisfaction in starting a job on the bench and making every part possible oneself, and I consider that this is where the real pleasure comes in. Articles on making coil-formers, winding coils, making chokes, transformers, grid leaks, and other resistances, are what is wanted by the man who likes to tinker, and I hope you will continue to devote your journal to this interesting class of hobby. In so doing you will be helping forward the work of the experimenter, and it has been mostly due to his activities that wireless has advanced so much in so short a time. Marconi, Prof. Fleming, and all these great men in wireless didn't buy ready-made components; they made their own, and in so doing laid the foundation stones of our present Broadcasting Systems. So, here's luck and every success to PRACTICAL WIRELESS, and may it continue to be practical.—WM. B. EDWARDS (Ebchester).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—That kilocycles may be converted to wavelengths by dividing 300,000 by the number of k/cs.
—That 746 watts equal 1 Horse Power.
—That a good cone for a loud-speaker may be made from Bristol Board (two sheet thickness).
—That a rough method of ascertaining the grid bias for a valve is to divide the H.T. by double the amplification factor.
—That a temporary H.F. choke may be made from an old tuning coil.
—That noisiness in a set earthed to a water-main may often be removed by using a buried earth instead of the water-main.
—That for variable-mu volume control a graduated resistance is preferable.

Difficulty in Obtaining Components

SIR,—I have been interested by the letter from Mr. Rivett which you published in your issue of November 5th. I feel very strongly about the matter, being myself connected with a firm manufacturing wireless components. We have had countless cases of members of the public writing in to us complaining of inability to obtain our components from their retailers, who in many cases profess ignorance of their existence, in other cases claim to be unable to obtain supplies, and occasionally flatly decline to be bothered with investigating a new component. We have been before the public since the early summer, and are doing business with most of the leading wholesalers, also we were careful before coming on the market to have a sufficient stock to meet any demand, and as we are in constant production there is no excuse for this attitude on the part of dealers. For your correspondent and those who have suffered with him, the solution is to insist on having what they want and to let the dealer know that he is not worth his name unless he finds out where, and how, to obtain the desired components for his customers.—S. M. GREEN (Hampstead).

Index Wanted

SIR,—I would like to second the suggestion that an index sheet be included with PRACTICAL WIRELESS. This might be issued with each weekly part, or monthly, and I feel sure that this feature would be more than welcomed by your readers. The very high standard of the contents of the first four parts of your new weekly promise to make it not only the leading Radio Journal but a splendid book of reference. Let us, therefore, have an Index and so spare the mutilation of our weekly parts. I would like to proffer my heartfelt congratulations on issuing such a wonderful three-pennyworth, and wish you every success. When are you going to publish something for us poor battery users—a jolly good battery-operated radiogram, of the screened-grid and pentode type ?—V. COOPER (London, S.W.).

A Radio Engineer's Tribute

SIR,—Having had the pleasure of starting from the beginning I wish to say that PRACTICAL WIRELESS is well worth reading. Being an experimental radio engineer, I can truthfully say that the paper will be a blessing and a boon to many. Therefore, I wish to express my heartiest congratulations to you all, hoping the paper will prosper in every way. In the near future I shall be making some of your sets and will give you my report regarding their quality and capabilities.—D. J. SAWYER, M.C., F.M.I.B.C. (London, E.).

Practical Pars Appreciated

SIR,—Congratulations on producing a really practical wireless paper. The first five numbers are full of the small pars with diagrams explaining in detail points which are so valuable to constructors. I hope the standard will be maintained. Small practical pars are worth pages of fulsome exuberance and are what we want. Please give us all the points possible about mains sets, as these are undoubtedly the sets of the future. May I also add my agreement to your correspondent who makes a plea for an index to each number. It is badly wanted. It is an onerous task poring through back numbers for a diagram and description of something one remembers seeing some time back, and if each issue had an index, the various numbers would form a valuable reference library on the subject, instead of being relegated to the limbo of forgotten things.—R. E. NICHOLAS (Leigh-on-Sea).

A Good Hearing Aid Wanted

SIR,—Being a registered reader of your new paper, I am very pleased to see Mr. E. Wood's suggestion on Aid to Hearing appliances. I have been hard of hearing for a number of years, and have tried hearing appliances from four different firms at prices ranging from ten to forty pounds, but I have not tried one which gives a true reception; every one of them badly distorts. I am confident that if an electrician could invent one to give as clear reception as the wireless, there would be a big demand for such an appliance, and it would be a relief to thousands.—H. BALL (New Cross).

DX Short-wave Club

SIR,—May I, through your valuable publication, appeal to all short-wave enthusiasts to come along and join the "Dee-Xrs. Short-Wave Club," of which I am Secretary. The Club is also desirous of getting in touch with S.W. Transmitters with a view to co-operation. It is felt that the time is opportune for such a club as there are a great many men and boys to whom "distance is no object" and who want to know just "what the short waves are saying." I might also add that we have in our ranks Mr. L. Saunders, who is well known as a pioneer of short-waves in New Zealand. Mr. Saunders was instrumental in forming the New Wellington S.W. Society. His reports on short waves in *New Zealand Radio*, the National Radio Magazine of that country, were always very much looked forward to. Mr. Saunders is now in England and is a member of our committee. Anyone desiring information *re* membership may communicate with Mr. W. Barden, 9, Grecian Street, Maidstone, Kent, who is Hon. Secretary.—W. BARDEN (Maidstone).

More Constructional Articles Wanted

SIR,—I have just finished reading the letters on the correspondence page of last week's issue and wish to endorse the opinions of several of your readers, particularly the one who suggests a Sale and Exchange feature. I think it would be a welcome feature. What I am most desirous of seeing myself is a series of articles, really practical, which would give full details of the building of such components as small power transformers, smoothing chokes, M.C. speakers, and such other apparatus which would not be beyond the range of the ordinary intelligent amateur. I may mention that, in 1927, I built a M.C. loud-speaker at a total cost of about 30s. which, in my opinion at least, still gives very satisfactory service. Also, I have a pair of transformers in my A.C. mains set, which, although rather ugly in appearance, are still giving splendid service after some four years' use. To my mind, the ordinary individual of to-day cannot afford to keep buying kits of parts, the building-up of which can be done in an hour or so. To keep him interested he needs stronger fare, and I suggest that if you give us something on the lines I have indicated, you will soon have a rapidly-widening circle of keen readers with a proud record of real achievement behind them. My best wishes for success in your new venture.—A. E. METCALFE (Hessle).

An Old Constructor's Experience

SIR,—I have read with great interest your publication entitled "25 Tested Wireless Circuits," and was rather attracted by the Short-wave Two Valver on page 36. I may say that I am a mechanical engineer by trade (or misfortune!) and was first interested in wireless when invited to correct a small mechanical fault in a ship's wireless installation during '17 or '18, I forget which. Like all bench-trained mechanics, I was duly awed by the array of gadgets, rotary converters, etc., in the wireless operator's cabin. I was serving as junior engineer at the time and keeping a watch on main engines. However, after the War I went through the "wireless mill" from crystal to S.G.3's and am now back to a 3-valver H.F.-Det.-P., and it is my firm belief that the "trade" will ultimately "do the same." What with "ganged condensers," chokes, "canned coils," resistances here, there, and everywhere, we shall require about 500 volts before long; each house will want a power plant to itself. However, I fear I shall be wasting your time. I may say that of all the wireless literature I've waded through, yours is the most sensible little book I've had the good fortune to strike, and *I mean that.*—CHAS. HAWORTH (Burnley).

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.

THE PHILOMEL RECEIVER

"SOMETHING New in Radio Sets" is the title of a neat folder giving full particulars of the Philomel All-Electric Receiver. Designed on modern lines, it incorporates all up-to-the-minute improvements, and is complete with enclosed aerial and mains-energised moving-coil loud-speaker. The circuit design provides for great selectivity and tonal quality, while screened-grid and power pentode stages ensure ample volume. Pick-up terminals are fitted, and the self-contained aerial permits the set to be conveniently used in any room. This fine receiver—which is obtainable for either A.C. or D.C. working—is priced at 17 guineas. The name and address is Philomel Radio Equipment, Philomel Works, Dover Road, Slough Trading Estate, Bucks.

THE MILNES H.T. SUPPLY UNIT

IN a new booklet we have just received from The Milnes Radio Company, full particulars are given of this unit which consists of indestructible nickel iron cells which are kept automatically fed from the L.T. accumulator, when the set is not being used, and is always ready to supply a steady H.T. current when required. The only attention required is to top up the cells with distilled water about twice a year, and an occasional refill of electrolyte about once in every two or three years. There is no possibility of sulphation, and the cells may be overcharged or discharged without damage to the unit. Readers interested in trouble free H.T. should make a point of getting a copy of this booklet, together with the technical data sheet, which will be sent post free on request. The address is Cottingley Bridge, Bingley, Yorks.

ERIE GRID LEAKS

THESE grid leaks and resistors are composed of a solid carbon and rare earth composition having the property of carrying a high load without any tendency towards open circuiting. The wire leads are soldered to copper which is forced into the ends of the resistor under intense heat. It is claimed for these resistors that they are absolutely silent and stable in use. A simple colour code is used to designate resistance values, and in addition, the resistance value is indicated on a small label. Particulars of the full range of these components are given in a folder we have received from The Radio Resistor Company, 1, Golden Square, Piccadilly, London, W.1.

"R.I." PRODUCTS

A COMPREHENSIVE range of R.I. components is shown in the latest catalogue recently issued by Radio Instruments, Ltd., Purley Way, Croydon, Surrey. The well-known "Parafeed" coupling unit' L.F. transformers, chokes for various purposes, metal rectifier transformers, valve rectifier transformers, dual range coils and volume controls, are all listed. Full particulars of each component are given, together with technical data which enables the constructor to choose suitable components for any particular circuit. A useful addition to the R.I. Range is a ciné transformer designed to meet the requirements of possessors of home projectors for use on A.C. mains. Also included in the catalogue are the Antinodal S.W. Amplifier Adaptor and a new short-wave coil unit which has been specially designed to eliminate threshold howl and other disadvantages that occur when receiving short waves lower than the natural wavelength of the aerial system, in cases where the aerial is used mainly for the reception of the medium and long wave broadcast bands. Particulars are also given of the "Madrigal" Three-Valve A.C. Mains Receiver and a new six-valve super-het receiver, a remarkable instrument which should suit the most fastidious listener. Constructors who look for high-class workmanship and technical accuracy in their components, should obtain a copy of this catalogue without delay.

FERRANTI POWER UNITS

THE construction of mains units calls for a certain amount of technical knowledge and experience. Messrs. Ferranti, of Hollinwood, Lancs, have specialised in such apparatus for years, and have prepared an interesting and valuable folder, No. Wa. 522. This contains constructional details for several different types of mains units, with theoretical diagram, wiring diagram, chart of D.C. output, list of components, and valuable technical details. In addition, there is a chart showing at a glance the value of resistance required to drop practically any voltage at any current. Copies of this folder may be obtained by readers by sending threepence in stamps to Messrs. Ferranti.

Broadcast Query Corner

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

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

1. Write *legibly*, in ink. Give your full name and address.

2. State type of receiver used, and whether transmission was heard on headphones or on loud-speaker.

3. State approximate wavelength or frequency to which receiver was tuned, or, alternatively, state *between* which two stations (of which you have the condenser readings) the transmission was picked up.

4. Give date and time when broadcast was heard. Do not forget to add whether *a.m.* or *p.m.*

5. Give details of programme received, and, if you can, some indication regarding the language, if heard.

6. State whether and what call was given and/or kind of interval signal (metronome, musical box, bells, etc.) between items.

7. To facilitate publication of replies, append a *nom-de-plume* to your inquiry.

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

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

Replies to Broadcast Queries

MCCAULEY (St. Johnston, Co. Donegal): (1) Apparently British Experimental transmitter in your immediate neighbourhood; cannot be identified unless you pick up the call letters; (2) Your question is somewhat confusing, as if on 224 m. cannot be on "long" waves, but if weather report, either Heston Airport (833 m.) or Croydon Aerodrome (900 m.).

ONE VALVE (Letchworth): If dial reading is 34 degrees, station cannot be between two reading respectively 74 and 81 degrees; according to morse interval signal (G), Moscow on 46.8 m. REACTION BRIDGETON (Glasgow): Prague; early morning transmission. Cock-crow used as interval signal; local time: one hour ahead of G.M.T. RADIO ROAMER (Botley, Hants): GBC, Rugby does not work on that wavelength, but you appear to have picked up some harmonic of a *long-wave* transmission from Rugby. ON THE SLY (Nottingham): WCAU, Philadelphia (Pa.), on 256.3 m. direct; relays WABC, New York (Columbia Broadcasting Network). I WUNDA (Acton): Moscow, now on 1,000 m., or Leningrad on 848.7 m. MASCOT (Spalding): Leipzig; new high-power transmitter on 389.6 m.; Frankfurt-am-Main is now on 259.3 m. COLEMAN (Folkestone): Cork, as stated. The call is in Gaelic. TURIN: E.I.A.R. Radio At'Italia. LISBON: Estaçion radio Lisboa. DUBLIN: Radio Ath Cliathe seo (This is Dublin calling) or Se Seo radio Ath Cliath agus radio Corcaighe (These are the Dublin and Cork stations). KHARKOV: Narodnya radio Stancia Kharkov. SCHEVENINGEN-HAVEN (Holland): Hier de Zakkelijke Omroep te Scheveningen-Haven. MOSCOW: Slootshaitje, Radio Stancia Imeni Moskva (Stalina) or Govoreet, Moskva Central (or Kominterna) according to which transmitter is heard.

ADVERTISEMENT INDEX

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OPERATING THE ARGUS FROM THE MAINS!

Practical Wireless

3D

Published by
GEORGE NEWNES LTD.
Vol. 1——————No. 10
NOVEMBER 26th, 1932
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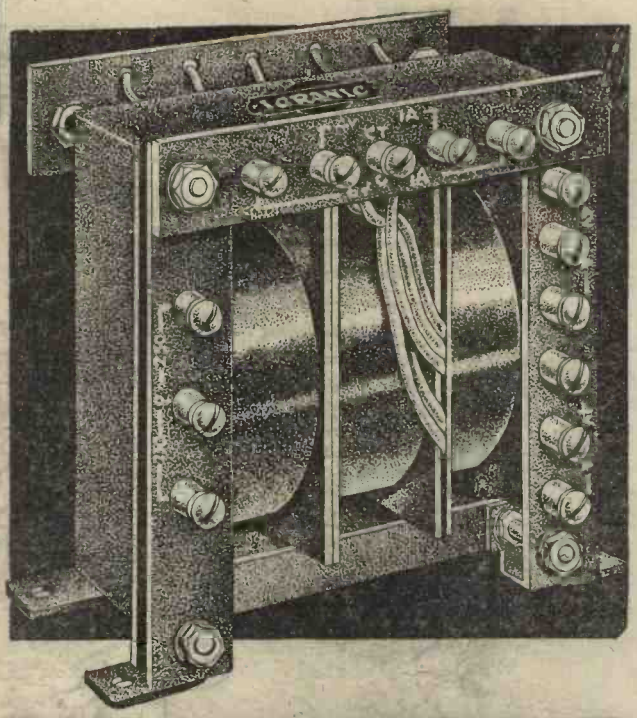
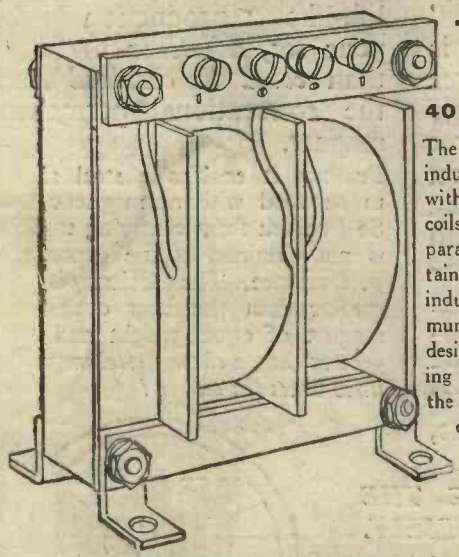
SPECIFIED FOR "THE ARGUS THREE"

The increased popularity of all-electric radio has resulted in a demand for mains components of unquestioned reliability. Igranic answer the demand with products that are built to the highest standards of quality and efficiency. The Igranic Mains Transformer is shown on this page. The primary windings are so arranged that it can be connected to any standard 50-cycle A.C. mains supply of from 200 to 250 volts. The input terminals, mounted upon paxolin boards, are clearly marked in 10-volt steps from 200 to 250 volts. Price **27/6**



The output terminals are also mounted upon a paxolin board and marked with their respective outputs as follows:—

Sec. 1 ... ... 4 volts 3 amps, centre tapped.
Sec. 2 ... ... 6 volts or 4 volts 1 amp, centre tapped.
Sec. 3 ... ... 4 volts 2 amps, centre tapped.
Sec. 4 ... ... 250-0-250 volts.



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40 henries, 40 m/A.

The type C.H.2 constant inductance choke is fitted with four terminals to enable coils to be put in series or parallel. This choke maintains a constant value of inductance up to the maximum current for which it is designed, so that the smoothing remains consistent up to the maximum carrying capacity of the choke. Price **9/6**

Write to-day for fully illustrated Catalogue No. J.1217 of complete new range of Igranic Quality Components.

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SEND FOR THE 1932 CATALOGUE

IGRANIC COMPONENTS WILL BE THE MAKING OF YOUR SET.

RADIO IGRANIC DEVICES

CVS—4

THE EMPIRE SHORT-WAVE THREE! See Page 498

ROUND *the* WORLD *of* WIRELESS

B.B.C. Operatic Relays

IT is good news to learn that during the present season of Gilbert and Sullivan Operas at the Savoy Theatre, London, the B.B.C. will carry out relays of certain performances. On December 3rd the second act of "The Mikado" will be heard by listeners to the National programme, and on December 9th, Act I of "The Gondoliers" will be broadcast on the Regional wavelengths. Other relays are to be carried out at regular intervals.

S.-W. Transmitters in Belgian Congo

AT present there are over forty short-wave transmitters working in the Belgian Congo on powers varying between 500 watts and 4 kilowatts. Of these, ten stations are solely used for telegraphy, but the others have recently been adapted for the transmission of both music and speech. They are to work with ORG, Ruysselede (near Bruges), Belgium, through which channel it is hoped to relay the Brussels wireless programmes in the near future.

Test Transmissions from Bouffarik (Algeria)

TEST transmissions on about 23 m. are being carried out by the new Bouffarik (Algeria) transmitter, which has been erected for the establishment of a public telephony service between Algiers and Paris. For the purposes of tests, broadcasts of gramophone records are made at irregular periods during the day.

Switzerland's Small Number of Listeners

IT is somewhat surprising to learn that although Switzerland has two high-power stations in operation and is now completing the construction of a third transmitter on Monte Ceneri, destined to give a service to the Tessin district, there are only 201,504 registered listeners in the entire country.

German Stations' Vertical Aerials

AS the Frankfurt-au-Main and Stuttgart (Mühlacker) studios exchange programmes throughout the day, and in view of the fact that broadcasts from the latter are equally heard in both cities, the power of the new Heiligenstock stations has not been raised above 17 kilowatts. All German stations of recent construction are equipped with vertical aerials; Frankfurt, however, still maintains its two lattice steel pylons, but the aerial is slung vertically between them. The station is a smaller model of the new high-power Leipzig transmitter working on 389.6 m.

Proposed Tax on Dutch Receivers

THE Dutch Government, with a view to securing a regular income for the broadcasting stations, proposes to levy a tax on wireless receivers. As the majority of listeners in Holland already subscribe voluntarily to one or the other of the Associations providing radio programmes, public opinion has declared itself against any alteration in the present system.

German Complaints of Interference

ACCORDING to statistics published by the German Listeners' Association, during the first half of 1932 some fifty-three thousand complaints in respect of interference with the reception of the broadcast programmes were dealt with by the authorities. Of these it was found that 12 per cent. were due to faults in the wireless sets, whereas 25 per cent. of the trouble was caused by other electrical apparatus used in the owner's house. On the other hand, over 9 per cent. of the complaints were fully justified in regard to oscillation caused by neighbouring wireless receivers.

Modern Dance Tunes Taboo in Russia

ALTHOUGH from time to time both Leningrad and Moscow carry out a relay of foreign broadcasts, if during such a tour through the ether the engineers come across a dance music transmission, they are compelled by the Soviet authorities to switch over to some other programme. Waltzes, polkas and kindred steps are tolerated to a small degree, but such post-war dances as the foxtrot, Rumba, etc., are drastically vetoed. In the opinion of the Bolshie, they constitute a symbol of the decadence of the monied classes!

Zeesen S.-W. Broadcasts

EVERY afternoon, at 3.0 p.m., G.M.T., through the Zeesen short-wave transmitter on 19.73 m., the Berlin studio broadcasts in both German and English full details of the evening programmes to be heard through the Königswusterhausen long-wave station.

Broadcasting in Iceland

AS the expenses of broadcasting in Iceland cannot be covered by the tax collected from listeners, the greater part of the programme consists of gramophone records. With a further view to economy, prominent State officials are invited to give talks, but for which no remuneration can be offered. It is expected that during the coming winter arrangements will be made to relay rammes from Copenhagen.

Sunday Morning Broadcasts from Antwerp

BELGIUM possesses a small transmitter which only broadcasts once a week; it is a privately owned station at Antwerp, working on 206 m. "Hallo, Hier Antwerpen, Radio Eglise du Christ" is the announcer's call at 10.0 a.m., G.M.T., every Sunday. The studio broadcasts a sermon, followed by sacred music, and closes down with the playing of the Belgian National Anthem.

Broadcasting in Egypt

BROADCASTING has not attained any notable proportions in Egypt, and listeners are anxiously awaiting the com-

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

pletion of the high-power transmitter in course of construction near Cairo. Alexandria possesses three small stations, namely, Radio Voice on 291 m. (1,030 k/cs); Radio Farid, an amateur experimental transmitter working simultaneously on 441 and 220.5 m. (680 and 1,360 kc/s), with a power of 600 watts, and the Alexandria Broadcasting Company, on 348.8 m. (860 kc/s). Transmissions are carried out between 11.0 and 2.0 p.m., 3.30–5.30 p.m., and from 7.0–9.0 p.m., G.M.T., and consist mainly of gramophone records.

Skamlebaek S.-W. Station

SKAMLEBAEK (Denmark) is known to the short-wave "fan" as the name of the Danish short-wave station which relays the Copenhagen programmes on 31.51 m. In addition, however, Skamlebaek performs a more important service, as from the same station weather reports are broadcast four times daily for shipping in the North and Baltic Seas. The wavelength used for this service is 840 m. Transmissions of such forecasts are made in both Danish and English.

No Political Broadcast in Japan

POLITICAL speeches may not be broadcast in Japan, and the Nippon government has refused permission to install a microphone in the House of Representatives. As it is deemed that the broadcasting company enjoys an adequate annual income, it may not indulge in any kind of microphone publicity.

Italy's High-power Transmitters

IN the course of nine years Italy has developed a powerful broadcasting system. On October 5th, 1924, the first station was opened at Rome; last month when the Fascists celebrated their tenth anniversary by the inauguration of the Milan high-power transmitter, Mussolini launched his eleventh broadcasting station, of which at least two (Rome and Milan) can now be heard throughout Europe.

German Variety Programmes

AN agreement has been made between the Funkstunde, Berlin, the Hotel and Restaurant Proprietors' Association, and a number of Variety Theatres and Cabarets, by which the studio, as hitherto, will continue to relay concerts and dance-music from these various houses of entertainment. The payment to be made for this service, however, will be entirely devoted to charitable purposes.

New Television Tests

A SERIES of interesting experiments are, at present, being carried out in Russia with a new system of television transmission. Broadcasts are made at regular intervals through two Moscow transmitters —namely, on 379 m. and 720 m.—the latter station being operated by the Central Post Office officials. Tests will also shortly be made on short waves.

INTERESTING & TOPICAL PARAGRAPHS

Porto Rico Transmissions

UNDER the letters WKAQ, the Radio Corporation of Porto Rico transmits a daily programme of concerts on 242 metres between 1.0 and 3.0, and 5.0 and 9.0 p.m., G.M.T.

Super-power Stations for Mexico

IT is reported that two super-power stations are to be erected in Mexico, one of 120 kilowatts at Piedas Negras in the vicinity of the capital, and one of 500 kilowatts at Villa Acuna. It is expected that these stations will operate on the medium waveband. Villa Acuna, Coahuila is already the site of a broadcasting transmitter owned by an American whose licence was cancelled by the Federal Commission of the United States. For the special purpose of transmitting sponsored and other programmes without being subject to any kind of restraint or control, he maintains his studios on the United States frontier and has installed the transmitting plant in Mexican territory.

A Ventriloquist Announcer

BARCELONA (EAJ 1) boasts of a ventriloquist studio announcer who fills up gaps in the radio programmes by imitating interviews with local celebrities; in the course of these dialogues he introduces a series of microphone advertisements.

Budapest Broadcasts Help Unemployed

SINCE the inclusion in the Budapest daily broadcasts of a special feature dealing with unemployment, during the past fifteen months, the programme organizers have found situations for over 12,000 persons. Nightly lists of addresses where work may be found are read out by the announcers.

Transmissions from Prangins

IN view of its unsuitability for the purpose, the wavelength of 20.64 metres in future will not be used for the weekly broadcast carried out by the League of Nations station at Prangins. All transmissions will now be given simultaneously at 10.0 p.m., G.M.T., on 31.3 and 38.7 metres.

Radio Luxembourg

THE official opening of the Radio-Luxembourg station has been delayed, owing to complaints received by the authorities from official aerodromes in respect to the interference caused to the services by the adoption of a 1,200-metre wavelength. In the meantime the station is testing on 1,275 metres daily between 12.30 and 1.30 p.m.

New French High-power Station

RADIO-STRASBOURG, the latest and most powerful station in the French State broadcasting system announces all items of its programmes in both the French and German languages; its interval signal consists of a deep buzzing note. The wavelength is 345.2 metres.

"Ferrocart" Coils

A FEW weeks ago we mentioned the invention by Hans Vogt (a German scientist) of an entirely new kind of coil wound on a ferrous material known as "Ferrocart." We are now able to announce that an English manufacturer has lately acquired sole manufacturing and selling rights for this country. The new British-made coils will be available shortly, when we hope to give a full test report and details of their application to modern receivers.

Altered Wavelengths of Some Russian Stations

IN view of imminent tests to be carried out by the 500-kilowatt Moscow-Noghinsk transmitter, alterations have been made in the wavelengths of some Russian stations. For experimental purposes Moscow (T.U.) hitherto on 1,304 metres, broadcasts on 1,000 and Leningrad on 848.7 metres.—JACE.

SKY POLICE CONTROL THE WAVES

There is an unofficial laboratory in Berlin on the roof of the Reichspost-Zentralamt at Tempelhof, where officials carefully watch to ensure that radio transmitters all over the world transmit on the wavelength as stipulated for them at international conferences.

SOLVE THIS!

Problem No. 10

Brown made up a two-valve receiver using as the L.F. coupling a transformer of well-known make. As he was very keen on good-quality reproduction, he parallel-fed the transformer. All components were of good make and were not defective, but reproduction was marred by a bad bass resonance. What was the reason?

SOLUTION TO PROBLEM No. 9

The fault was due to a sagging filament. As this expanded when it attained its maximum temperature it sagged and touched the grid, resulting in the "click" and cessation of signals.

The following readers receive books in connection with Problem No. 7:—

Mr. P. Booth, 273, Oldham Road, Limehurst, Ashton-under-Lyne, Lancs.; Mr. A. Balfour, 3, Little Chapel Street, Aberdeen, Scotland; Mr. H. E. Gee, 133, Edgwarebury Lane, Edgware.

A NOVEL LOUD-SPEAKER CABINET

By W. T. SCHOLLAR

THE neat loud-speaker cabinet of very modern design described here is within the capabilities of any hand skilled amateur wood-worker. It can either be made in oak or walnut, but if a really attractive-looking job is desired, mahogany should be used, the main portion of the cabinet being afterwards polished to a rich mahogany tone. The plywood fret and wood ornament which goes beneath it should be stained ebony and polished before being fixed to the front of the cabinet with strong glue. Should this kind of finish be adopted, the combined two-colour effect of polished mahogany and ebony will be found to give a very smart and pleasing appearance, as seen in the perspective view, Fig. 1.

If the instructions given here are closely followed, no difficulties should arise when making it. The

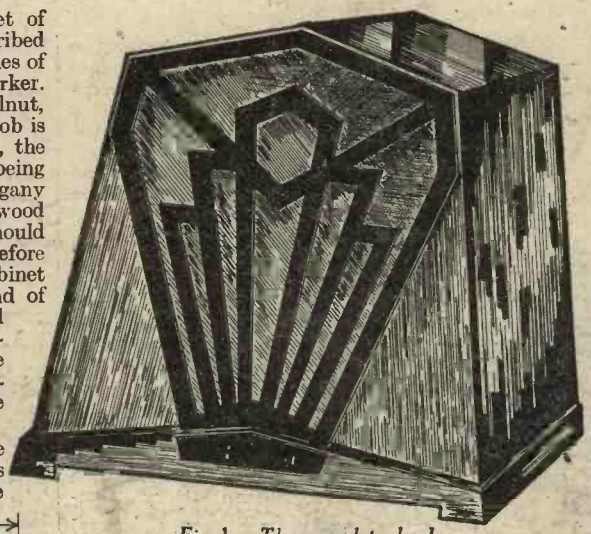


Fig. 1.—The complete loud-speaker cabinet.

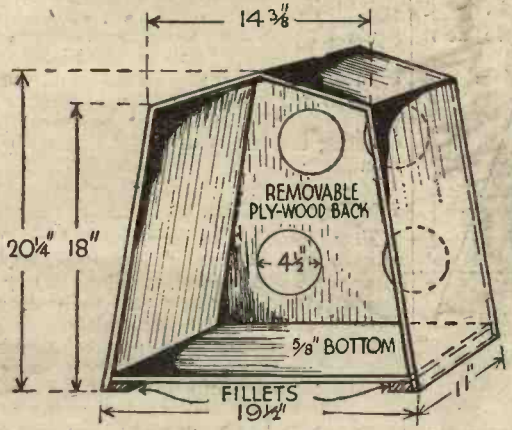


Fig. 2.—Rear view.

timber required is stated on the accompanying cutting list. This material can be obtained already machine planed from any of the cabinet supply firms, at a moderate price.

