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FREE BOOK INSIDE! ALL ABOUT TUNING AND TUNING COILS

Practical Wireless

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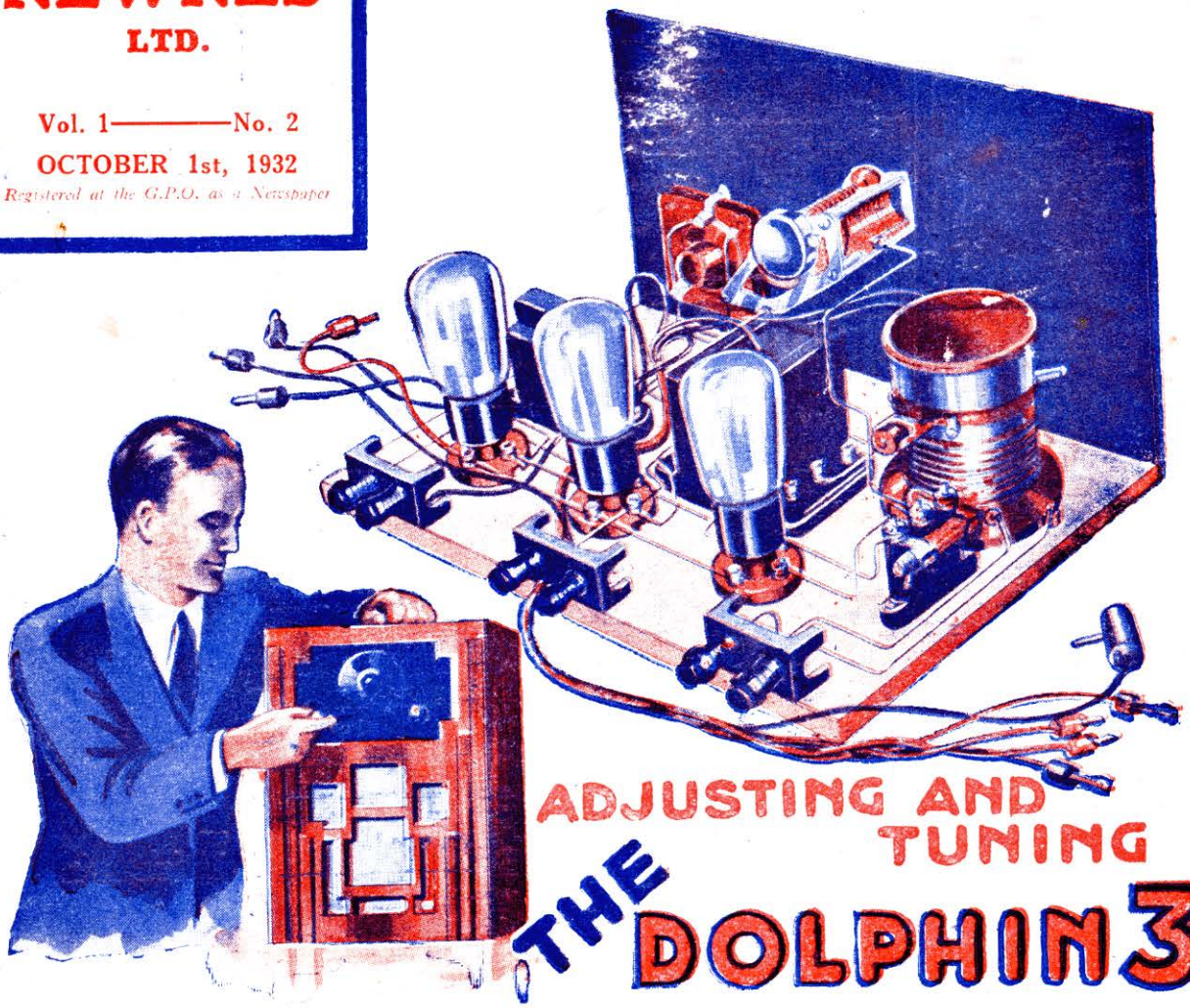


ADJUSTING AND TUNING THE DOLPHIN 3

how to bring in more stations

fit COSSOR S.G. VALVES

NEXT WEEK: THE MAINS EXPRESS THREE!

ROUND THE WORLD OF WIRELESS

"Narrowcasting"

THEY have a way of doing things in America that seldom occurs to people on this side (just as well, perhaps). The other day, for instance, it was the occasion of the opening of the new 50 kW WGY transmitter at the Schenectady Station of the General Electric Co. of New York, and a huge crowd of people were present at the ceremony. Even the Government co-operated in the affair, and loaned the United States Navy airship, the *Los Angeles*, to participate in a stunt piece of transmission through the new transmitter. The airship from aloft shot a beam of light on to a mirror some half a mile away, and a programme was sent over the beam that was easily followed by the audience below. This method of "narrowcasting," as they call it, was that originated by Mr. John Bellamy Taylor, this gentleman having sent the human voice over a beam of light on many occasions. In this case the transmission was particularly successful, as the programme was picked up by a sister airship, the *Akron*, many miles away over the Pacific. The beam of light is modulated by the voice, and the photo-electric tube in the receiver responds to the modulated light, affecting the electrical impulses in the amplifier, from whence it is fed to the transmitter. As a freak transmission, I suppose the system serves its purpose, but I am afraid I cannot see much future for it commercially, at any rate, particularly as a good pea-soup fog would put the whole thing out of action, I should think.

Prague's Giant Broadcaster

THE new radio station is situated in the geographical centre of Europe, some 35 kilometres east of Prague, in the vicinity of the small town of Cesky-Brod. This new high-power broadcasting station is rated at 200 kilowatts (C.C.I.R.), and is the most powerful broadcaster operating is the medium-wave broadcast band. During preliminary tests it was heard in many European countries, including the British Isles. The new station, which operates on a wavelength of 486.2 metres, has been designed to give very high-quality reproductions with low running and maintenance costs. Apart from its high power, the station contains a number of novel features, not the least of which is the special system of electrical and mechanical interlocks which prevent operators not only from touching dangerous voltages, but also from receiving a shock from the discharge of a condenser. The equipment will cater initially for two studios in Prague, though provision has been made to extend service to ten studios when required.

Unknown Listeners

A LOT of publicity is being given to the forthcoming B.B.C. talks to "The Unnamed Listener." G. B. S. comes into the limelight—is he *ever* out of it?—with a talk "To a Politician," and various prominent people are to give talks to other unknown listeners. It would not need a very fertile imagination to suggest scores and scores of other listeners we would like to say a few words to, but I do think the season could be very well started off with a talk—and a really good talk at that—to "An Unknown Oscillator."

Who'd Be a Manufacturer!

A DISGRUNTLED customer wrote as follows to a certain manufacturer concerning the non-arrival of a volume control which had been on order for eight days:—

"Supposing the said volume control was made by hand, inspected by an inebriate and handed over to a half wit, I, in my innocence would have imagined that it might have been delivered by now.

"I don't want to hurry or worry you in any way, but I would be most grateful if same could be delivered before Christmas.

"If you get just one teeny weeny factory working night and day on my volume control, I should dream dreams of having my amplifier completed before the next 'Show' tells me it's out of date."

Said control had never been ordered from the manufacturer by the local dealer who had the original order. *Verb. sap.*

New G.E.C. Conversion Unit

OWING to the extension of the grid system throughout the country, a considerable number of D.C. areas are being switched over to A.C. This means that many thousands of owners of wireless sets who employ the mains for their source of energy find it a difficult problem to convert such sets to operate from A.C. mains. We understand that the General Electric Co., Ltd., is shortly bringing out a conversion unit which will solve this problem by giving the equivalent of the original D.C. supply at a very economical rate.

New Italian Station

THE new 60-kilowatt transmitter which is now being erected at Milan (Italy) will shortly carry out its initial tests. October 28th has been fixed as the date of its inauguration; it coincides with the tenth anniversary of Mussolini's Fascist rule.

How Germany Does It

IN Germany the listening tax is paid monthly, and its collection from set owners is made by the postman on his rounds. The annual broadcast licence costs twenty-four marks, or at to-day's rate of exchange about thirty shillings. Germany possesses roughly four and a quarter million registered listeners. Radio pirates are discovered by the municipal chimney sweeps, who, in the course of their daily duties, visit all houses, flats and apartment houses. It is their duty to notify all wireless receivers to the local authorities, thus allowing the latter to make the necessary investigations.

One Mast Aerial

THE 120 kilowatt Budapest (Hungary) transmitter is being erected on the island of Csepel in mid-Danube; its aerial will be of a distinctive pattern, and will consist of one pylon over 320ft. high. It is somewhat similar in construction to the one now in use at Breslau for its new station.

Round the World of Wireless (continued)

INTERESTING AND TOPICAL PARAGRAPHS

The Prague Cockerel

FOR its early morning transmissions, the Prague (Czechoslovakia) studio uses the crowing of a cockerel as an interval signal. As the sound could not be imitated successfully by mechanical means alone, several birds were induced to crow, and a gramophone record was made of the best farmyard rooster.

Marconi Television

UNDER the call-letters G2BS, the Marconi Company (Chelmsford) has carried out interesting experiments in television transmission on a wavelength of 750 metres. On a recent occasion, when a demonstration of the system was made, pictures were transmitted from the Chelmsford laboratories and clearly received at St. Peter's School, York, some 150 miles away.

More Power for Sofia

SOFIA (Rodno Radio) will shortly possess a 15-kilowatt transmitter to replace the present low-power plant. Work on its construction is being hurried forward, and the Bulgarian authorities state that there is a possibility of the station being brought into regular operation by the end of the present year.

Saving Programme Material

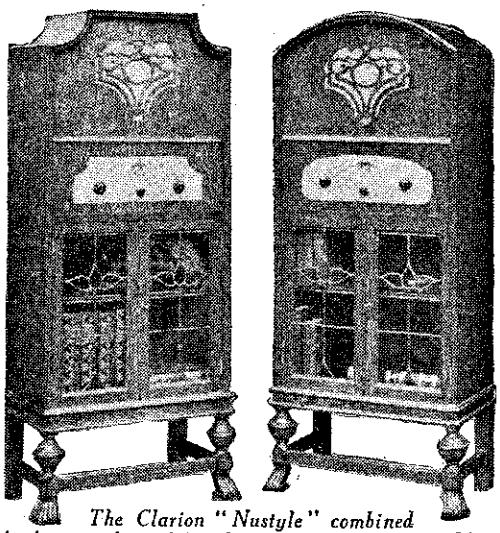
IN order to economize on programme material, with the exception of two nights weekly, the German studios will close down nightly at 11.0 o'clock G.M.T. On Mondays and Thursdays, however, according to a rota, one station will broadcast a special late concert from 11.0 p.m. until 12.30 a.m. For the benefit of Germans living abroad this transmission will be relayed to Königs Wusterhausen (1,634 m.) and to Zeesen (DJA), on 31.38 m.

Extensive French Scheme

THE French State Posts and Telegraphs are considering a further development of their short-wave broadcasting service with a view to bringing their overseas colonies into closer touch with the mother-country. The experimental station at Tananarive (Madagascar) is to be endowed with more powerful plant, and the authorities also contemplate taking over the working of the Chi-Hoa transmitter (Radio Saigon) in French Indo-China as, owing to lack of local financial support, the programme service was suspended some months ago. In addition, new short-wave stations are to be installed at Rabat and Casablanca (Morocco), and, to complete the system, transmitters will be erected at St. Denis (Reunion Island), Dakar (French West Africa), Brazzaville (French Congo), and at St. Pierre (Martinique). When the net is complete the authorities hope to broadcast special news bulletins and concerts from Radio Colonial (Pontoise-Paris) which, in turn, would be picked up and re-transmitted by the French overseas stations.

Austrian Change Round

THE 100-kilowatt broadcasting station which the Ravag authorities are building at the summit of Mount Bisamberg, in the neighbourhood of Vienna, will eventually take over the duties of the Rosenhügel transmitter. The latter, in its turn, is to be dismantled and re-erected at Graz as a more powerful relay of the Austrian main programmes.



The Clarion "Nustyle" combined bookcase and wireless cabinet. It is 57in. high, 24in. wide, and 14in. deep.

A New Idea in Programmes

IN an endeavour to cope with unemployment amongst musicians, Radio Vitus (Paris) has inaugurated a broadcast feature by which "situations vacant and wanted" are made known to interested parties. A small charge is made for these radio ads., and all answers from employers are addressed to the studio officials.

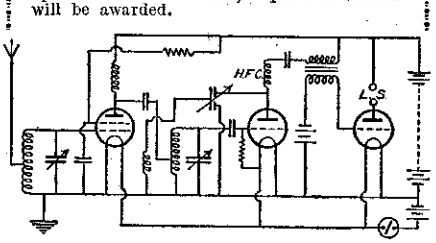
Warsaw's Drum

FROM Warsaw, in the course of the evening programmes, you may have picked up the roll of a drum. This sound, which is produced by a gramophone record, invariably precedes certain important official communications. It has been chosen for its distinctive nature in order to attract the special attention of listeners to the ensuing announcement.

SOLVE THIS!

"Hallo, Brown. How's the wireless set going?" Brown looked glum and, producing a grubby piece of paper, said: "Well, I re-wired my set last night. Here's the circuit. When I switched on nothing happened. The wiring agrees with this, and I can't see anything wrong, can you?"

This is the circuit, and for the first three correct solutions to this problem which are opened on October 3rd, a prize of a book will be awarded.



ANSWER TO LAST WEEK'S PROBLEM:

As the detector valve was R.C. coupled to the next valve it already had a high value of resistance in the anode lead. The addition of a decoupling resistance of 100,000 ohms resulted in a large voltage drop, and so gave the reduction in signal strength.

A Ship's Band Broadcast

EVERY Sunday morning, at 5.15 G.M.T., the Hamburg station relays a concert given by the ship's band of one of the transatlantic liners in dock or at Bremerhaven. This early transmission is also usually taken by Königs Wusterhausen, Breslau, Berlin, Mühlacker, Frankfurt-am-Main and Langenberg. The orchestral concert is preceded by the tolling of the St. Michael bell, the German "Big Ben."

Double Power

CONTRARY to statements made in Continental newspapers, Poznań (Poland) is not to be the site of a new 100-kilowatt transmitter, but the power of the existing station may be doubled in the near future.

Programmes for Prisoners

AT Malmö (Sweden) the Central Prison has been equipped with wireless loud-speakers so that the inmates may listen to the local radio programmes at fixed intervals during the day. The loud-speakers are placed in the corridors, thus enabling the prisoners to listen whilst confined in their cells. Concerts and instructional talks or lectures are permissible, but at periods when news is broadcast from Stockholm, the Chief Warder switches off the main receiver.

Doctor Radio

ON 160 metres (1,875 kilocycles) you may pick up a call—*Elbe Weser Radio*. It originates from the German coastal station DAC, which broadcasts news bulletins to shipping in the North and Baltic seas. This channel is also used for the transmission of expert medical advice from the Cuxhaven naval hospital, and is given to shipping of all nationalities, on request, in case of sickness or accident on board.

More Chaos

GERMAN listeners to the Heilsberg station have complained that broadcasts of their programmes are marred by interference from the Polish transmitters. As the power of the Heilsberg plant can be increased to 150 kilowatts, the German authorities propose to work on a minimum of 100 kw. in the near future. Should this not meet the case the transmitter will be used at its full capacity. Such a power would bring the Königsberg broadcasts within the reach of most set-owners in the British Isles.

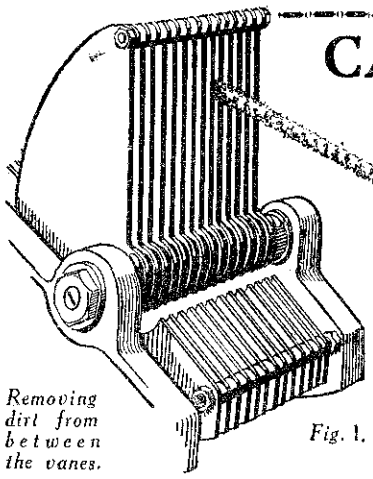
A Lesson for Us

IN most European countries listeners to the radio programmes suffer from interference due to electrical plant in their immediate neighbourhood. The Danish authorities have passed a stringent law making such interference an indictable offence. In order to cope with the floods of complaints which have been received, the Copenhagen police compel any person who notifies the name and address of a possessor of electrical apparatus troublesome to his neighbours to deposit with them the sum of 10 kronen. If the complaint is justified and the culprit convicted the money is returned; if not, it is confiscated to defray the expenses of an unnecessary prosecution.—JACE.

CARE AND UPKEEP

Periodic Attention to the Points Mentioned in this Article will Considerably Enhance the Performance and Life of the Set.

By GILBERT E. TWINING



Removing dirt from between the vanes. *Fig. 1.*

THE life and successful operation of a wireless receiver depends upon the way it is handled and maintained. A set which is carelessly operated cannot be expected to give full satisfaction for any length of time, whilst even if it is treated with care and consideration wear will nevertheless be taking place; condensers are being strained by voltages across them, valve filaments are deteriorating and transformers, chokes and resistances are subjected to magnetic strain. Therefore, in time, some fault may develop which will need correction.

Dust and dirt are some of the worst enemies of wireless, causing weakness in signal strength, breakdowns in insulation, together with crackling. The point is that when any symptoms of trouble occur a search for the cause should be made immediately. It is of no use letting it continue, for, unless it is due to external influence, it will not right itself and will probably become worse. Where crackling noises, coupled with loss of volume and distortion are heard in a circuit, the first test must be to determine to which class the interference belongs. Remove the aerial, and, if the noise still continues, remove the earth. If the disconnection of both aerial and earth do not remove the noise, the trouble is probably due to bad contacts or faulty components. High-tension, low-tension, grid-bias and loud-speakers, grid-leaks and their holders, resistances, etc., should be looked over for loose connections.

Faulty Switch Contacts

Switches are sometimes the cause of lost volume owing to bad contacts being made, due to the presence of dirt, or looseness. Attention should periodically be paid to all switches inside or underneath coils, panel switches for L.T., etc. Where these are of the plunger type the plunger ought to be withdrawn, and the side springs cleaned and bent slightly closer together. Dirty valve pins making bad contact with the valve holders can cause crackling and loss of power, as also dirt and dust between the variable condenser vanes, especially noticeable when tuning: a pipe cleaner passed between the vanes will effectually clean these, as shown in Fig. 1. All terminals should be tested and screwed down firmly; dirty or badly-fitting wander plugs may need cleaning, and the pins opened out with a pocket knife. The spades and terminals of the L.T. accumulator, especially the negative side, become corroded by the action of the acid; these should be cleaned and a little vaseline smeared around them.

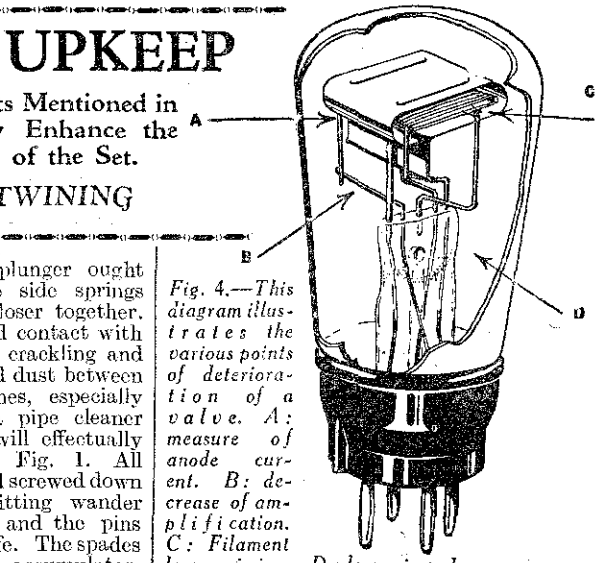


Fig. 4.—This diagram illustrates the various points of deterioration of a valve. A: measure of anode current. B: decrease of amplification. C: Filament loses emission. D: lower impedance.

Look to Your Accumulator

Never let an accumulator stand in an uncharged state. It should be recharged immediately, otherwise the plates will sulphate, and this can only be corrected by charging slowly at half the normal rate. If the plates are sulphated badly, however, it will probably mean renewing them. Always keep the electrolyte up to the correct level by adding distilled water. After an accumulator has been in use for some time it will be much benefited if washed out, cleaned and the cells refilled with fresh electolyte of the correct specific gravity. This is specified on the label by the makers. With a hydrometer it is a simple matter to test the density of the acid (see Fig. 2).

When a trickle-charger is used it may be found that the L.T. battery is being undercharged. In time, the voltage will fall so low that the volume is reduced. The cells may be damaged if they are continually being used in a more or less uncharged condition, and a good charge should therefore be given at regular intervals.

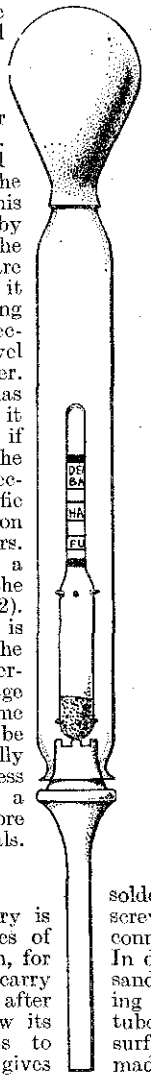


Fig. 2.—A hydrometer for testing L.T. accumulators.

Battery Troubles

The high-tension battery is one of the chief sources of lost power and distortion, for most users are tempted to carry on with the old battery after the voltage has dropped below its useful life. A good test is to reduce the grid-bias voltage; if this gives louder signals, it proves that the H.T. current is too low, and consequently, the valve is over-biased.

The grid-bias battery deteriorates in time, and should be renewed every six or nine months: it is far cheaper to look after this small battery than to spend money on large expensive H.T. batteries. The amount of G.B. given to the power valve will determine the amount of current flowing from the H.T. battery, given a certain H.T. voltage; therefore, it must follow that if the G.B. is kept constantly at 9 volts or the amount stated by the valve maker, the H.T. battery is being used as economically as possible. Too little or too much grid-bias, however, will both lead to distortion. The set must always be switched off when altering G.B. voltages: if you adjust it without doing so the bias to the valve is removed, and the plate current immediately increases. This, of course, is very detrimental to the valve, and if often repeated would, in time, ruin it. Also switch off when making other adjustments inside the set, and, as an extra precaution against short-circuits, withdraw the negative wander plug from the H.T. battery.

Aerial and Earth

The aerial and earth system is a most important part of the set, and should receive regular and careful attention, for no matter how perfectly the set may be working, it cannot give its best reception if this is faulty. Partial short-circuiting of the aerial to earth may easily mean weak signals: the points to watch are perished lead-in tubes, broken insulators and dirty earthing switches, etc. In the case of outdoor aerials it is even advisable to fit a new wire every twelve or eighteen months, on account of corrosion due to oxidization of the metal: this process will take place much more quickly in towns than in the country, however.

The earth lead must be short and as stout as possible: $\frac{7}{22}$ gauge stranded copper aerial wire is suitable: it should be soldered to the earth tube or sunken plate, not screwed down under a terminal. A bad earth connection leads to instability and distortion. In dry weather, or if the soil is inclined to be sandy, the earth should be kept moist by pouring water down the earth tube, the top of which tube should project about an inch above the surface of the ground. A good earth can be made by joining up to a convenient water pipe, employing one of the usual earth-clips sold for the purpose. The pipe must first be scraped quite clean to ensure a good contact, and should be wrapped with insulating tape to protect it (Fig. 3).

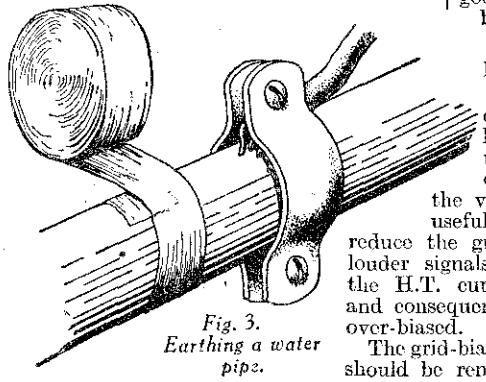


Fig. 3. Earthing a water pipe.

(Continued on page 112)

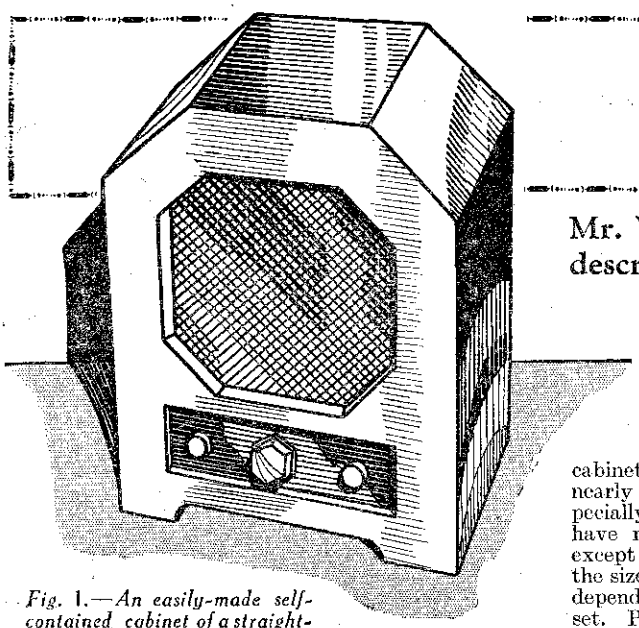


Fig. 1.—An easily-made self-contained cabinet of a straightforward design.

NEW IDEAS IN
INCLUDING SOME

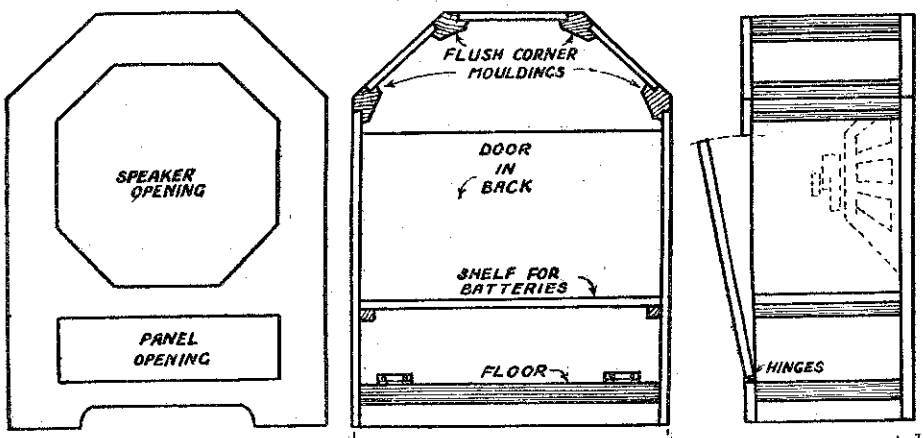
Mr. W. B. Richardson has investigated the Design describes in the first of two articles the Construction

AT one time receivers were so cumbersome and irregular in shape that anything like symmetry in the design of the case was impossible. Nowadays, however, sets are usually quite compact, and the controls are limited to one or two knobs only. This makes the task of building pleasing and distinctive cabinets much easier, and well within the capabilities of the average constructor.

There are several good reasons for building your own cabinet. You may require a special design that is unobtainable ready-made. It may be a question of expense, or again, you may like to do it as a hobby.

Original Designs

For the first reason, I offer here only original designs. You will find you cannot buy cabinets exactly the same in the shops. For the second and third reasons, I have kept the construction as simple as it is possible. The use of machine-cut plywood and mouldings greatly reduces the labour involved besides keeping the cost down. Of course, design and construction are to a large extent dependent one on the other. I do not hesitate to simplify my original designs if by so doing I can secure easier construction. After all, in a small piece of work such as a radio cabinet the simplest designs nearly always look best—especially if nicely finished. I have not given measurements except for certain details, as the size of the cabinet naturally depends on that of your set. Plywood, either plain or veneered, is used almost exclusively for the main parts. Any framework necessary is made up of lengths of moulding. Some shops will cut all the stuff up with a machine to your measurements. One I know of locally will do it while you wait. This is naturally a great help, as you can then be sure of everything being squared up correctly besides saving time. The rest of the work then consists merely of assembly and finishing.



Figs. 2-4.—(Reading from left to right) A front, sectional and side view of the cabinet shown in Fig. 1.

Combined Speaker and Wireless Cabinet

This is one of the most popular arrangements. Figs. 1 to 4 show a simple but effective design. There is no frame in the ordinary sense, the whole structure being kept rigid by the use of a stout floor-board half-an-inch thick, together with corner mouldings as the "beams" of the roof. The panels of the roof, sides and back are all of $\frac{3}{16}$in. plywood, but the front may well be of $\frac{1}{4}$in. material to avoid resonance. The pe nt roof is supported by four lengths of oc tagonal corner moulding. The particular pattern shown has rebates $\frac{3}{16}$in. by $\frac{1}{4}$in. into which the three sections of the roof and the sides fit, as in Fig. 2. In starting to work, first determine the measurements, bearing in mind the size of your set and speaker. Then build up the roof by nailing and gluing the panels in the rebates in the mouldings. Countersink the nails and fill in the holes with plastic wood or some similar stopping. Nail and glue the two sides to the floor-board, and then secure the roof to the sides in the same way.

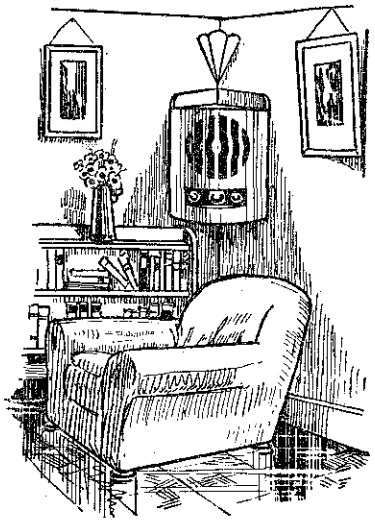


Fig. 10.—A novel and ornamental cabinet, details of which will be given next week.

Now fit the front. It should be glued in position and nails driven through into the moulding and floor-board. No other fixing should be necessary if all parts are true, but a brad or two down the sides will help if there is any tendency to bulge. Before fixing the back cover the speaker opening with a piece of gauze and fix the speaker in position. If the batteries are to be housed in the case, a

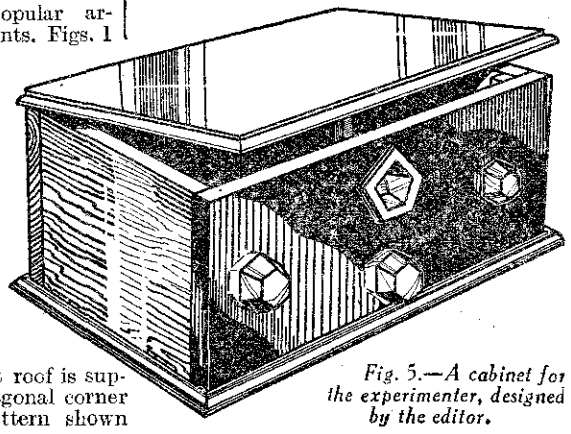


Fig. 5.—A cabinet for the experimenter, designed by the editor.

WIRELESS CABINETS

NOVEL DESIGNS—PART I

of Wireless Cabinets very thoroughly, and here of a Number of Original and Novel Cabinets

Photograph shows Mr. W. B. Richardson.

shelf should be fixed just above the set. The back is made in two parts. The upper part is fixed like the front, but the lower part is hinged to the floor-board and drops down for the insertion of the set and batteries. There is also a small strip to fill the space below the floor-board (see Fig. 4). A good idea is to drill holes in the back and cover them with gauze so as to allow the sound waves from the back of the speaker to emerge, and so prevent any "boxed-in" effect. Careful rubbing down with glasspaper until all joints are smooth and flush completes the work ready for polishing.

For the Experimenter

Figs. 5, 6 and 7 give details of a novel arrangement for the man who has frequent need to get at the "innards" of his set. It is quite orthodox in appearance, but instead of merely having a hinged lid or back it has *lid, back and sides all hinged!* The whole thing can be completely opened in a jiffy. It then presents the appearance shown in the inset in Fig. 6. In order that it should not fall asunder unexpectedly, catches are fitted as shown. When these are in position the lid can still be raised as in the more usual type of cabinet. You will notice I have shown the panel extending the whole length of the front and overlapping the end-pieces; if, however, you prefer the ends to overlap the front and back, there is no reason why they should not. In this case the rails fitted to the front and back as stops to prevent the ends leaning in would be omitted, but instead rails would have to be fixed to the end-pieces as a support to the back. One point to note is the direction of the grain of the wood. In the end-pieces it should be horizontal, not vertical, otherwise the screws fixing the hinges to the lower edge will tend to pull out. Naturally the whole secret of success with this model lies in the fitting of the hinges. Fig. 7, shows how they should be secured to give full movement. The axes of the hinges must be level with the edge of the wood, and the wood should be recessed just sufficiently for the hinges to lie flush. If you do not recess the wood, there will be nasty gaps and the cabinet will not close properly.