Details of Construction

Start by planing all the wood to a fine surface with a smoothing plane. When this is done, mark out on a large sheet of plywood or drawing paper a full-size outline of the front of the cabinet. This drawing will be found very useful for testing the accuracy of the splayed mitred angles, when mitreing the sides together to form the box. The corner joints should be held together with clean glue and fine panel pins; a few small angle blocks being glued to the inside of the mitred corners, for additional strength.

The perforated plywood back, which is made removable, is then fitted to the cabinet, and the ⅜in. by ⅜in. wood stop fastened around the inside to keep the back in position. Next come the deal fillets, shown in Fig. 2, which are fixed to the bottom and sides to keep the job rigid, also to provide a fixing for the four rubber feet which are put on to prevent the bottom from scratching polished surfaces.

Fitting the Panels

When the cabinet has reached the stage shown in Fig. 2, the two front triangular panels are fitted and fixed into position, taking care to keep the face of the panel flush with the face edge of the base and sides, as shown in Fig. 3. Particular care should be taken to get a fine joint between the edges of the panels and the mahogany sides of the cabinet, otherwise the general appearance of the whole job will be spoilt. The piece marked A is now added; this forms a fixing for the plywood fret, and then the shaped mahogany plinth is mitred around the bottom to form a suitable finish. It should be noted here that the return plinth B, see Fig. 3, has bevelled edges to the same splay as the face edges of the front plinth.

The next problem is that of marking and cutting out the fret, and also the plain wooden ornament which is fixed beneath it. Details of these are given in Fig. 4. The whole job can now be thoroughly cleaned up with fine glasspaper, and polished as before described. The silk gauze, which can be obtained in a variety of shades, is then fixed inside by coating the back of the fret with glue, using a fine brush for the purpose. All that remains to be fixed now are the four metal fasteners, which are screwed in place to prevent the back from falling out. This can be done in a few minutes, after which the cabinet is ready for the speaker.

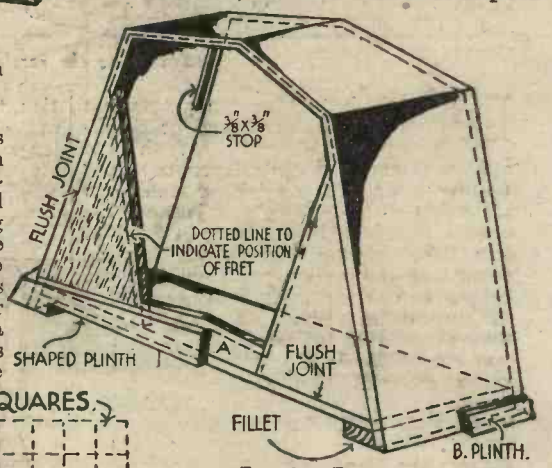


Fig. 3.—Front view.

Readers who do not wish to make their own frets may like to know that it is possible to buy fretted fronts ready for use, although such frets may not be strictly applicable to this cabinet. Local wood workers will undertake the fret for you for a few pence.

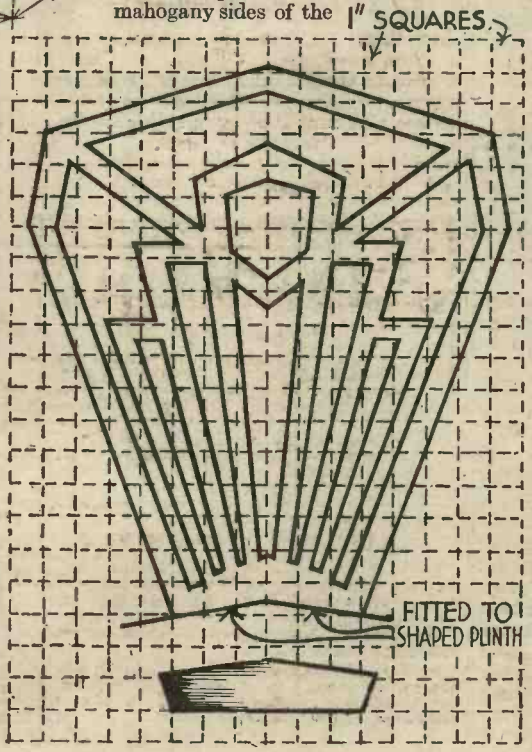


Fig. 4.—Design for the fretted grille.

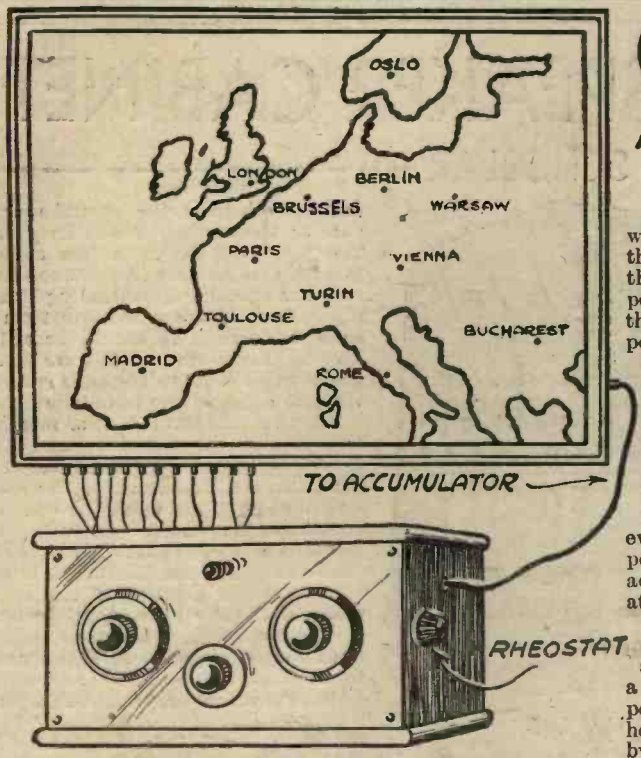
CUTTING LIST

Description.	Length.	Width.	Thickness.	Material.
	Ft. ins.	ins.	ins.	
Sides ..	4 6	11	⅜	Mahogany.
Front Panels	1 6	7	⅜	,,
Shaped Plinth	4 0	3	5/16	,,
Ornament	0 7	1½	⅛	,,
Bottom Board	1 9	11	⅝	Deal
Fillets ..	2 0	1	½	,,
Stops ..	5 6	⅜	⅜	,,
Back ..	1 8	20	ply-wood	Alder
Fret ..	1 6	16	,,	Single-faced Mahogany.

All Prepared Sizes.

CONSTRUCTING THE

An Ingenious Method of Automatically Illuminating Receiving. The Device is Operated



The completed map connected up to the receiver.

DO you wish to hear the programme from Vienna, or Rome, or Stockholm, or Warsaw? With the apparatus herein described you need not bother to refer to any log, or trouble to remember dial readings, you just see the station illuminated on a map in front of you. Turn your dial knob, and in rapid succession the various stations light up. Select the one you want, *from the map*, without peering into a small scale on the dial. If you can build a set, you can make and fix this map—*always* correct whatever the wavelength of the stations may be.

Making the Map

To make the map, proceed as follows. Procure (or draw) a large map of Europe. One can be purchased from the B.B.C. mounted on linen for 3s. Cut this down to about 2ft. 4ins. square, and back it with ¼in. ply-wood. With a 3/16in. punch, punch out (map uppermost) holes of all stations that your set is capable of receiving, no two holes being closer than half an inch, for reasons seen later. If one town has two or more stations (such as London or Paris) place them as near as possible to name.

Construct a wooden tray about 1¼in. deep inside, and to the measurements of the map, the base being 3/16in. by 2ft. 4in. by 2ft. 4in. The sides can be ¼in. thick and 1¼in. deep. Depth is slightly more than the overall height of the bulb and holder.

Fit the map (acting as a lid) to the tray by battening the underside edge of the map with ½in. by ¼in. wooden strips going full length (screwed on from the top) half an inch from the edge. These battens provide strength for the map as well as means of holding it into the tray. Lay the map aside—cover the inside of the base of the tray with metal foil as thin as possible, leaving a small piece to extend to the right-hand lower edge of the tray from which to take a tapping to the L.T. battery. Replace the map and, with a sharp-pointed instrument, mark through the holes the position of the broadcast stations so as to indicate the approximate position of the bulb-holders.

Place the bulb-holders, which must be of the all-metal type with terminal at side, immediately over the position marked. However, to obtain the exact position (and this must be accurate) insert a bulb, attach two very thin temporary leads, take outside the tray, replace the map and test the position with a flash-lamp battery. Temporary fixing of the bulb-holders can best be done by drawing pins.

The bulb-holders all being in position, to the screw at the side of each holder attach a length of the *thinnest* rubber-covered flexible wire, just *more* than long enough to reach to the lower edge of the tray. To the ends of these wires attach the smallest plugs obtainable. Now insert sockets (*open each end*) in holes drilled in the lower edge of the tray and insert the plugs.

View showing dial-repeater board fixed to back of panel.

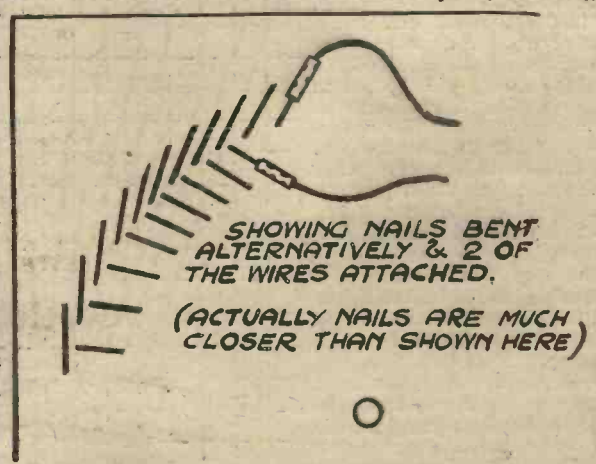
The map itself is now complete except for the socket to be fitted to the right-hand lower edge of the tray, connecting with the tinfoil, in which will be inserted the plug with the lead from the L.T. battery (L.T. — or +, whichever is *not* earthed).

Adapting the Receiver

If the tuning condenser is of the hollow spindle type, remove the existing spindle, obtain and insert another that reaches just beyond the back (or side) of the baseboard. Should the existing spindle of the condenser already protrude sufficiently beyond the frame, an extension can be added with a "gang coupling" device (obtainable at any wireless shop, price 9d.). If neither of the above conditions apply to your tuner, it will be necessary to substitute a hollow spindle variable condenser for the one already in the set. To the end of the condenser spindle must now be soldered or clamped an arm of brass about 2¾in. long and narrowing down from about ½in. at the spindle end to ¼in. at the point. The narrow end should be rounded off and the tip can be turned to engage with the studs of the dial-repeater board to be described later. As an alternative, a solid stud of metal about ¼in. square (corners rounded) could be inserted. At the broad end should be a piece projecting enabling the whole to be fixed securely to spindle.

Dial-Repeater Board

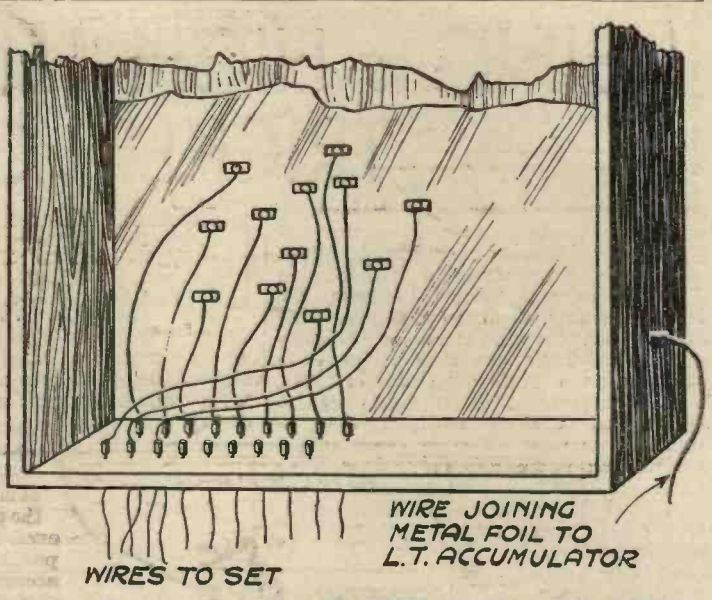
Now proceed to construct the *dial-repeater board* which, with the pointer, reproduces the dial readings along a row of metal studs. Prepare a well-seasoned piece of wood about 3/16in. thick (perfectly flat), about 6½in. wide, and of sufficient height that, when fixed to the rear edge of the baseboard there is about ½in. clear above the top of the pointer when the latter is in an upright position. Measure the height of the spindle from the baseboard and mark this exact point on the dial-repeater board (allowing for the overlap of the baseboard at the bottom). With this as the centre and the length of the pointer as radius, scribe a semi-circle, with a metal point, *not pencil*. This must be done with *great* care and very exactly. At the central point, drill a hole, a fraction larger than the size of the spindle of the condenser. Now, along the line marking the semi-circle, insert as closely as possible ½in. wire nails (those with the smallest heads—almost like brads). It may be found best to drill the holes for these at least three parts of the way through the wood—but *they must* fit tightly and the heads when



Part of back of dial-repeater board, showing nails bent alternately, and two of the wires attached.

STATIONDICATOR

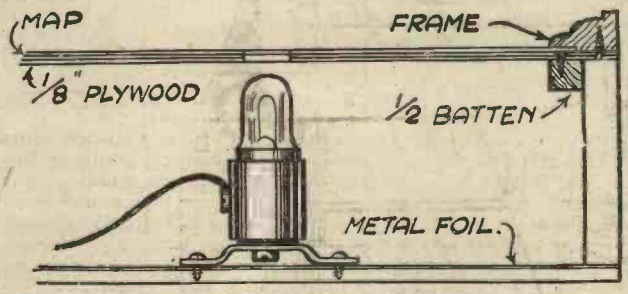
On the Map the Station You are Actually by the Tuning Dial



Lower half of tray (map removed) to show connections to bulb holders.

the nails are knocked home flush with the surface, must only just be separated. See, however, that there *is* a definite space between. By sandpaper or file make the surface of the wood quite level. It will later make the fixing of the leads easier if the projecting portions of the nails at the back are turned alternately up and down. Screw the dial-repeater board to the rear edge of the baseboard so that the end of the spindle just fits into the centre hole. It now remains to adjust the pointer. Loosen the spindle screws, turn the dial to read "0" and the pointer to the extreme left or right of the studs. Then tighten the fixing screws. Proceed to tune to local station (say, London Regional). It will be seen that the pointer is in contact with a certain stud (or nail). To the back of this attach a length of the thinnest possible rubber-covered wire. The length of this must be judged by the distance to the sockets on the underside of the map (leaving a few inches to spare). The method of attaching the wire to the backs of the studs may present some difficulty. The writer, however, found the following method satisfactory. Insert the wire (bared about ¼in.) a short distance into an ordinary brass spade terminal, so that it is held by two of the grips only. Break off the spade portion and take a spare nail (one of the sort used for the studs), insert in the opposite end to the wire and close the remaining three grips tightly over the nail—then withdraw the latter. It will now be found possible to slide the attachment on to the back of the stud. To the other end of the wire attach a small plug, and insert into the London Regional socket. For carrying the wires outside the set from the back of the dial-repeater board it is necessary to cut one large or three small holes in the back of the cabinet.

As the spindle of a tuning condenser is invariably earthed, the L.T. circuit for the map will be completed when the plugs are in their sockets. To be able to switch the map light on and off with the set, connection can be made to the accumulator through the on-and-off switch. For the above experiment .06 fuse bulbs were used, as they are economical in current consumption. In this case a rheostat was inserted in the negative filament from the map as the full two volts was rather too much for the bulb to work with safety.



Section of tray with map, showing bulb and holder in position.

General Notes

1. In constructing the dial-repeater board make sure that the radius of the semi-circle of studs is larger than the radius of the actual dial. The larger the repeater-board is, the better and easier for accurate tuning. But remember this will necessitate a longer pointer.

2. So that the light from one bulb does not illuminate neighbouring holes, a piece of black insulating tape can be bound round the bulbs, just leaving the top exposed.

3. It would necessitate too complicated a system to separate the lighting of long and short wave stations by switching. But if coloured bulbs, or coloured paper, pasted over the holes, be adopted, it can at once be seen whether the station indicated is long or short wave.

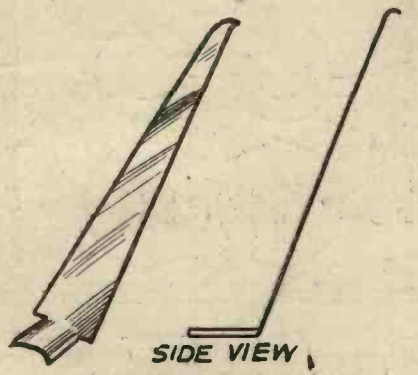
4. A sheet of glass can be placed over the map, kept in position by a moulded frame, which, when stained and polished, presents a more pleasing appearance.

5. Brass hooks and eyes are put round the edge of the completed map to hold it in position.

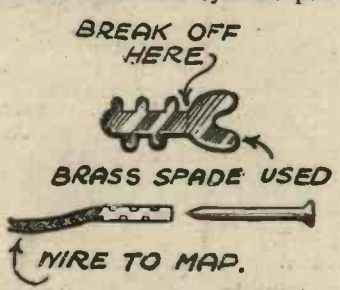
6. The completed map can be hung upon the wall or stood on top of the set.

It should be borne in mind that the total current of all the lamps will never be required at one time. There is, therefore, no need to worry about the voltage drop. As the dial is rotated only one lamp is brought into circuit at a time, and by choosing bulbs of the type mentioned, which only consume 60 milliamps, the additional load on the accumulator may be ignored.

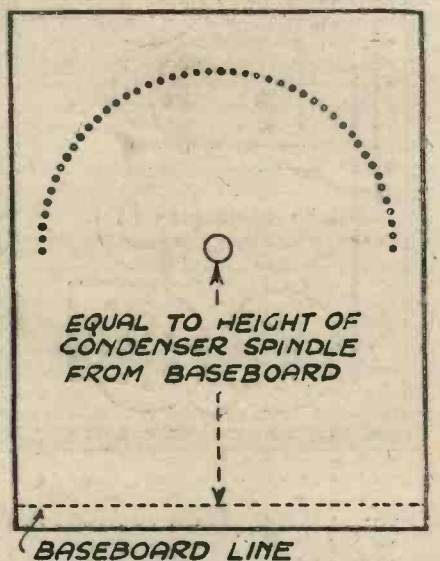
When a station for some reason of other changes its wavelength, the plug attached to the lamp indicating the station should be removed and reinserted in a socket corresponding to the new tuning point. In this manner the map will always be up to date, and may continually be modified to suit the changing conditions of the European broadcast. The choice of a map of Europe has been made to date for those who have multi-valve receivers capable of picking up the majority of the European broadcasting stations. For those, however, who possess modest receivers and can only get two or three English stations, the same idea may be applied to a map of England.



Details of pointer.



How to prepare the ends of spades.



Front of dial-repeater board.

USING *a* HIGH-TENSION UNIT *and* TRICKLE CHARGER

Explaining How the Two Units May Be Wired and Switched.

By W. J. MIDGLEY

A LARGE number of readers, doubtless, are in possession of High-Tension Units and Trickle Chargers, the latter enabling them to maintain their Low-tension Accumulators in first-class condition. They are thus virtually in the position of owning "All-Mains" sets, and consequently the favourite home-constructed wireless receivers can be retained, thereby affording opportunities for making improvements from time to time.

A good deal of trouble is experienced, however, in connecting and disconnecting one piece of apparatus to make way for the other, and there is the additional inconvenience of having to change over the accumulator leads from the wireless receiving set to the trickle charger, and vice versa. To entirely eliminate these tiresome alterations, the arrangement outlined below will be found extremely useful, and will certainly prevent many a wrong connection being made, with consequent damage to expensive apparatus.

An examination of the scheme, as indicated in the theoretical diagram (Fig. 1) will reveal that the outstanding advantages are (1) it is quite impossible for the trickle charger and the H.T. unit to be used simultaneously, (2) the valves in the receiver are entirely isolated during charging operations, and (3) the "Mains" plug can be left in its socket continuously, as the current is made or broken by a switch on the control board.

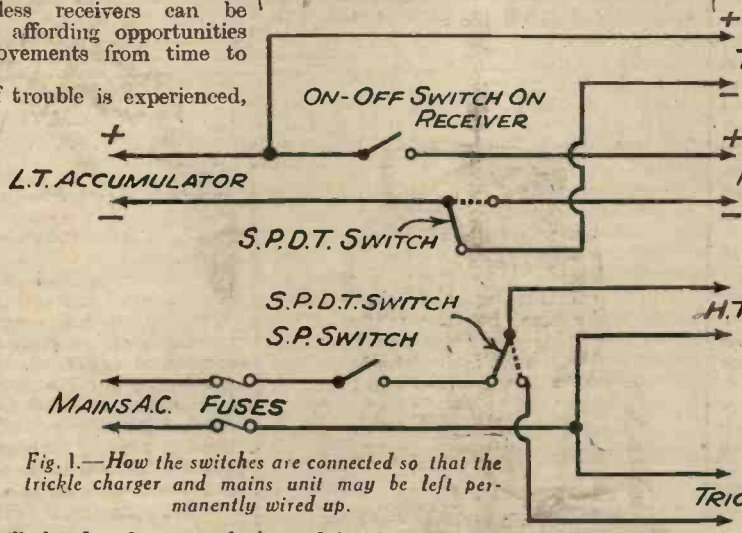


Fig. 1.—How the switches are connected so that the trickle charger and mains unit may be left permanently wired up.

Constructing the Unit

To make the apparatus the following components will be required:—

1 Wood Block (say 6in by 8in. or larger if desired).
2 Ordinary batten holders.
1 Single-pole tumbler switch.
2 Single-pole double-throw tumbler switches.
2 Fuse holders.
1 Ebonite bridge.
Wire. Screws.

These items can be obtained at a reasonable cost from any electrical supply stores.

The disposition of the switches, etc., on the wooden base is shown in Fig. 2. They should, of course, be fixed with ordinary wood screws after drilling the necessary holes for all wiring points. The fuse holders can be omitted, if desired, but these are helpful in safeguarding the unit and charger from any surges of current that may occur. The fuse wire employed should be not larger than 25 S.W.G. lead-tin alloy of 3-amp. The wiring of the switches, etc., as shown in Fig. 3, is simplicity itself, but care should, of course, be used in selecting the wire which carries the "mains" current and should be carried out with well-insulated material to obviate the risk of short-circuiting. The electrician at whose establishment the switches, etc., are obtained, will supply suitable wire for a few pence. Good quality flex should be used from the terminals in the fuse holders, and this should naturally be of sufficient length to reach the "mains" plug or lamp socket from which the current is obtained.

When the wiring has been carried out and the switch covers screwed in position, the two switches at the top of the board should be bridged so as to work in conjunction with each other, and here it is well to remark that the distance between these switches is dependent upon the length of the "bridge," and this point should be carefully borne in mind before definitely screwing these particular components in position.

The Control Board

The control board can be fixed in a position adjacent to the charger and high-tension unit, and preferably on the side of the receptacle which is invariably used for housing such apparatus near to the wireless receiver. Whatever means are adopted in this direction, it will, of course, be

(Continued on page 484.)

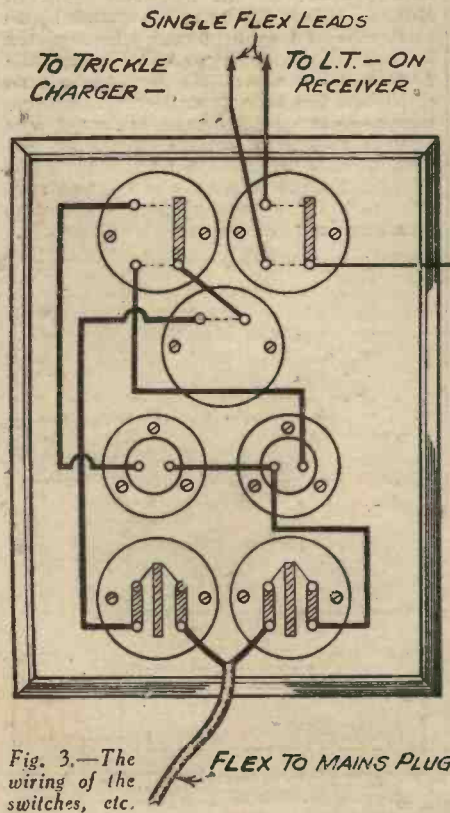


Fig. 3.—The wiring of the switches, etc.

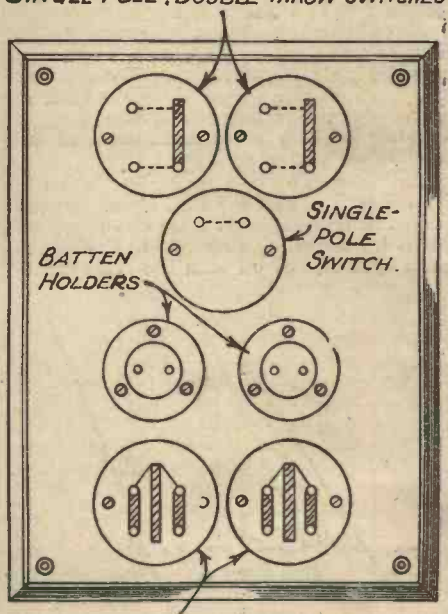


Fig. 2.—The arrangement of switches.

THE FUTURE *of the* MULTI-ELECTRODE VALVE

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

IT is but a few short seasons ago since the only valves employed, even in sets of advanced design, were those of the three-electrode type. To-day, quite a large majority of wireless receivers contain at least one multi-electrode valve, either a screened grid, high-frequency valve or a pentode-output valve, the intricate assembly of the first named being shown in the accompanying illustration, Fig. 1. Many listeners, indeed, use both, and it is safe to say that the development of these two types has done much to put really efficient and pleasurable radio, with consistently good distant reception, in the reach of the ordinary listener. In fact, some people go so far as to assert that the only type of three-valve receiver which can claim to fulfil present-day requirements as to selectivity, sensitivity and output, is that employing the combination of a screened-grid valve, a detector and a pentode output.

The National Radio Exhibition at Olympia offered a good opportunity for assessing the trend of modern radio practice, and it was noticeable that, with the exception of the multi-mu valve, which appeared in quantity at Radiolympia for the first time, all the evidence tended to show that, for this season at any rate, nothing very startling in the way of valve innovations is likely to occur. But this must not be taken as a sign that valve technique has reached a high-water mark, and that no further progress is being made or is likely to materialise in the not too distant future. A very large amount of preliminary work on certain very interesting developments has already been done, and it is certain that the receivers of coming seasons will be very different from the standard models of to-day.

Likely Directions of Progress

Progress is likely to occur in three different directions. In the first place, every radio designer will admit that we have not yet exhausted the possibilities of existing types of multi-electrode valves, so that modifications and improvements in methods of operating them are to be expected. Then it is almost certain that new applications will be found for valves identical, or at least very similar, in design to those at present manufactured. Finally, it is well known in technical circles that valve forms of almost startlingly novel type have already reached the laboratory stage and are, in some countries, being given exhaustive try-outs under practical working conditions.

What Will Happen to the Multi-mu Valve?

As most listeners are aware, the multi-mu valve is the latest modification of the

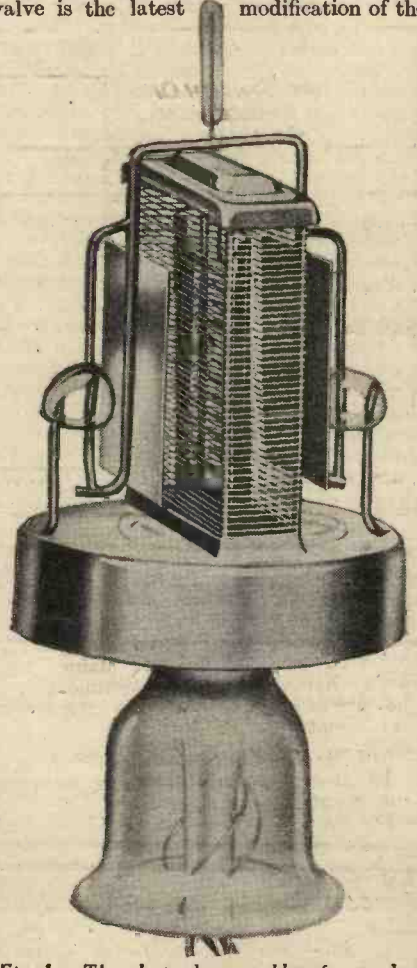


Fig. 1.—The electrode assembly of a modern Screen-grid valve.

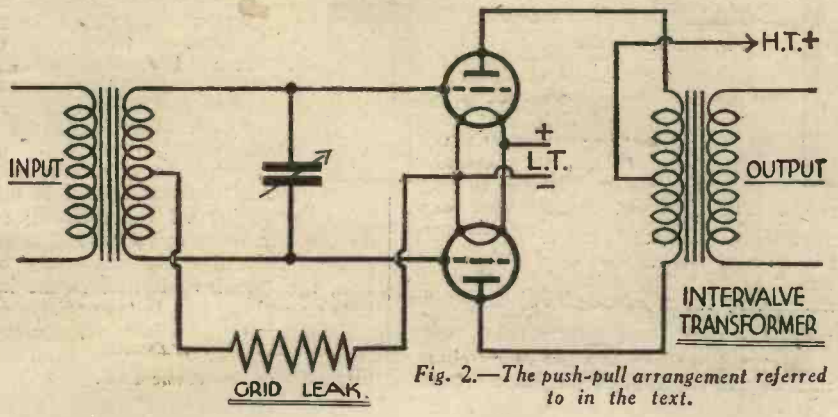


Fig. 2.—The push-pull arrangement referred to in the text.