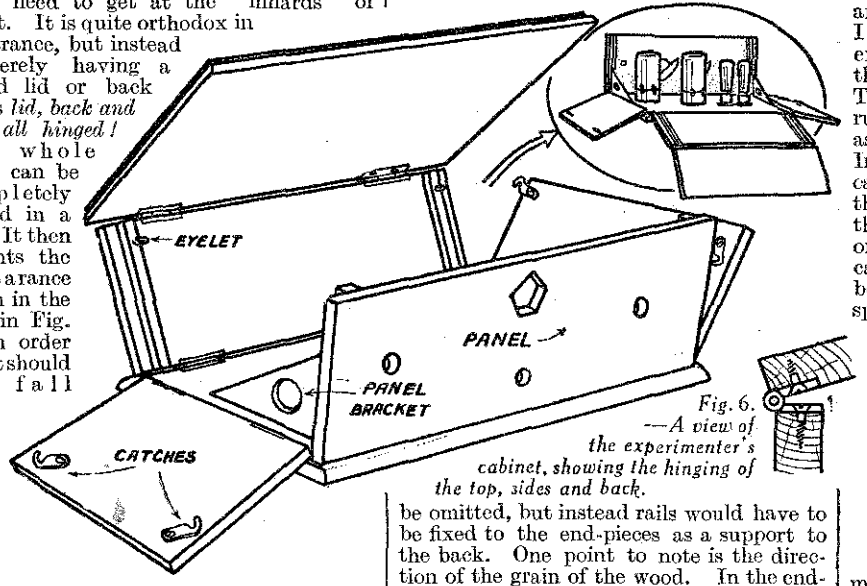


Fig. 6.—A view of the experimenter's cabinet, showing the hinging of the top, sides and back.

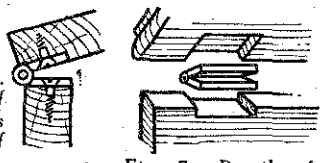


Fig. 7.—Details of the hinges for the experimenter's cabinet shown in Fig. 8.

Easy to Make But Very Effective

The little cabinet shown in Figs. 8 and 9 is perhaps the easiest of any to make, and yet it has quite a modern note about it. I think you will find the drawings self-explanatory, but here let me say that the whole effect is dependent on the finish. The joints in the wood should be well rubbed down, and the grain should be such as to conceal rather than emphasize them. In both this and the experimenter's cabinet the height may be increased so that the set only occupies the upper part, the lower being used to house the batteries or mains-unit. In this case a deeper panel can be used extending below the base board or a wooden panel used to fill the space below the ebonite panel.

Securing a "Professional" Appearance

So far I have not said anything about how to stain and polish the work, but I strongly advise the amateur to investigate the polishes put on the market by such firms as Hobbies Ltd., Dereham, Norfolk. They also supply all kinds of fittings, and many of the mouldings.

(To be concluded next week.)

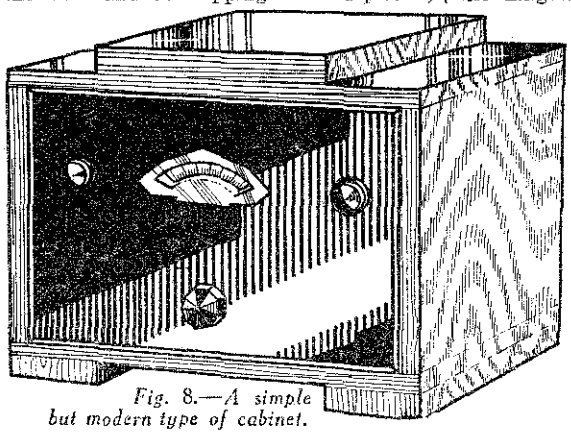


Fig. 8.—A simple but modern type of cabinet.

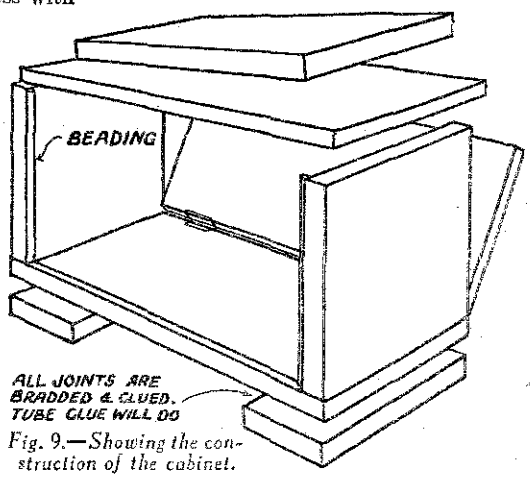


Fig. 9.—Showing the construction of the cabinet.

THE WHY AND THE WHEREFORE—2

A Series of Weekly Articles Dealing with the Function of the Various Components of a Broadcast Receiver

By JACE

WE saw last week how the energy was received by the aerial and tuning circuit of our receiver, and it would perhaps be as well to point out here that, no matter what form of tuning is employed, *i.e.* aperiodic aerial coils, band pass tuners, etc., the principle is the same. The various types of tuner abovementioned are simply incorporated in order to ensure that the receiving set shall be "selective," that is, will only deal with a narrow band of

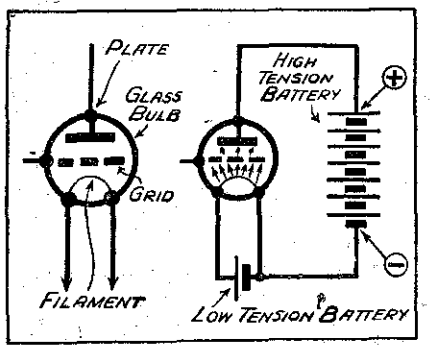


Fig. 1—The wireless valve, and a diagram of the way in which the electron stream is emitted.

frequencies at one time. For the purpose of these articles, however, we may regard them all from the same angle, namely, the reception of the high-frequency oscillations modulated by the speech or music of the transmitting station which we are desirous of hearing.

Well, then, we have got to the point where these particular oscillations are present in our tuning circuit, but unfortunately they are very weak. We must therefore treat them in the same manner as the microphone currents were treated at the broadcasting station, that is, amplify them in order to have a current sufficiently strong to be efficiently "detected" or rectified. To understand this amplification it is essential for us to know how the ordinary wireless valve works, and the following brief explanation, in conjunction with Fig. 1, should make this perfectly clear.

The Three-electrode Valve

The ordinary type of valve contains three elements: a filament (or cathode); a grid; and a plate (or anode). These elements are known as "electrodes" and this gives us the term "three-electrode valve." The filament consists of a thin wire across which is joined a low voltage battery—known as the "low tension battery." This causes the filament to glow, and in its incandescent state it gives off a stream of electrons. Surrounding the filament, but at some distance from it, is a metal plate—the anode, which is joined to the positive side of a high-voltage battery, known as the high-tension (H.T.) battery. The negative side of this battery is joined to the filament, and this completes an electrical circuit giving a steady current through the valve. Situated between the filament and the anode is a spiral of wire known as the grid, and it is to this electrode that the received oscillations are fed. The result of this is to vary the steady current which we have just referred to, and we therefore have in the anode circuit a varying current exactly similar to that which was received by the aerial circuit, but now many times stronger.

The Neutrodyne

Unfortunately, we cannot use the ordinary three-electrode valve in this way, as owing to the small space between the electrodes, some of the energy "feeds back,"

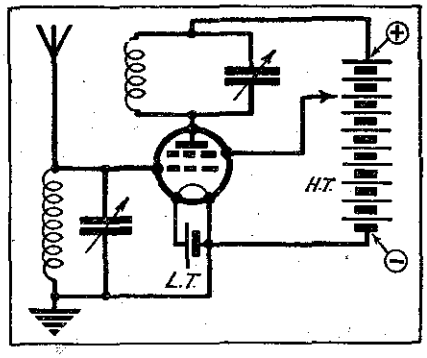


Fig. 3.—A screen-grid valve employing tuned-anode coupling.

and this results in instability. Various suggestions have been made for overcoming this trouble, and the most popular until fairly recent times was the neutrodyne circuit. With this arrangement a coil is connected to the anode of the valve, and the centre of this coil is joined to the H.T. positive terminal. The other end of the coil is then joined, through a very small variable condenser, to the grid of the valve. Across the ends of the complete coil a tuning condenser is connected, giving a tuned circuit similar to that in the aerial lead. The small variable condenser, known as the neutrodyne condenser, is then adjusted until the capacity of the valve is "balanced out" and stability results. The process of neutralising is rather tricky, and it is very difficult to arrange that the setting will hold over a large tuning band, and therefore the arrangement was not so popular as it could have been.

The Screen-grid Valve

These deficiencies are overcome, however, in the screen-grid valve, which is an ordinary three-electrode valve with the addition of a further grid. This extra grid is joined to a point on the positive side of the H.T. battery having a slightly lower voltage than that applied to the anode, and provided the coils in the aerial and anode circuits are adequately screened, the circuit is perfectly stable.

Instead of a tuned circuit in the anode lead, an H.F. choke may be used. This is simply a very large coil of wire, which is not tuned in any way, and it has the effect of providing a barrier to the high-frequency oscillations. They are thus prevented from passing through the H.T. battery to earth. In order to pass on the maximum signal strength it is essential that any choke used in this position should be specially designed for the job—and not one of the ordinary small reaction-type chokes. Sometimes, in order to give greater selectivity, and to obtain greater signal strength, the tuned circuit associated with the anode may be joined between the anode of the valve and earth, the H.F. choke being retained in the anode lead.

Fig 2 shows the neutrodyne circuit, whilst Fig. 3 shows the complete circuit arrangement so far as we have described at present, employing an S.G. type of valve. We have now got at our disposal a strong high-frequency oscillating current, which is an exact counterpart of the transmitted signal, but before we can turn this into speech or music it must be "detected" or rectified, and we shall deal with this function next week.

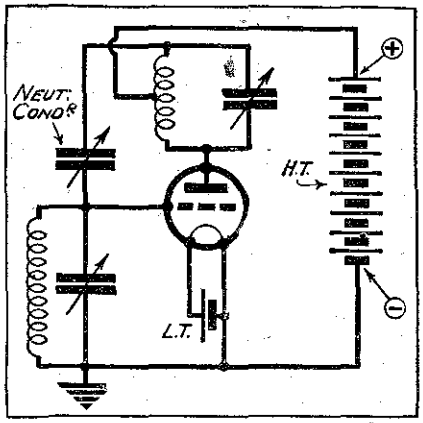


Fig. 2.—The well-known neutrodyne method of H.F. coupling.

With home-made radio-grams and converted gramophones there is often a background of "chattering" which is very annoying when a record is being played. The noise emanates from the pick-up as it traverses the record, and is partly due to cabinet resonance.

Preventing Cabinet Resonance

The trouble can be remedied very easily by lining the edges of the lid of the cabinet with a good thickness of felt.

The same trouble is often experienced when a loud-speaker is enclosed in a square box type of cabinet. The "boomy" results often complained of with this kind of loud-speaker can be largely overcome by lining the interior of the cabinet with thick felt or packing the corners with slag wool held in thin canvas bags.

ABOUT VARIABLE CONDENSERS

Some Valuable Information Concerning a Component which is Often Taken for Granted.

By H. J. BARTON CHAPPLE

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

IT is really surprising how a chance remark or action will open up a train of thought the germ of which was quite outside the realm of the original subject of discussion. This was exemplified when I was talking over with two or three radio men the question of laying out a wireless receiver, the components for which were being collected together after the theoretical circuit had been finally approved.

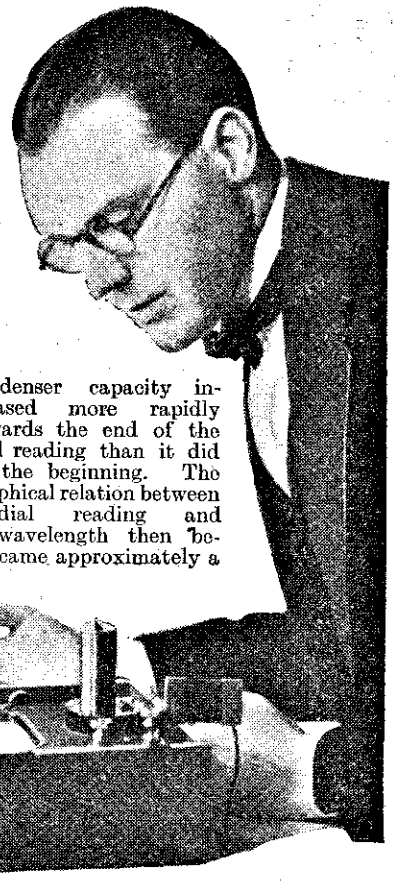
As was to be expected, each component was being reviewed rather critically to ensure that the set's performance would fulfil adequately the aims of the designer, and when the question of suitable variable condensers arose it became necessary to choose a pair that could be accommodated easily in the somewhat limited panel space available. One of the company then passed a remark to the effect that it would have been awkward if the older type straight-line frequency condensers were the only ones available. Another of those present, being fairly new to the art of wireless, owing to his youth, asked to be enlightened on this point, and it occurred to me that there must be many other present-day wireless constructors and listeners quite unaware of the phases of development through which variable condensers have passed before reaching present-day standards. I am not concerned so much with mechanical construction, or the outcry that was made four or five years ago for "low loss" components—an era that was carried to such extremes that in many cases it defeated its prime object—but rather with the shape of the condenser plates and matters allied to this.

Condenser Capacities

For example, it has often been said that the wavelength range of a tuned circuit—say, the familiar 200 to 600 metres—is actually altered by using different-shaped plates in a variable condenser. This is quite erroneous if each of the variable condensers employed has identical capacities at the minimum and maximum settings. The range of wavelengths covered by a coil shunted with a variable condenser is a function of the product of the inductance of the coil and the capacity of the condenser. Hence, in the case of the latter, if the measured capacity of every condenser used is the same when the fixed and moving plates are completely meshed, then obviously the shape of the plates bears no relation to the top tuning limit. The same remarks apply to the lower tuning limit when the plates are unmeshed. The important point is to make the minimum capacity as low as possible so as to extend the range, for it must not be overlooked that the actual maximum and minimum capacities of any variable condenser are in effect increased when incorporated in a wireless receiver. This is owing to the presence of stray capacities in the wiring and components, especially the self-capacity of the coil being tuned.

Straight-line Condensers

Why, then, have variable condensers been marketed having plates shaped according to certain preconceived designs? Well, first of all, when wireless began to make its presence felt as a hobby for all, the only type of variable condenser that enjoyed any vogue was the straight-line capacity. The condensers had semi-circular plates and the capacity of the condenser was proportional to the dial setting. That is to say, if a graph had been plotted with capacity as one ordinate and dial reading as the other, then a straight line would have resulted. As the number of broadcasting stations began to increase the logging of the stations became more difficult to the average listener. We can see this if we realize that the wavelength of the tuned circuit is proportional to the square root of the capacity in that tuned circuit. To double a wavelength, therefore—that is, jump from a 200-metre station to a 400-metre one—meant an increase in dial reading of four times with straight-line capacity condensers, and this was apt to be disconcerting and not proper logic to the listener whose arithmetic was none too brilliant.



Here you see Mr. H. J. Barton Chapple, of our Technical Staff, at work in our laboratory.

Square-law Condensers

This type of condenser was, therefore, superseded by the straight-line wavelength condenser, or as it was more popularly termed, the square-law condenser. The plates were not semi-circular but shaped more like a heart cut in two so that the condenser capacity increased more rapidly towards the end of the dial reading than it did at the beginning. The graphical relation between dial reading and wavelength then became approximately a straight line, and everyone was happy for a time. I say approximately because of the allowance that still had to be made for stray external capacities introduced by the wiring and components. With wireless increasing in popularity, however, and more and more transmitting stations of high power being erected, the heads of the various national broadcasting concerns found it necessary to get together and suggest a solution to avoid chaos as a result of stations overlapping one another.

Finally a definite frequency separation was decided upon between the various stations at home and abroad. When this scheme was put into operation it was noticed by listeners that there was a certain crowding of the stations logged at the bottom end of the condenser tuning dial. The explanation was simple, for with a given frequency difference the wavelength difference is less on the shorter wavelengths than it is on the longer wavelengths, hence the crowding.

Straight-line Frequency Condensers

Condenser manufacturers bowed to popular demand for a cure of this new trouble by introducing the straight-line frequency condenser with long narrow plates somewhat like an elongated heart cut in halves. There was only a very small capacity increase per degree reading at the lower end of the scale, and in consequence calibrations were frequently upset by the increased relative importance of the stray capacities to which we have alluded previously. Furthermore, when unmeshed, the distance between the ends of the fixed and moving plates was large compared to the other types and in consequence necessitated greater panel space when working, while to crown the woes of the manufac-

(Continued on page 108.)

DO YOU KNOW?

—That a larger value of grid leak than usual is often found advantageous on the short waves. Values as high as 5 megohms may be tried.

—That the valves should be shielded from the sound waves from the speaker if very loud signals are obtained, in order to avoid microphonic troubles.

—That all leads carrying H.F. currents should be kept as short as possible.

—That all metal used for screening should be "earthed" if it is to act as a screen.

—That reaction control is smoother if a small condenser is connected between the anode of the detector valve and earth.

—That all by-pass condensers in a screen-grid stage should be of the non-inductive type to ensure stability and assist in greater stage gain.

—That in mains-operated sets all leads carrying alternating current should consist of twisted flex (of the ordinary electric lighting variety) to reduce the risk of induced hum.

That where possible all controls should be at earth potential to avoid hand-capacity effects.

Act to-day—and make sure

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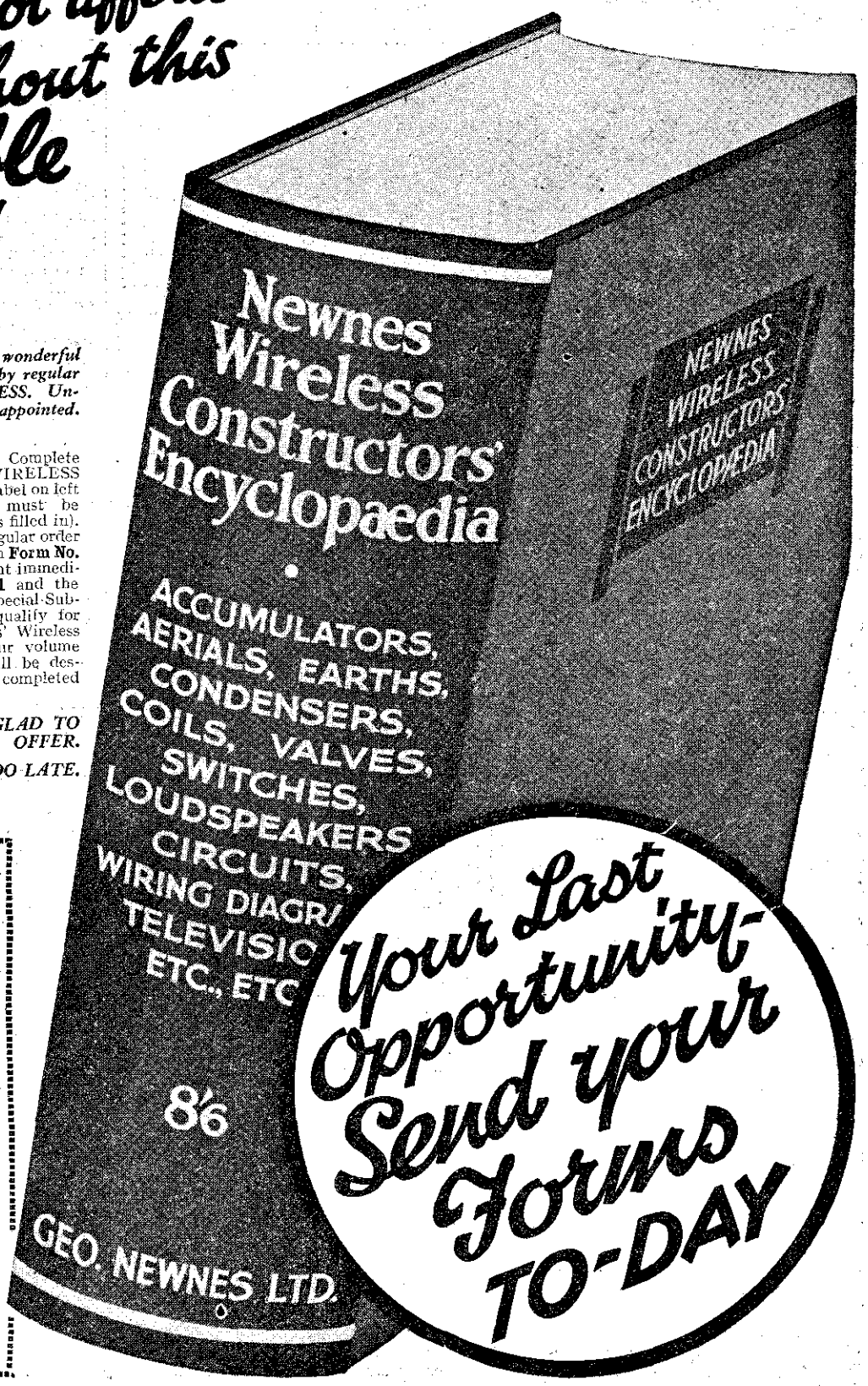

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The last day upon which reservation forms will be accepted is Wednesday, October 12th.

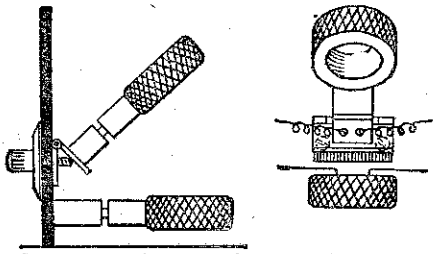
Radio Wrinkles FROM READERS

THE HALF-GUINEA PAGE

Converting Plug-in Coils

MANY enthusiasts are converting their wireless sets into more modern sets, and those wishing to economise may find this idea useful.

With the exception of a brass hinge, ebonite knob, and a screw of suitable length, no other parts are required. One plug holder is fixed to the panel while the other is attached to the panel with a brass hinge, as shown. A tapping hole is drilled in one leaf of the hinge which is nearest to the panel. The screw passes through a clear hole in the panel to the tapped hole, and the weight of the coil keeps it in close contact with the end of the adjusting screw. An excellent adjustment of reaction is also possible.



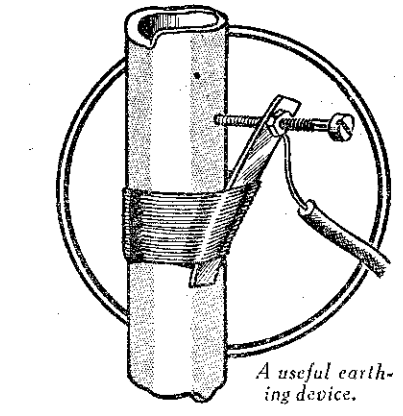
Converting plug-in coils to panel mounting with a fine adjustment.

Curing a Microphonic Valve

ONE of the common troubles a listener has to contend with is a noisy background, and this is sometimes caused by a microphonic detector valve. The noise is in the form of a howl which may start at any time during reception, or only when a certain note is reproduced by the loudspeaker, the sound waves from which interact on the bulb of the offending valve. A thick felt or rubber ring placed round the valve will often cure the trouble.

A Simple Earth for Your Wireless

A SOUND earth connection is essential for good reception, and most wireless enthusiasts will find that quite a good earth can be obtained from a wire run from an ordinary cold water pipe. A section of the pipe should first be scraped clean, after which a short length of metal should be attached to the pipe by means of copper wire, as shown in the sketch. A hole is then drilled in one end of the metal strip and an ordinary bolt is inserted with nuts on either side. By screwing in the bolt the strip acts as a lever and the wires are pulled tight against the pipe. The earth wire is then connected as shown.



A useful earthing device.

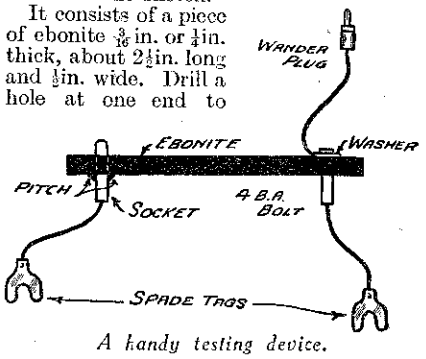
THAT DODGE OF YOURS!

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

A Testing Hint

THE majority of milliameters have two terminals for connecting purposes, and it is a job when one wishes to measure the anode current of a set to connect wander plugs on to pieces of wire, etc. To overcome this make up the simple device shown in the sketch.

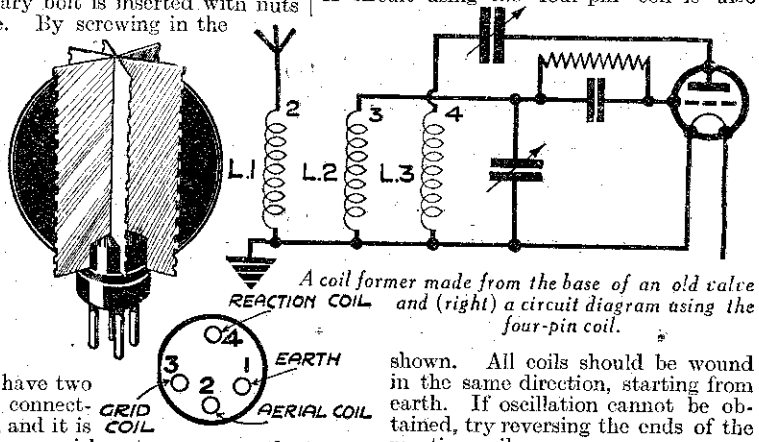
It consists of a piece of ebonite ⅜in. or ¼in. thick, about 2½in. long and ½in. wide. Drill a hole at one end to take a 4 B.A. bolt, and drill a clearance hole in the other end to take a brass socket which can be obtained from an old H.T. battery. Pitch should then be poured round the hole and allowed to set. Before inserting the socket into the strip, however, a piece of flex, about 2in. long and carrying a spade end tag at one end, is soldered on the bottom of the socket. A similarly equipped piece of flex of the same length is secured under the 4 B.A. bolt, and also under this bolt is fastened a 9in. length of wire carrying a wander plug. To use the device the milliameter is connected to the spade ends, the H.T lead on the set extracted from the H.T. battery and inserted in the socket, and the wander plug on the strip is inserted into the H.T. on the battery.



A handy testing device.

A Handy Coil Former and Base

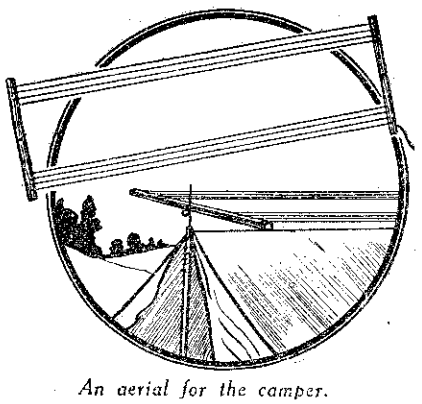
A USEFUL coil former and base can be made from an old valve-holder and the bottom of a discarded valve. The coil former can be made of cardboard which has previously been painted with shellac, and mounted on the valve base by cutting slots down each side of the latter as shown in the diagram. The required number of cuts to be made can be determined by the type of coil made. The above method will be found to function equally as well as the commercial type of six-pin coil and former. A circuit using the four-pin coil is also shown. All coils should be wound in the same direction, starting from earth. If oscillation cannot be obtained, try reversing the ends of the reaction coil.



A coil former made from the base of an old valve and (right) a circuit diagram using the four-pin coil.

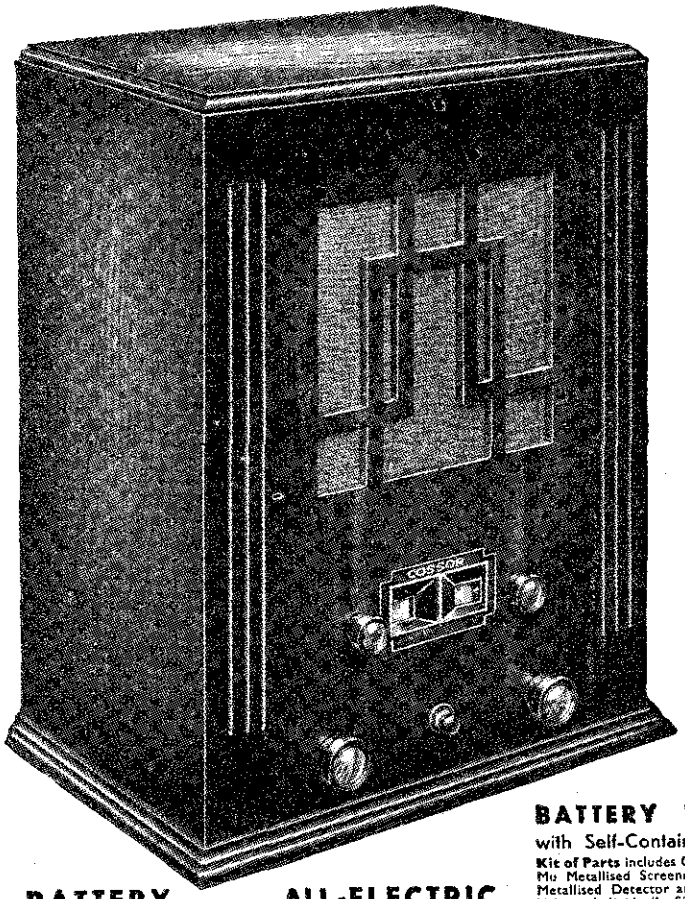
A Handy Aerial for the Camper

THE aerial shown in the diagram will prove very useful to campers, as it can be carried in a very small space. It consists of two pieces of wood, 15in. by ½in. by ½in. Four holes are bored at each end of the wood about an inch apart. Twist a piece of thick wire round each tent pole at the top, so that a piece extends upwards above the top of the tent. Bend the wires half-way up so that the bars do not slip down (see sketch). Thread the aerial wire through the holes in the two pieces of wood and the spare end can be used as a lead-in to the set.



An aerial for the camper.

A Masterpiece of SCREENED GRID Radio



VARIABLE-MU S.G. VALVE
SELF-CONTAINED SPEAKER
ALL-METAL CHASSIS

PRESENT Day Radio conditions demand a *Screened Grid* Receiver. No other type can cut out powerful nearby stations and bring in the programme you want. And the Screened Grid Receiver that offers you the greatest value for money is the new Cossor Melody Maker

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The new Cossor Melody Maker is so simple that you can build it yourself — and save pounds — even if you know nothing about Wireless. For the bare price of the parts you can own this up-to-date Receiver. Money cannot buy a more efficient 3-valve Screened Grid Set.

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PRACTICAL INDOOR AERIALS

This Article will Interest All Readers who for Any Reason Cannot Avail Themselves of an Outdoor Aerial. The Author Describes Many Novel Forms of the Indoor Type, Some of which are Not Generally Known

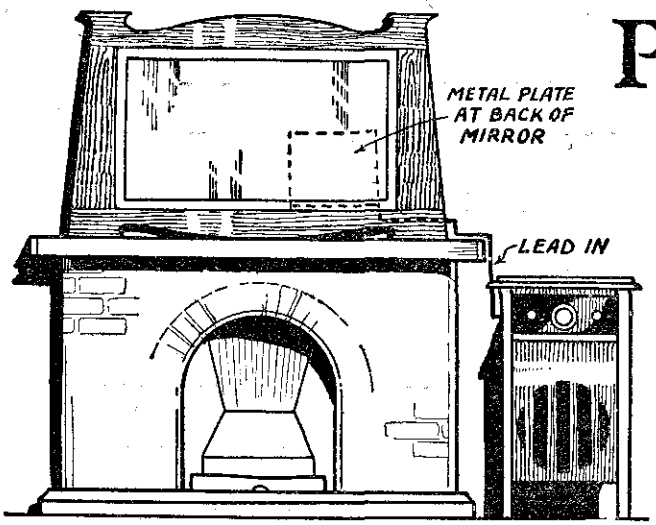

Fig. 3.—The metal backing of an ordinary mirror as an aerial.

APART from those listeners who object to an outdoor aerial on the score of appearance, there are countless others who are so situated that they are unable to erect one for purely practical reasons. To these the choice of a suitable indoor substitute is of vital importance.

The type chosen will naturally depend on the facilities available. Probably the most efficient type is a replica of an outdoor aerial erected in the loft. However, it is often the case that the listener who has access to a loft can also arrange an outdoor aerial. On the other hand, where an outdoor aerial is out of the question the indoor facilities are also rather limited. For this reason I shall confine remarks to a description of some of the more practical arrangements of the type likely to be available to the flat-dweller and those living under similar conditions.