Barton Chapple, from a sketch by P.K.B.C.

screened-grid high-frequency valve, and has the very useful property that its effective sensitivity decreases smoothly as negative grid-bias is applied. By increasing the grid-bias, therefore, the overall amplification, or "stage gain" is decreased, but at the same time the valve is able to handle stronger signals without distortion. Such a valve, therefore, is of great value in a receiver which requires to be extremely sensitive in order to pick up at good strength the programmes from weak or distant stations, but must also handle the powerful signals broadcast from the local station without overloading.

In some of the most advanced receivers of this season, an additional refinement is employed in the high-frequency stage or stages. This is known as "automatic gain control," and is a device whereby the biasing of the multi-mu valve is adjusted automatically, so that no matter how close or distant the station, all signals are reproduced at the same volume. Moreover, this arrangement also compensates for the variations in signal strength due to the effect known as fading. There is no doubt that one of the most important developments of the next few months will be the general employment of automatic gain control in what may be called the "average" receiving set. There is not space in the present article to describe in detail various methods by which this automatic control is achieved, and it must suffice to indicate one of the most simple methods. It will be agreed that in a detector circuit there is, due to the rectifying action of the detector valve, a direct current voltage between the two ends of the grid leak, this voltage depending upon the strength of the signal handled by the detector. By coupling this voltage back to the grid circuit of the multi-mu valve it may be employed as an additional biasing voltage. If the signal strength increases, this extra biasing voltage is increased, and the effective sensitivity of the multi-mu valve is cut down until the volume again reaches normal level. If, on the other hand, the signal fades, the extra biasing voltage is reduced and the multi-mu valve is made more sensitive. The only disadvantage of this arrangement is that while "searching" for stations, the set is brought automatically into its most sensitive condition, with the result that all "mush," interference, and

unwanted noises are amplified to the fullest extent, so that tuning-in becomes a rather unpleasant process. This will be overcome in the sets of the future by an arrangement known by the name of "noise suppressor." In one form this consists of an additional valve, usually of the screened-grid type, connected in a special manner. The grid of this valve is excited by the voltage existing across the grid leak of the detector, while its anode circuit is used to supply additional bias to one of the low-frequency valves. When no signals are being received during searching operations, the bias to the auxiliary valve is small, its anode current rises, and increased bias is thus applied to the low-frequency valve, sufficient to render that valve inoperative and practically shut down the set. Immediately a signal is tuned in, however, this "muting" bias is removed and the station comes in at full volume.

The Future of the Screened-grid Valve

With the rising popularity of the multi-mu valve, it may be thought that the day of the ordinary screened-grid valve is over. This is, however, a very mistaken idea. One suggested sphere of activity will probably be as an intermediate frequency amplifier in super-het receivers, while it must not be overlooked that there is the use of the screened-grid valve as a detector. Some extension of the application of screened-grid valves to low-frequency amplification may also be looked for, the circuit to be employed being, of course, resistance-capacity coupling with a moderate value of anode resistance.

High-frequency Pentodes

A development which has been too long delayed, is that of the high-frequency pentode. Valves of this type have a much higher amplification factor than screened-grid valves of the tetrode type, and also a much higher impedance. It can be shown mathematically, that a high-frequency pentode having characteristics of an order that can be quite easily achieved in a commercial valve, and operated with ordinarily efficient tuned circuits, may well have an overall gain, half as much again as an ordinary screened-grid valve, while with tuned circuits of super efficiency, the gain may be two and a half times that commonly obtained in a screened-grid stage.

Valves for Push-pull Detection

It has long been recognized that an extremely good form of detector is the push-pull detector in which the detector stage acts, to a great extent, in a way similar to that of a full-wave rectifier. Hitherto, all attempts at applying this system have been with two valves, a conventional circuit being that shown in Fig. 2. It will be agreed that this arrangement has many valuable advantages. The full-wave rectification is highly efficient, and free from distortion, while the high-frequency currents in the detector-anode circuit are practically eliminated. Moreover, owing to the centre-tapped arrangement of the intervalve transformer, the magnetizing force due to the anode current of one valve is cancelled out by that due to the anode current of the other valve, so that distortion arising from transformer saturation is also avoided. The arrangement, indicated in the diagram, has certain disadvantages among which the most serious is the impossibility of using standard tuning condensers in which the rotors are earthed. American radio engineers, however, have developed valves for full-wave detection, which register a decided advance. In one form, known as the "Wunderlich" valve, there are two grids wound side by side. It is claimed for these valves that they possess all the advantages of the two-valve push-pull detector arrangement, and give excellent performance, both as regards quality and amplification. Although there must be an inevitable time-lag between the first publication of this invention and its practical application, in even the most advanced receivers, it is most interesting in these early days to do a little more than speculate upon the possibilities of the new method. It is not unlikely that in a season or two, valves operating on this principle, or some modification of it, may be found as the standard detector arrangement in sets of really high-class design.

Finally, lest it be thought that this article savours too much of "off with the old love and on with the new," let us remember that the use of our good friends, the screened valve and pentode valve, have not been exploited to the full. There are thousands of listeners still in the "detector and L.F. stage" of developments, and it will be several seasons before most of the devices suggested in this article become general practice, before some are even introduced on the market. Those who are desirous of improving their reception, and who have not yet used screened-grid high-frequency or pentode output, will be well advised not to delay on the account of possible developments, but should remember that what is *the best* in to-day's advanced design, will still be good practice for next season and, perhaps, for a few seasons to come.

USING A HIGH-TENSION UNIT AND TRICKLE CHARGER (*Continued from page* 482).

essential to provide accessibility for the three wiring points of the top right-hand switch, which distributes low tension negative either to the receiver or the trickle charger. The flex leads from the accumulator should be revised in accordance with Fig. 4, which indicates the arrangement ready for operation.

The adaptor from the high-tension unit should be placed in the batten holder at the left-hand side, and the one from the trickle charger fixed in the other holder. When the bridge, which is fixed across the two switches at the top of the board, is placed in the "down" position, the H.T. unit is available for use. In the reverse position, the charger can, of course, be utilised. The lower switch controls the "mains" current to complete the circuit either to one or the other. It will be appreciated that when the receiving set is not in use, the valves are isolated from the "positive" side of the L.T. accumulator by the usual on-off switch.

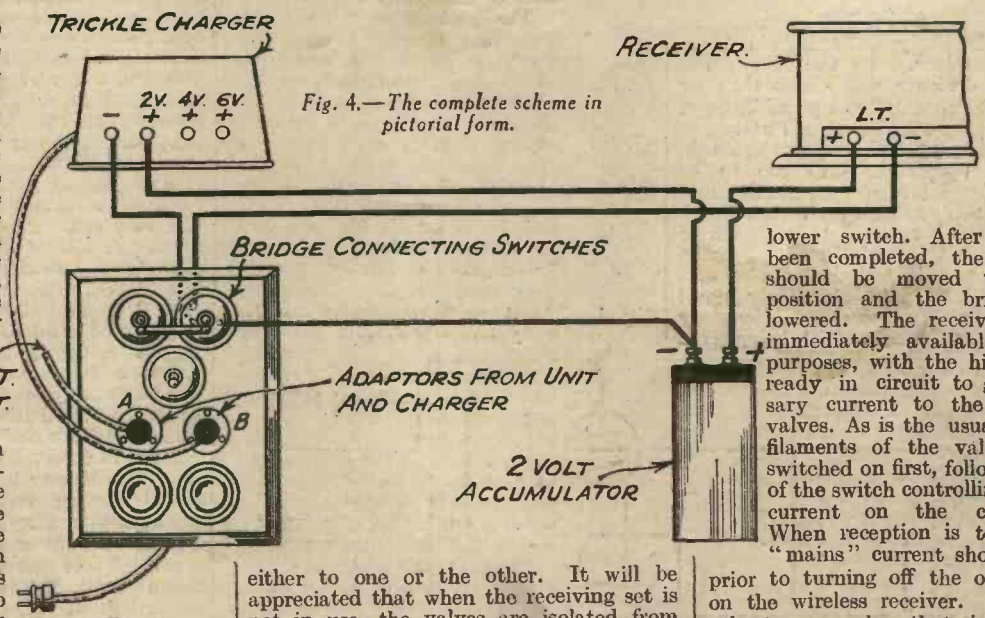


Fig. 4.—The complete scheme in pictorial form.

Using the Unit

The practice of giving a few hours' charge each day to the L.T. accumulator becomes a simple operation, as all that is necessary is to raise the two top switches by the connecting bridge, and turn on the current by the lower switch. After charging has been completed, the latter switch should be moved to the "off" position and the bridged switches lowered. The receiving set is then immediately available for reception purposes, with the high-tension unit ready in circuit to give the necessary current to the anodes of the valves. As is the usual custom, the filaments of the valves should be switched on first, followed by a turn of the switch controlling the "mains" current on the control board. When reception is terminated, the "mains" current should be cut off, prior to turning off the ordinary switch on the wireless receiver. It is a golden rule to remember that in every operation, the "mains" switch is the last to turn on and the first to turn off.

Shocks from condensers are also avoided if you remember always to turn the filaments off *after* the H.T.

Receivers and their Records

We shall be glad to advise readers regarding purchase of complete sets.

IN many households where a multi-valve receiver is used, it happens frequently that the set is monopolised for the reception of a local broadcast, whereas in the opinion of some members of the family it should be employed for the capture of a foreign, and more distant entertainment. It is true that few households possess two receivers, although exceptions must be made in the case of an additional portable; but there is no doubt that at times the use of a smaller yet efficient set would prove a boon. This argument leads to the conclusion that to receive the local broadcasts a big receiver is not a necessity, but it should, when called upon to do so, be able to provide alternative entertainments if a tour around the Continental stations is desired.

In this respect the *Atlas Two*, which can be supplied in battery, D.C. and A.C. mains models, will fill a long-felt want. They are inexpensive, yet capable of giving entire satisfaction. They are so simple to operate that as a "stand-by" receiver alone, they would prove a valuable asset, but in addition, their efficiency is such that any *Atlas Two* will readily provide for its owner alternative entertainments. The D.C. mains model (type RD2) under review gave a very satisfactory performance. Made to operate on voltages between 200 and 250, it requires, to suit any individual mains, a slight adjustment to the terminal strip at the back of the cabinet. It is

Clarke's "Atlas" Two Valve (Model RD2)

designed to work with outdoor, indoor, and mains aerials, and the choice rests with the listener, but it must be borne in mind that to obtain all the advantages of this small two-valver, a good outdoor aerial and earth should be chosen, if at all possible.

The circuit is a perfectly straightforward one, offering no complications likely to cause trouble, and makes use of two Mazda valves, D.C. 3/HL as detector, and a D.C./2P as power output, feeding a mains energised "Atlas" moving-coil loud-speaker. With an outdoor aerial you are given the choice of two sockets at the back of the receiver, namely, A for the reception of distant stations, and A1 for local transmissions; although test was carried out at about fifteen miles from Brookmans Park, the second alternative provided excellent loud-speaker strength for an averaged size living-room. The mains aerial, if required, is connected by merely inserting a plug into the socket marked for this purpose. In this instance, no other aerial is necessary, but it is obvious that such an arrangement necessarily limits both the range and efficiency of the circuit. It is, however, a useful "stand-by" in case of emergency.

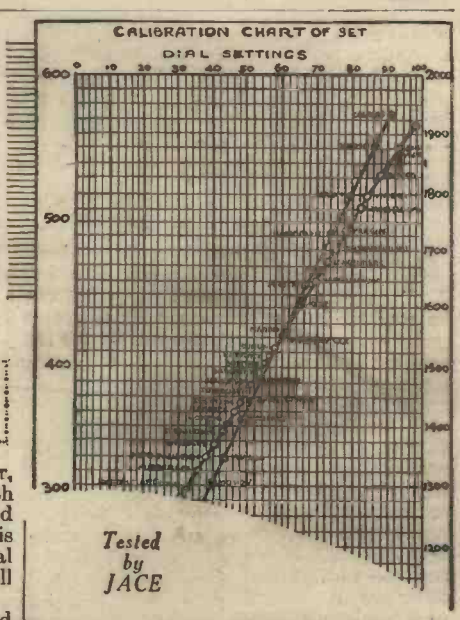
The controls on the receivers are very simple to operate; there are three in all, and these are placed immediately underneath the condenser scale. That on the left operates a two-way change switch; when turned to the right the long waveband (1,000-2,000 metres) is switched in; when turned to the left, the receiver is set for the reception of stations working on wavelengths between 200–600 metres. The centre knob controls the tuning condensers, and moves the indicator finger over a scale clearly marked in degrees. Volume, once a station has been tuned in, can be increased by means of the right-hand knob acting as a reaction control. For the capture of local broadcasts, even with an indoor aerial, very little reaction was needed, thus furnishing ample latitude without reaching oscillation point for finding more distant transmissions.

From such a simple two-valver too much must not be expected; it will not bring in all Europe, but with an outdoor aerial it was found possible to log Radio-Paris, Eiffel Tower, and even Warsaw on the long waves during daylight hours, with, in addition, Oslo, Motala and Huizen after dark. Daventry National provided a good signal throughout the day and evening. On the medium waveband, London National and Regional were free from mutual interference, and a number of foreign broadcasts, including Poste Parisien, Leipzig (new transmitter), Brussels and Prague were tuned in at a strength which classed them as "possibles" under favourable conditions. The selectivity of the *Atlas Two* is good, inasmuch as with some little care in the use of the controls it is possible to cut out such powerful transmissions as those from Brookmans Park, and to receive broadcasts from foreign transmitters: the reaction control is exceedingly smooth and greatly facilitates the work.

The moving-coil speaker was of very pleasing tone; in its reproduction of music the quality was all that could be desired, for speech it struck me particularly in regard to clarity. Although boxed into a small cabinet, there was no boom, and mains hum at no time was very noticeable. On all models, two special sockets are provided on the terminal strip for the connection of a pick-up, with the addition of an external potentiometer—the volume control on the receiver is inoperative when a pick-up is used—records were strongly amplified and reproduced without distortion. Moreover, provision has also been made for an additional loud-speaker; it is only necessary to plug the leads into the sockets at the back of the cabinet. If, however, the second speaker is used at some distance from the set, one lead may be connected to a terminal of a 2-microfarad condenser, the other terminal of which is taken to the upper L.S. socket on the receiver. The other unconnected lead of the speaker is then run to the nearest earth or water-pipe connection.

Finally, the receiver is housed in a tasteful cabinet of good appearance. Made by H. Clarke & Co. (Manchester), Ltd., Atlas Works, Eastnor Street, Old Trafford, Manchester, both D.C. and A.C. models are sold at £10 10s. 0d. complete; the battery model, with permanent-magnet moving-coil speaker, being priced at £6 10s. 0d. (without batteries or accumulator). The *Atlas Two-Valver* is a well thought-out receiver, economical in upkeep, and can be recommended for its all-round efficiency.

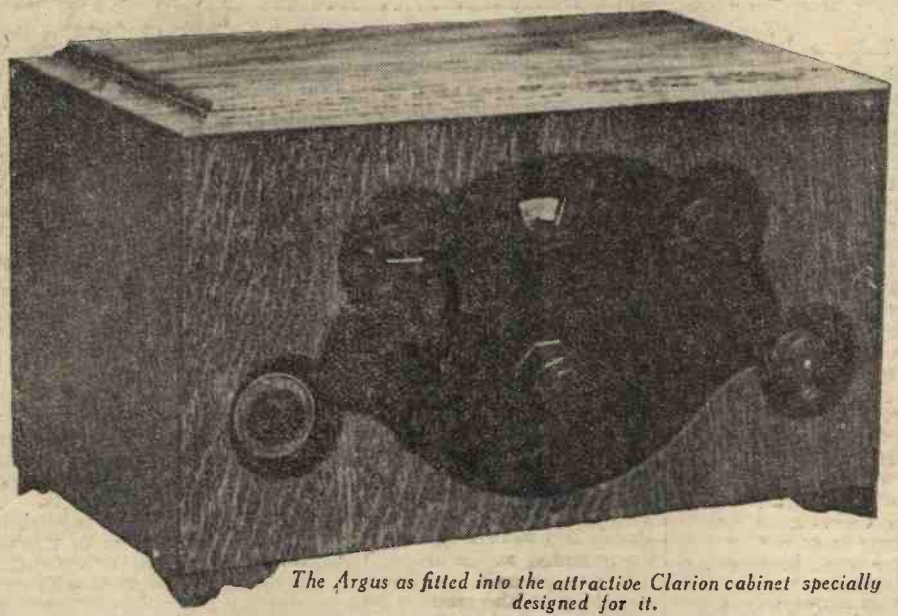
The very attractive lay-out and high degree of finish of the Clarke's "Atlas" two-valve model R.D.2 is apparent from this illustration.



ELECTRIFYING—

How to Modify Our Wonder Receiver (Described in Last Week's Issue) Unit. No Modification to the Actual Set

A NUMBER of enquiries have been received from readers who are building the Argus, asking if it can be worked in conjunction with a mains unit. Other readers are anxious to use the receiver in the construction of a radio-gram. Unfortunately, there are four positive H.T. tappings for this receiver, and one of the voltages is rather critical. A mains unit to give the voltages required is not easy to obtain, and therefore a special unit has been designed, and this article is written for those who wish to make both the mains unit and the radio-gram version of the Argus. It has been decided not to convert the receiver to "all-mains" operation, as this would entail a completely re-designed receiver, and, in addition, with two S.G. valves, the receiver would require very careful construction and elaborate screening to prevent instability. This would lead probably to such modification of components, etc., that the Argus would lose its identity. In addition, no doubt a good many readers have already started purchasing the necessary components, and would not wish to discard any of them. Therefore, it will still be necessary to use an accumulator for lighting the filaments of the valves in this electric version of the receiver, but this is not an expensive item, and as only a two-volt accumulator is needed, and a large radio-gram cabinet is provided, one of the larger types of accumulator may be installed, and will only require recharging at long intervals. From the illustration it will be seen that the well-known Adaptagram cabinet has been used, with a Simpson's electric turntable and Igranic pick-up. The receiver is exactly as has been described in the last two issues of PRACTICAL WIRELESS, and no deviations whatever are required to this receiver. The mains unit is made up as a separate part, and is stood at the bottom of the cabinet, the battery cords provided on the receiver reaching down to the unit. The loud-speaker is fitted to a small baffle behind the speaker grille, and a mains on-off switch is attached to the side of the cabinet. To all intents and purposes, therefore, the receiver is an all-mains radio-gram.

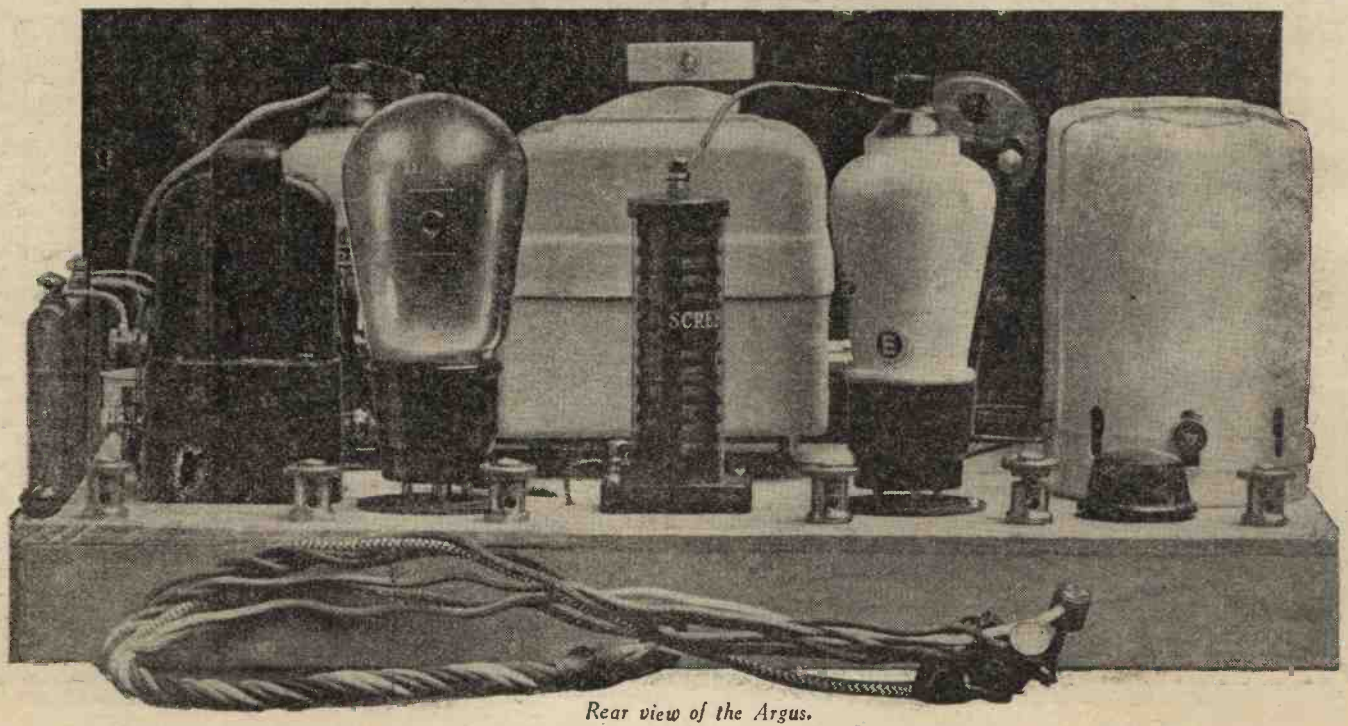


The Argus as fitted into the attractive Clarion cabinet specially designed for it.

FOR WIRING DIAGRAM AND LIST OF COMPONENTS OF THE MAINS VERSION OF THE ARGUS SEE PAGE 488.

The Mains Unit

The first item to receive attention is the mains unit, and it will be noticed that a mains transformer is employed which is provided with two unused windings. The reason for this is that, with the progress which radio makes in these days, it is quite



Rear view of the Argus.

THE ARGUS

for Mains Operation, by Means of a Simple

is Necessary

conceivable that before many months have elapsed the reader will be desirous of either remaking the receiver portion of the set or trying out some other mains apparatus. The provision of the windings on the transformer will, therefore, avoid any further expense, and at the same time a transformer is obtained which is a thoroughly reliable and well-made article. The eliminator will prove a good investment, therefore, and should be constructed exactly as described. The baseboard for the unit is 12in. by 8in. The mains transformer is mounted at the end of the base, and the flex which is attached to the mains side of the transformer should be anchored to the baseboard with a strip of wood in order to avoid it being pulled off and so producing a short-circuit. It will be noticed that a length of flex is required, and that the switch is wired in one of the leads. This is best carried out by attaching the Belling Lee terminal block to the baseboard, and joining the two terminals to the appropriate mains transformer terminals, according to the house supply voltage. The unit should then be stood on the baseboard in the position it is finally to occupy, and a single length of flex cut off which will reach from one of the terminals to one side of the switch. Another single length of flex must then be cut which will reach from the switch to the house plug which will be employed. From this plug a single length of flex is then required which will reach to the remaining terminal on the baseboard. When these lengths have been decided upon, they should be plaited together, so that the final effect is one length of twin flex, with the switch inserted in one wire. A small insulated bell staple should be driven into the rear upright just above the switch to firmly hold the flex and prevent it being pulled off. It may also be attached along the leg of the cabinet with staples in the same way. Next mount the choke, fixed condenser and other components on the baseboard, adhering to the wiring diagram and using the Glazite wire which we specify. The panel must be drilled and the terminals and potentiometer mounted as shown.

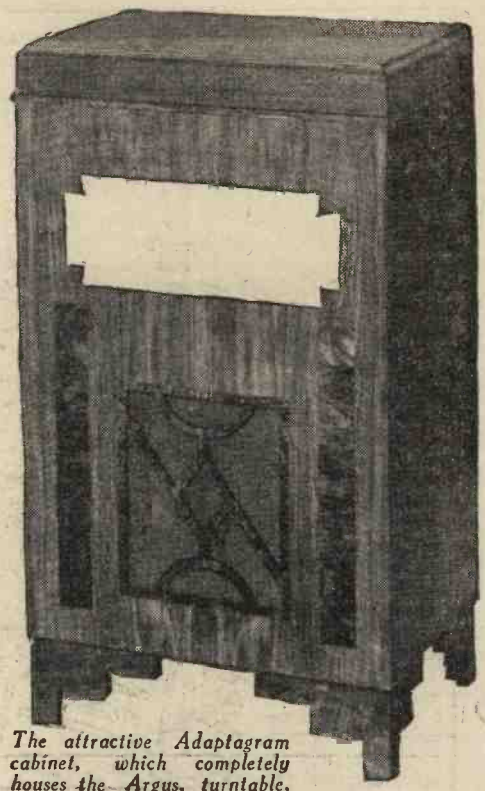
The Gramophone Motor

The electric turntable will require to be mounted in accordance with the makers' instructions, and this part of the work will be found exceedingly simple. Use the template supplied with the pick-up when mounting the carrier arm, and pay particular attention to this part of the work, as the life of the records will depend upon accurate tracking, and this is only obtained when the unit is accurately mounted. The leads from the pick-up must be long enough to reach the pick-up terminals on the receiver chassis, and they should be twisted together. No mains interference should be experienced with this receiver, and there is therefore no necessity to employ metal-sheated leads for this part of the wiring. The mains leads for the gramophone motor should be joined to the two terminals which are mounted at the end of the baseboard of the mains unit. In this way the act of switching on the receiver also switches on the electric supply to the motor, the separate motor switch being then used to start or stop the turntable.

The leads for the motor should be twisted with the other mains leads.

Mounting the Receiver Chassis

A small piece of wood ½ ins. thick will have to be placed on the receiver shelf, which is supplied in the adaptagram cabinet, in order to raise the chassis so that the on-off switch will clear the lower part of the panel cut-out. The receiver should then be placed in its position, and to avoid movement it is advisable to attach small brass angle brackets or some similar device at the sides of the chassis, and, when in its correct position, screw it down. Connect up the respective leads, joining the battery cords to the terminals of the appropriate voltages, and set the potentiometer on the unit about one-third of the way round. Join up an accumulator to the L.T. cords, and the receiver is ready for testing.

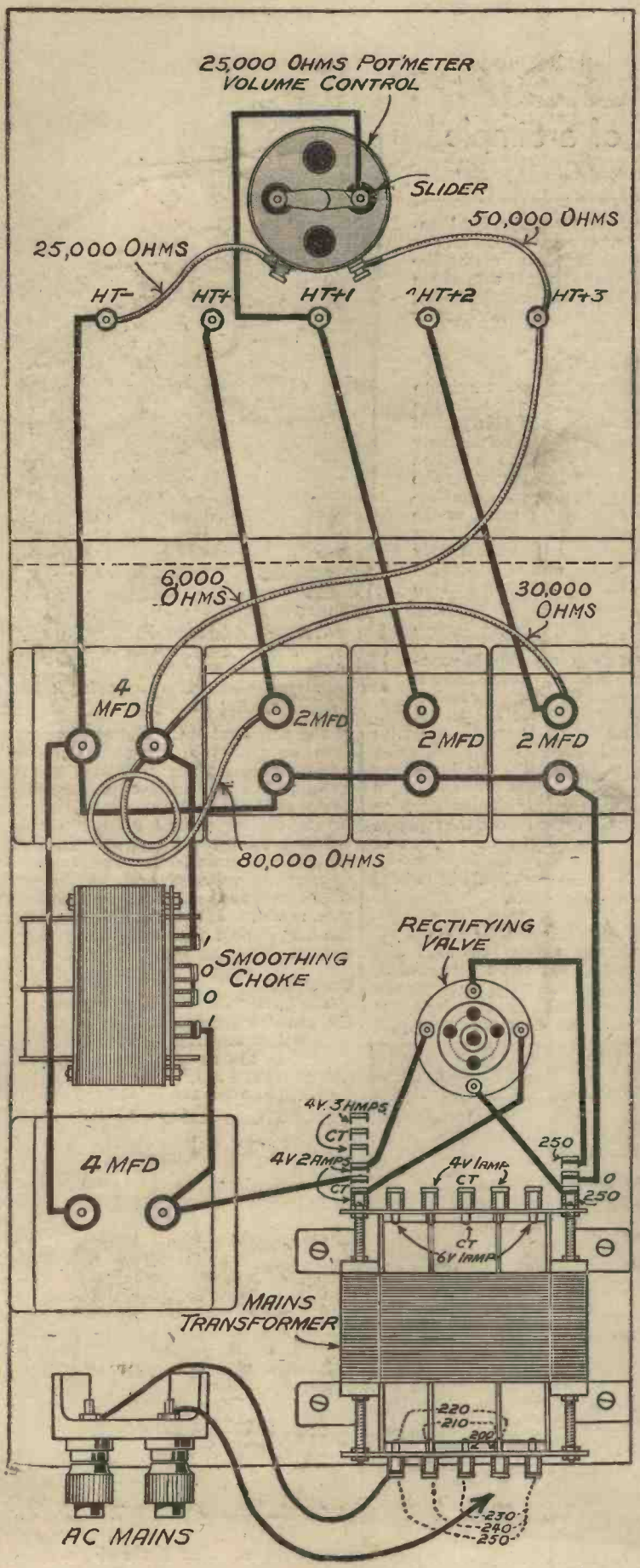


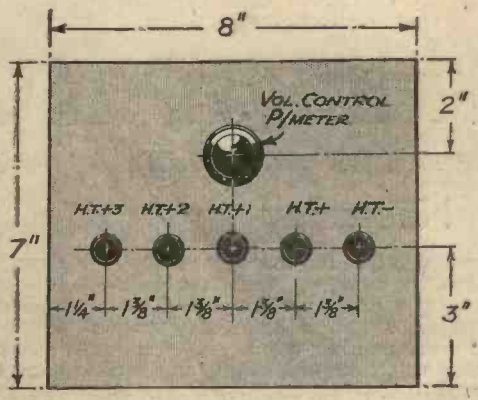
The attractive Adaptagram cabinet, which completely houses the Argus, turntable, and mains power unit, thus converting it into an efficient radio-gram.

Operation

The instructions for operating are exactly the same as for the battery set described last week, the only differences being in the battery voltages. H.T.+, H.T.+2, and H.T.+3 are already provided for in the unit, but H.T.+1 will require adjustment on the potentiometer to get a nice, smooth control of the reaction.