Indoor Aerials and Mains Operation

Before going into details of particular types, I want to make a few general remarks. In the first place, most sets nowadays have a small condenser in series with the aerial to increase the selectivity and in some cases to act as a volume control. With an indoor aerial this condenser is usually a disadvantage, since it cuts down signal strength considerably, also the selectivity with a small aerial is already far better than with the longer outdoor type. First of all, then, "short" this condenser with piece of wire, if possible. This applies to all receivers except those operated from D.C. mains. D.C. sets should have a good condenser of about .01 mfd. in series with the aerial besides the condenser which is already included in the earth lead and is usually incorporated in the mains unit. I say first of all short the aerial condenser for the reasons I have just given, but naturally, if you find that the tuning is not sharp enough, you must include it. If it has too much effect, try one a little larger. If you have a band-pass set alteration of the aerial condenser may necessitate slight re-adjustment of the first trimmer condenser. Now as to the aerial itself.

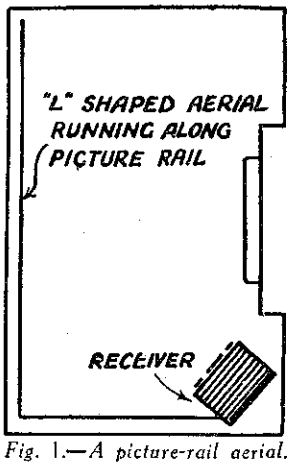

Fig. 1.—A picture-rail aerial.

Using the Picture-rail

The piece of wire draped along the picture-rail is so well known as to need no introduction. When properly arranged it is very efficient and costs next to nothing. All that is needed is a length of single bell wire, of a colour to blend with that of the walls, and one or two drawing-pins. Pin the wire at intervals of about four feet in the recess at the top of the rail. Carry it along two sides of the room only, so as to form an "L," as in Fig. 1.

With the question of the aerial comes that of the earth. Fig. 2 shows a neat and effective arrangement where a gas bracket is handy. The earth is joined to the bracket by scraping the metal clean near the wall and twisting the bared end of the earth wire round it. Soldering the joint is better still. Where no gas bracket is available, there is sometimes a "point" for a gas fire which will work equally well. Failing that, you must resort to a length of wire concealed under the carpet and extending to the bathroom or kitchen water tap. A connection to an iron fireplace or even a brass fender is better than no earth at all, but in this case the aerial should be a good one to make up for the poor earth, otherwise results are likely to be disappointing.

While on the subject of "earths," here is a tip worth trying. Change over the connections to the "aerial" and "earth" terminals of your set—that is, join the aerial to the earth terminal and the earth to the aerial terminal. You may get better results!

The Use of Mirrors

It was during a thunderstorm that the idea of using a mirror as a "pick up" of radio energy first occurred to me. I was thinking what a nice large surface of metal there was in a mirror opposite to me, and wondering if it had a sufficient charge on it to make a spark to earth if I connected a wire to it, and also what sort of a mess would result if a chunk of lightning chose a path to earth that way. Well, after the storm was over, I tried out the looking glass as an aerial by making careful connection to the quicksilver at the back. It certainly

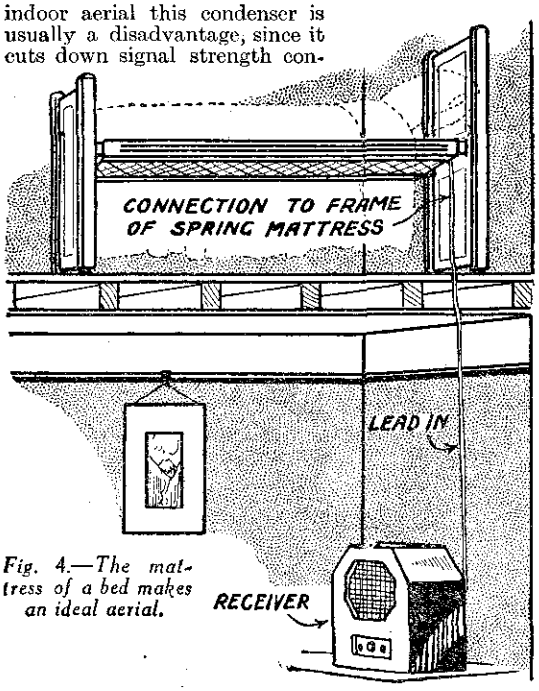

Fig. 4.—The mattress of a bed makes an ideal aerial.

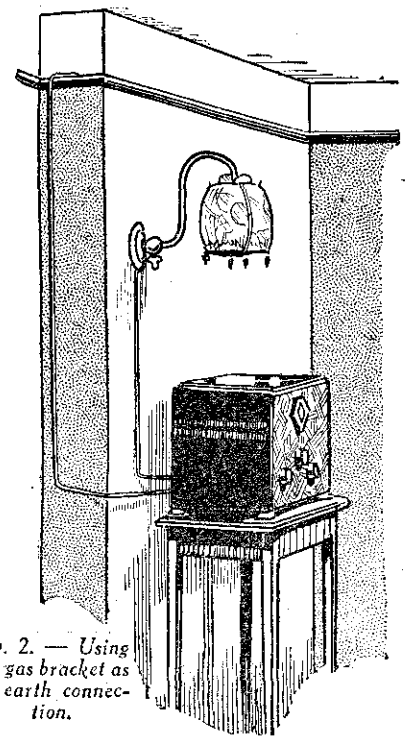

Fig. 2. — Using the gas bracket as an earth connection.

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Practical Indoor Aerials

(Continued from page 84)

worked, and brought in the radio with the inevitable atmospherics. The only difficulty was in the method of connection, which was too uncertain for universal use, so I did away with direct connection and placed a sheet of copper foil against the back of the mirror itself and replaced the wooden back. The mirror and the foil formed a condenser, and connection to the set was made *via* a wire soldered to the foil. The arrangement is shown in Fig. 3 if you care to try it. It is quite simple, and zinc or aluminium may be used in place of copper.

The Bedstead Aerial

Here is an arrangement that is so old that it has been almost forgotten. I don't quite know why it should be, unless it is because constructors nowadays do not have their sets in their bedrooms, as did some of the amateurs in the old days, when they sat up all night listening-in while their fond mamas thought they were fast asleep. Anyway, a spring mattress forms quite a good indoor aerial, and you will see how to fix it from Fig. 4. Of course, if the set is in the room below, you will have to take the lead-in through the ceiling. That is perhaps why it is not very popular, as it means drilling a small hole in the plaster, and it is difficult to conceal the wire. With the receiver in the bedroom the job is simple enough.

A Picture-frame Aerial

Quite an effective frame aerial can be wound on the back of a large picture. Details are given in Figs. 5, 6 and 7. Of course, it has no advantage over the orthodox type apart from the appearance, but, as with most of these schemes, it is intended to make the aerial as inconspicuous as possible, and that is its recommendation. If the wooden cross-pieces are no thicker than ¼in., and do not extend quite to the corners of the picture, they will not cause it to stick out from the wall. The little pegs on which the wire is wound are short pieces of matchstick stuck in at an angle. The number of turns of wire must be found by experiment. About ten turns of 28 gauge D.C.C. wire will be suitable for the medium waves with a picture 3ft. by 2ft. As with all frame aerials, the receiver must be placed immediately underneath, as long leads reduce the efficiency. There is one drawback with the picture-frame aerial, and that is that it is strongly directional. If most stations lie east and west of you, it should hang on a wall running east and west, but if you depend chiefly on programmes coming from a northerly or southerly direction, then hang the picture on a wall at right angles to the first.

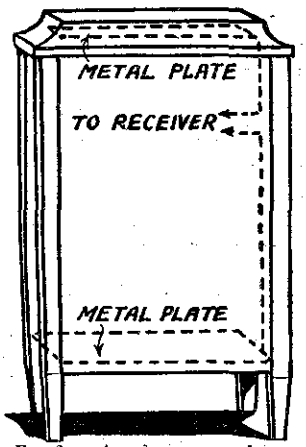


Fig. 8.—A radio-gram cabinet containing aerial and earth plates.

A Radio-gram Aerial

When constructing a radio-gram, the arrangement shown in Fig. 8 is worth trying if there is no room for a frame aerial. It consists of a metal plate in the lid and another in the floor of the cabinet. They are connected respectively to the aerial and earth terminals of the set. Fig. 9 shows how to make an adapter to plug into a lamp socket, and so use the mains wiring as an aerial. Two small condensers are held together with a rubber band and connected as shown. Various values round about 0.1 mfd. may be tried. An alternative arrangement with one condenser is also shown. With this pattern the plug should be inserted first one way round and then the other to ascertain which way it works best. With both patterns it is also best to try them with the lightning switch first in the "On" and then in the "Off" position.

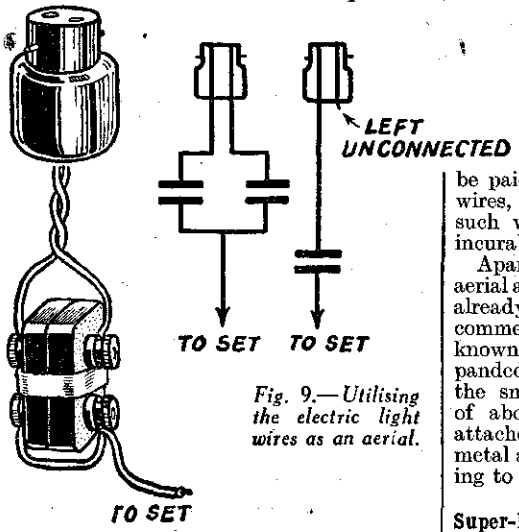
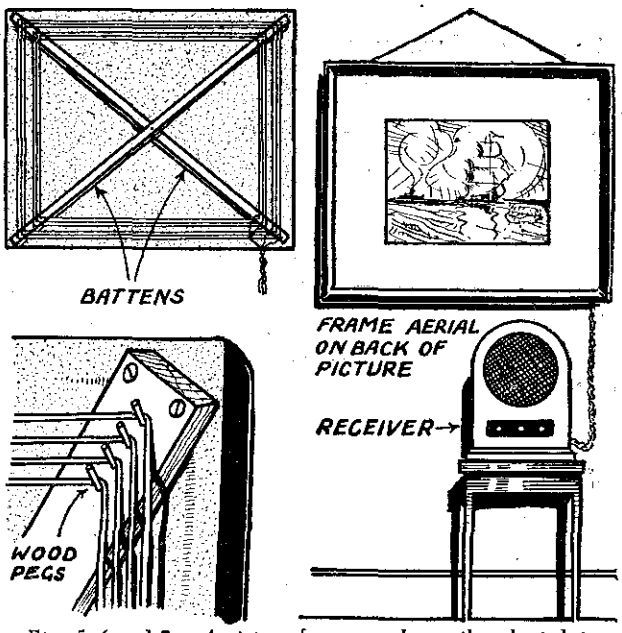


Fig. 9.—Utilising the electric light wires as an aerial.

Only good condensers which will stand the voltage of the mains should be used. Needless to say, no current is consumed. When the adaptor is completed, wind it round with insulation tape to protect the terminals from accidental short-circuiting.

Convenience Considered

Finally, let me repeat that the various forms of aerial given here are designed with a view to convenience and inconspicuousness before everything else. They are not all equally efficient, but each has certain merits relative to the circumstances governing its use. If efficiency comes before convenience, then the loft aerial shown in Fig. 10 needs a lot of beating. If the loft is long, then one wire will be sufficient, but if it is very small then two or three wires are better. A small insulator should be used at each end.



Figs. 5, 6 and 7.—A picture frame can be easily adapted to accommodate an aerial.

There are, of course, certain important details which must be attended to where efficiency is the main consideration. As with an outdoor aerial, the wire should be kept as far from earthed bodies as possible, a good rule to observe being that no part of the indoor aerial should be allowed to run closer than 12ins. to walls, ceilings, etc. Attention should also be paid to the disposition of electric light wires, as an aerial running parallel with such wires may result in hum, which is incurable by all ordinary methods.

Apart from the types of home-made aerial above-mentioned, there are, of course, already on the market various types of commercial aerials. There is the well-known spring-type, which has to be expanded and attached to opposite walls; the small "cage-type" aerial, consisting of about a dozen strands of thin wire attached to cardboard discs; and the sheet metal aerials which are intended for attaching to the outer walls, chimney-stacks, etc.

Super-het. Aerial

Those readers who own, or intend to make a super-heterodyne receiver, should remember that it is very desirable to use an indoor aerial in connection with them, and as short an indoor aerial as possible, too; otherwise, much of the selectivity associated with this type of receiver will be lost. Another point is that on an outdoor aerial, considerable interference with neighbouring reception is likely to accrue.

Best results may be obtained when the super-het. is used with a frame aerial.

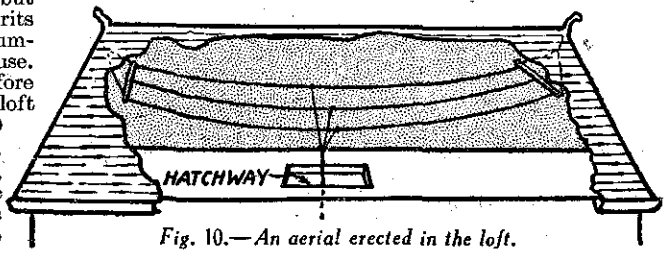


Fig. 10.—An aerial erected in the loft.

ALL ABOUT—

VARIABLE MU VALVES—1

By PERCY RAY

Their advantages and the correct method of using them

A FEW months ago the variable mu took the listening public by storm; everybody asked everyone else if they had fitted one, and those who knew little about it felt that they were years behind the times.

Following the usual fate of a new valve, the variable mu is looked upon with suspicion, as a fair percentage of screen-grid users have replaced their old valves with this new wonder and are keenly disappointed with the results.

The great mistake is to assume that this is a new form of S.G. valve that requires no alteration to the receiver and merely has to be plugged in. Such a line of action will usually result in a loss of selectivity and range.

In order to avoid any doubts as to the writer's opinion of this type of valve, let it be quite clear that the variable mu will improve the selectivity of any screen-grid receiving set and give range at least equal to the original type if, and only if, the essential simple alterations are carried out.

How the Variable Mu Works

The selectivity of a screen-grid receiver is often ruined by what is called cross-modulation, which is a freak effect of the valve that will shift a programme from one wavelength to another; thus, if two stations are applied to the grid, it may pass on to the next valve the carrier wave of one plus the two programmes. The strange point is that, when suffering from this form of jamming, the troublesome stations disappear when the wanted station closes down. This is caused by the screen-grid valve becoming overloaded because it has a very small grid swing, while the general selectivity is not exceptional owing to the low impedance necessary to give the valve a reasonable amount of grid swing.

The variable mu differs in construction from a standard valve only in the grid, which is irregularly spaced, but this small detail has a remarkable effect on the working of the valve, as it gives it a long, gentle slope, as shown at Fig. 1, very reminiscent of a super-power valve. Thus it is possible to put a considerable grid bias on the valve, and so increase the grid swing in exactly the same manner, as the bias allows the power valve to handle large signals.

In addition to this, the increase of grid bias on a variable mu valve will reduce the slope and raise the impedance. Thus if some form of variable bias is used, it is possible to have a control that will go from

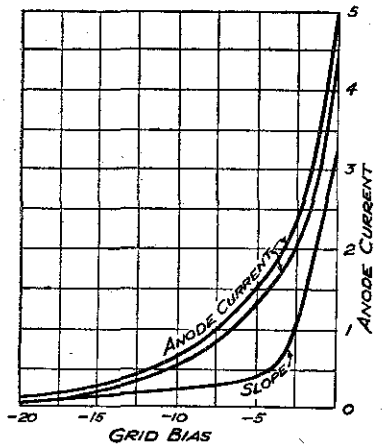


Fig. 1. The characteristic curve of the variable mu valve. Note the long, gentle slope caused by the irregularly spaced grid.

flat out up to any degree of selectivity that may be required, the only limit being if the amplification is too much reduced before the desired selectivity is obtained.

If such an arrangement were used with a screen-grid valve, a matter of three volts would give the most horrible distortion, and at about four volts the valve would stop working altogether, while the selectivity would be considerably reduced.

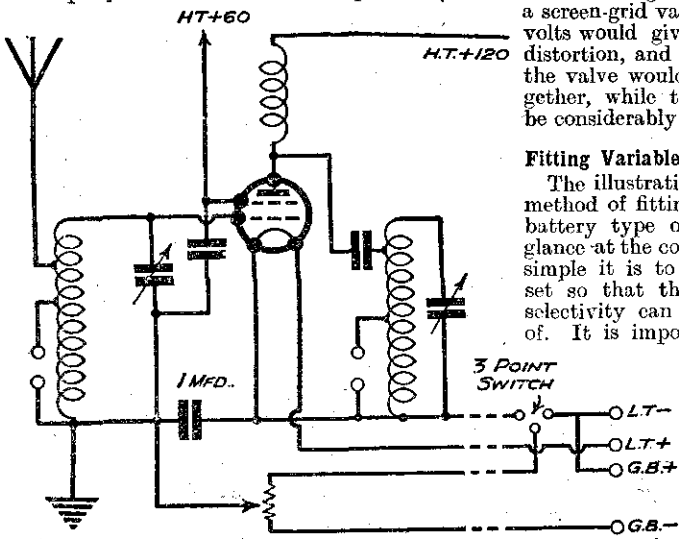


Fig. 2. The method of fitting variable bias to a battery type of variable mu.

Fitting Variable Bias

The illustration Fig. 2 shows the method of fitting variable bias to a battery type of variable mu. A glance at the connections shows how simple it is to adapt any existing set so that the great increase in selectivity can be taken advantage of. It is important that a three-point switch is used to stop the grid battery from running down when not being used, but if an ordinary switch is already in use, another one can be put in the positive lead and used in addition to the filament switch.

The only parts required in addition to the valve are a 50,000 ohm potentiometer (preferably graded) and a 1 mfd. condenser. It is important that this latter component be non-inductive, such as a T.C.C., otherwise it will upset the working of the set. If only one variable mu is being used, an ordinary nine-volt grid battery will do, but if two stages are used a fifteen or eighteen volt unit is desirable. It should be quite clear that the same battery will be used to bias the power valve and any other necessary. Fig. 3 shows the method of arranging the variable bias on an indirectly heated mains valve. The actual value of the resistances will vary with the particular make of valve used, but instructions are usually included with the valve.

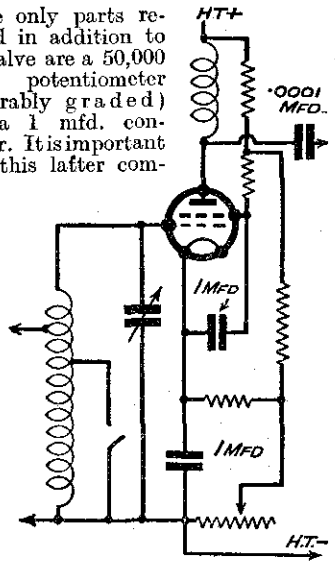


Fig. 3. The method of arranging the bias on an indirectly heated mains valve.

A Wide Range of Volume Control

The use of a variable mu will give several other advantages in addition to the vital one of increased selectivity already mentioned, perhaps the most important being the enormously wide range of volume control obtainable from the variable bias control. The chief charm of this control is that the quality of reproduction improves as volume is decreased. Thus excellent fidelity is possible from a powerful station a few miles away; with any form of volume control other than this, quality falls off with volume. An additional advantage is that this control can be turned through its full rotation without upsetting the tuning in any way. Thus it does away with the difficulties so often met with when tuning is so dependent on the selectivity control that three hands seem necessary to tune-in properly.

Reduced Background Noises

Another advantage is that any background noises will be reduced to a minimum, and will be reduced at least in proportion to the incoming signal, which is very delightful after the usual type of valve that reduces the programme and leaves valve hiss at the original level.

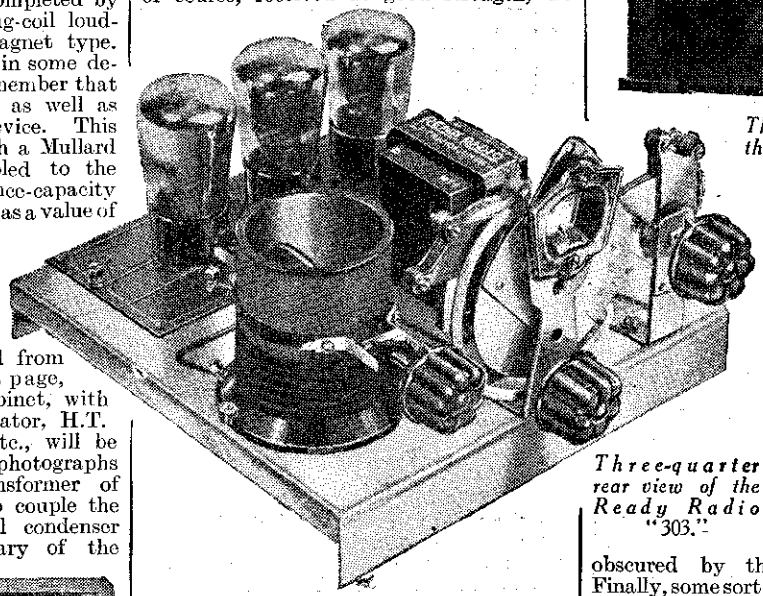
When designing a set to incorporate a variable mu valve, it is not necessary to make any special arrangements for selectivity in the aerial coil, such as band-pass tuning, as selectivity can only be obtained at the expense of volume.

THE LATEST KITS REVIEWED

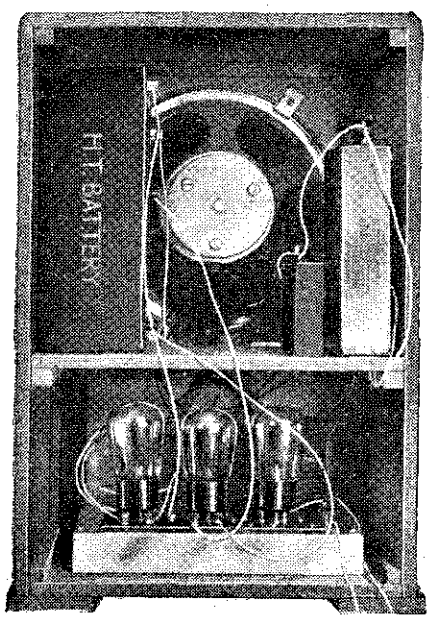
By JACE

THE READY RADIO "303"

KIT sets are now becoming both more popular and also more interesting in many ways. The latest kit to be placed on the market is the "303," which is a simple three-valver, using the same coil as the Dolphin Three described in last week's number of PRACTICAL WIRELESS. The kit consists of a small metal chassis upon which is mounted the terminals, valveholders and some other parts of the receiver. Five wires are also included in the kit, which is completed by a cabinet containing a moving-coil loud-speaker of the permanent magnet type. The tuning coil was described in some detail last week; readers will remember that it contains the on-off switch as well as range switch and selectivity device. This coil is used in conjunction with a Mullard detector valve which is coupled to the first L.F. valve by a resistance-capacity coupling. The anode resistance has a value of 20,000 ohms, and the coupling condenser has a capacity of .01 mfds., so that the amplification and low-note response for this stage should be quite good. The very attractive lines of the assembled kit can be gauged from the centre photograph on this page, and the sturdy lines of the cabinet, with ample space for the accumulator, H.T. battery, grid-bias battery, etc., will be apparent from the other two photographs reproduced. An L.F. transformer of generous dimensions is used to couple the output valve, whilst a small condenser is shunted across the primary of the output transformer, which is of the universal type and is suitable for either power or pentode valves. The assembly of the kit was readily carried out, and the completed receiver was tested in North-West London. The two London stations were, of course, received at good strength, no reaction being needed to build up these signals, which were sufficiently loud to fill the room. Selectivity with the special coil control was quite sufficient for all ordinary requirements, and eight or nine stations were easily received on the aerial used for the test, which was a rather good one, being situated on a hill and attached to a 30-foot mast. On the long waves, 5XX, Radio-Paris, Hilversum and Eiffel Tower were also received before dark, so that the performance is very good indeed, and is a tribute to careful design.



Three-quarter rear view of the Ready Radio "303."



Rear view of the Ready Radio "303."

Three-quarter front view of the Ready Radio "303."

There are just one or two points which perhaps could be criticized, and which no doubt could be easily adjusted by the makers in order to still further improve this little kit. One is the rather awkward situation of the aerial terminal, the identification of which is very difficult if no instructions are handy. The indications of the terminals at the rear of the chassis also, in my opinion, are engraved on the wrong side, as they are partially obscured by the terminals themselves. Finally, some sort of indication on the wander plugs would facilitate the correct adjustment of the grid and anode potentials.

The kit is one of the most interesting we have seen, and when the price is borne in mind—which is £3 10s. 0d. exclusive of valves—it will be realized that this represents extremely good value for money.

Cabinets, generally speaking, are of rather plain construction, but the cabinet supplied with this particular kit is much above the standard usually met with. Walnut, with a very good finish, and a simple type of speaker grille with a silver fabric, enable the set to harmonize with practically any type of furniture. The general trend in kits is certainly in the direction of simplification, and with assemblies of the type of the "303" it can certainly be definitely stated that there is nothing difficult to be done. Even the removal of the insulation of wires has been obviated by the special type of terminal, which has a pointed end which pierces the rubber covering of the leads when tightened up. This fact must be borne in mind, of course, when attaching the wires so that good electrical contact is made. This creates a new standard in kit sets, and will appeal to those who wish to build up a receiver in the easiest manner.

KIT:
Ready Radio "303."

MAKERS:
Ready Radio, Ltd., Eastnor House, Blackheath, S.E.3.

SPECIFICATION:
Metal chassis, detector and two L.F. circuit. The ingenious dual range coil unit comprising on-off switch, selectivity device and wave-change switch is employed—one R.C.C. stage and one transformer coupled—moving coil loud-speaker of the permanent magnet field type—the whole housed in a walnut case.

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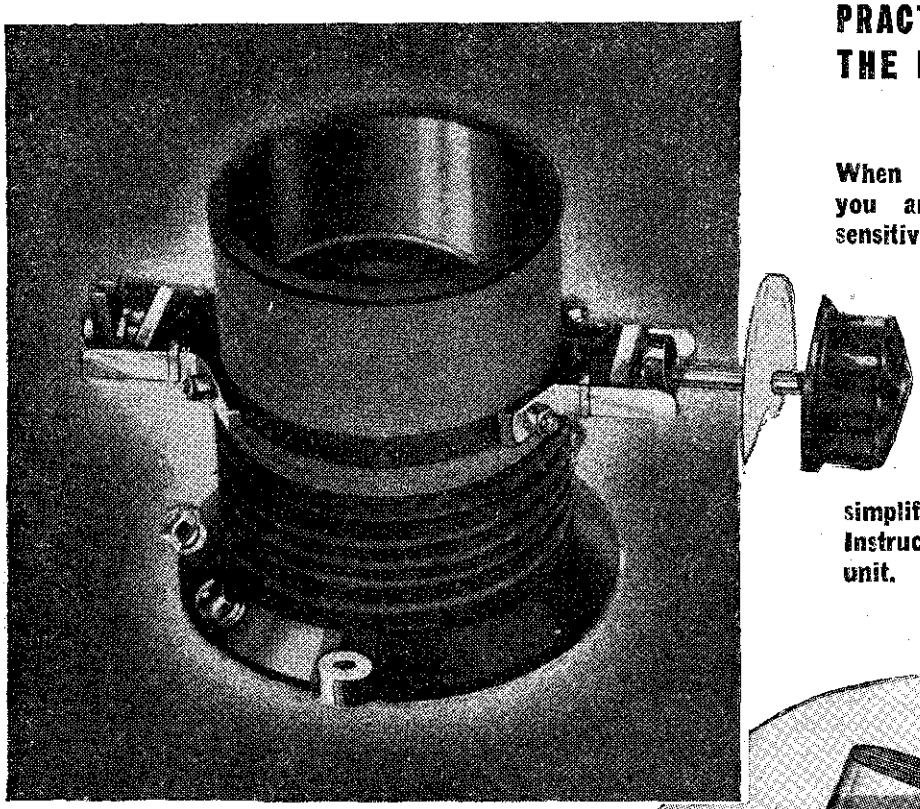
SUPER-SHARP SELECTIVITY FOR THE DOLPHIN THREE



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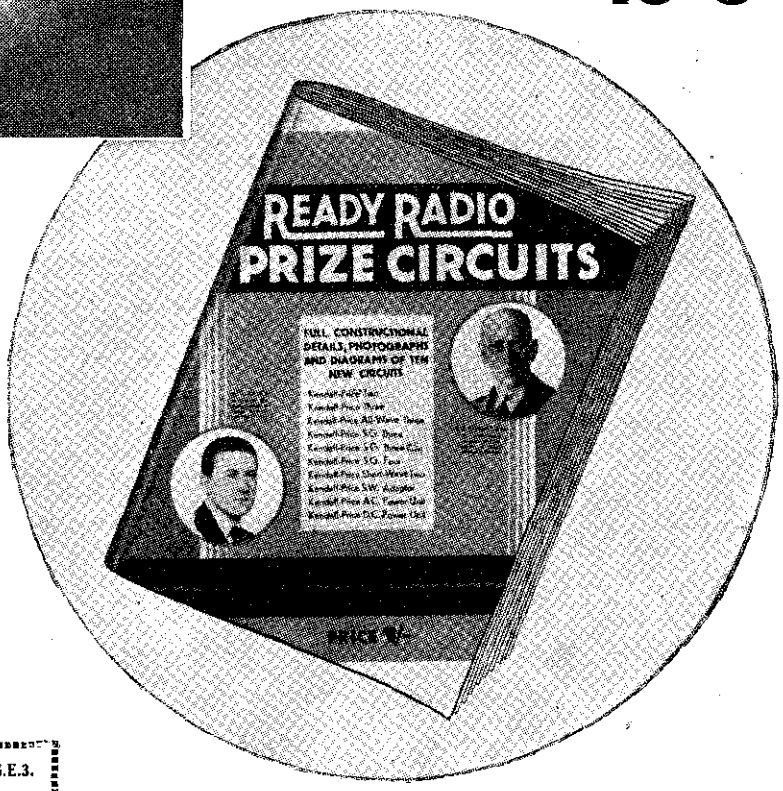

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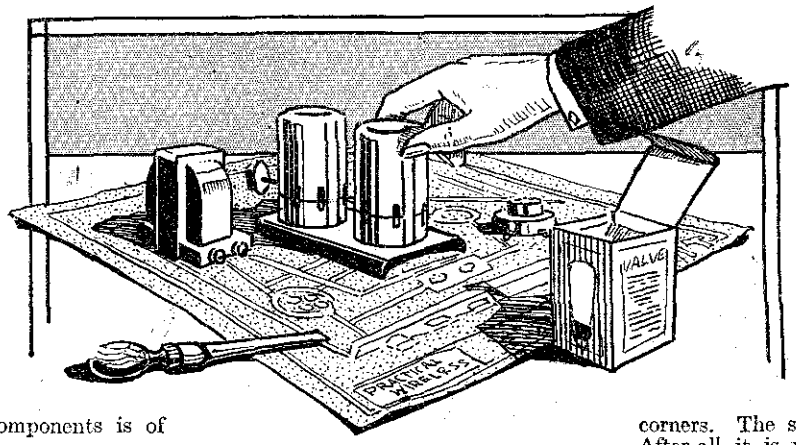
How To Use a Blue Print

An Interesting Article Explaining How to Make the Best Use of Our Wiring Diagrams.

By JACE



PROBABLY the quickest way of building a set exactly to specification is to use a full-size blue print. Although primarily intended for the guidance of the beginner, there is no doubt that even the expert home constructor will find his work greatly speeded up by using a blue print instead of relying on the usual small wiring diagram. Besides that, there is the question of accuracy. With some modern receivers of very compact design the accurate positioning of the components is of utmost importance.

Making Ready

Now as to procedure. First of all stand all the components which are to be mounted on the baseboard direct on the blue print and have a good look at it. This will give you some idea of what the finished thing will look like, besides showing you if you have forgotten any of the parts. You can now either take them all off and stand them on the baseboard in approximately their right positions, and then make the final adjustments by careful measuring from the blue print, or you can stand them on the table while you mark the positions by placing the print on the baseboard and pricking through it with a sharp bradawl. The latter method is perhaps the better so long as you make the marks clear. The same method can be employed with the panel.

Alternative Components

It may be that some of the components you are using are not the same make or quite the same pattern as those shown on the blue print. You may be using the alternatives to those specified in the list. In this case it is usual to mount the components with the terminals in as nearly the same position as those shown on the print. This may mean turning the component round. However, in the case of unshielded coils or chokes it is better to lengthen or shorten the leads rather than alter the position of the components in relation to others.