Three-quarter rear view of the Argus.





PANEL LAYOUT

ELECTRIFYING THE ARGUS

(Continued from page 487.)

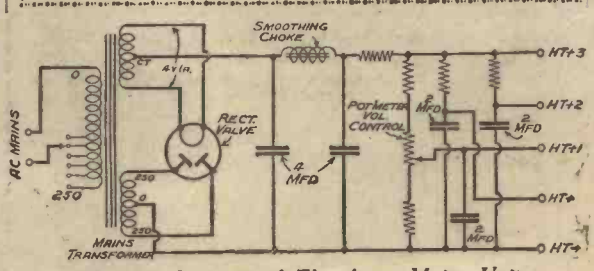
The receiver should, therefore, be adjusted to a weak station, and then the potentiometer turned slowly, trying the effect of the reaction control at the same time. A position will be found where maximum results are obtained without the receiver bursting into oscillation. Once this position has been found, the Unit will not require touching again. It will be noted that we have specially selected an Adaptagram cabinet for the Argus. The photograph on the preceding page indicates the attractive lines of the cabinet, and no difficulty will be experienced in fixing the set into it. When the top of the cabinet is lifted ample space will be found in which to accommodate one of the electric turn-tables of the induction motor type ; or alternatively, if the reader desires to use a clockwork gramophone motor, there is still ample space between the motor-board and the top of the set to accommodate it. The manufacturers of the Adaptagram cabinet will supply it with turn-table, motor, etc., complete.

We should like here to stress the fact that we have been to enormous pains to perfect the Argus so that it would satisfy the most critical home-constructor and listener, and it is very desirable, therefore, when writing to advertisers, to order the parts we have actually specified. If you do this, you are bound to obtain from this, the most modern of all receivers, the same remarkable results as we obtained.

Do not hesitate to write to us if you encounter the slightest difficulty.

ADDITIONAL COMPONENTS REQUIRED FOR THE CONVERSION OF *THE ARGUS THREE.*

Igranic Mains Transformer (Cat. 2250-24).
Igranic Choke CH2.
Two Formo 4 mfd. Fixed Condensers.
Three Formo 2 mfd. Fixed Condensers.
Four Lewcos Spaghetti Resistances, 25,000, 30,000, 50,000 and 80,000.
One Telsen 4-pin Valve Holder.
Lewcos 50,000 ohm Potentiometer.
Igranic Pick-up and Tone Arm.
Cossor 506 BU Rectifying Valve.
Becker Mains Switch, Type 475.
Peto-Scott Adaptagram Cabinet.
Goltone Combination Mains Plug.
Two yards Twin flex.
Simpson's Electric Turntable.

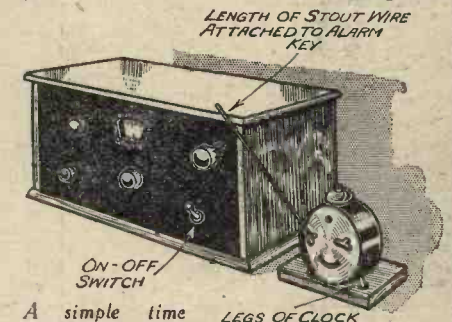


Theoretical circuit of The Argus Mains Unit.

THE HALF-GUINEA PAGE — Radio Wrinkles FROM READERS

A Simple Time Switch

THE accompanying diagram shows how I work my automatic time switch. It is very simple for anyone to fix, provided they have the necessary alarm clock and a piece of stiff wire. When fitting this

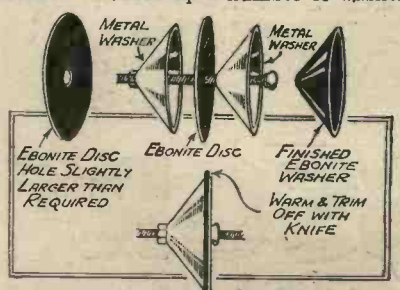


A simple time switch made from an alarm clock.

gadget I found it necessary to replace the usual push-pull switch with an easy-action toggle switch. My object in devising the gadget was for it to be possible to have the set switched on at the right time; for instance, when I did not want to listen to a particular programme but did not want to miss the beginning of the next part, such as a vaudeville preceded by a talk. To operate, the clock is set to the required time, and when the alarm is set going this causes the "key" to revolve; in turn the wire is carried down with sufficient force to knock the switch on. The wire then passes over the switch knob and down on to the shelf or whatever the cabinet is resting on. To re-set, all that is necessary is to bring wire up again, which rewinds the alarm automatically.—F. GAGE.

Cone Washers for Speakers

FINDING the usual type of metal cone-washer apt to produce rattle, particularly with linen-type speakers, the following idea occurred to me, and worked well in practice. I made up a number of washers



Anti-rattle cone washers made from ebonite.

in thin sheet (veneer) ebonite, by the simple process of warming the sheet ebonite, cutting out discs, and clamping between two metal cone-washers of the required size, warming again, and screwing up tight and leaving till cool. I find that washers made in this way are completely free from rattle. When warmed, this thin veneer ebonite becomes quite limp, and will be found to cut quite easily with a pair of scissors.—R. L. GRAPER (St. Albans).

THAT DODGE OF YOURS!

Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? For every item published on this page we will pay half a guinea. The latest batch is published below. 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 Wrinkle."

A Useful Accumulator Tray

THE following suggestion may prove useful to readers whose accumulators, when delivered by the local accumulator service, are generally covered with spilt acid. Obtain a piece of thin sheet lead 2in. bigger on all sides than the base of the accumulator. Mark off a line 1¼in. from each edge and bend the metal up on these lines. This is best done by placing a block of wood on the marked piece of lead, and tapping the lead up to it with a light mallet or

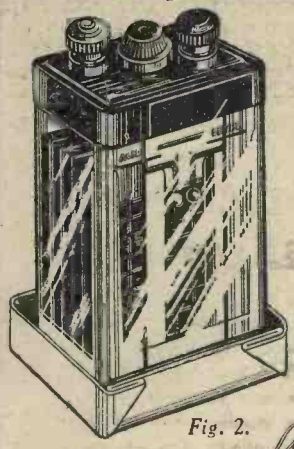


Fig. 2.

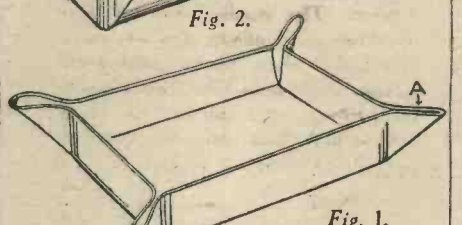


Fig. 1.

A handy accumulator tray.

hammer. The metal will then assume the shape indicated in Fig. 1, with projecting lugs at each corner which should be flattened as at A, and finally bent over to complete the tray as shown in Fig. 2. The result is a neat acid-proof job which can be used for L.T. or H.T. accumulators. Care must be taken not to pierce the metal in bending it up as the resultant leak would render the tray useless.—O. S. PICKERING (Birkenhead).

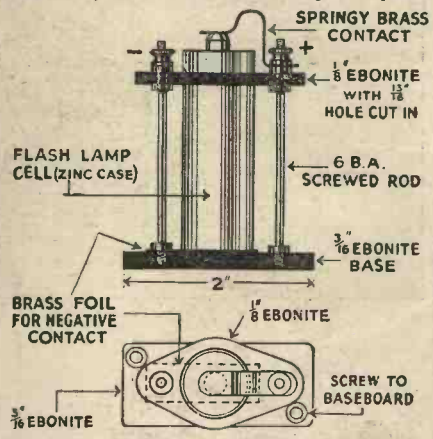
A novel earth.

An Efficient Earth

FOR the past twelve months I have been using the earth system shown in the accompanying sketch. A copper canister is filled with salt and bits of copper wire and foil. The end of the aerial wire passes through a hole in the lid, to which it is well soldered. This arrangement makes a very damp and efficient earth. Instead of the canister, a large cocoa tin can be used, but this, of course, would not last so long as a copper container.—H. CASE (St. Helens).

Cheap Grid-bias Current

A CONSTANT and cheap supply of grid-bias current for the ordinary type of screened-grid valve is assured by the little device illustrated herewith. It is simple to construct, and a fresh cell is easy to replace.

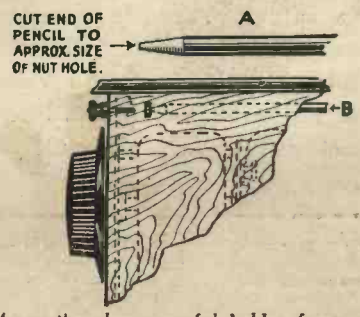


Using flash lamp cells for grid bias.

I have been using this idea for the last two years, and have found it reliable in use. The ordinary flash-lamp battery, after doing its service in the lamp, will generally contain one or two cells which register 1 to 1½ volts, and these cells will give a bias supply for three to four months. To replace the cell, swivel the brass contact round. Any convenient number of these holders can be made, according to the voltage required.—J. C. METCALFE (Beverley).

Fitting Nuts in Awkward Places

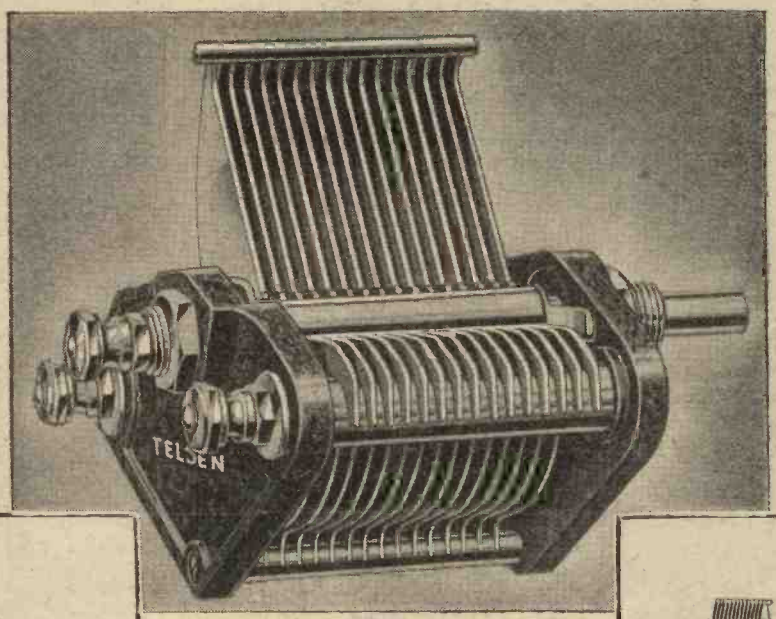
THIS simple dodge enables nuts to be easily put on the ends of terminal stems, or other screws, in places inaccessible to pliers or the hands. Cut off the tip of an



A pencil makes a useful holder for nuts.

ordinary pencil or wooden skewer, as shown at A, and push the end about half-way through the nut. Hold the nut against the end of the screw, press slightly, and give the pencil a twist. Screw up from the other side, and the screw will push the pencil out as it engages the thread of the nut.—H. LYTE (Warrington).

PRECISION

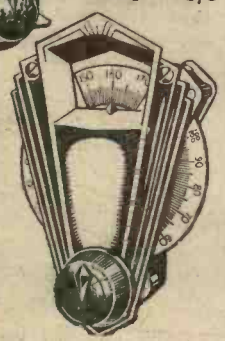


TELSEN TELORNOR

An illuminated Disc Drive embodied into an unusually handsome silver oxidised escutcheon plate, complete with artistically grouped Volume, Tuning, On-Off, and Push-Pull controls 7/6

TELSEN DRUM DRIVE

Embodies numerous refinements, including cord drive and rocking stator trimmer. An extra scale, graduated for wavelength tuning, is supplied free of charge - 8/6



TELSEN ILLUMINATED DISC DRIVE.

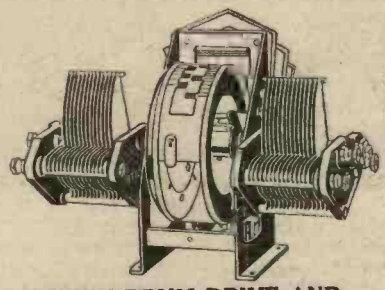
Fitted with handsome silver oxidised escutcheon plate and incorporating an improved movement, making for delightfully easy tuning . . . 3/6

TELSEN LOGARITHMIC VARIABLE CONDENSER

The Telsen Logarithmic Variable Condenser is a component whose precision, allied to its sturdy construction, ensures years of faithful service. The sturdy frame is braced by three solid pillars, and the vanes clamped at three points, making distortion impossible. The rotor is also built into a rigid unit and the vanes held at both ends, generous bearings preventing backlash or endplay.

Cap. .00025	4/6
Cap. .00035	4/6
Cap. .0005	4/6
Cap. .0005 (left-hand movement with trimmer) ...	5/-
Cap. .0005 (right-hand movement with trimmer) ...	5/-

TELSEN RADIO COMPONENTS



TELSEN DRUM DRIVE AND CONDENSER ASSEMBLY.

A complete drum drive and ganged condensers tuning unit, with a handsome escutcheon finished in oxidised silver. An extra scale (marked in wavelengths) is supplied free 17/6

TELSEN SMALL FRICTION DISC DRIVE.

A low priced disc drive for auxiliary controls. It is extremely robust and may be used for main tuning condensers where considerations of space make it desirable . 2/6

TELSEN SLOW MOTION DIAL.

(Black or Brown Bakelite)

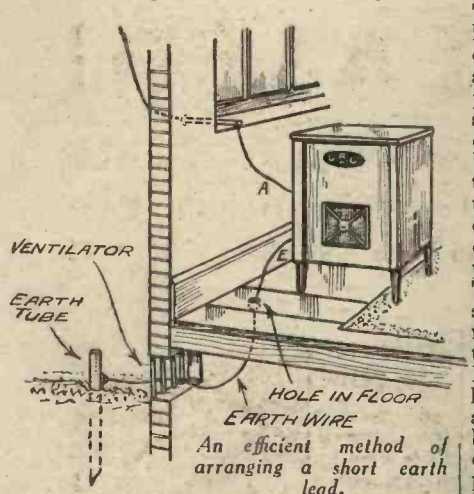
Made with a gear ratio of 8-1, the disc being graduated from 0-100 in both directions. Supplied complete with instructions for mounting on all panels up to 3/16" thick . 2/-

TELSEN RADIO COMPONENTS ARE 100% BRITISH

ANNOUNCEMENT OF THE TELSEN ELECTRIC CO., LTD., ASTON, BIRMINGHAM

A Short Earth Lead

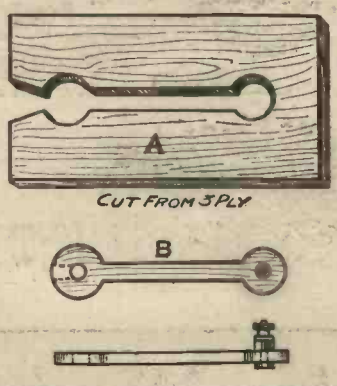
A VERY short earth lead can be provided in the following manner. Bore a small hole in the floor as close as possible to the ventilator in the wall, as indicated in the sketch. Push the earth wire down through the hole, and then, from outside the house, pull the wire through the ventilator with the aid of a length of stout wire with a hooked end. Secure the end of the wire to an earth tube driven into the soil close to the ventilator, and you have a short and efficient earth.—M. F. DAWE (Dartford).



An efficient method of arranging a short earth lead.

Making Lead Terminal Tags

THE bugbear of corroded terminals on the L.T. accumulator can be obviated by a simple attachment. All that is necessary is a small piece of three-ply wood cut out to the shape A in sketch. To each side of this is placed two plain pieces of plywood of the same overall size and the whole is then clamped or tied tightly together—this being the "mould" for the extension arms. Now obtain some scraps of lead and place in the lid of a tin to which a lip has been made for pouring. Heat over a gas ring until the lead becomes molten, then carefully pour into the mould at the V-shaped end, and the result will be a casting as indicated by B in the sketch. In one end a hole sufficiently large is made to fit on the accumulator terminal stem, the other end having a terminal fixed on for wiring to set. A slotted alternative end can be made, as indicated by dotted lines in sketch B, enabling quick release from accumulator for charging purposes.—E. DAVEY (Plymouth).



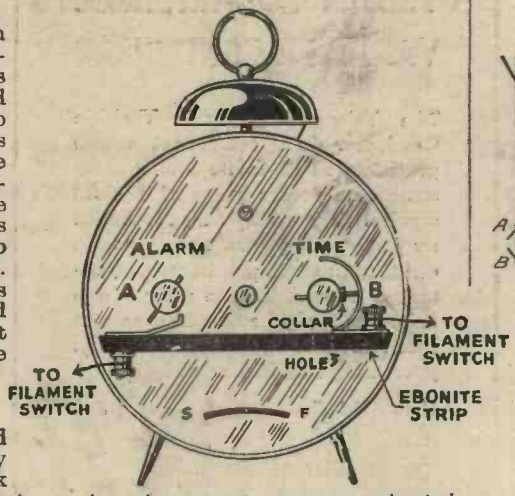
A method of making lead terminal tags for accumulators.

Auto Remote Control Switch

IN the accompanying illustration, which is almost self explanatory, the winding key handles of the clock are removed, and pieces of thin brass rod fixed in place of them. The alarm side is fixed and the other side is a good sliding fit, a collar being fixed as shown to make a stop on one side. The switch, which is connected by short leads across the filament control switch, operates as follows: The clock is wound, and the alarm being set to the time the programme is required, contact B is set in such a position that it may travel on the contact for a pre-determined time when the brass rod will drop out through a hole in the ebonite strip, thus breaking the contact and switching off the set. The rate of travel of contact B may easily be calculated by timing the clock over a certain period and noting the distance travelled. Thus, when the programme is due to start, the alarm is released and the brass rod makes contact with the fixed contact, thus completing the circuit through A and B. After the required item has been heard, loose contact B should, by then, be approximately ready to fall out, thus breaking the circuit. The ordinary control switch should be in the off position when the automatic switch is being used. As shown in the sketch, the switch is in a position such as it might occupy before making contact for about two hours' duration.—W. H. M. JAMES, (South Norwood).

Battery-charging Switch

THE accompanying sketch shows a very cheap and convenient switching arrangement, which enables users of home battery chargers to always have a fully charged battery ready at a moment's notice, just by throwing over the knife switch and plugging into the respective sockets, a matter of a few seconds. The cost of this convenient device is about one shilling, and reference to the sketch will show how it is constructed. All that is required is a double-throw double-pole switch, and three old plug-in coil bases, mounted on a piece of wood. Even when batteries are charged elsewhere, few listeners who have a stand-by battery make use of this type of switch. The batteries can be connected to the set ready for immediate use by taking set leads to knife terminals, and battery leads to each of the respective poles, no plugs being required for this.—A. K. V. SMITH (Swanscombe).



A simple automatic remote control switch.

A Useful Rotary Switch

THOSE constructors who have jacks of various types from old receivers will probably find the switch shown in the accompanying sketches an improvement. It is fitted with an extension handle which makes it possible to mount the switch close to the grid of the first valve, thus avoiding H.F. losses. In the illustrations, Fig. 1 is a perspective view of the complete switch, showing how the jacks and rotor are mounted. Fig. 2 shows the notches for making and breaking circuit, and Fig. 3 shows the application of the switch in a detector circuit.—D. H. ALDINGTON (Brixton).

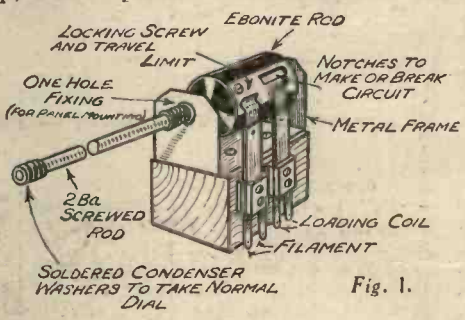


Fig. 1.

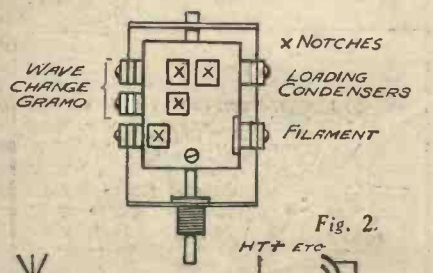


Fig. 2.

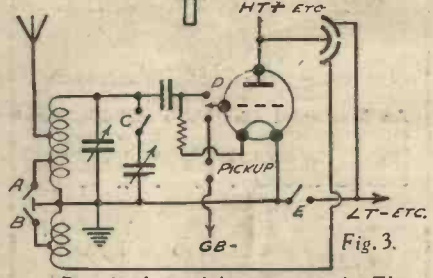
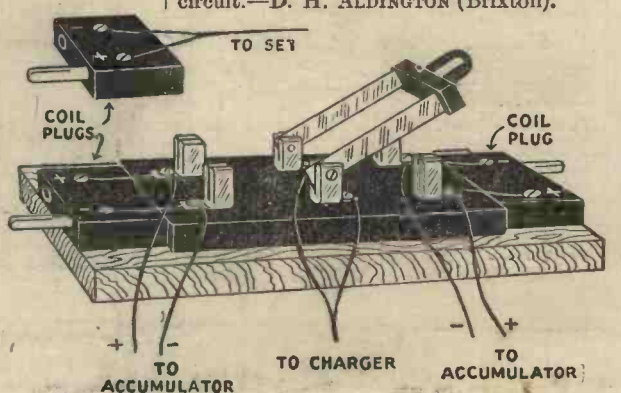
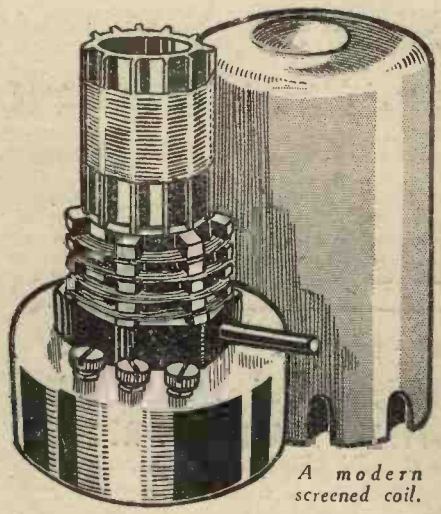


Fig. 3.

Details of a useful rotary switch. The lower diagram shows its application.



A handy switching arrangement for battery charging.



A modern screened coil.

SOME NOTES ON THE CHOICE OF COMPONENTS

By R. S. ROBERTS

Points which the Amateur Set Designer Should Watch

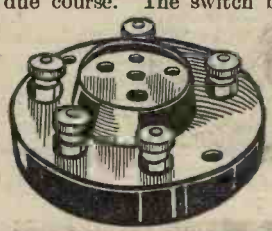
WHEN you have settled on the design of your new receiver—the number of valves and the circuit—you reach the point where the individual components have to be considered in detail. Shall I use A's choke or B's? C's condensers or D's? In the case of a receiver design published in PRACTICAL WIRELESS the question hardly arises. The designer, after careful tests and consideration, has decided that certain components are suitable for his design, so he uses them. The reader who decides to build the receiver may wonder whether he can use any components that he has by him; it will be shown later that such a question needs very careful consideration before any departure from the specification is attempted.

The reader who is creating his own design has such a wide choice of components available for use in his circuit, that it will pay him to give very careful consideration to his selection. Quite a number of excellent designs and circuits have been spoiled by the choice of a component that is not quite suitable for its job; it may be a very excellent article, but the disposition of its terminals may be such as to lead to an awkward layout, often resulting in instability. It must not be thought that there is an abundance of "dud" components on the market awaiting a home with the unwary purchaser; whilst such a state of affairs may have existed some years ago, it certainly does not exist to-day. Keen competition and progress in design in this country have resulted in a large range of reliable components that are excellent value for money, and second to none in the world.

Tuning Coils

Let us consider what might be termed the artery of the receiver—the coils. We can obtain coils suitable for almost any purpose; we can have them screened or unscreened, we can have them with built-in wave-change switches or we can arrange for wave changing to be accomplished by switching separate from the coil. There are several generalisations we can make regarding coils. The most important is that a "Canned" coil is less efficient than an unscreened coil of the same overall dimensions; this implies that with the less ambitious receiver of the "Det-L.F." type, we have nothing to gain by using a screened coil (unless we are using a pair in a band-pass arrangement)—in fact, we have everything to gain by using an unscreened coil of fairly large diameter to obtain the utmost efficiency.

The question of wave-change switching for the coils and layout, should generally be considered together. The coil may have a built-in switch of the push-pull type, whilst the other controls on the panel are of rotary type, or *vice-versa*; we may find that we upset the symmetrical arrangement of our panel layout if we attempt to use a coil with a built-in switch, we then have no alternative but to select a coil with the necessary terminals to connect to a switch on the panel—of the type we require be it either push-pull or rotary, and we can put it in the position we choose to maintain our "clean" panel layout. Regarding coils with built-in switches, it is well worth our while to examine the switching mechanism before putting the coil into use. A nut or screw may have become loose during transit from the manufacturer to the dealer; the movement should seat into its position yet be free in action, no harshness or grating should accompany a rotation of the spindle, otherwise trouble is almost certain to arise in due course. The switch blades should



A standard valve holder.

"give" slightly when in the make position, thus ensuring a sound and reliable contact.

Valve Holders: Good Contact Essential

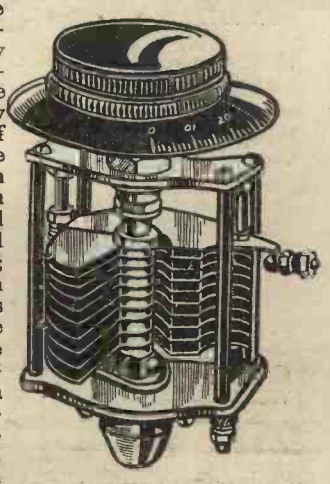
The importance of good contact is often overlooked in the design of another important component—the valve holder. The resistance due to a bad socket between the socket and the legs of the valve may cause quite an appreciable voltage drop, resulting in the valve being under-run; this is especially important where mains valves are used. The voltage drop due to a resistance—such as a bad contact, is directly proportional to the current flowing in the circuit; it will be seen, therefore, that the comparatively heavy current taken by mains valves results in the effects of bad contact in the valve holders being far more serious. Another important point arising out of the question of valve-holder contact concerns the two types of valve pin. Battery valves are usually fitted with pins of the split or "banana" variety and good contact can generally be ensured by spreading the leg with a penknife; mains valves are fitted with a solid pin and good contact can only be obtained, therefore, by selecting a valve holder with a socket that grips the pin. It should be pointed out that a few battery valves are fitted with solid pins and their holders should receive the same considerations as for mains valves.

Variable Condensers

Now, let us consider variable condensers. When considering the purchase of this important component it will be found that a satisfactory and reliable article will be obtained if the choice is limited to the more well-known British makes. A number of cheap foreign condensers are offered to the public at a price that seems attractive, but is in reality a poor investment for high electrical losses and eventual mechanical failure. The electrical losses are usually concentrated in the material that is used to insulate the fixed from the moving plates, this material is therefore of the utmost importance if we are to obtain the greatest possible efficiency from our receiver. Bakelite, Paxolin or Ebonite are usually quite satisfactory, but compounds of doubtful nature should be avoided.

The mechanical features of the condenser are often the items that "let down" an otherwise good component. Most condensers now have plates shaped to conform to a "Log" law, but in some cases the moving plates do not fully disengage from the fixed when the dial is turned to 0; this, of course, results in the minimum capacity being somewhat higher in value than it need be, resulting in a limited tuning range. The bearings for the spindle should be large and of such a type that the spindle cannot develop end play that might result in the vanes touching. The movement should be free from any "jerk" and should be quite smooth in action; it should not tighten at one end, and not be so free that the moving plates tend to fall under the action of gravity!

The manner in which the contact is taken off the moving plates should receive special attention. Condensers relying on a terminal secured to the metal end plate to provide this contact, are very often noisy in use due to the H.F. currents having to traverse the bearing surfaces before reaching the moving plates. Some manufacturers overcome this difficulty by short-circuiting the bearing by means of a flexible connection between the end plate and the spindle; in such cases it is advisable to examine this connection very carefully, making sure that it is really flexible and



The variable condenser of the slow-motion type.

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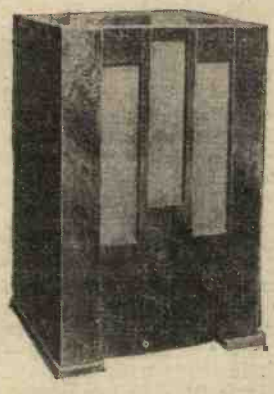

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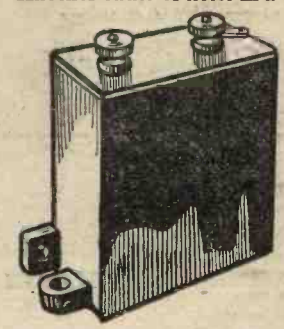
that it does not take a sharp bend at any point. It should be realised in this connection that, mechanically speaking, the variable condenser is probably the hardest-worked component in the receiver! Condensers for short-wave work should be examined very critically for anything that may give rise to noise; loud crackles might be caused by mechanica weaknesses that may cause no trouble whatever when applied to condensers used for long-wave working, bearings are the chief offenders and there is a lot to be said in favour of the few short-wave tuning condensers that have only one bearing. Another cause of noise in a tuning condenser is our old enemy—dust. Most of the good modern condensers are now fitted with covers which serve the double purpose of excluding dust and maintaining a neat appearance.



A fixed condenser of the Mansbridge type.

A word about trimmers before we leave the subject of variable condensers. Trimming of a modern ganged condenser is usually achieved by varying the distance between two small plates, insulated from one another by a thin sheet of mica. The adjusting screw should show no tendency to overturn, and the mica sheet between the plates must have plenty of overlap to prevent the plates touching and resulting in a short-circuit of the condenser section.

Condensers in All-Electric Receivers

With all-electric receivers and sets that derive their H.T. supply from a power unit, a considerable amount of thought is usually given to the smoothing condensers in the power unit to see that the correct "working voltage" types are obtained; it is not often realised, however, that some of the more humble condensers in the receiver proper have to withstand the full voltage that the power unit will deliver.

Let us consider, for example, the reaction condenser in the detector anode circuit of a simple receiver. One set of plates is usually connected to the H.T. positive—as a rule through an H.F. choke, and possibly the primary of an L.F. transformer, another set of plates is connected to H.T. negative, either directly or through the reaction coil. If the detector is working on the power grid principle a voltage of anything between 100 and 200 is usually used. A breakdown of the reaction condenser's insulation might result in a burnt-out H.F. choke, transformer, reaction coil, or the whole lot!

It will be realised that any fixed condensers that are used for resistance coupling between valves or resistance feed to an L.F. transformer have to withstand the full anode voltage, but there are two important considerations to be borne in mind when selecting condensers for these positions. The first is that if the condenser has a slight leak—even though very small—a current will pass through it from H.T. positive to H.T. negative (an examination of almost any modern circuit diagram will make this clear). The effect of this leakage is to put a positive bias on the grid of the succeeding valve. This unintentional positive bias tends to cancel the normal negative bias we are putting on the valve—it may even cancel it entirely—resulting in the anode current being very much higher than it should be, and the quality of reproduction being very much below standard.

The second consideration applies where indirectly heated valves are used in the receiver. These valves take some time for the cathode to become sufficiently hot to allow any anode current to flow, and during this time, if the power unit uses a directly heated rectifier valve or a metal rectifier, an excessive voltage is being applied to all the condensers connected between H.T. positive and H.T. negative. This voltage may be as much as twice the normal working voltage, due to the fact that the voltage of a power unit rises when there is no load on it, the load, of course, being the anode current taken by the valves.

It will be seen from the foregoing remarks that condensers for resistance coupling, transformer feeding or any position in the circuit that causes the H.T. to be connected across them, should be carefully considered. As a rule mica condensers should be used in preference to those with paper insulation, the insulation resistance being very much higher and the risk of breakdown lower. If a receiver is fitted with a choke output circuit, the condenser feeding the loud-speaker should receive special consideration. In addition to having to withstand the normal working voltage (and any increase due to no load on the power unit), high voltages are being developed by the L.F. energy that is feeding the loud-speaker, and may quite easily cause a breakdown that may prove disastrous to the speaker and possibly the output choke.

Transformers

The selection of L.F. transformers can sometimes lead one astray, chiefly owing to the large number of different types that are available. Transformer coupling can be grouped into two classes: (1) direct—that is, where the primary is connected directly into the plate circuit of the preceding valve, and (2) resistance fed, where the primary is fed from the plate circuit by a resistance-condenser combination.

The chief difficulties with class 1 transformers lie with the choice of ratio. All ratios are available from 1–1 to 1–10, and the constructor is often bewildered by the variety of ratios available. Unfortunately, the whole question is too complicated for us to lay down a hard and fast rule and say "A 1–1 should be used here and a 1–1 there"; but probably the most important item to consider is the inductance of the primary winding. Generally speaking, it can be assumed that the transformer with the lowest ratio has the highest primary inductance and the transformer with the highest ratio has the lowest inductance. The inductance of the primary has an important bearing on the quality of reproduction and—again speaking generally—the higher the inductance the better will be the amplification of the low frequencies. The position is somewhat complicated by the facts that the inductance varies with the amount of anode current flowing through it, and even amplification of all frequencies depends to a large extent on the impedance of the valve; it will be realised, however, that we cannot take advantage of the increased amplification offered by, say, a 10–1 transformer and hope to retain the high quality of a 2–1 ratio.

With class 2 transformers, the inductance of the primary is unaffected by any variation of anode current due to it being isolated from the plate circuit by the condenser; only the A.C. representing the low frequencies we are amplifying is allowed to flow through the primary, which thus maintains the high inductance so essential to quality. A snag with this system is presented by the voltage drop across the coupling resistance preventing the valve working at the same efficiency as it would with a direct-fed transformer. The whole question of the choice of transformer coupling becomes very involved when considered in detail, but sufficient has been pointed out to show that a designer who specifies a particular L.F. transformer has good reasons for doing so, and any alteration may lead to a loss of amplification or inferior quality.

Volume Controls

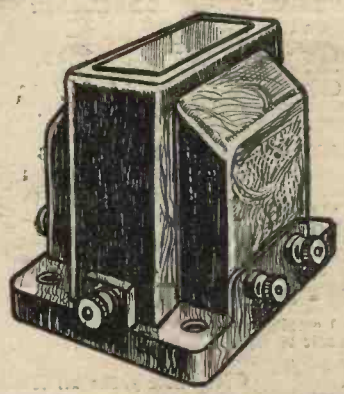
Finally, a word about variable resistance volume controls. These are generally to be found in two types, either with a wire-wound or using a carbon element in some form or other. The most important practical considerations for the selection of wire-wound controls are:

(1) The wiper or contact must not drag or otherwise strain the fine wire forming the element.

(2) The element should be completely enclosed to protect it from damage and dust. Dust on the contact track will result in noisy operation.

(3) The "wattage" rating of the control should be carefully considered with due regard to the amount of current passing through it when in use. Insufficient attention to this point (particularly if the control is to be used for varying the bias to variable-mu's in A.C. sets) may result in a burnt-out or over-heated volume control.

Regarding carbon type controls, the manner in which the contact is taken off the track should receive attention. If a wiper is used to rub directly on the track, the resistance value will, in all probability change with use, unless the contact itself is graphite or soft carbon. If the element is made by impregnating a strip of paper, it is almost certain to absorb moisture from the atmosphere and cause the resistance to alter. Carbon type volume controls must not be used in any part of a circuit where they will be required to pass a current exceeding about one milliamp unless a definite power rating can be obtained from the manufacturers for the particular type.

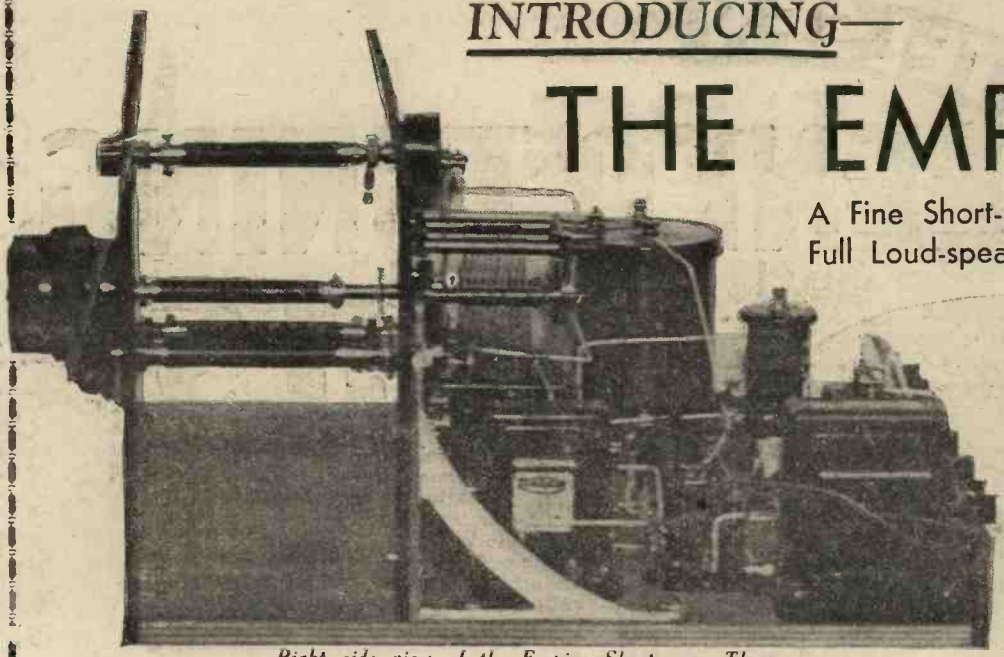


The Low Frequency Transformer. Note the terminal at the side of this model for earthing the core.

INTRODUCING—

THE EMPIRE SHO

A Fine Short-wave Receiver Which Will Rece Full Loud-speaker Strength. Wiring Diagram be Given Ne



Right side view of the Empire Short-wave Three.

WHAT is the Empire Short-wave Three? How does this receiver differ from other short-wave receivers? These are two of the questions that no doubt will come to the minds of some of our readers, so we will commence this article by stating that the Empire Short-wave Three is simply a three-valve receiver for working on the Short-Waves, *but* it has been designed in such a way that it overcomes at one blow all the shortcomings of other short-wave sets. There is no hand-capacity effect; there is no threshold howl; there are no "dead spots"; and finally it covers a wave-band of 12 to 80 metres, and employs a switch for wave-change purposes. It is obvious, therefore, without studying the circuit diagram, that there is something new about this receiver. The photographs and illustrations bear out this statement, for it will be noticed that a new and novel method of construction has been used for this receiver. Two ebonite panels, instead of the customary one, have been called into use, and the actual controls are mounted on the rear panel, with the control knobs on the front panel. The coupling from component to control is carried out by means of ebonite extension handles, and this method of construction definitely overcomes all hand-capacity effects. The tuning coil is a special component which has been designed and developed by Radio Instruments, a name which is certainly not new to radio. This coil is the result of much research, and overcomes the "dead spot" effect which has up till now been the cause of the failure of many short-wave receivers.

The Circuit

Before further discussing the design of this receiver, it would be as well, perhaps, to examine the theoretical diagram. The coil, it will be noticed, has a secondary winding, exactly similar to the ordinary dual-range broadcast coil, that is, it consists of one large winding, with a switch for short-circuiting a section of that winding, for use on a lower wave-band. The aerial coil will be seen to be in series with another coil, and it is this latter which makes all the difference to easy tuning on short-waves. As no doubt the majority of short-wave enthusiasts know, there are certain points on the short waves where the frequency of the aerial circuit is of such a value that the damping due to the load which this imposes on the tuned circuit becomes excessive. Dead-spots; threshold howl; weak reception points, and some other difficulties are caused when using the ordinary broadcast aerial. There are, therefore, two switches for this coil, one for changing the wave-band over which the coil operates, and the other for bringing into operation the aerial loading inductance. The detector valve operates on the ordinary leaky grid principle, with the leak taken to the arm of a Potentiometer in order that the valve may be worked at its most suitable point. The coupling between detector and first L.F. is by means of resistance capacity coupling, and in view of the fact that the first valve is of the R.C. type, having a large amplification factor, quite a good step-up is obtained. The first L.F. valve is transformer coupled to the output valve, and is also decoupled to avoid instability. The output valve, a Mazda P.220, is fitted with an output filter, so that the receiver is not simply an experimenter's "hook-up," but is a carefully designed receiver, employing the latest and best wireless practice.

The Layout

Returning again to the layout, it will be noticed that special rotary switches are employed for the wave-change and Antinodal switches, and the extension handles for these two components are slightly different from those used for the other components. These particular handles are provided with a small fitting at one end, which enables the small switch-knob to be attached, and this keeps the panel nice and neat. The tuning condenser is provided with a slow-motion drive, which has the remarkable reduction gear of

LIST OF COMPONENTS FOR T

Readers ordering parts should

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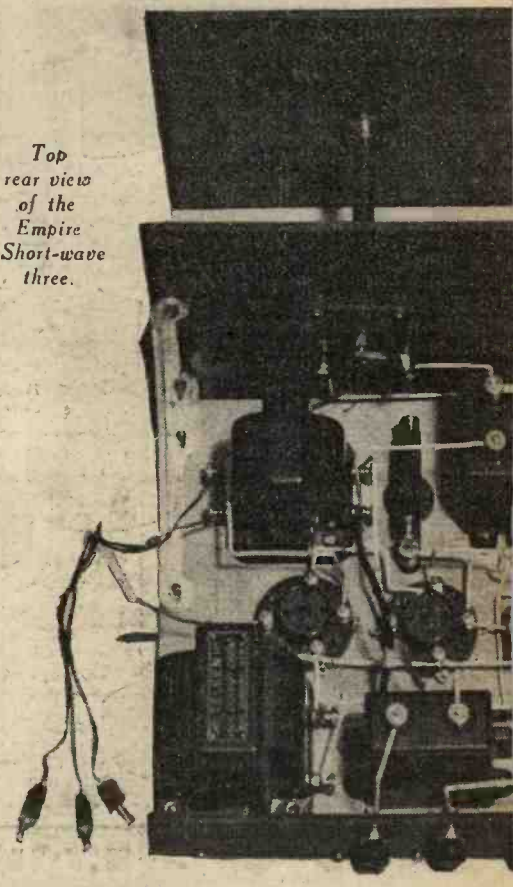
.0002 Telsen reaction condenser.
Utility Micro Dial type W181.
R.I. Antinodal coil.
Slektun Short-wave H.F. choke.
Lissen Hypernik transformer.
Telsen output choke.
Three Graham Farish Horizontal Holders.
Three Graham Farish Ohmite Resistances, 100,000 ohms, 1 megohm, 1 megohm.
T.C.C. fixed condensers.
Two 2 mfd. Type No 50.
One .0002 Type S.
One .005 Type S.
Lissen 400 ohm baseboard mounting potentiometer.
Ready Radio On-off Switch.
Two Bulgin Rotary On-off Switches Type S.85.



Top rear view of the Empire Short-wave three.

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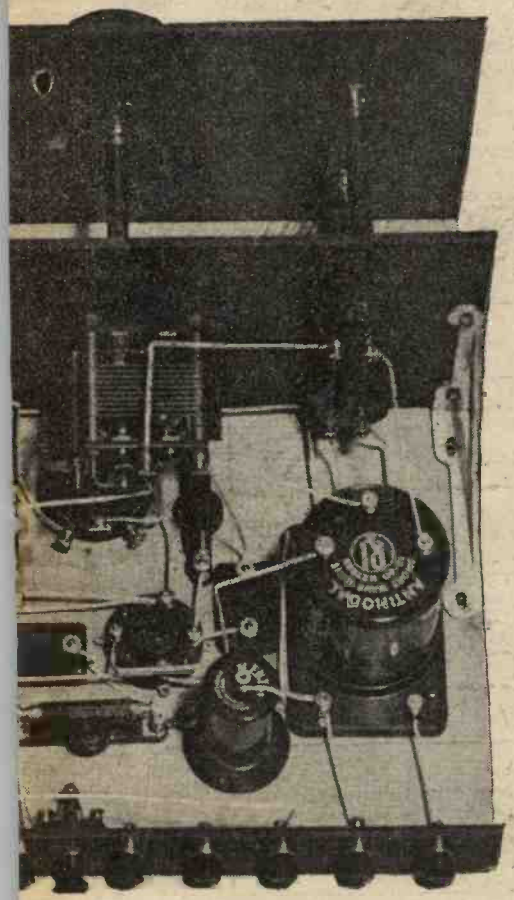
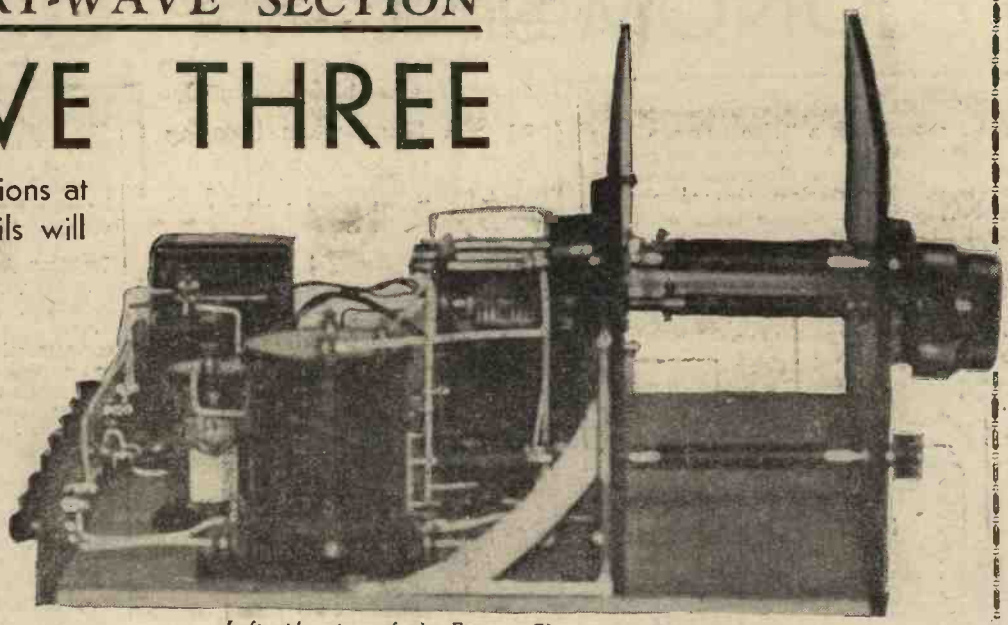
- Three Grid-Bias Plugs. G.B.+ G.B.—1, G.B.—2. Clix.
- Two Peto-Scott Panel Brackets.
- Wooden Baseboard 14in. by 12in.
- Two coils of Glazite Connecting Wire, Flex, Screws, etc.
- One Terminal Strip 14in. by 2in.
- One Osborne No. 237 Cabinet.
- 120 v. Hellesens H.T. Battery and 9 volt G.B. Lissen 2 volt Acc.
- Ormond R.452 Loudspeaker.





Left side view of the Empire Short-wave Three.

70 to 1, so that there is very little chance of passing a station. The components on the baseboard may seem rather cramped, but with this particular receiver there are no troubles from this cause, and they are not so close that wiring-up is difficult. There is very little else we can say about the receiver, so now we will proceed to describe its construction.

The Construction

The first part of the work to be done is to remove half an inch from the edge of one of the panels. This is so that it may be mounted upon the baseboard, and not project above the other panel. The exact amount removed is not critical, but less than half an inch should not be removed, as the baseboard will be at least ⅜ of an inch thick. Mark out the uncut panel in accordance with the panel dimensions, and drill the two centre holes ⅜ of an inch, and the two left hand holes 5-16 of an inch. The smaller panel should then be marked out in a similar manner, but care must be taken to see that the centres of these holes coincide with the holes in the other panel. It is best, therefore, to mark the centre of this panel, and then mark the centres of the holes the same distance above this line as you cut off the panel in the first instance. Another method of doing this marking out is, of course, to mark it out before cutting off the edge. The exact method may be left to individual taste. The holes in the second panel will not be the same as those drilled at first. The two switch holes are 5-16in. in diameter; the hole on the right is ⅜in. in diameter, and for the centre, the template supplied with the condenser must be called into use. It will be seen that a centre hole 5-16in. in diameter is required, with three small holes equally spaced round it. These latter must be carefully marked and drilled, as there is no margin for error here. When these holes are satisfactorily drilled, three small holes, for wood screws, should be drilled along the bottom of the large panel, and two small holes at each side of the small panel for the panel brackets. These latter should be marked out by laying the brackets on the panel. Attach the bushes to the large panel, noting that the bush for the centre hole is put on back to front, that is, with the nut in front. This is in order that the tuning dial may be attached.

Mounting the Components

ATTACH the two small rotary switches, with a disc of ebonite or some similar spacing material at the back of the panel. (If this is not done, it will be difficult to get the panel close enough to the front one to attach the tuning condenser spindle.) Attach the Tuning Condenser, Reaction Condenser and Panel Brackets, tightening up the screws for the latter whilst the panel is standing on the baseboard, so that the brackets are in the correct position. Now mark a line 3¾in. from the front of the baseboard, and arrange the coils and other baseboard components in the positions shown by the illustrations. When carrying out this part of the construction, do not screw any part down until every item has been laid down and you are absolutely certain that there is sufficient clearance everywhere. Place the rear panel in position to make quite certain that the distances from the pencil line are O.K., and when you are absolutely certain that nothing is wrong, then screw down the parts.

When all the parts are in their correct position the two panels may be fitted, or, if preferred, the front, or main panel, may be left until the wiring has been completed.

To attach the tuning dial the instructions, which are included in the box, should be carefully followed. The nut of the small Bulgin bush should be treated as the nut of a one-hole fixing condenser, and used in conjunction with the large washer supplied with the dial. The instruction for wiring and wiring diagram, together with further constructional details, will be given next week.

ECONOMISING IN CURRENT

Simple Methods of Cutting Out an S.G. Stage when Listening to the Local.

By R. H. ALLEN

A SCREENED-GRID valve is generally regarded as a "sine qua non" for sets which are intended for receiving programmes from other stations beside the local. Nevertheless, the majority of listeners probably devote most of their attention to the local station, and for this purpose a screened-grid stage is by no means necessary. In fact, in many cases a difficulty will be found in reducing the volume from the local station without distortion, and the usual methods of volume control may cause a considerable wastage of power. This will not worry users of "all mains" sets, but it is a matter of some concern when batteries are employed.

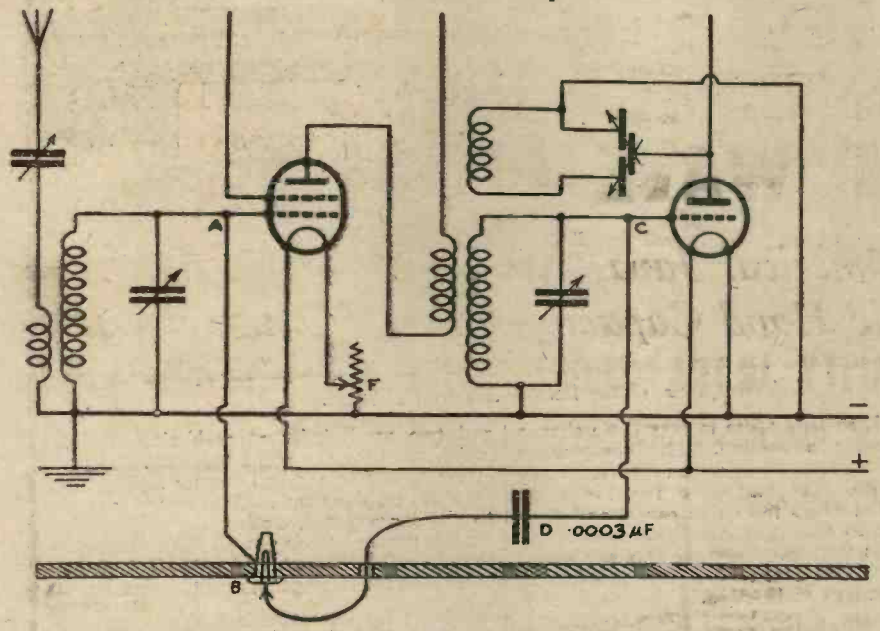


Fig. 1.—A simple method of cutting out the H.F. valve.

In the accompanying diagrams are shown some simple alternative methods of dispensing with the use of the screened-grid valve when listening to local or other powerful stations. The circuits shown incorporate the well-known "Q" coils, but the methods are equally applicable to other arrangements employing "tuned grid" coupling between the screened-grid valve and detector. In Fig. 1 is shown a coupling between the aerial tuning coil and the detector coil. It consists in making a temporary connection from the grid end A of the aerial coil, to the corresponding point of the detector coil C, through the medium of a condenser D, a suitable value for which is .0003 microfarads. The writer has used a permanent connection from A, to a socket B, on the front panel (if this is of metal the socket must, of course, be insulated), connection being made, when required, by means of a wander plug attached to the condenser D by a short piece of rubber covered flex passing through the panel. When the screened-grid valve is in use, the wander plug is allowed to hang loose. A simple "on-off" switch could equally well be used. It is assumed that there is a filament rheostat F in the circuit, so that the screened-grid valve can be completely switched out when listening to the local station. A peculiar feature of this arrangement is that the two tuning circuits are interdependent. For example, if the dial readings for the local station with the screen-grid valve in use are 55 and 52, with the special connection in use, one condenser need only be set approximately, say, at 60, and the other will then tune in at about 47, i.e., the sum of the dial readings is approximately constant. This is a great advantage for a "family" set with separate tuning dials, for one can be roughly adjusted, and correct tune very easily obtained with the other.

Omitting Aerial Coil

In Fig. 2 two alternative methods are indicated. In one case the aerial and grid connections of the aerial coil and detector coil respectively, are permanently connected to two sockets, B and G, fixed on the panel. The aerial is connected through the usual pre-set condenser, to a wander plug which is fixed in either socket according to whether the screened-grid valve is to be used or not. Alternatively, a two-way switch can be used for making the connection. This method dispenses with the aerial tuning coil completely, and is less selective than the first mentioned with the type of tuning coil illustrated. This effect is minimised, however, by using a lower value, say, .0001 for the condenser D. The tuning of the detector in this case is unaffected by the setting of the aerial coil condenser, so that it is equally suitable if the condensers are ganged.

The third arrangement is in some respects the simplest and consists in joining the grid connection C of the detector coil to the socket G through a .0001 condenser, and using a short supplementary aerial for listening to the local station. This aerial may consist of a short wire suspended from the picture rail and plugged into the socket when required (H, Fig. 2). A suitable length for this wire is soon determined by experiment; in the writer's case it is 3ft., the set being located at Highgate, where the "Brookman Twins" are very powerful. If there is no filament rheostat for the screened-grid valve, an "on-off" switch will be required at this point, as the S.G. valve must always be "off" when using the detector only.

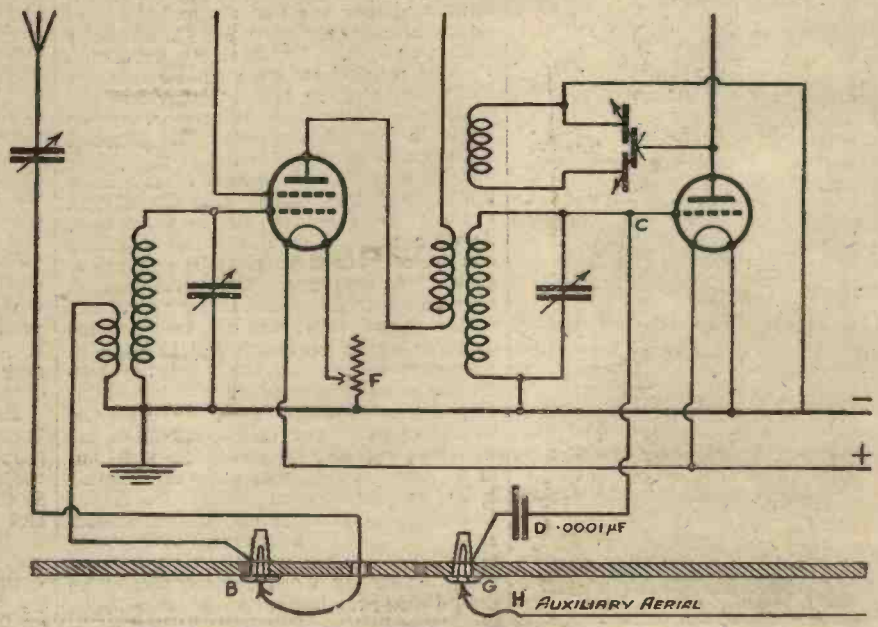
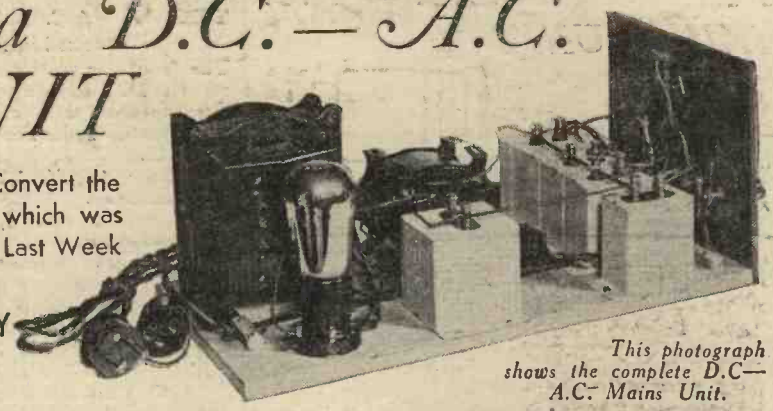


Fig. 2.—The alternative method which cuts out the valve as well as the tuning circuits.

MAKING a D.C.—A.C. MAINS UNIT

How to Convert the D.C. Unit which was Described Last Week

By W. J. DELANEY

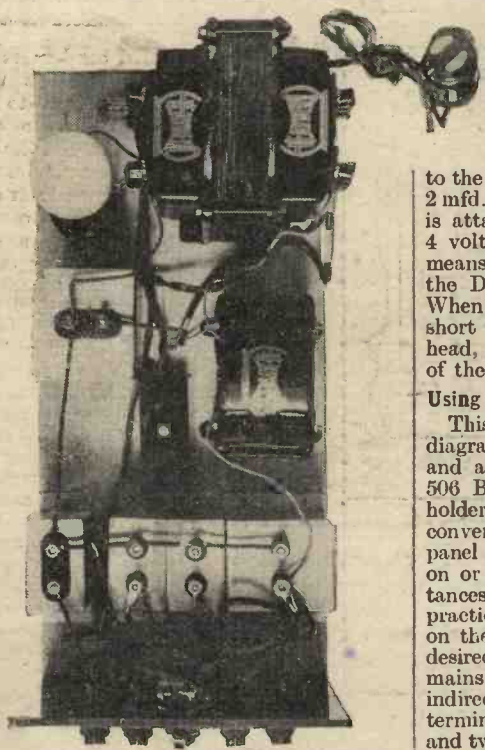


This photograph shows the complete D.C—A.C. Mains Unit.

LAST week we described how to make up the D.C. part of this interesting unit, and we shall now tell you how to convert this for operation from A.C. mains, a procedure which is essential if you move from your present address, or have the D.C. mains changed over by the local authority. It is true that in the majority of cases where the conversion from D.C. to A.C. takes place the local authority makes good all domestic apparatus which is rendered obsolete by the change, but this unit conversion goes one better than would be the case if the local authority simply replaced the D.C. unit with a similar A.C. unit. The mains transformer which is fitted to this model is provided with a heater winding delivering 4 volts at 2 amps., so that if, at some future date, you wish to redesign your receiver so that it may be made an all-mains model, the winding is there all ready for you.