The Wiring

Do not necessarily mount all the components right away. If they are at all crowded you will find it best to fix them one by one, and complete as much of the wiring as possible each time. Perhaps I should have mentioned that in the case of sets employing under-baseboard wiring all holes for the wires to pass through should be drilled before mounting the components. In sets of this type you will usually find the underside of the baseboard will have to be marked out as well as the upper. Any skirting to the baseboard should be fixed last of all. As you wire each component cross off the corresponding wire shown on the blue print. When you have finished, all the wires should have been marked off. If any are not you know you have missed them out. At this stage, however, you will not have crossed them all off, since you still have to fix the panel to the baseboard and wire up any final points between the two. I always think that this is the best method, as if all the components and panel are in position first it is such a fiddling business making connections in the corners. The set also becomes unwieldy. After all, it is no joke keep twisting and turning a heavy chassis perhaps containing a massive ganged condenser, whereas there is no difficulty in handling the baseboard or panel separately.

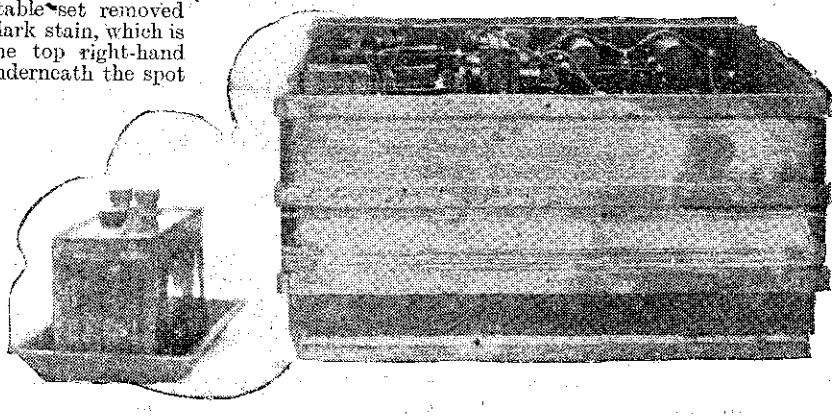
A Few "Don'ts"

In conclusion, here are a few "don'ts." Don't spread your blue print on the baseboard and panel and fix the components directly on top of it with the idea of tearing it away when the parts are all fixed. You will find it a job to clear it away properly from between each component. Also you will most likely want it as soon as it has been "scrapped." When drilling holes for chassis type valve holders, etc., don't drill straight through from one side, but turn the work over as soon as the point of the bit comes through and drill from the underneath. This will give a clean edge to the hole. Don't be in a hurry to drill your panel till you have made certain that the components you are using will not foul one another. Alternative components may, for instance, need positioning slightly differently from those shown on the blue print.

"ACID DROPS"

SULPHURIC acid in its proper place is all very well, but see that it stays there. Accumulators after recharging are unfortunately not always delivered in the dry condition externally that they should be, so make sure that yours is before putting it to further use.

A case of neglect in this respect is that shown in the accompanying illustration, which is of a transportable set removed from its cabinet. The dark stain, which is clearly noticeable in the top right-hand corner, is immediately underneath the spot occupied by the L.T. battery, when the set is in the correct position, and was caused by acid penetrating the woodwork. Corrosion of the wires forming the frame aerial followed causing a breakdown necessitating re-winding. It is always advisable to place a piece of easily-cleaned material unaffected by the action of sulphuric acid's action, such as sheet glass, in the cabinet to stand the accumulator upon. The ideal article to use for this purpose is a Xylonite photographist's tray of a suitable size. Such a tray is illustrated on the left-hand corner of the photograph.



Should an accident occur, and the accumulator be inadvertently dropped or knocked over, a simple precaution will avoid the ruination of carpets, etc. Common washing soda is all that is required, and it should be heaped on the spilt acid, and further soda added until effervescing ceases, after which the spot should be carefully washed. This will prevent a hole being burnt through the material, and the same remedy may be applied to any fabrics over which the acid is unfortunately spilt.

A TRIP ROUND EUROPE ON THE LONG RANGE EXPRESS

Last Week We Explained How t
This Week's Article Deals with Operati

The attractive modern lines of the 1933 Adaptagram Cabinet, into which the Long Range Express can comfortably be accommodated together with turntable, motor, etc. The same cabinet will accommodate the Mains Express Three to be described next week.

WHEN Mr. Percy Ray handed me the "Long Range Express" I was immediately impressed with its advanced design. I had not previously seen it, and therefore lost no time in looking over its general design. The first point that pleased me was the elaborate arrangements made to utilize the full output of the pentode, while adequate arrangements were made to overcome the shortcomings experienced with most loud-speakers when worked with a pentode valve. There is no novelty in this idea, but it is a novelty to find it in a battery set which is so often skinned down to the last penny with but little regard for performance and still less for musical quality.

Connecting Up the Set

No time was lost in connecting up the batteries, aerial, earth, and loud-speaker—which, incidentally, was a 66v. As this report will serve as a guide to the intending constructor it will be necessary to set out the conditions of test, a point which is so often omitted and without which a test report is obviously of little use. The district was South-east London at a spot exactly twenty-one miles from the Brookmans Park twin transmitters, which, as every reader will know, are using a power of 50 kw. on each waveband. The aerial is of the conventional L type with a horizontal length of 20ft., with a down lead 18ft. long, the actual height of the horizontal section being 25ft. This aerial is indeed of modest dimensions, but is erected with unusual care regarding clearance from gutters and other earthed objects.

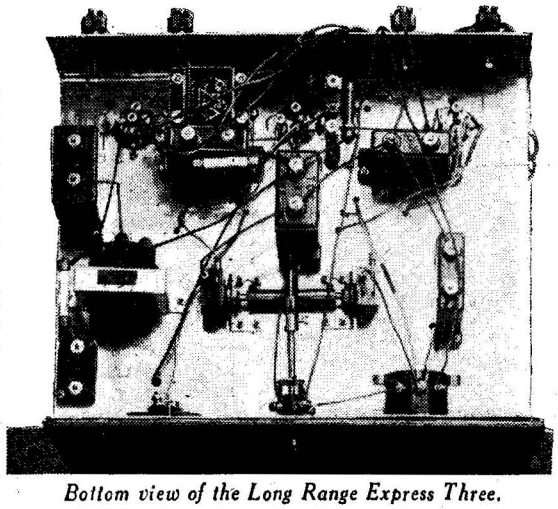
Handling the Variable Mu Valve

After a quick run round I realized that it would be necessary to acquire the knack of handling a variable mu valve, as it works in a manner that is notedly different from any other form of selectivity control. With the controlling potentiometer set for maximum volume and correspondingly minimum selectivity, about one dozen stations were received; but the full possibilities of the set I quite lost until the volume control and reaction are used together. When two stations are locked together it is necessary to tune in the wanted one carefully and to reduce it in volume until it can only just be heard; next bring back the volume by advancing the reaction with the usual slight readjustment of the anode tuning condenser. When this delightfully simple operation has been completed it will be found that the unwanted station has vanished.

Remarkable Selectivity

Before actually setting out to make a log of stations I ran over the receiver to see how it shaped. The remarkable selectivity was soon apparent, due presumably to the use of a variable mu valve and the special coil designed to suit its characteristics. Combined with this the smooth volume control is a great boon. This is the only three-valve battery set that I have ever handled where a volume control has been necessary on *foreign* stations in a large room, and with the Long Range Express it is very necessary indeed. I commenced to compile the station log at nine in the evening and finished at exactly five minutes to eleven. I may add that it was not Sunday night, and therefore the two London stations were working during the whole of the test. For the convenience of readers the stations logged are divided into two sections: (*a*) those being clear and pleasurable and (*b*) those that were jammed, but might have been all right on another evening. Stations below loud-speaker strength are omitted. For this test the balanced armature loud-speaker was replaced by a permanent magnet moving-coil, as the volume justified such a course.

The accompanying list of stations was identified by means a of heterodyne wavemeter, and their correctness is to some extent dependent upon the assumption that they were working on their published wavelengths.



Bottom view of the Long Range Express Three.

Ample Pentode Output

Naturally some stations, such as Fécamp, were fading very badly, but this cannot, of course, be attributed to the receiver as this bugbear of long-distance radio is brought about by factors outside human control. The output of the pentode is truly phenomenal considering the very small amount of high-tension current that this remarkable valve consumes, namely 5.9 m.a. (this with 120 volts H.T. and 100 on extra grid) although when using the moving-coil loud-speaker I raised the extra terminal voltage to 120 with a corresponding increase in H.T. current to 6.5 m.a. The total high-tension consumption of the set is very low even when the big output is not taken into account, being 9.5 on the locals and 13 on the most distant stations. Readers will be a little surprised that the H.T. consumption varies in this manner, but it must be remembered that when the volume is turned by means of the potentiometer, extra grid bias is given to the variable mu valve, which accounts for the drop in anode current.

Stations Free from Interference and at Normal Room Volume on a Moving-coil Loud-speaker.

Station.	*Country.*	*W.L.*	*Power.*
Radio-Paris	France	1725	75
*Konigswusterhausen	Germany	1635	60
Daventry 5XX	Britain	1554.4	30
Motala	Sweden	1348	30
Kalundborg	Denmark	1153	7.5
Budapest No. 1	Hungary	550	18.5
Vienna	Austria	517	15
Prague	Czechoslovakia	488.6	120
*North Regional	Britain	480	50
Langenberg	Germany	473	60
Rome	Italy	441	50
Midland Regional	Britain	398.9	25
London Regional	Britain	356	50
Brno	Czechoslovakia	342	35
Poste Parisien	France	328.2	60
Breslau	Germany	325	60
*North National	Britain	301.5	50
Hilversum	Holland	296.1	20
Heilsberg	Germany	276.5	60
Turin	Italy	273.7	7
London National	Britain	261.6	50
*Toulouse	France	255	.7
Trieste	Italy	247.7	10
Fecamp	France	223	10

* Receiver at medium volume only

Stations at Good Volume but Not Clear of Interference.

Eiffel Tower	France	1445.7	13
Brussels No. 1	Belgium	509	15
Florence	Italy	500.8	20
Scottish Regional	Britain	376.4	50
Mühlacker	Germany	360.5	60
Brussels No. 2	Belgium	338.2	15

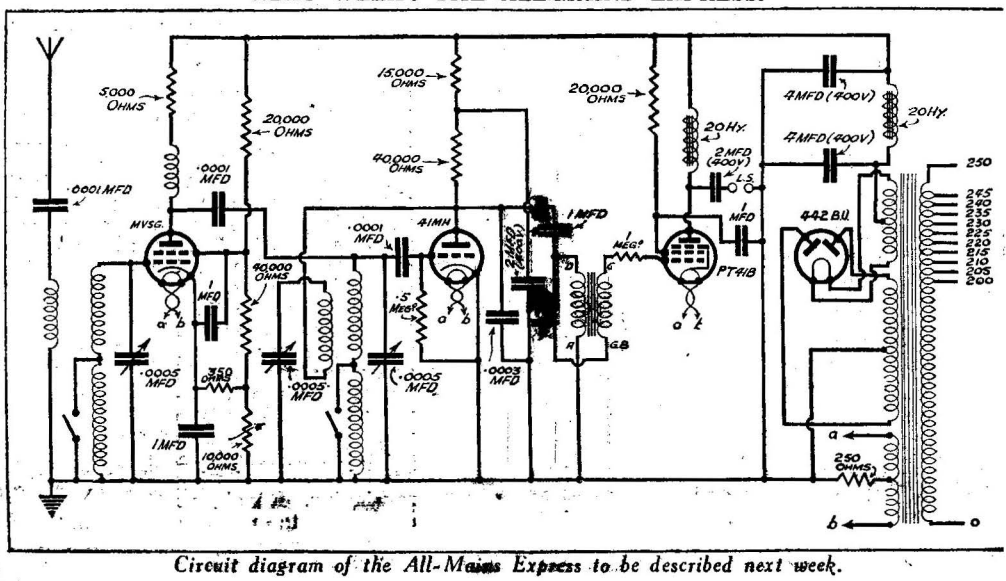
Tone Control

The "tone" of this set is remarkable while the available volume is more than is usual from a battery set or at least from a battery set taking less that 25 m.a. Personally, with the particular loud-speakers I used I am inclined to think that the tone compensation had been a little overdone. I would recommend those who require musical perfection above the average to replace the .01 condenser associated with the output arrangements by one having a value of .006, while on the other hand those preferring a real thump in the bass might prefer the result of making this condenser .02 mfd.

On an Indoor Aerial

I also made a brief trial on an indoor

NEXT WEEK: THE ALL-MAINS EXPRESS.



Circuit diagram of the All-Mains Express to be described next week.

E LONG

:o Build the Set. ıg and Adjusting It.

The table in the centre of these pages indicates the fact that the set really is "long range."

A blueprint of this splendid receiver was given with last week's issue.

A mains version will be dealt with next week.

By HAROLD DOWNING

aerial with results that I fully expected, from testing it on the outdoor aerial; about ten stations were obtainable with really good punch, which is very good for a receiver of this type, as for this purpose two screen-grid stages are desirable, although the performance of the Long Range Express under these conditions would more than please those who require the locals, Radio-Paris, and half a dozen other programmes thrown in.

Good Results from Pick-up

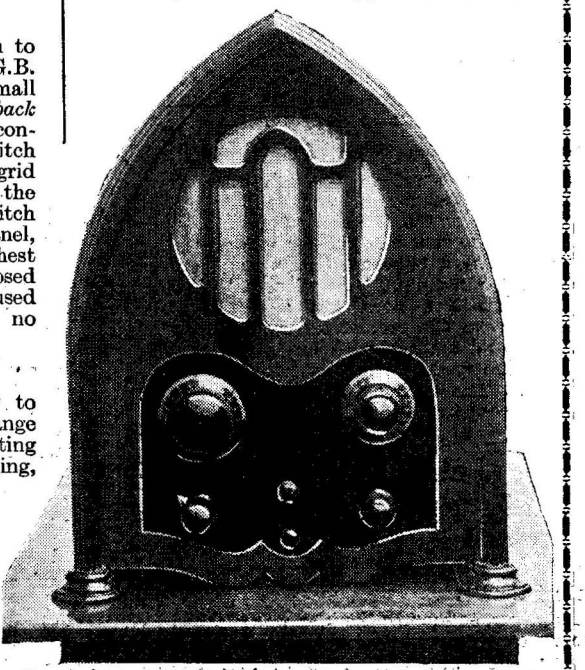
Before uncoupling the set I decided to try a gramophone pick-up, although the hour was somewhat late. I used the new Varley pick-up duly equipped with volume control, and connected one lead to the grid of the detector valve and the other I tried in G.B. — 1½ and 3 with the particular valve I had the 1½-volt tapping was ample. The volume available was, of course, somewhat limited, as with all battery sets principally designed for radio, but the quality of reproduction was good. I fitted a Novotone between the pick-up and set with very pleasing results; readers who are unacquainted with this device will be interested to know that it is used to modify the output from the pick-up, which suffers from the deficiencies of the gramophone record brought about, to some extent, by the size limit imposed by domestic requirements.

Permanent Connections for Pick-up

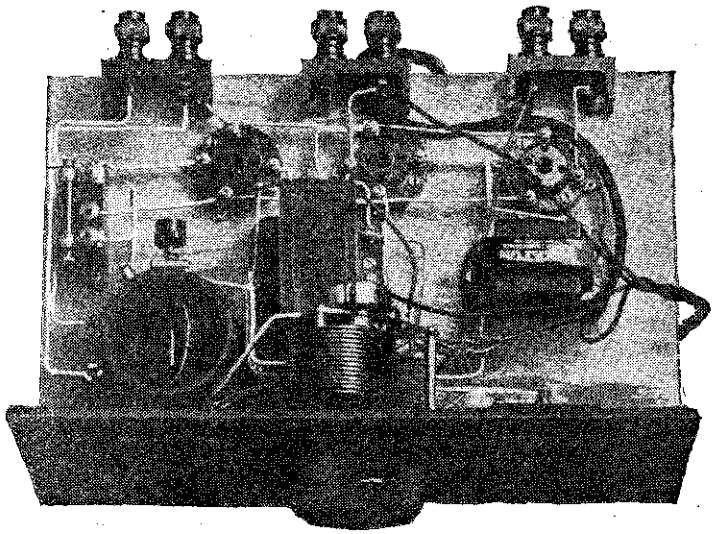
For making a permanent connection to the pick-up, one lead may be left in the G.B. battery and the other taken to a small "on-off" switch placed on the *back* panel as *near as possible* to the grid condenser, the other terminal of the switch being taken to the terminal of the grid condenser that is already connected to the grid of the detector valve. As this switch is alive it *must* be insulated from the panel, while the switch must be of the highest quality, otherwise the losses imposed would affect the radio performance. I used a Wearite which made absolutely no difference to the radio side.