Necessary Alterations

The illustrations and photographs show that the only extra parts necessary for this change-over are a mains transformer; another 4 mfd. fixed condenser; a valve-holder, and a rectifying valve. There is ample room on the baseboard for these extras, and they should be laid out exactly in accordance with the wiring diagram. If you lay this diagram by the side of the diagram on page 432 of last week's issue, you will see that in addition to the extra wiring, there are one or two slight alterations which have to be made to the wiring of the D.C. section. First of all, the wire from the fuse-holder to the negative H.T. lead must be removed, as must the other wire on the same side of the fuse-holder. To these two terminals a short length of twisted flex must be attached, and the other ends of this flex must be joined to the primary terminals of the mains transformer. You will notice that there are four of these, the top three bearing the figures 230, 240, 250. One of the pieces of flex must be attached to the bottom one of this row of terminals, and the remaining piece of flex must be joined to the terminal which corresponds with the voltage of your own supply mains. If there is no terminal which does agree, use the next value above that voltage. For instance, suppose your mains are rated at 240 volts, you would use the 250 terminal. A length of twin flex must then be joined to the two terminals marked 4 v. at the opposite side of the transformer, and these are taken across to the "F" terminals of the valve-holder.

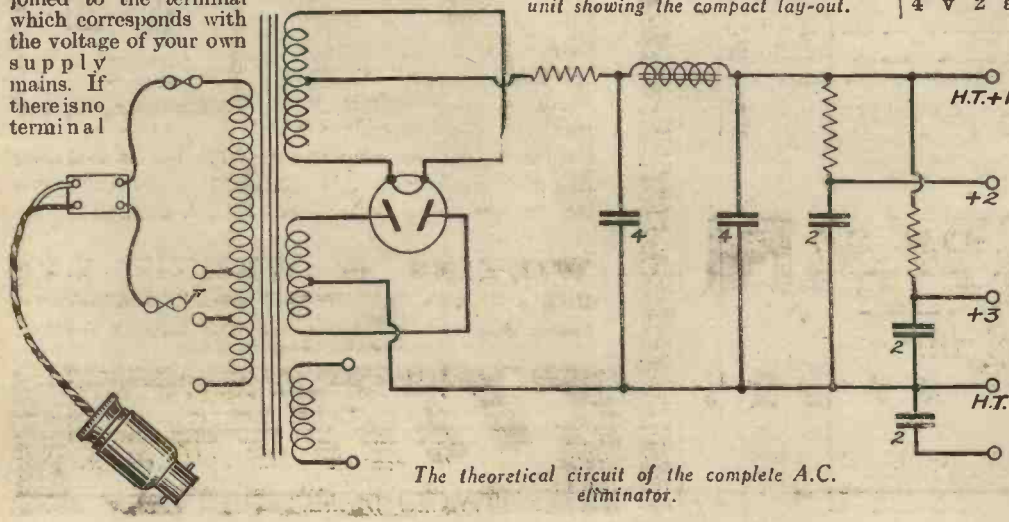


(ABOVE)—A plan of the complete unit showing the compact lay-out.

The two terminals marked 250 are connected with Glazite to the "G" and "P" terminals of the valve-holder. The terminal in the centre of these two latter mains transformer terminals must be joined to one side of the added 4 mfd. condenser, and this terminal should then be joined to the H.T. negative terminal of the nearest 2 mfd. condenser. The spaghetti resistance is attached to the centre terminal of the 4 volt filament winding, and is joined by means of the screw on the baseboard as in the D.C. unit, to one end of the choke. When driving this screw home attach a short length of Glazite under the screw head, and take this to the free terminal of the added 4 mfd. condenser.

Using the Unit

This completes the alteration, and the diagram should make all these alterations and additions quite clear. Plug a Cossor 506 B.U. rectifying valve into the valve-holder, and plug the mains plug into a convenient socket. The switch on the panel now enables the unit to be switched on or off, and the voltage dropping resistances are still of the correct value to give practically the same readings as shown on the circuit diagram last week. If it is desired to employ this unit with an all-mains receiver—that is, one employing indirectly heated valves—two additional terminals should be attached to the panel, and twisted flex used to join these terminals to the transformer terminals marked 4 v 2 amp. The voltage obtained at terminal 3 may then be increased by removing the 5,000 ohm spaghetti resistance, and connecting the choke direct to the transformer. In this case it may also be necessary, or even essential, to substitute for the spaghetti resistances some more substantial wire-wound resistances, as the currents from the mains valves may be greater than the spaghetti resistances are intended to carry, and this will lead not only to damage to the resistances, but in wrong voltages at the terminals. The values for the resistances can be ascertained quite easily by dividing the voltage, which has to be dropped from the total output of the unit, by the current in milliamps, and multiplying by 1,000.

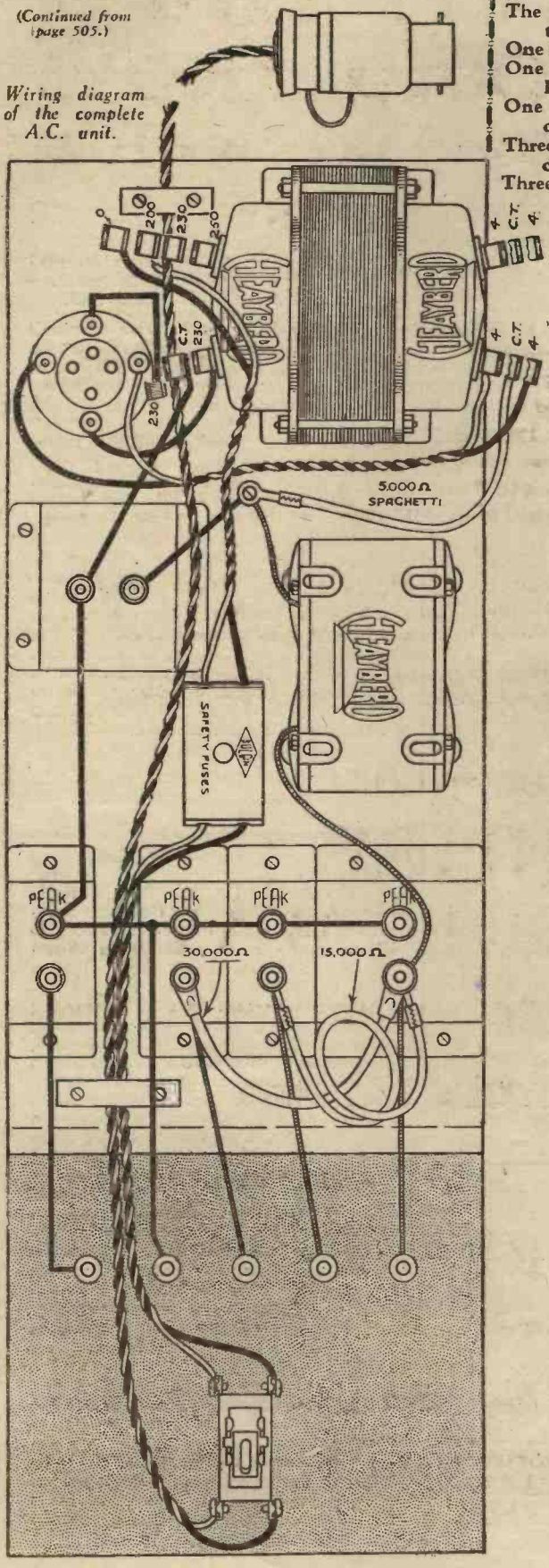


The theoretical circuit of the complete A.C. eliminator.

MAKING A D.C.—A.C. MAINS UNIT

(Continued from page 505.)

Wiring diagram of the complete A.C. unit.



THE D.C.—A.C. MAINS UNIT
(Described last week)

The following parts are required for the D.C. section of the Unit :—

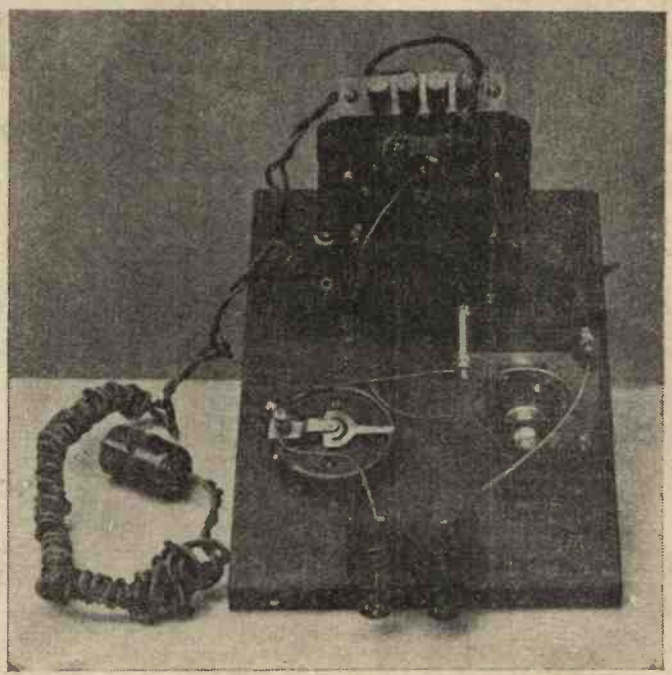
One Heayberd mains choke, Type 751.
One Bulgin Twin Fuseholder, Type F.14.
One Peak 4 mfd. 1,500 volt test condenser.
Three Peak 2 mfd. 1,500 volt test condensers.
Three Lewcos spaghetti resistances, 5,000 ohms ; 15,000 ohms and 30,000 ohms.
Five Belling-Lee terminals, type "H" — H.T.3, H.T.2, H.T.1, H.T.— and Earth.
One Becker switch, Type 462.
One Goltone combination mains plug.
Ebonite panel 7in. by 7in.
Two yards good quality flex.
Wooden baseboard, 14in. by 7in.
One coil Glazite, screws, etc.

ADDITIONAL COMPONENTS REQUIRED TO CONVERT TO A.C.
(Described this week)

One Heayberd Mains Transformer, Type 715.
One Peak 4 mfd. 1,500 volt test condenser.
One 4-pin valveholder.
One Cossor rectifying valve, Type 506 B.U.
Short length of flex, Glazite, and a few screws.

TUNING CONDENSER "ATMOSPHERICS"

VARIABLE condensers are so reliable nowadays that one seldom expects them to be the cause of trouble. But they *can* be a nuisance, and many of the crackles and artificial atmospherics that are heard probably have their origin in one of the tuning condensers. Crackles (or, in other words, bad connections) originating in a variable condenser are generally only noticeable when the dial is being turned, but this is not always the case. When a condenser is wrong, the fault can often be traced to a bad connection between the spindle of the moving vanes and corresponding terminal. If the contact is a frictional one, the rubbing surfaces may have become corroded by damp or by the gas given off from an accumulator, or the pressure between them might be insufficient. In the former case, the lower bush must be removed and the surfaces well cleaned with emery cloth, but in the latter it might be necessary to dismantle the condenser and increase the power of the pressure-spring by carefully bending it. Sometimes the crackling is due to the two sets of vanes touching at some point as the dial is rotated. This can often be detected by inspection, but, in case of doubt, a definite test can be applied by connecting the condenser in series with a grid-bias battery and loud-speaker. There should be no click in the speaker as the condenser dial is turned ; a click would indicate a short-circuit. When it has been established that the vanes are touching, a cure can generally be effected by screwing the lower bush in or out. If the short-circuit is due to bent vanes, however, the latter should carefully be straightened with the blade of an ordinary table-knife.



This illustration shows the complete A.C. trickle charger, described by Frank Preston in the November 19th issue of "Practical Wireless."

FACTS YOU SHOULD KNOW ABOUT THE MAZDA 2-VOLT RANGE

In this exceptionally efficient range of 2-volt valves will be found types to suit all battery operated sets.

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THE S215 VM, *is a new variable-mu screened grid valve of extreme sensitivity and low inter-electrode capacity.*

THE PEN 220 and PEN 220A *are two economical pentodes, which will give ample volume with a very low signal input.*

THE P220 and P220A *will operate balanced armature and moving coil speakers respectively at full volume with extremely economical anode consumptions.*

Full details of these and other useful Mazda 2-volt types will be found in the Mazda Catalogue, sent FREE on request.

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V168

AUTOMATIC VOLUME CONTROL

Most Readers Know How Annoying Distant Fading Can Be; This Article Tells You How to Overcome It.

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

NOW that the dark evenings are with us, we are getting an increasing number of distant stations coming in at loud-speaker strength, even the modest three-valver being capable of twenty or more stations. In fact, with the improved reception conditions and the increased power of these stations the set is often overloaded. One real difficulty with the enjoyable reception of these Continental stations is the fading effect. The manual volume control does not provide a satisfactory means of compensating for this. Even if one could follow accurately all the changes of signal strength by adjusting the volume control by hand, there would be no time left to appreciate the programme. This is where the advantage of a continuously variable volume control worked automatically by the signal strength of the incoming station shows itself.

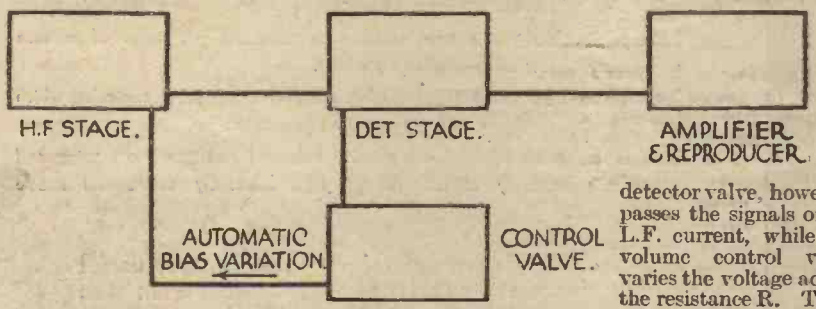


Fig. 1.—Diagrammatic illustration of the effect discussed.

Overcoming Fading

In America, where long-distance reception has always been "the thing," this idea is in common use, and after testing it one finds something lacking in the ordinary set. The signal strength of the distant station is kept practically constant, and one has all the advantages of local station reception because fading has been overcome. The only hint that an experienced listener would get of the fading effect would be the slight rise and fall of the background noise. All that is required is another valve in parallel with the detector valve and a slight modification of the circuit, as shown in Fig. 2.

Let us see what happens when a station is received. The signal passed on by the H.F. valve affects both the detector and the volume control valve equally. The detector valve, however, passes the signals on as L.F. current, while the volume control valve varies the voltage across the resistance R. There is a certain signal strength to the grid of the control valve, and this determines its anode current. As this current varies with signal strength, so the voltage across R varies, and with it the grid bias applied to the H.F. valve. Thus, as fading takes place and the signal strength decreases, so the anode current in the control valve decreases, the bias to the H.F. valve decreases, and its amplification increases. The converse also holds, and thus the overall result is practically constant reception strength all the time. Fig. 1 illustrates in diagrammatic form exactly what happens.

The receiver should be sufficiently powerful so that the loud-speaker will work on a weak station. Thus the receiver will only be working full out on the weakest signals. Also R should be of the semi-variable resistor type so that a value may be selected for the best operating conditions for the H.F. valve.

In conclusion, it is probable that this method of control will soon come to the fore because of its usefulness in cutting out the peculiar rapid fading which is met in long-distance short-wave reception. It is also useful in keeping volume at a pre-arranged level for home use.

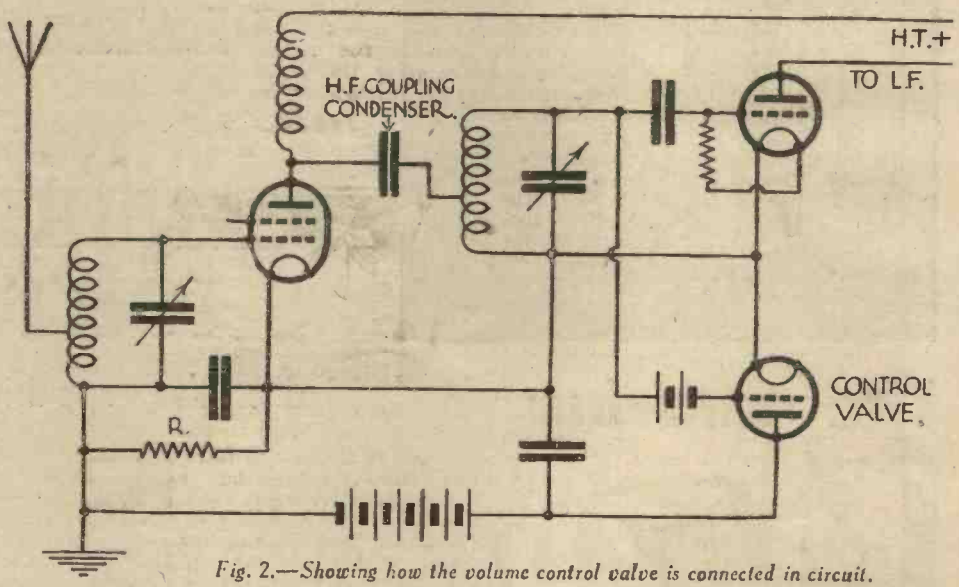


Fig. 2.—Showing how the volume control valve is connected in circuit.

A Valuable Year Book

THE 1933 edition of "The Wireless and Gramophone Trader YEAR BOOK AND DIARY," just published, contains many new and important features to assist retail traders in the course of their daily business. This is the ninth successive year of its publication.

A new addition of great practical utility is a section giving condensed but complete specifications of the most popular receivers and radio-gramophones marketed by nearly 100 well-known manufacturers. The directory of mains-supply voltages has been brought up-to-date in accordance with changes made during the year. The section devoted to practical servicing and testing has been extended by an article on guarantee and service schemes. "Accumulator Charging," "Electrical Interference," "Valve and Speaker Matching," and "Instability in Receivers" are other subjects dealt with in the technical section.

Each of the four trade directory sections is printed on different tinted papers. The directory of manufacturers includes names, addresses, telephone numbers and telegraphic addresses. The directory of wireless and gramophone wholesalers lists alphabetically and territorially practically every wholesaler in the country. To this section is added a list of the manufacturers and wholesalers subscribing to the recently introduced "Fair Trading Agreement." Some 1,300 proprietary and trade names are contained in the next section, which is followed by an 80-page buying guide to goods supplied, arranged under more than 200 different headings.

The price of the book is 5s. 6d. post free, with a special rate of 3s. 6d. post free to subscribers to "Trader" journals. It is published by The Trader Publishing Co., Ltd., at St. Bride's House, Salisbury Square, Fleet Street, London, E.C.4.

The BEGINNER'S SUPPLEMENT

Conducted by F. J. CAMM

THE INSIDE OF A FIXED CONDENSER

This special beginner's supplement has been introduced in response to a general request from hundreds of readers who have only just commenced to take an interest in wireless construction. In it we propose to explain, week by week, in very simple language, facts about the various aspects of the practical side of wireless. To the many thousands who cannot yet understand the circuits or terms used in connection with wireless we extend a cordial helping hand.

OUTWARDLY a fixed condenser is one of the simplest and most unimpressive of wireless components, and yet for all this it is a precise and very carefully-made piece of apparatus. Let us examine one closely.

Before actually picking it to pieces perhaps it is just as well to know roughly what to expect. There is no need, of course, to go into the theory. Briefly, a condenser consists in its simplest form of two metal plates separated by an insulator such as air, ebonite, mica, waxed paper, etc. Condensers are graded according to their *capacity*, that is to say, how much electricity they will store. The unit of capacity is the farad. However, for wireless purposes this unit is much too large, so we use the micro-farad (one millionth of a farad).

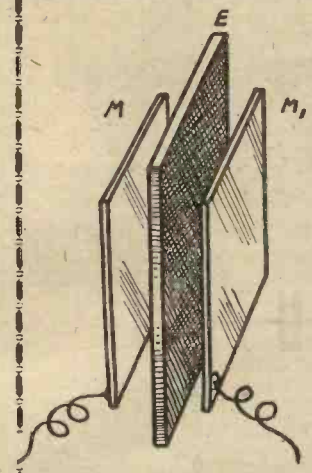


Fig. 1.—Two metal plates separated by a plate of ebonite.

The capacity of a condenser depends on three things. Firstly, there is the size of the plates. The larger they are the greater is the capacity. Secondly, there is the distance they are apart. As they are brought nearer together so the capacity increases; and lastly, there is the nature of the material separating the plates. This is known as the *dielectric*. It can be a gas, like air, a liquid, or a solid. In fact, anything of an insulating nature, but the point is that some materials give a greater capacity than others. For instance, if you had two plates fixed a certain distance apart in air, so that they had a capacity of, say, one micro-farad, and then you slid a sheet of ebonite between the plates without moving them, you would find that, although the plates were still the same size and still the same distance apart, their capacity had increased slightly (see Fig. 1).

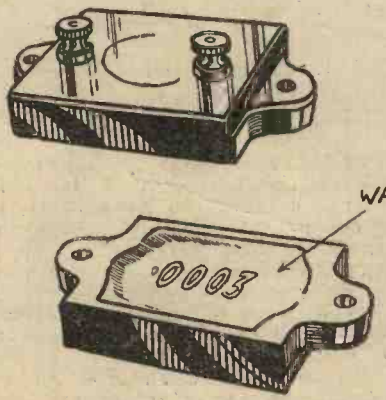


Fig. 2.—How an ebonite case is used to house the fixed condenser.

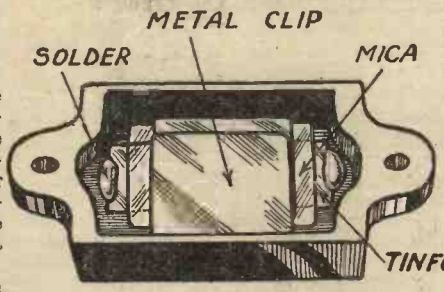


Fig. 3.—The inside of a fixed condenser, with the wax filling removed.

Besides the capacity of the condenser there is also the question of its efficiency. This is largely dependent on the dielectric, which must have good insulating properties, otherwise a current of electricity will gradually leak from one plate to the other. Another thing is that with a condenser used where high voltages are employed, it must be able to stand a large strain without "breaking down," that is to say, it must be able to resist any tendency for a spark to pass through it from one plate to the other.

Three Types.

Bearing these facts in mind, it is easy to understand why care and precision are necessary in the manufacture of a fixed condenser. For example, in order to obtain a large capacity, and at the same time keep the whole thing as compact as possible, the plates have to be very close together. This means that the dielectric separating them must be very thin, but at the same time must have good insulating properties. There are principally three ways of obtaining this. One is to use a large number of small plates instead of two large ones, and to separate them with very thin sheets of mica (one of the best insulators

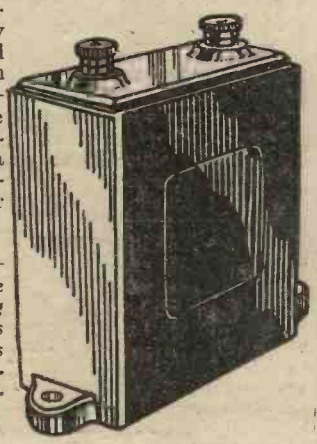
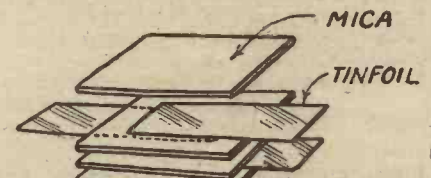


Fig. 5.—The large smoothing condensers known as "Mansbridge Condensers."



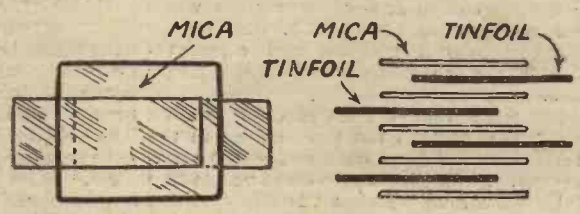


Fig. 4.—How small fixed condensers are made up. This shows how the plates are interleaved, and stepped.

known). Another is to use two large plates, but to construct them of flexible material such as tinfoil and to roll them up tightly with strips of specially prepared waxed paper between each plate. The third way is that employed in the electrolytic condenser, in which the dielectric is produced by electro-chemical action and consists of an exceedingly thin film of insulating material, so that the plates can be quite small compared with those necessary when even the thinnest mica is used.

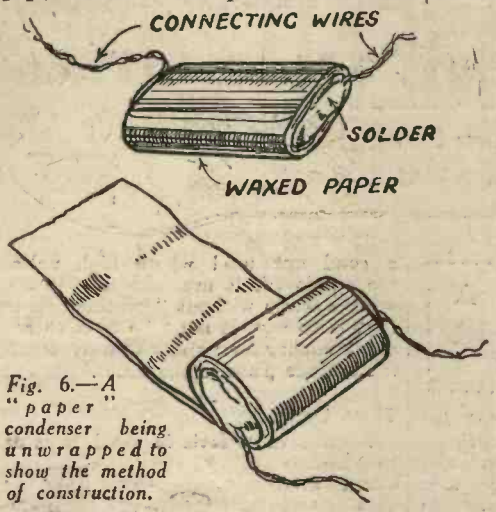


Fig. 6.—A "paper" condenser being unwrapped to show the method of construction.

The Mica Condenser

Now let us have a look at the condenser in Fig. 2. It is of .0003 microfarad capacity, and is of the type generally used for grid condensers and by-pass condensers in H.F. circuits. If you examine it closely you will notice it is sealed underneath with wax.

In the interests of investigation let us carefully dig out this wax with a penknife and see what is inside. We shall have to go warily, in case we disturb something vital. However, by carefully feeling our way with the point of the knife we shall finally uncover the whole of the interior, as in Fig. 3. This reveals a metal clip A, which is used to keep together a sandwich of alternate layers of mica and tinfoil. The sheets of mica are wider than the tinfoil ones, but not so long, so that the foil projects in the form of tabs from each end of the sandwich. These tabs are soldered to the two terminals. If we prise the clip open we shall see the exact arrangement of the foil and mica sheets. Fig. 4 shows this clearly. It will be noticed that the strips of foil are so placed that they project alternately from one end and then from the other end of the sandwich. Half of them are connected with one terminal and half of them to the other, but each group is separated from contact with the other by means of the sheets of mica. This is the usual arrangement for condensers of small capacity. The details may not be quite the same with different makes, but the fundamental arrangement of alternate layers of metal foil and mica is always to be found. For example, some condensers have copper foil instead of tinfoil. Others, again, do not have the metal clip round the assembly.

Paper Condensers

The next type of condenser we shall examine is that shown in Fig. 5. Its capacity is .05 mfd. Here it is more difficult to remove the wax, since there is only a small opening at the bottom. Of course, the manufacturers, when they made it, did not intend that it should be pulled apart again. It was quite easy for them to insert the condenser in this small opening in the case and then to seal it up with hot wax, but we have the job of removing this wax, now that it has set, before we can get at the condenser itself.

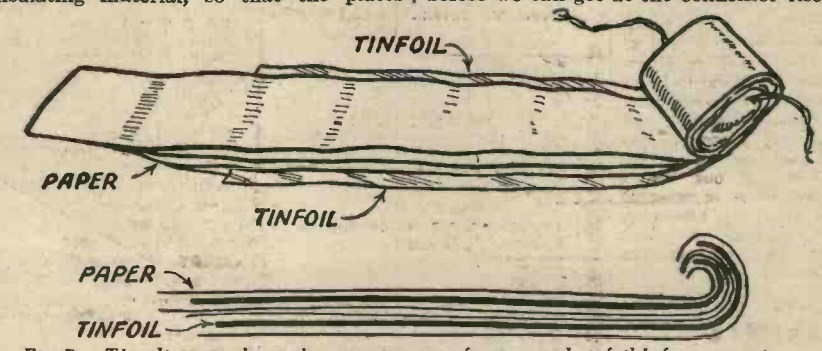


Fig. 7.—This diagram shows the arrangement of paper and tinfoil before wrapping.

However, let us assume that by gently heating it we have managed to remove sufficient wax for us to prize out the "innards." This time we find a little oblong affair wrapped round with waxed paper and with the connecting wires soldered one to each end. These wires are in turn soldered to the terminals so that we must cut them in order to free the little packet from the case. When we have done this we can tackle the packet itself.

By inserting the blade of our penknife under the edge of the waxed paper we are able to peel it off. It commences to unravel as in Fig. 6. When a few turns have been removed we discover that the single strip of paper has been supplemented by three others. Thus we are unwinding a layer of four strips of paper at once. These are interleaved with two strips of tinfoil. Fig. 7 will make this clear. The strips of tinfoil are not completely covered by the layers of paper.

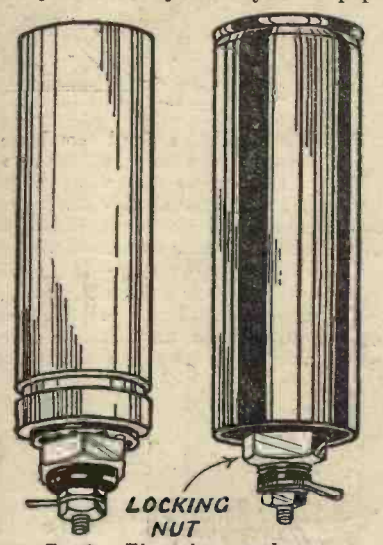


Fig. 8.—Electrolytic condensers.

One projects slightly from one side and the other shows a thin edging of bright metal from the other side. It is to these exposed edgings of tinfoil that the connecting wires are soldered. On completing the unravelling we can see exactly how the whole condenser was built up. It now consists of a long belt of four strips of paper and two of tin-foil in the order of a layer of paper, then one of foil (slightly offset), then two of paper, another of foil (offset to the other side), and finally a layer of paper on top. It is clear that this arrangement, when rolled up, as it was before we unwound it, gave two thicknesses of paper between each strip of tinfoil.

When the condenser was assembled by the manufacturers, it was not simply a matter of rolling up the foil and paper and popping it in the case. The whole

(Continued on page 520.)

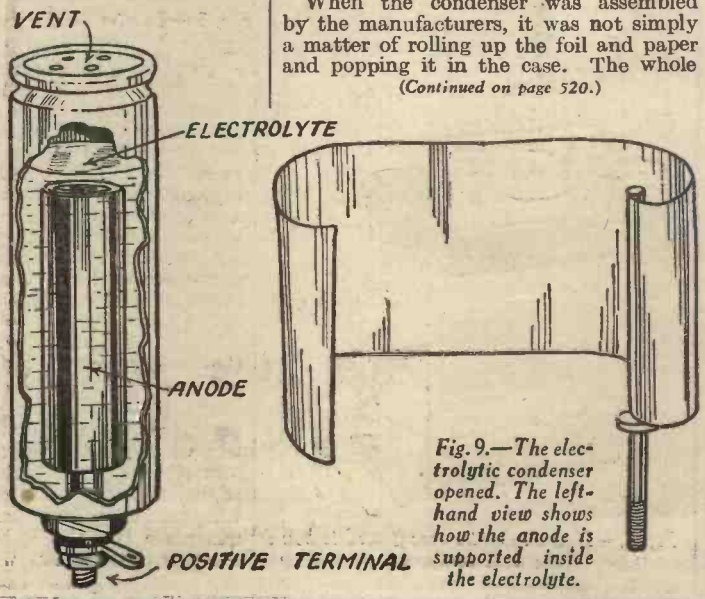
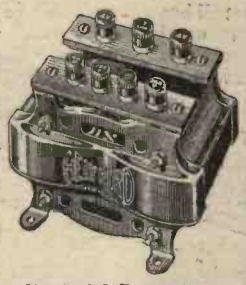


Fig. 9.—The electrolytic condenser opened. The left-hand view shows how the anode is supported inside the electrolyte.

What we Found..

HEAYBERD TRANSFORMER

THE L.T. Transformer illustrated, a Heayberd type 723, is designed to deliver 4 volts at 3 amps for three indirectly heated valves, and is provided with a centre-tap. The primary is fitted with three tappings, for 200, 230 or 250 volts. The component is excellently made up, and fitted with a stamped metal casing. This is perforated to provide adequate ventilation, and keeps the instrument quite cool in use. The core is substantial, and the gauge of wire is sufficiently heavy to give good voltage regulation. The price is 12s. 6d.



Heayberd L.T. transformer.

IGRANIC OUTPUT UNIT

WE have constantly advised listeners in these pages to fit an output filter, and the usual method consists simply of a good L.F. choke in the anode circuit with the loud-speaker join from anode to earth *via* a fixed condenser. The Igranic Company have developed a special unit for this purpose, which not only avoids the purchasing of the two necessary components, but gives in one case a really universal arrangement. It consists of a bakelite case which is provided with seven terminals and a flexible lead provided with a spade end. The terminals numbered 5 and 6 are joined to the loud-speaker, no matter in what manner the unit is used. From terminals 1 to 4 there is connected an iron-core choke with a "Bimetal" core. This choke will safely carry a current of 30 mA, and is therefore suitable for all normal requirements. The flexible link may be joined to various terminals on the unit to provide a number of different ratios, and in addition the unit may be used as a pushpull output choke with a centre tapping. This will be found to be a very useful component for the experimenter, and the price, 12s. 6d., is quite moderate, when one considers that it incorporates a large fixed condenser.

R.I. POWER GRID CHOKE

WHEN using power grid detection, the standing anode current should be of a high order. This entails the use of a very large battery if the correct value of resistance is included in the anode circuit. This is, of course, a drawback to this particular method of detection, as one is forced to use high tension batteries totalling 300 volts or so, or to compromise by using a small anode resistance and thus not getting the best from this feature. The special choke manufactured by Radio Instruments, and known as the power grid choke, is designed to overcome the drawback of voltage drop, whilst at the same time giving high impedance in the anode circuit. This component has a nickel alloy core of very high permeability which results in a neat and small dimensioned choke. The winding is carried on a sectionalised bakelite bobbin, and this reduces the self-capacity to a minimum. The inductance value is 300 henries, and the D.C. resistance is 2,900 ohms. It will carry a maximum current of 10 milliamps. The size of this choke is less than 3ins. square, and it takes up very little room on the baseboard. The price is 21s.

LISSEN SLOW-MOTION DIAL

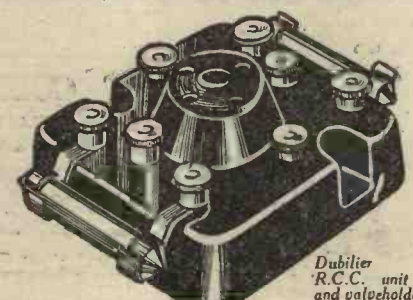
THERE are a great many types of slow-motion dial on the market, all differing in slight details. The Lissen dial is a massive affair containing mounting plugs for two condensers. The front of the dial consists of a bakelite plate carrying an oblong escutcheon window and a small control knob. At the back there is a massive metal mounting plate carrying a large drum driven by cat-gut. This form of drive is very positive in its action, and has absolutely no backlash. The gut is anchored at one end to a spring, so that all slackness is taken up. A small flashlamp bulb holder is mounted at one of the side plates, and at the side of this a piece of the metal is bent inwards at an angle of 45°. This brings it behind the transparent tuning scale, and therefore has the effect of giving a very bright and, at the same time, even illumination of the scale. The movement is delightfully smooth and velvety, and enables two ordinary condensers to be joined together for ganging purposes. The price of this component is 8s. 6d.

A.C. SHORT-WAVE CONVERTER

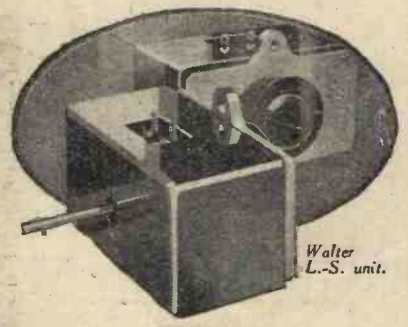
IT has been previously pointed out in these pages that the converter for short waves possesses the advantage of enabling the broadcast receiver to be employed for short-wave reception by converting it into a super-het. When a mains receiver is in use for broadcast reception it is a rather difficult matter to arrange for the addition of the necessary short-wave converter as there are the various potentials to be supplied to the mains valve in the converter. Radio Instruments have now developed a most remarkable A.C. converter which is the only instrument of its type at present on the market. It contains a short wave coil, choke, condenser and the other elements of a combined first detector and oscillator, and a Mazda AC2HL valve. This valve is, of course, of the indirectly heated type, and therefore requires a 4-volt 1 amp. heater supply as well as its necessary high-tension supply. This is provided for inside the unit by means of a mains transformer and a metal rectifier which is mounted directly upon the transformer. By this means it is only necessary to join the plug provided with the unit to a convenient lamp socket and the unit is then in a working condition. The aerial and earth leads are detached from the broadcast receiver, and attached to the two requisite sockets on the strip at the rear of the converter, and there are two plugs attached to a flexible lead at the back of the converter for attachment to the aerial and earth terminals of the receiver. By setting the tuning of the broadcast receiver to 2,000 metres the entire assembly becomes a most efficient super-het working over a waveband of 12 to 80 metres. Owing to the special Antinodal coil employed in the unit there are no dead spots, and a perfectly smooth control is provided through the entire range. The price of this unit, complete with valve ready to join to your receiver, is only £6.

COMBINED R.C.C. UNIT AND VALVE-HOLDER

IT is often found necessary to add a valve to an existing receiver and difficulty is found in accommodating the various parts on the existing baseboard. The Dubilier Company have produced a combined valve-holder and R.C.C. unit, and all that has to be done is to remove the present valve-holder and fit the unit in its place. The valve-holder which has been removed may then be put on the baseboard for the output valve, and this will usually be found quite simple to accommodate. The base of this unit contains a fixed condenser, and clips at the side accommodate the two resistances. As supplied, these have values of 1 and 2 meghoms, but these are the ordinary metallized resistances and therefore are interchangeable. Terminals are provided on the unit, and it is connected into circuit quite simply. The price is 5s. In addition to this special combined unit, the Dubilier Company manufactures complete R.C.C. units on exactly the same lines as the ones illustrated—with the exception of the valve-holder portion. The price of these units is 5s. and the resistances are capable of easy adjustment to suit individual requirements.



Dubilier R.C.C. unit and valveholder



Walter L.-S. unit.

WALTER LOUD-SPEAKER UNIT

THIS unit is probably one of the smallest which is made, but one would not realize it to judge by its performance. It is totally enclosed, as can be seen from the illustration, and it is a very sensitive unit, although so small in actual dimensions. The actual manufacturing design is very original, not a single screw or bolt being employed in the make up. It is different from any other unit on the market, both in construction and principle, and gives wonderful reproduction of both high and low notes although so small. The price is 7s. 6d., and it will find numerous applications, either for portable receivers or for larger instruments. It is guaranteed for one year, and is manufactured by J and H. Walter, Ltd., 31a, Farm Lane, Fulham, S.W.6.

THE W.B. MANSFIELD MAGNETIC SYSTEM

AN important advance in the design of permanent magnet moving-coil speakers has been made by the Whiteley Electrical Radio Co., Ltd., the old-established manufacturers of W. B. products. This year's "Mansfield" models, Senior and Junior, incorporate an entirely original magnetic system which forms the subject of a patent application. On test it gives an astonishingly high flux density for the size of magnet used. The unusual performance is due to an unconventional arrangement of steel alloys which cuts down the reluctance (or magnetic resistance) of the circuit and reduces losses due to "stray" magnetic fields almost to nothing. The back of the magnet, instead of consisting of cobalt steel, is made from a different steel alloy which is a far better "conductor" of magnetism than cobalt. The pole-piece, which normally consists of soft iron, is in this system made of steel having a very high cobalt content. This actually forms the magnet, the back acting simply as a return-piece to complete the circuit.

Thus leakage across corners of the magnet is reduced to a minimum, and less energy is wasted in overcoming the reluctance of the circuit. The majority of the flux is concentrated in the gap, and a small popularly priced moving-coil speaker is made to perform in a way which would not have disgraced a larger and expensive instrument a year ago. An incidental advantage claimed is that a steel chassis can be bolted direct to the magnet without loss of efficiency. The extra strength of the framework is useful in reducing the risk of bad centering caused by distortion of the framework. Rough handling in transit or over-enthusiastic use of the screwdriver when mounting on a baffle will have less chance of spoiling results. After testing both models we are of opinion that the makers' claims are well justified, and that the development of this new system is a valuable contribution to moving-coil speaker technique.

Full test reports of W.B. Models incorporating the "Mansfield" magnet will appear in a later issue.

Telsen

MICA CONDENSERS AND GRID LEAKS

MAKE ALL THE DIFFERENCE TO YOUR SET!

TELSEN MICA CONDENSERS

Represent an important advance in technique resulting in the virtual elimination of H.F. losses, even in the larger sizes. In attractive moulded cases, adaptable to flat and vertical mounting. Grid leak clips (for mounting in series or in shunt) are supplied free with the smaller capacities. Made in capacities of from .0001 to .002. mfd. . . **1/-**
Also .006 mfd. . . . 1/3

TELSEN PRE-SET CONDENSERS

The only pre-set condensers to give so wide a variation between maximum and minimum capacities, providing a correspondingly wide range of selectivity adjustment when used in the aerial circuit. Superbly constructed throughout, for high insulation with low loss. Easily adjusted and provided with locking ring. Made in mfd. capacities of from .002 (max) and .00025 (min.) to .0001(max)and .000005(min.) **1/6**

FOLLOWING on the recent discovery that no less than 98% of 'Kit' Sets and home constructor receivers are 'down' in efficiency through faulty Grid Leaks and Mica Condensers, Telsen Radio Engineers set to work to discover the cause of, and provide a remedy for, this rapid deterioration and consequent loss of efficiency. Their tests embraced every known make of these components in conjunction with every type of receiver and it is as a direct result of their successful investigation that the new Telsen Mica Condensers and Grid Leaks were introduced. They have been designed on entirely new lines, being made to a standard and not to a size, overcoming the numerous faults disclosed by the investigation and embodying the principles formulated to prevent deterioration. They give lasting efficiency.

TELSEN
RADIO COMPONENTS

TELSEN GRID LEAKS

This new type of improved efficiency is absolutely silent and practically unbreakable, the resistance being unaffected by the application of different voltages. They are guaranteed to be completely non-inductive and to produce no capacity effects. Made in capacities of from 5 to ¼ megs. . **1/-**

TELSEN TAG CONDENSERS.

Of extremely compact and sturdy construction. May be mounted on either insulated or metal panels by utilising the two base-board screw holes in the neatly designed moulded casing. The tags enable the condensers to be connected to any other components, either directly or by soldering. H.F. losses are negligible. In capacities of .0001 mfd. to .002 mfd. . . . **6d.**

IT'S THE 'LASTING EFFICIENCY' THAT COUNTS

ANNOUNCEMENT OF THE TELSEN ELECTRIC CO. LTD. ASTON, BIRMINGHAM

SOME CURIOUS DETECTORS

An Interesting Retrospect

By W. B. RICHARDSON

NOWADAYS one almost takes it for granted that a valve will be used as the detector even in the simplest sets, and yet not so very many years ago crystal detectors were used extensively. They were not confined to the crystal set pure and simple, but were often used in conjunction with valve amplifiers.

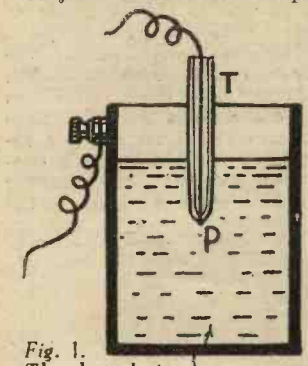


Fig. 1. The electrolytic detector.

About 1924 they figured largely in the many "reflex" circuits which were in vogue at that time. These circuits were something of the nature of an economy stunt in so far that they were designed with the idea of making one valve do the work of two. The poor valve was expected to work efficiently both as an H.F. and L.F. amplifier. First, it amplified the incoming signals. This was followed by a crystal detector and then the rectified current was fed back to the valve again, when it this time performed the function of L.F. amplifier. In some sets two or more valves were employed in this way, although it was not usual to reflex more than two owing to the complication. Ingenious devices of chokes and condensers were used to direct the signal impulses in their somewhat hazardous course through the receiver and to keep the H.F. and L.F. components each to their own part of the circuit.

Fig. 3—The modern detector valve.

I should imagine more crystal detectors were used during the reflex craze than at any time before or since. There were many types in use but, undoubtedly, the most popular was the natural mineral *galena*. In fact the large number of proprietary crystals which were on the market at this time, and were usually disguised under some impressive name ending in "ite," were mostly nothing more than galena.

Home-made Crystals

Besides the more orthodox crystals there were also a certain number of rather unusual types in use and many amateurs dabbled in the construction of home-made detectors often producing some very weird arrangements which would undoubtedly "work" but whose efficiency was usually open to question.

I remember making one or two elementary experiments myself. My chief aim was to "manufacture" galena, which is, I believe, almost pure lead sulphide. Reading from notes I made at the time I find that in my most successful effort I used a mixture of red lead (lead oxide to the chemist and designated Pb^3O^1) and sulphur in the proportion of about twice the bulk of red lead to that of sulphur. This was heated in a covered crucible so that the mixture fused and was then allowed to cool slowly. The result was a grey substance not unlike coke in appearance but with a slightly metallic lustre. Some of it was powdered. However, the solid part was dug out and tried as a detector with a "catswhisker." If my notes record the honest truth this "crystal" worked as well as a silicon detector but not quite so well as galena.

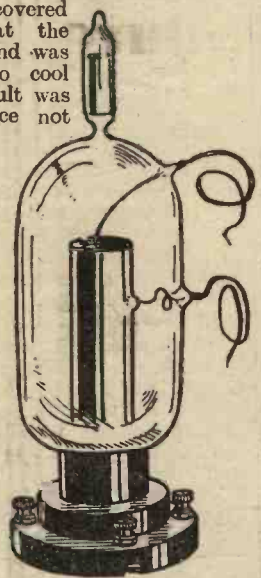


Fig. 2.—Early form of detector.

"Cokeite"

Amongst the many weird substitutes for crystals which have been tried are included a piece of coke, the carbon granules of a microphone, a piece of potato, a knob of sugar, and a gas flame.

No doubt the close resemblance of coke to some of the proprietary crystals suggested its use in the first place, anyway "cokeite" did actually "work"—if you got hold of a good piece.

Electrolytic Action

As you know a crystal works by reason of its offering a low resistance to current in one direction but a high resistance in the opposite direction. Some of the freak

(*Continued on page 516.*)

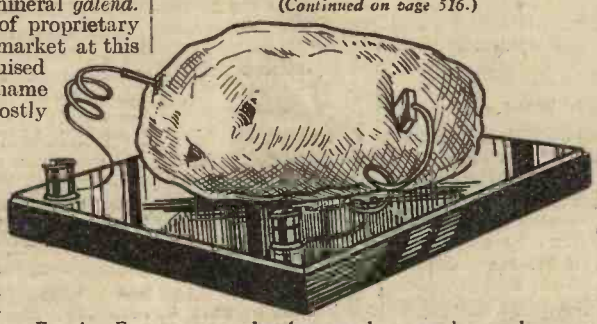


Fig. 4.—Even a potato has been made to work as a detector.

Some Curious Detectors

(Continued from page 515.)

detectors I have just mentioned, such as the potato, worked on the electrolytic principle. They usually needed two dissimilar metals with which to make the contact. The action would be similar to that of the electrolytic condenser when being "formed." The passage of a current in one direction would cause the formation of a high resistance film of some kind or other, even perhaps of gas, as in a polarised battery. This, however, would break down on the change in direction of the current, so that more current would flow in one direction than in the other thus producing a direct current component. This, of course, would be modulated in the same way as the original carrier and would therefore operate the 'phones. Needless to say most of these were not efficient enough to give results a long way from a transmitting station.

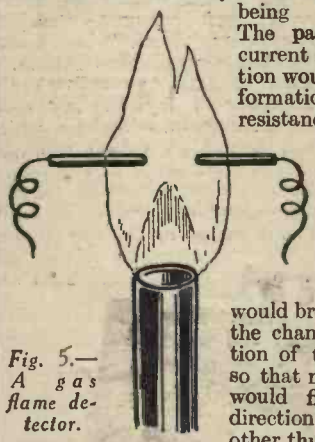


Fig. 5.—A gas flame detector.

Of course the electrolytic detector proper was known for years but was not often used by amateurs. A diagrammatic representation of one type is given in Fig. 1. A small metal point (P) just emerges from a glass tube (T) immersed in a solution which constitutes the electrolyte. The point (P) forms one contact and the container of the electrolyte forms the other. The action is explained by the alternate forming and dissolving of a minute film of gas on (P) according as the current altered its direction.

A Singing Flame?

The gas flame was the blue flame from a Bunsen burner. Two wires were inserted in the flame and connected to the set. This type apparently depended for its action on the ionisation of the gases in the flame. Whether a polarising voltage was necessary in order to start the action I am not certain.

Although the valve detector is almost universally used at the present time it is vastly different in appearance and construction from some of the earlier types. Compare, for instance, the specimen of about 1915 vintage shown in Fig. 2 with a modern detector as represented by the Cossor valve in Fig. 3. Fundamentally, of course, they are both the same. Each has a filament, a grid and a plate, but there the resemblance ends. Notice, for instance, the way the plate and grid connections of the old war-time warrior are brought out through the side of the bulb. I wonder what is the correct expression to use when one breaks off flush with the bulb!

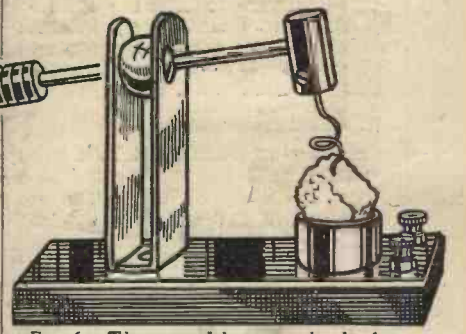


Fig. 6—The crystal here is a knob of sugar.

Why Not Join Your Local Radio Society?

THERE are clubs and societies in almost every town where members meet to discuss, or listen to lectures on radio. Very often well-known technical men from our leading manufacturers give admirable demonstrations. The subjects dealt with are varied, and always interesting. They deal with set operation, technical faults, and talks of an elementary character, which so enlighten the listener that he is soon enabled to correct faults in his receiver without having to run round with his set to the local radio engineer. Usually the social side is well catered for, and there is an "at home" feeling at every meeting. The man possessing a good knowledge of radio is ever ready to assist those who have no knowledge. The Editor tells me he will be pleased to find space for any Radio Society publicity if the secretaries will send along particulars of their activities regularly.

A Word of Advice

IF you are buying a loudspeaker, don't follow the example of one of my Press friends. He toddled into a radio store and heard several demonstrated, eventually choosing one which appealed to his ear. Arriving home with his new treasure, he forgot about dinner in the haste of testing it out and surprising the family. Imagine his surprise in finding a terrific amount of distortion and tonal reproduction which was not a patch on what he had heard at the demonstration. It was so disappointing that he not only lost his appetite, but his temper as well. Now here is the advice. When buying a new speaker it is always advisable to have it tested on your receiver. The reason for this is, many receiving sets are designed to suit a particular range of frequencies, and distortion may not be noticeable with one type of speaker. With another, which is more sensitive, the imperfections may be accentuated considerably. Keep this in mind and don't blame the speaker.

Short-wave Receivers

SHORT-WAVE receivers do some very remarkable things when carefully operated. They bring America, Australia, and other far outposts into our homes, and offer the greatest opportunities for radio thrills at a very small cost. With the introduction of Empire broadcasting, a new vista of radio utility will be opened to us for further research, and no doubt many surprises for the curious. There is much real pleasure to be had from short-wave reception, if you are so inclined, and the making of a receiver is quite a simple matter. For those who prefer it, there are a number of excellent short-wave adaptors on the market which can be used in front of an ordinary screened grid type of broadcast receiver with little or no trouble.

Radio Ramblings

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

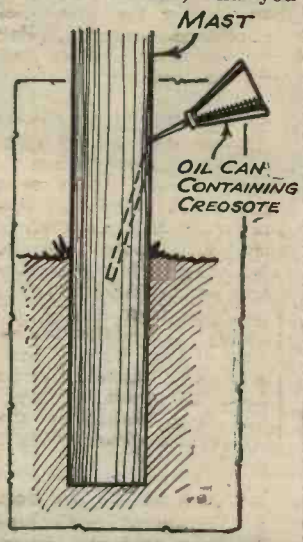
The Proper Care of Aerials

THE time of the year is upon us when both reception improves considerably and when insecure and indifferent aerials and masts fall down. Journeying by train through a populous suburb last week, I saw the first of the winter crop of fallen aerials, an annual event that marks with unfailing accuracy the advent of stormy weather. Considering that even in modern times, with modern sets, our aerials are after all the only means we have of connecting our sets to the ethereal vibrations that mean so much to us; considering all this, I say, it is a wonder we do not as a class give more attention to their care and upkeep. It is a super-fan who, painstakingly, dismantles his aerial year by year, cleans the insulators, renews the wire, and carefully examines ropes, pulleys, and the mast for any possible defect. Even so, you know this should be done, and there is no gainsaying that the annual overhaul pays over and over again for the comparatively small trouble it involves. Human nature being what it is, however, I suppose we will continue to put it off until the aerial falls, and we go to efforts out of all proportion to reinstate the fallen. A few hints might not be amiss, therefore, that will enable you to forestall a catastrophe of this nature, and at the outset I would advise you, on the first fine Saturday, or even Sunday, to make sure that the rope which supports the aerial itself is in good order.

If it is rotted at all, cut the poor piece out altogether, making sure that sufficient rope is left to allow of the aerial wire being let down to the ground. Failing this, purchase a new length of rope of ample length to allow of trimming and cutting next year. *Do not* let the old rope run through the pulley without thinking, or else you might be faced with the prospect of a risky climb up a delicate mast, and amateur aerial masts are rarely of sufficient strength to make shinning up them a sinecure. A much preferable way of fitting a new rope is to tie a long piece of string to the free end of the old rope, and pull this through the pulley. To the other end of the string attach the new rope, and in turn pull this through the pulley and then affix to the aerial insulators. It is a good plan to make a knot in the rope in such a position that in the event of it breaking or running out of your hands, it will stop against the pulley while still leaving a sufficient length for you to catch hold of.

A Mast Hint

CONTRARY to popular belief, the place where a wooden mast invariably rots and breaks off is where it emerges from the ground. Great and justifiable precautions are taken to ensure that no rain enters the top of the mast, by the fitting of a suitable knob or capping, but the part of the mast within immediate reach is too often neglected. A very good plan is to drill a small hole obliquely into the mast, about six or nine inches from the ground, as shown in the accompanying sketch, and periodically squirt into this a few drops of creosote previously put into an ordinary oil can. After a while, the creosote will permeate the whole of the bottom of the mast, and it will be as rot-proof as you can make it. The secret of doing this little job successfully is to give a little squirt *often*. It is no good pouring half a pint around the hole and forgetting all about it. A drop or so every day for a month is the correct method, and you will be amply repaid by having a well-treated mast that will stand for years. If you want to make a really good job of it, it pays to make a small plug of wood to fit the hole; this can be removed when inserting the creosote, and will keep all rain out at other times. Do not drill too large a hole or you will weaken the cross section of the mast—about a quarter of an inch diameter is ample.



A method of preventing an aerial mast from rotting.

The Aerial Wire

HOW many times have you been told that it pays to use enamelled aerial wire? It only costs a few pence more, but it is worth it, for the coating of enamel resists the corrosion that invariably takes place in smoke-laden atmospheres in a very short time. When using enamelled wire, however, care is necessary in making the joint with the lead-in wire. If you attach the aerial direct to a lead-in tube, carefully scrape all the enamel from every strand before connecting up, but if the aerial is first joined to another lead-in wire, every strand should be scraped as before, and the two wires soldered together. The soldering can best be carried out by melting a small "pool" of solder in a boot-polish-tin lid, and allowing the two ends of the wires, which have been thoroughly scraped, and twisted together, to dip into the pool of solder. In this way the solder will cover the whole of the joint, and if it is held still with a pair of pliers until set, a perfect "crackle-proof" joint will result. I cannot say much more about aerial systems now, but one day I will put before the Editor an article showing how a perfectly sound aerial arrangement can be erected at low cost.

B.B.C. Quality-testing Broadcasts

Well, the five million licences have been achieved, but there are still approximately a further eight million houses in Britain which are not fitted with wireless—or, at least, have not taken out licences. It is estimated that the change over to electricity of large numbers of houses is accounting for the large sales of all-mains sets, and that crystal-set users are more inclined to purchase valve sets when there are no batteries to worry about. Even though this is the electrical age, over nine million houses in Britain are unwired for electricity and six million of these have no wireless of any sort. The remaining four million houses are wired for electricity—a very small proportion really—and half of these have wireless. So, you see, there is still a large potential market for wireless sets, and it is in the interest of all radio enthusiasts to procure as many new listeners as possible. More licences will mean more and better programmes apart from the increased number of workers that would be needed to supply the wants of an increasing army of radio fans. There is no doubt that it is a desirable thing for the proportion of listeners among our population to be raised, and there is a way in which every amateur can help. How? you say. Well, by only putting out the very best quality your set is capable of when you are demonstrating it to any non-listening friends. More harm has been done to radio by distorted, screechy outputs than can be estimated, so never mind getting Timbucto-cum-too-much-reaction. Tune in the local and let all possible converts hear real quality—good bass *and* some high notes as well—and an output as realistic as you can make it. If you make a PRACTICAL WIRELESS set you can do it—our Technical Staff will see to that—but the handling of the receiver is your department. The B.B.C. are now giving valuable assistance in the matter of quality, and you will notice that in connection with a series of new talks a series of quality-testing notes will be broadcast—in fact have been by the time you read this—with a range of from 50 cycles to 6,000 cycles frequency, so that you will be able to judge the high and low "cut-off" of your set.

Static Discharges

Some further interesting papers have been read at the International Congress of Electricity held in Paris, and a section has been devoted to lightning research. Anything dealing with lightning and electrical discharges in the atmosphere should be of interest to radio men, and a considerable amount of work has been

carried out by an enthusiastic band of scientists with instruments known as oscillographs. A Dr. Norinder gives the important statement that he has found that a lightning flash, while appearing to be one discharge, is in fact merely the culmination of a large series of partial discharges. If you have listened during a thunderstorm you will have noticed that practically the whole of the time crackles and splutters come from the speaker quite separately from the large crack made by a flash itself. A M. Dauzère has carried out investigations on the flash itself and has found that lightning essentially consists of a transport of ions at incredible speed through a narrow channel. A considerable difference of opinion is held by various schools as to the polarity of a lightning flash, but M. Dauzère believes in common with several other great scientists that the discharges are mostly positive. Experiments with localities most prone to lightning discharges have shown that granite is the most susceptible rock to lightning, as are the various clays that are the product of decomposed granite. Strata at the other end of the scale—the calcalarious formations are the least dangerous from a lightning point of view. It may be a coincidence, but I believe I am right in saying that the granite clays, in fact most clays, make the best wireless earths, so that there might be some sort of connection between the two facts. Very interesting are the attempts made to measure the energy of a flash, and results obtained indicate that the energy of a flash is in the region of 10^9 Joules. The greater part of this energy is dissipated in heating up the air along the path of the flash. The Joule is the work done by I watt during the time of one second, and as a lightning flash takes but a fraction of this time, one can gather that quite a useful job of work is being done which calls for the release of at least 10,000,000,000 Joules, or about the same number of watts per second. If this were harnessed, how long would it work your wireless set? No prizes offered for the solution excepting a headache!

Radio Toulouse

AS I mentioned before, reception has been steadily improving of late and more and more difficulty is being found in separating the high-power stations. That real old-timer, Radio Toulouse, who has been on the air almost since broadcasting first started, is raising his power in the mad race to make themselves heard that stations are indulging in. His new power will be some 60 kW. and, in comparison with his present 7 kW., is a really tremendous output. I have always had a warm corner in my heart for Toulouse; he is always dependable, and seems to be always working, both early and late. Otherwise the station has little to commend it, for I know of no other station so prone to quick fading, and his programme material, most of which is gramophone records, leaves much to be desired. On the other hand there is no other station giving out so much piano-accordion music, and this instrument seems to imbue the spirit of Paris like no other instrument does any other locality in the world, not even the Negro "twanging" string instruments. In view of my remarks a week or so ago concerning the growing practice of building the transmitter outside the town of its origin and sending the programmes into the town, it is interesting to note that the new Toulouse is being accommodated in an old chateau some 20 miles from Toulouse. I wonder if he will fade as badly as the old station?

Records Made by a Secret Process

YOU all heard of the method employed by a Hollywood producer to judge the laughs and applause given a London play by the audience in order that he might estimate its box-office appeal as a film. He had thirty records made—at ten pounds apiece—and on these the whole of the play *and* the applause was faithfully recorded. Those laughs cost him some three hundred pounds, but if the film is a success as a result of the enterprise he will have the last laugh after all. All this brings me to the fact that some records have been presented to Mrs. Enrico Caruso, the widow of the famous tenor, on which is recorded some of her late husband's most famous arias. These records have been made from old ones made seventeen years ago, the novelty being that new synchronized musical accompaniment has been added. The method employed is a secret one, but it employs the modern method of electrical recording with "mikes" and valves. As a novelty it may have its appeal, but it strikes me as being rather similar to the unsuccessful attempt to popularize a modern "Hamlet" played in evening-dress clothes which was tried a few years ago.

Election Results via Poste Parisien

IN this election-mad world you probably heard the German election results and probably those of the New York presidency. Ordinary listeners heard the latter results *via* Poste Parisien during the early hours of Wednesday morning, November 9th, although the *real* radio amateur was probably only satisfied with receiving them from America direct. The Poste Parisien broadcast was arranged by the *New York Herald*, for the benefit of Americans abroad, and they say it was a good broadcast. I received the results free from fading or atmospherics with remarkable clearness—in the papers next day!

British Artist for New York Radio City

I AM almost beside myself with joy to hear that the Americans have employed a British artist to decorate the walls of their colossal Radio City now building in New York. The wonders of this edifice are legion, but I hope the least of them will not be the mural paintings depicting the march of American progress by Mr. Frank Brangwyn, R.A. That they should have to come to the "old country" for someone to show them how America has progressed is encouraging, but Mr. Brangwyn is already in trouble with a little difficulty of finding lady models sufficiently plump to be a true representation of old-time American ladies. It won't be long now before the U.S.A. will be appreciating the advantages of British designed, and made, valves!

BEGINNERS' SUPPLEMENT

(Continued from page 510)

assembly was compressed until it registered the correct capacity and also all air bubbles were expelled; it was soaked in paraffin wax to ensure that no moisture or air could gain an entry once it was sealed, and the tinfoil projecting from the ends was carefully hammered over to make a good soldered connection with *every* turn of the foil and not just here and there. This last precaution is taken chiefly in order to make the condenser as non-inductive as possible. It reduces the chance of the coiled foil acting as a tuning coil, which would lessen its efficiency as a condenser.

Electrolytic Condensers

When it comes to the larger capacities such as those of about 4 or 8 mfd., the paper type of condenser becomes rather bulky. A much more compact component is the electrolytic condenser. This has certain limitations but is admirably suited as a smoothing condenser for rectifier, decoupling and filter circuits in mains units and the power circuits of mains sets. In appearance it is cylindrical and somewhat like a single cell from a dry battery. In its construction also it is not unlike a dry cell.

Electrolytic condensers are of two types—wet and dry. The wet ones actually contain a liquid, but the dry ones are not strictly dry, since they contain a moist paste or similar substance for the electrolyte in much the same way as does a "dry" battery. They differ from the other types in that when first assembled they have no dielectric like mica or paper. One plate of the condenser is in direct contact with a liquid, the electrolyte just mentioned, which also forms the other "plate." How a liquid can take the place of a plate is more easily understood when we remember that it is a liquid which will conduct electricity—not a liquid like oil, which is an insulator. The two "plates" then are in contact. Now, in order to convert this arrangement into a condenser it has to be "formed" by passing a current through it. This causes an electro-chemical action to take place, with the result that an exceedingly thin film of non-conducting material is deposited on the one true plate or *anode*, as it is called. This deposition is similar to ordinary electro plating, except that a non-conducting and not a metallic substance is deposited. When forming is complete we have a condenser composed of one metal plate, a dielectric consisting of a thin, non-conducting film on this plate, and another plate which is really the liquid surrounding the dielectric.

Now, having cleared away these somewhat technical preliminaries, which nevertheless are rather essential if we are to appreciate fully what we are about to find inside, we can get down to an examination of an actual condenser. Let us take one of those shown in Fig. 8. First of all, the inside is far different from that of the previous two types. The "core" of the whole thing is the anode, which consists of a coil of aluminium wound round an aluminium rod. The lower end of this rod passes through the bottom of the condenser and is fitted with a terminal (see Fig. 9). The aluminium anode is coated all over with the thin non-metallic film just mentioned, and surrounding this is the electrolyte—a special liquid, the exact composition of which is usually a trade secret. We are assuming now that we have chosen the wet condenser for examination, but in the case of the dry one we should probably have found either a paste as the electrolyte or some absorbent material soaked in a liquid. The liquid electrolyte almost fills the space between the anode and the case. This latter is of metal and serves to contain the liquid and to make contact with it. Another terminal is not used in the particular model illustrated, as it is intended for one-hole fixing direct to a metal chassis. The locking nut serves to secure it in position and to make contact between the metal case and the chassis.

Simple Arrangement for Automatic Tuning

WHEN a small set is used near a Regional station, and all that is wanted and can be received are the dual programmes, automatic tuning is an advantage. If only one tuning coil is used, all that is required is one push-pull switch and two pre-set condensers, as shown in Fig. 1. With the switch off, tune the lower wavelength on the first condenser, then with the switch on, and moving the second condenser only, tune the higher wavelength. When two tuning coils are used, a two-pole four-point switch and four pre-set condensers are needed, as in Fig. 2. With this method the usual .0003 pre-set condensers can be used, even though a station comes in high up on a .0005 tuning condenser. — W. MUIRHEAD (Falkirk).

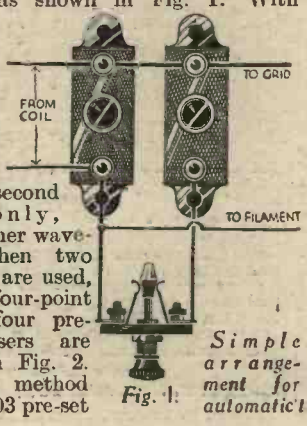


Fig. 1.

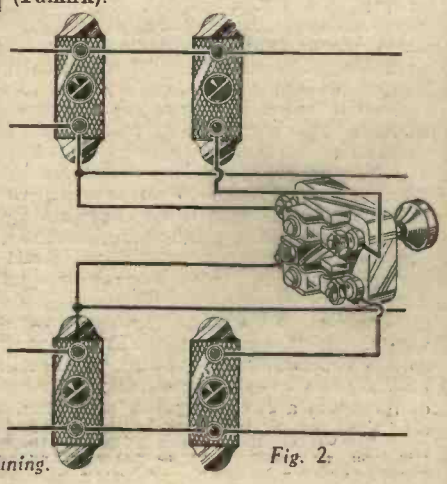


Fig. 2.

Simple arrangement for automatic tuning.

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 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.

SHOCKS FROM THE SPEAKER

"I have recently fitted my receiver with an output filter circuit, employing a good make of choke and a good make of fixed condenser. This has a value of 4 mfds. Whilst trying out some different makes of speaker the other night I received a shock, in both senses of the word. That is to say, I touched the two loud-speaker terminals and received a definite electric shock. According to what I have read in your pages, the idea of fitting a filter circuit is to avoid the current running through the loud-speaker, and it was for this purpose that I fitted it. I shall be glad, therefore, if you can explain the apparent contradiction."—(F. P. O., Bognor.)

There is no contradiction, F. P. O. The fitting of an output filter *does* remove the direct current from the loud-speaker windings, and there is nothing wrong with your components. The matter is explained quite simply, when you remember that the signal impulses are in the form of oscillatory currents. Now your receiver is no doubt a fairly large one, and you were probably receiving a fairly strong signal when you touched the L.S. terminals. The signal currents are, therefore, sufficient to give you quite a good shock, and in fact can be caused to light a lamp if it is included in place of the speaker.

A SIMPLE SCRATCH FILTER

"I have fitted a pick-up to my receiver, but am very disappointed with the reproduction. The surface noise from the records is terrible, and if anything it seems worse than a cheap gramophone. Is there anything I can do to cure this? My L.F. stages are quite all right for broadcast reception, and I do not want to interfere with these if it can be avoided. Perhaps you can suggest some scheme which can be switched in when using the pick-up so as not to spoil my broadcast programmes."—(R. S., Hendon.)

The simplest remedy is for you to connect a high-resistance across the pick-up. The exact value will depend upon the pick-up and the amount of top note cut-off which you can put up with. If you use a variable resistance having a maximum value of 100,000 ohms, you can join this across the pick-up terminals, and then set it to give the reproduction you require.

IMPROVED AERIAL

"I have been reading the hints in PRACTICAL WIRELESS, and believe that my aerial insulation could be improved. I have got simply one small insulator of the egg type at each end of the wire, and think that perhaps more would be advisable. Should I join these in parallel with the one already there, or in series? I should be glad of your remarks."—(G. B., Whitchurch.)

If the aerial insulator is not too small, it should be sufficient for ordinary purposes. However, if you wish to be on the safe side you may add some more, but do not include these in parallel. They should be joined in series, that is, in chain formation.

LOUD-SPEAKER WINDINGS

"I have an old moving iron type of loud-speaker which has been kicking about for a long time and has the windings broken. I am thinking of rewinding it. Can you tell me how many turns should be on each bobbin? Should both be wound the same way? What gauge wire should I use? I am a regular reader of PRACTICAL WIRELESS, but have not been able to pick up points on this subject. I enclose a sketch of the unit."—(T. J., Newbury, Berks.)

These coils are wound with an exceedingly fine gauge wire (probably No. 48 or 49 gauge) if, as we assume, it is a high-resistance speaker operated from set direct without a step-down output transformer. The total resistance of the bobbins is probably 4,000 ohms and may be marked on the speaker. This will need 190yds=about 1-15oz. in silk covered. If No. 48 is used 340yds=about ½oz. The wire is divided between the two bobbins, which are wound in the same direction. Your easiest plan is to purchase wire to the pattern of that now on the bobbins, and fill them as they are at present.

WRONG RESISTANCES

"I am experiencing some trouble with my set, S.G. det. and pentode. When I first made the set I ran my H.T. from an eliminator off A.C. mains. I have since had to move to where the supply is D.C. I purchased another eliminator, but the set would not work, until I inserted a grid leak in the screen grid H.T. lead as shown on the attached sketch. Two days ago the set went right off, and I found the trouble was in the grid leak. Not having another one of the same value by me I used a higher value, but the set gradually lost its power, and I had to use another leak, which again cured the trouble. Now when I adjust the volume control, which is a potentiometer in the screen grid circuit, I get a very coarse rumbling noise from the set. I would be please if you could help me cure my trouble."—(S. W., Wood Green.)

It would appear that the grid leaks used as a resistance have not sufficient capacity to stand up to the job, and they will not stand even the small current passing through them. If you have them by you try 2 or 3 1-mcg. leaks in parallel, or better, a spaghetti or other type resistance of 100,000 ohms. This should stand up to the work.

TONE CONTROL

"In the 'Long Range Express Three' elaborate arrangements are made for tone compensation, and in the description you say that all loud-speakers except moving coil types require this. Why then do you recommend a moving coil speaker? Would it not be better to connect the primary of the loud-speaker transformer in the anode circuit of the pentode in this case?"—(S. B., Paddock Wood.)

We have designed the "Long Range Express Three" and included tone control so that maximum efficiency with regard to frequency response can be obtained by the user. It is obvious that our readers who build this receiver will be using all types of moving coil speakers, with different ratio transformers, and we feel sure you will agree with us that the best method is to include this tone control, although it may not in some cases be required, rather than leave the tone control out, and so necessitate having in quite a number of instances to show readers how a tone control can be connected to the set.

THE GRID BATTERY AGAIN

"I have a —— set which I bought just over a year ago. It was excellent when it was new, and has given yeoman service until the last few months, when it has gradually developed a horrible scratchy tone. Speech sounds sort of muffled, and when loud musical passages come through, they seem as though they are coming through thick blankets. The H.T. was renewed less than two months ago, but it is no better. I should be glad to know how I can find what has developed, as I am becoming keen on understanding the inside of a receiver since taking in your book. I do not, of course, want to take the set to pieces, as it is a factory-made receiver, but I am only just 'sitting-up and taking notice,' and do not know the most likely place to look for the trouble."—(G. B., Watford.)

You say the set is just over a year old; that the H.T. was renewed less than two months ago. So far, so good, but what about the grid battery? This would seem most certainly to be your trouble. You will find it tucked away inside the set on the right-hand side behind the large transformer. You have probably not recognized this, as it is not one of the usual 9-volt cells, as it is untapped, and was made specially for those particular receivers. However, the voltage is 9 volts, so you must remove the two plugs at each end, and fit a new battery, inserting the positive plug (that is, the red one) at the end of the battery marked with the plus sign. The black plug then goes into the other end of the battery, and you will then find the receiver will be as good as new.

MAINS-TRANSFORMER WINDINGS

"Reading your article on the construction of Mains Eliminator, could you please advise me what would the difference in the mains transformer be to suit my mains 110 volts, 25 cycles. As it is difficult to obtain an eliminator for these mains, would it be possible to make one?"—(W. P., West Smethwick.)

You can obtain the same make of transformer designed for operation from 110 volt, 25 cycle mains. This will be somewhat more costly, since the secondary windings will require twice as many turns to give the same voltages.

You could make a transformer as described in PRACTICAL WIRELESS No. 5. The primary winding would require 1,760 turns; the H.T. Secondary (for 200 volts) 3,200 turns, and the L.T. Secondary, sixty-four turns. In each case the wire would be as specified in the constructional article.

The transformer should be connected as shown in the wiring plan on page 220.

MILLIAMMETER AS VOLTMETER

"I propose building a Four-range Test Meter following your description in this week's PRACTICAL WIRELESS (Oct. 29th). The milliammeter I have, however, reads from 0 to 30 milliamps, and I should like it to give:—

0 to 30 milliamps.
0 to 3 volts.
0 to 30 volts.
0 to 300 volts.

Based on your constructional article, would you kindly tell me the correct resistance values."—(D. P., Southampton).

We give below the resistance to be used in series with your m/A for the readings you require.

0–30 m/A	..	No resistance.
0–3 volts	..	100 ohms.
0–30 volts	..	1,000 ohms.
0–300 volts	..	10,000 ohms.

DATA SHEET No. 10

DIELECTRIC CONSTANTS

(otherwise known as Specific Inductive Capacities)

Cut this out each week and paste it in a notebook.

Material	Dielectric Constant	Material	Dielectric Constant
Air	1	Paraffin, Liquid	2
Castor oil ..	5	Paraffin wax	2
Ebonite ..	2.5	Rubber, pure	2
Glass ..	5-10	Shellac ..	3
Mica ..	6	Sulphur ..	4
Paper (waxed)	2	Wood ..	5

The dielectric constant is the ratio of the capacity of a condenser using a particular material as compared with a similar condenser employing air for the dielectric. Thus, a condenser with the plates separated by mica would have a capacity six times as great as one employing air—provided the plates were of the same size and had the same separation.

FREE ADVICE BUREAU COUPON

This coupon is available until Dec. 3rd, 1932, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 26/11/32.

Practical Letters from Readers.

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

Elementary or Advanced

SIR,—If you maintain the standard for this journal which you have established, you will increase your subscribers. It is difficult to please everybody, but there is a real need for a journal which sets itself out to provide not only elementary information for the very keen student of wireless, but information which will be of interest to more elementary enthusiasts. The observation of a correspondent in your current issue that technical terms should be avoided, and that point to point wiring should be substituted for technical circuits, will certainly not encourage the type of man who is anxious to progress. I think you have hit the happy medium and, if you will bear in mind the requirements of the more advanced student, your journal will continue its prosperity.—R. JACKSON (Heswall).

Reasons Why !

SIR,—Congratulations ! Your new paper has created a record ; below are my reasons, which I think are shared by hundreds of other readers.

1. You cater for both the beginner and experienced hand.
2. The quantity and quality of your articles are irreproachable.
3. The diagrams are clear and understandable, while the reading matter is explicit as possible.
4. Your query section is free.
5. Your sets seem to be of a high standard and of a moderate price.

But—there is a but. Could you not publish occasionally, only once in a while, a super-cheap set, one that although inexpensive, will give good results from the local ? The demand I think is universal, for there are many wireless enthusiasts who have been "hard hit" by the "Government's" economy stunt, and to those it would be a boon.

That, I think, is the only thing wanted to make PRACTICAL WIRELESS perfect.—GEORGE (Northampton).

Really Practical

SIR,—Just a word about your new PRACTICAL WIRELESS : after the fourth issue, I have come to the conclusion that it really is a *Practical Wireless* Guide, it is a book that gets out of the rut, it breaks away from that dreary sameness. I look forward to every Wednesday with more pleasure than before.—H. G. STEEL (Poplar).

Identifying the Foreigners

SIR,—You would be supplying a much-needed want by publishing a chart in PRACTICAL WIRELESS, by means of which readers could identify the principal broadcasting stations in Europe in their numerical wave-length order.—J. JONES (London, N.W.5).

Gas Pipes As Earths

SIR,—As the author of the article referred to I was particularly interested in Mr. Walker's letter in PRACTICAL WIRELESS dated Oct. 29th. I am fully aware that the Gas Association look with disapproval on any fitting attached to their supply pipes other than those supplied by the Gas Companies, but it is Mr. Walker's explanations of the Association's objections which I find need rather a lot of swallowing. First, he says that the experience of many users is that an earth effected through a gas pipe is much less satisfactory than the normal type. I am sure it is very nice to feel that the Gas Association has the interests of wireless listeners so much at heart, but the fact remains that however badly the joints are made from the point of view of conductivity (as Mr. Walker would have us believe) practical experience shows that a gas pipe usually makes a *very excellent* earth for a receiving set, quite apart from its convenience. For instance, comparative tests show that a gas pipe earth is often far more efficient than a metal rod stuck direct into dry earth. It is certainly infinitely better than no earth connection at all, which is the only alternative in the case of some flat dwellers. Regarding the resistance of the pipe joints this is actually comparatively very low as the joints are screwed metal-to-metal. The red lead used does not make the joint but is used to fill up any little interstices and so safeguard against gas leakage.

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—That a short-wave converter is preferable to an adapter for using your own receiver on short waves.
—That when two coils are coupled together so that a change in current in one coil produces an E.M.F. in the other, they are said to possess "mutual inductance."
—That ordinary wire netting may be used for screening purposes instead of sheet metal.
—That the inclusion of iron in a solenoid increases the inductance of the solenoid.
—That a fuse for battery-operated receivers should be used to join H.T.— and L.T.—.
—That an H.T. battery should always be shunted with a large-capacity fixed condenser.
—That a buried earth may be greatly improved by packing the earth plate with rock salt.

Now as to the question of danger. First of all I would point out that I recommended the gas pipe earth in connection with an *indoor aerial* so that the question of damage by lightning does not arise. Secondly, does Mr. Walker really expect us to believe that a leakage of current from the electric light mains due to a defect in an all-mains set could possibly be so great as, not only to *heat* the pipe but actually to *melt* it ? He seems to forget that the electric light mains are fitted with fuses which would blow immediately a small leak occurred, let alone the enormous current which would be required to fuse a pipe. In short I challenge Mr. Walker to produce evidence of a single instance where damage has been caused to the pipes or joints by leakage of current from a mains receiver.—W. B. RICHARDSON (Chiswick).

Another Suggestion

SIR,—Allow me to congratulate you for the best "Practical" wireless journal yet published and also for the high standard of your "Complete Wireless," of which I am also a reader. What I like about both these journals is the way things are backed up by diagrams which are far more understandable than mere words. Now may I make two suggestions with regard to PRACTICAL WIRELESS ? First, that all advert. matter be so placed that it may be removed at the end of a volume without disturbing reading matter. Secondly, that a complete index be published to each volume. Nothing is more irritating than having to scour through a dozen or so weekly parts for one particular item. Well I won't take up any more of your valuable time, but please keep up the good start you have made.—E. RIDGWAY (Hyde, Cheshire).

Cheap Portable Wanted

SIR,—Let's have a good, cheap and powerful portable in PRACTICAL WIRELESS as soon as possible. S. G., Det. and Pentode and adaptable for outside aerial and earth. If you can give us something round about £5 I think it would be very welcome to thousands of your readers. I have tried several "contemporary" portables but there is always something lacking in those which the average working man can afford to build. He feels he has not got value for his money. I'm not going to eulogise on PRACTICAL WIRELESS. Any fool knows when he's got value for his money. I'm after that Encyclopædia.—"PORTABILITY" (Felixstowe).

A Reader's Thanks

SIR,—Your excellent paper is both practical and wireless all through and is not concerned with the furnishing of broad-

casting studios and the personal descriptions of radio "stars," which some other papers seem to favour. For this many thanks. I was particularly glad to read in your first number that you would give instructions for adapting your circuits for portables, frame-aerials, etc. I do hope you will do this. There is a surprising dearth of good, practical instruction in home-made portable sets in the wireless press.—H. F. (Northwood).

An Appreciation, and Some Criticism

SIR,—May I offer you sincere congratulations on your production of a weekly for the non-technical, as well as the technical fans of our great brotherhood. I particularly wish to stress the importance of more publication of the "Facts and Fallacies" of our hobby and may Mr. Richardson expose still more in further articles, and so let people know facts, instead of remaining in ignorance of many old fads and fallacies. I have in every instance of conversation with many of my non-technical customers told them of several of the items in the article mentioned, and have instructed my junior service staff in this respect. I have one or two little moans to make, the first being in reference to your article in No. 3, *re* valves in push-pull and parallel. Your correspondent states, when mentioning necessity for two matched valves, that any valve manufacturer will supply with a pair of valves so matched at no extra cost. This is misleading, as manufacturers will not do this, but will charge 20 per cent. extra for matching, and they are permitted to do so in accordance with B.V.A. Regulations. Secondly, in your test report of Lotus "Landmark" Three Kit, you state in about three places words to the effect that the whole of components used are made by Lotus. Now this is not correct, as having made up, sold and still stocking these kits, may I point out the following:—75,000 ohms Spaghetti by Messrs. Lewcos; one 1 mfd., one .0002 mfd. and one .006 mfd. fixed condensers by Messrs. Dubilier; three grid leaks by Messrs. Graham Farish.—W. J. MATTHEWS (South Norwood).

"The S.G. Amplifier"

SIR,—I trust I may be permitted to point out a small error which appears in Oct. 15th issue of PRACTICAL WIRELESS, in connection with fixed potentiometers supplying voltage to screen grid valves, under the heading of "The S.G. Amplifier," by L. F. Thomas. Mr. Thomas says that if we used a fixed potentiometer with the two arms made up of resistances of 30,000 and 50,000 ohms respectively, we shall obtain a voltage on the screen of five-eighths of the total voltage of the battery. This is, of course, incorrect. The facts are as follows:—

Assume a battery voltage of 150 Volts. Then the total current drawn by an 80,000 ohms potentiometer will be 1.875 milliamps and the upper arm (30,000 ohms) will be carrying 1.875 milliamps *plus* the actual current taken by the screening-grid itself. This latter current may be taken to be some .6 milliamps under normal working conditions, and therefore the total current carried by the upper arm is 1.875 plus .6 milliamps. The voltage dropped in this resistance is consequently thirty times 2.475 milliamps, which equals 74¼ volts; leaving 75¾ volts to be applied to the screening-grid, which is approximately *half* the voltage of the battery, and *not* five-eighths. The correct procedure when ascertaining the voltage applied to screening-grids is as follows:—Find the total current passed by the potentiometer by dividing its resistance into the battery voltage; add to this current the current taken by the screening-grid under normal working conditions (this information may be obtained from the valve makers' leaflet), and then divide this figure into the voltage required to be dropped in the upper arm. The result is the resistance of the upper arm. The resistance of the lower arm is then found by simple subtraction. The example quoted above is self-explanatory. With best wishes for success with your excellent new weekly.—HAROLD STRIPE (Fareham).

More Co-operation Wanted

SIR,—I have read with interest the first six numbers of PRACTICAL WIRELESS and must say that they promise to provide something of a long-felt want in the way of a wireless journal not too technical. The sets so far published are quite up to the standard of modern requirements, and looking at the chassis construction, have quite a professional appearance. The same cannot be said of the panel lay-out, which has still got the home-constructed look about it. Take, for example, the Long Range Express Three (battery or mains). The appearance of the panel on both these receivers could have been much improved if it were possible to fit a bakelite escutcheon to take the two .0005 mfd. condensers, one right hand and one left hand. Also, why not a multi-point switch which will give us wave change, radio-gram, and on and off? These would enhance the look of the receivers without inpairing the efficiency. Most keen radio fans buy or make a good-looking cabinet and then proceed (through no fault of their own) to fit several knobs, not always the same size, and as a rule not of a suitable colour to match the cabinet, simply because the set designers and component manufacturers do not co-operate and let us have what is wanted in this line. Until this happens I'm afraid our home-constructed sets, while being very efficient, will still look "home made." Wishing your paper every success and trusting you will be able to wake up some of our component makers.—A. B. TOLLERTON (Crowborough).

Space for Notes Wanted

SIR,—In the first place, allow me to add to the congratulations. PRACTICAL WIRELESS is establishing itself firmly. I have a suggestion to offer, but it is editorial, not constructional. It may, nevertheless, be of interest. My suggestion is that you should include in your paper a space for listeners' notes. The reason is that there is now such a variety of material offered to listeners through National and Regional programmes that very often an item which is looked forward to may be missed, through the time of performance being forgotten about. The advantage of a space for notes would be that the listener could insert, under each day, the time and nature of special items desired, and have this ready to refer to at a glance. Alternatively, this may be designed to take the form of a small booklet, which would cover a certain period. This, I fell sure, would find a ready sale; or, if cost permitted, might be offered as one of your usual supplements. I think that something on the lines suggested would add to the value of your already valuable paper.—ROBERT SHARP (Kilbirnie).

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.

PETO-SCOTT'S SHORT-WAVE BOOK

ALL home constructors contemplating the building of a short-wave receiver will find a mine of useful information on the subject in a well-printed book just issued by Peto-Scott Co., Ltd., 77, City Road, London, E.C.1. Full particulars, together with lists of components, are given for making a good S.W. Adaptor, the Tourist Two, Courier Three, and the Discoverer S.G.Three. The author is a recognized authority on short-wave work, and his adaptor bears the stamp of simplicity and efficiency. A full-size blue print of the adaptor is given free with the book. The Tourist Two will appeal to constructors requiring an inexpensive set capable of trans-Atlantic and Continental reception on the loud-speaker. The Courier Three is a long-range short-wave receiver, simple to handle and inexpensive to build, covering wavelengths from 15 to over 100 metres. The valve combination consists of detector and two L.F. stages, and the circuit is the acme of simplicity. With regard to the Discoverer S.G.Three, this fine set represents the last word in modern S.W. receiver design. It combines all the advantages of S.G. amplification with extreme simplicity of operation, and is in every way a remarkable set. Photographs of the completed sets, together with theoretical and wiring diagrams, are given in the book. Full-size blue prints of all the sets are available, and the prices of these are included in the book, which also contains many useful hints and tips on short-wave working and several illustrations of the world's best-known short-wave stations. Priced at one shilling, this useful handbook is obtainable from any bookstall or direct from Peto-Scott Co. at the address given above.

NEW BLUE SPOT RECEIVERS

IN a folder we have just received from The British Blue Spot Co., Ltd., particulars are given of two new receivers incorporating the popular Blue Spot loud-speakers. One receiver (K252) is a table model, and is fitted with a No. 100 U speaker. The other model is of the pedestal type and is equipped with a Blue Spot permanent magnet moving-coil speaker. Each receiver is battery operated and utilizes two of the latest type variable-mu screened-grid valves, detector, and power valves. Provision is made enabling the use of a pentode output-valve if desired. Both receivers cover a tuning range of 200-2,000 metres, and are fitted with gramophone pick-up connections. Housed in attractive cabinets, the table model is priced at twelve guineas, and the pedestal model at sixteen guineas. The address is 94-96, Rosoman Street, Rosebery Avenue, London, E.C.1.

CELESTION SPEAKERS

A COMPREHENSIVE range of loud-speakers is shown in the latest folder issued by the Celestion people. Mostly of the permanent-magnet moving-coil type, the models include the fine PPM79 speaker which has remarkable sensitivity. Its large "Hyflex" diaphragm gives a wide tonal response. A universal transformer is fitted, which allows all valves to be accurately matched. Another model with high sensitivity, great handling power, and a full tonal response is the PPM9, a little giant among moving-coil speakers, and priced at only thirty-five shillings. There is also a more powerful model in the PPM29, a high-class moving-coil speaker with a massive cobalt magnet and a 10in. diaphragm. Two very moderately priced D.C. speakers are also listed. Celestion speakers, which are the outcome of careful research work over a period of more than seven years, can be recommended to the discerning listener who wishes for "true to life" reproduction. The address is London Road, Kingston-on-Thames.

LEWCOS RADIO PRODUCTS

PARTICULARS of the Lewcos Wire-Wound High-Resistance Potentiometers are given in a folder we have received from the London Electric Wire Company and Smiths, Ltd. These potentiometers are supplied in varying ranges from 100,000 to 250,000 ohms. Other folders deal with Lewcos Dual-Range Screened Coils and Spaghetti Resistances and H.F. Chokes. In a fourth folder, L.F. transformers and the Lewcos L.F. Choke are listed. These transformers embody the latest improvements in design and are provided with a nickel iron core of ample proportions. The Lewcos L.F. Choke, which has been produced to meet the demand for a reasonably priced high-class component, is metal shrouded, and the winding is centre-tapped. The address is Church Road, Leyton, London, E.10.

Broadcast Query Corner

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

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

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

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

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

Replies to Broadcast Queries

D.J.W. (Bush): WPG, Atlantic City (N.J.), Columbia Broadcasting Network on 272.6 m. J. B. M. (Glasgow): VK2ME, Sydney, N.S.W. (31.28 m.).

ADVERTISEMENT INDEX

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