The All-Mains Express Three

Next week we shall describe how to make a mains version of the Long Range Express, pursuing our policy of adapting our sets to suit all needs. If anything, the performance of the mains set is even better than the battery. Bearing in mind that the whole country is in process of changing over to alternating current there is definitely a need for a three-valve all-mains set free from the necessity of frequent accumulator charging and the expense of H.T. battery renewals. As with the battery model arrangements have been made for the chassis to be available with every hole correctly drilled thus making mistakes impossible. Every constructor will know that the set he builds will be identical with the original. The Adaptagram Cabinet shown at the top left-hand corner of this page will also accommodate the Mains Express Three. Wiring diagram and complete details will appear next week.



Front view of the Long Range Express, the construction of which was fully dealt with last week.



A front view of the panel and baseboard.

WHAT THE "DOLPHIN" WILL DO

How to Manipulate the Attractive Receiver Described Last Week. Simplicity is its Keynote

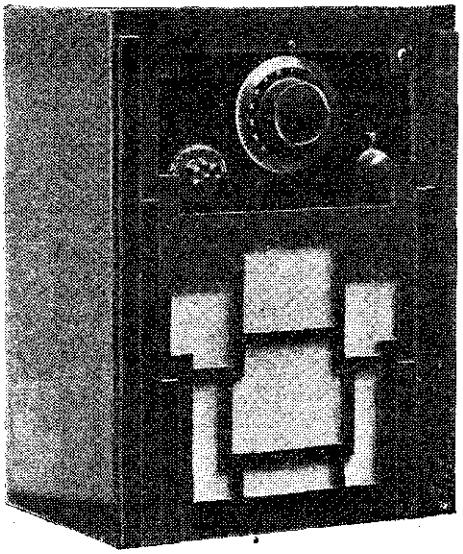
WHAT, actually, is it possible to hear on the Dolphin Three described in these pages last week? This question has probably arisen in the minds of those many constructors who have made up the receiver, and also those who are not certain whether or not to build this particular set. Accordingly the following interesting test was carried out under ten miles from Brookmans Park—in the neighbourhood of Golders Green. The receiver was taken into a house which could not boast a wireless set, and consequently no aerial was available, and the residents knew nothing at all about wireless. They were elderly people with no liking for modern ideas, and consequently it was thought that they would be ideal for the test in view. For an aerial a length of 22 D.C.C. wire was attached to the fence separating the gardens, the total height being only 5 feet. The wire was laid along the top of the fence and taken in through the french windows, with a piece of the same wire taken to the water pipe—a distance of 10 feet. The batteries were connected up and I handed a copy of the tuning instructions to the owner of the house and asked him to carry on.

First Test

He read the article through once or twice and then turned on the receiver. Actually, he turned the control knob halfway round so that the pointer was on the little indication between the letters "C" and "T" of the word "Selectivity." The tuning dial had been left about eight degrees below the correct tuning point for the Regional station, with the result that this station could be faintly heard in the speaker. The tuning dial was rotated to the correct tuning point, and quickly turned back again, and it was too loud for my friends. I had, in this particular instance, to demonstrate the use of the selectivity device, although the majority of listeners will have no difficulty in discovering how to manipulate the selectivity dial and reaction control.

Actual Results

However, as soon as the idea was grasped the following results were obtained. The tuning dial was turned to 0, and the selectivity was adjusted to its weakest point—that is, to the point of maximum volume. The National programme could be heard in the speaker although the exact tuning point for this station was 50 degrees. Selectivity was increased slightly until the National disappeared, and then reaction was advanced slowly. Speech could faintly be heard, and on rotating the tuning dial just four degrees the voice of the announcer at a German station was clearly heard. No station name was given as apparently it had just been mentioned before the announcement being made, which was to the effect that the next item would be a Fox-trot—"Underneath the Arches." A few bars of this were listened to, slight fading being experienced, and then the dial was rotated a few degrees higher. Three stations were heard before London National was reached, the strength being more than sufficient for entertainment value.

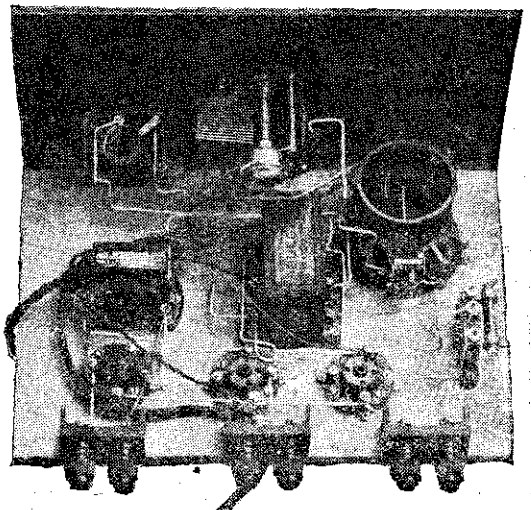


A three-quarter front view of the set, the construction of which was dealt with last week.

Too Loud

The National programme was much too loud with the selectivity control in its present position, and to make the volume of a level which was enjoyable the pointer of the control knob was turned to the indication under the letter "S." This gave a signal quite enough for all ordinary results, and the National occupied a space of 8 degrees on the dial—without, of course, any reaction being used. Two more stations were just audible, with reaction, between the National and the next station to be comfortably received, which was the Regional. For this station the settings had to be the same as for the National, and, naturally, there was no background to spoil the reception. Selectivity was decreased and the tuning dial was rotated until at 108 degrees the Midland Regional was audible, with the London Regional in the background. A little reaction, and slightly increased selectivity, and the Midland came through quite clearly with no interference whatever. Billy Merlin and his Commanders were giving a very enjoyable dance programme, which was received at about the same volume as that to which my friends had reduced the London stations. A few minutes to enjoy the programme and the test was continued. Without altering either selectivity or reaction, the tuning dial was advanced, and when 119 degrees was reached a good, clear signal was heard. Nothing was touched, and as soon as the band had finished playing, the voice of the lady announcer at Rome was clearly heard. Increasing the reaction slightly, and a small adjustment of the tuning dial, and Rome was sufficiently loud to give an enjoyable programme, without interference.

Nothing further could be comfortably received until the North Regional was tuned-in at 133 degrees. Langenberg, just below the North Regional, could not be adequately separated, as the selectivity control had to be reduced too much, and then insufficient reaction could be employed owing to the resultant distortion. When the North Regional was silent, however, Langenberg came through at about the same strength as Rome.



Rear view of the baseboard and panel.

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LONG RANGE EXPRESS 3

Described in "Practical Wireless" September 24th, 1932.

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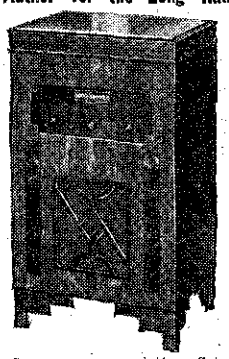
1933 ADAPTAGRAM

Trade Mark

Specified by the Author for the Long Range Express 3.



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

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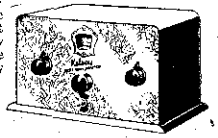

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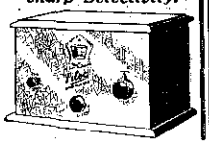

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THE VOICE OF THE SET

Mr. W. J. Delaney Explains Some Interesting Points About the Disposition and Methods of Connecting the Loud-speaker

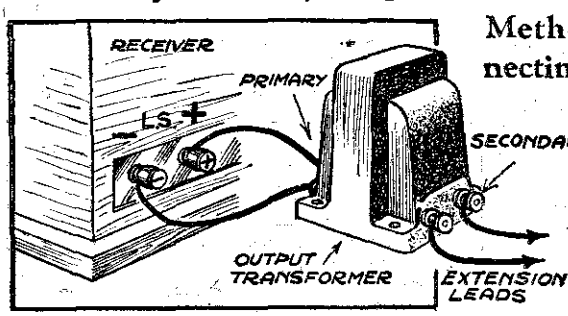


Fig. 1 (left).—An output transformer connected between set and speaker.

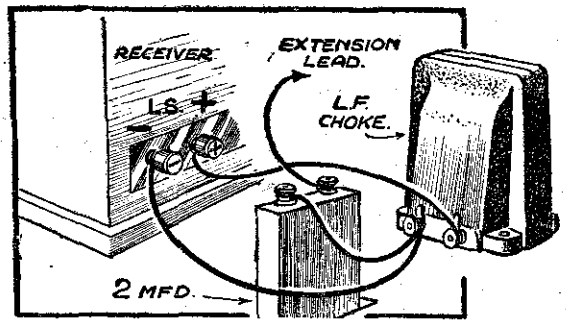


Fig. 2 (right).—An output filter as an external addition.

QUITE a number of wireless listeners are under the impression that because the loud-speaker, when it is purchased, is fitted with connecting cords about six feet long it must be joined to the loud-speaker terminals of the set by those cords and placed as near to the set as possible. This is not the case by any means, and if you are doing this you may not be getting the best from your speaker.

First of all, the set, owing to its particular size and shape, will have to be placed on a table or sideboard where it will look nice, and at the same time be in a position convenient to the lead-in. This means that it is generally placed near a window. Where the speaker is of the cabinet type it is usually stood on top of the wireless set, or by its side. Just for an experiment, join two long lengths of covered wire to your loud-speaker leads and connect the ends of these wires to the correct loud-speaker terminals. Now switch your set on and take the speaker round your room, trying the effect of it in different positions. What do you find? In the majority of cases you will find that there are two or three places in the room where the music sounds much more pleasing, either due to reflection from the opposite wall (or the reverse, absorption by a drapery), or due to the height at which the speaker is placed. Try the effect of your own particular speaker standing on the floor, anywhere in the room. Now lift it up, and support it by some means right near the ceiling. Is not there a great difference in these two positions?

Long and Short Leads for the Speaker

If you have carried out the above little test, you will have found that there is most likely some place in your room where the speaker is at its best, and this is some distance from the receiver. Now, in most receivers (unless they are fitted with an Output Transformer or Filter) the current from the last valve has to pass through the windings of the loud-speaker, and naturally this results in a slight drop in voltage. When the speaker is joined to the set by a short lead of a few feet, this drop is not of very much importance. When, however, long leads, such as are occasioned by the above test, are employed, then this drop may become of real importance, especially in the case of the small receiver employing a valve of the Power Type running from a small H.T. battery. An Output Transformer or Filter will, however, enable you to use any length of lead for the speaker, and by this means the receiver may be operated in a different room.

A High-resistance Speaker

The connections for an Output Transformer are shown in Fig. 1. The Transformer should be of the 1 to 1 type where a high-resistance speaker is employed, and of the step-down type (of the correct ratio) if a low-resistance speaker is used. Fit the transformer on to the back of the receiver cabinet, as near to the loud-speaker terminals as possible. The primary is joined to the L.S. terminals, and the leads to the loud-speaker are joined to the secondary. With this arrangement there is no need to bother about the gauge of the extension leads or the kind of wire, except that the two leads must be insulated from one another.

The Output Filter arrangement is shown in Fig. 2, and consists of an L.F. Choke and a 2 mfd. condenser. The Choke should be of good quality, and is joined across the L.S. terminals. The condenser has one side only joined to the L.S. *negative* terminal (this is very important), and the remaining terminal of the condenser is joined to one lead for the speaker. The other lead is joined to H.T. negative. It will be noticed that in all receivers the H.T. negative lead is joined to earth, and therefore it will be obvious that there is no need with this filter arrangement to take two leads away to the loud-speaker. The one lead from the condenser may be taken to any distance and joined to one lead of the speaker (it does not matter whether this is positive or negative as there is no current flowing), and the remaining lead of the speaker may then be joined to the nearest convenient earth. In the case of the speaker taken down into the garden, for instance, it will be quite sufficient to stick the tag on the end of the wire into the ground. This latter arrangement will be found of great use during the summer, as only one strand of the waxed variety of bell-wire need be run along the garden fence, and this is both cheap and weather-proof. Where the speaker is used in different rooms in the house, a convenient earth can usually be found, and the bell-wire can be run from room to room in quite a neat manner, the speaker terminals in each room being joined up to the bell-wire and earth.

Falling Off of Signal Strength

Where the speaker has been joined to a receiver in the ordinary way, and has been in use for some time, it may be found that signal strength has fallen off. This is due to the fact that the wrong connection of the speaker leads has demagnetized the magnet, and it will be necessary to have it re-magnetized. This only costs a few shillings, but the above methods of connecting the speaker will avoid this trouble, and consequently the expense of the transformer is justified, both in the extension of life of the speaker, and in the improved reproduction which will in most cases be obtained.

How To Choose Your Radio Batteries

DESPITE the growing use of the all-mains receiver, the ordinary battery-operated set still remains by far the more popular type, and is likely to maintain this position for several years to come.

Users of battery sets frequently forget when they have to purchase a new battery that the technical engineers who planned the receiver made it one of their first considerations to see that the valves and other component parts are such that they will give the best results when working in conjunction with each other.

The outcome of this is that the set becomes a complete unit made to give you perfect radio reception.

The selection and use of the high-tension and grid-bias batteries must, therefore, be in accordance with the type of valves in the receiver, as batteries play their part in helping to weld the set into the complete unit as much as the component parts themselves.

The manufacturers of Drydex batteries, for example, tabulate some 120 different types of portable sets alone, and recommend which of their five different types of high-tension batteries should be used to meet the requirements of the various sets.

There are many points which are overlooked by the inexperienced wireless fan, and guidance by the battery manufacturer should, therefore, be all the more welcome. When the ordinary standard-sized H.T. battery is used, for example, the maximum plate current taken up by the valves should not exceed 6 milliamps. If the rate of discharge is greater than this, you should see that you get a battery of sufficient capacity to withstand the extra strain and so have a reasonably long life.

Drydex batteries, for example, are produced in various grades to meet the requirements of sets of different plate current. For the multiple-valve sets, which demand a very heavy plate current, there are batteries which are capable of withstanding a discharge up to 30 milliamps.

Simple Tests Without Instruments

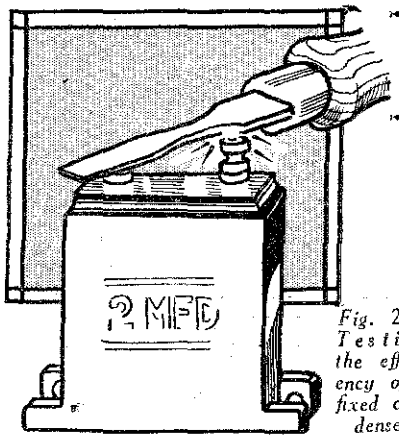


Fig. 2.—Testing the efficiency of a fixed condenser.

Efficiency of H.F. Chokes

AN easy way of testing the efficiency of an H.F. choke, is to connect it across the tuning coil of your receiver as in Fig. 1. This will naturally result in some loss of signal strength dependent on the efficiency of the choke, but with a good one it will not be very great, although the tuning will be slightly altered owing to the self capacity of the choke.

Testing a Choke

To test the choke thoroughly the set should be tuned-in to all wavelengths. This will show up any flat spots in the choke. For instance, a choke which is inefficient over part of the waveband will cause a loss of sensitivity in your receiver when tuned to that particular part of the scale, whereas a really "dud" component will cut the signal strength down very low on almost any wavelength. There is just one word of warning: If, by any chance, your choke is faulty, due to a break in the windings, which is very rare indeed, this test would be of no use. In such a case, however, the fault would most likely have been discovered beforehand through the receiver in which the choke was previously connected having stopped working altogether.

Testing Fixed Condensers

Fixed condensers of 1 mfd. capacity or more may readily be tested by connecting them momentarily across the terminals of an H.T. battery. On removing the condenser, it will be in a charged state, and on shorting the terminals with a wooden-handled screwdriver, or similar metal tool which is insulated from the hand, quite a snappy spark will occur at the terminals. See Fig. 2. Any condenser which is of any use at all will do this, but to test its efficiency properly you should see how long it will retain its charge. If on shorting the terminals an hour after charging a spark occurs then the condenser is O.K. A very good one will hold a charge overnight if the weather is dry. When charging the condenser do not touch the terminals or the electricity will immediately leak away and your test will be useless.

Atmospherics or Worn-Out Battery?

If your receiver develops intermittent crackling noises, and you are in doubt as to whether they are caused by atmospherics or are due to some trouble in the set itself, such as a worn-out H.T. battery, or burnt-out L.F. transformer, you can soon ascertain by disconnecting the aerial. If the noises stop or diminish very greatly they are due to atmospherics. Crackling caused internally would not be diminished by this procedure.

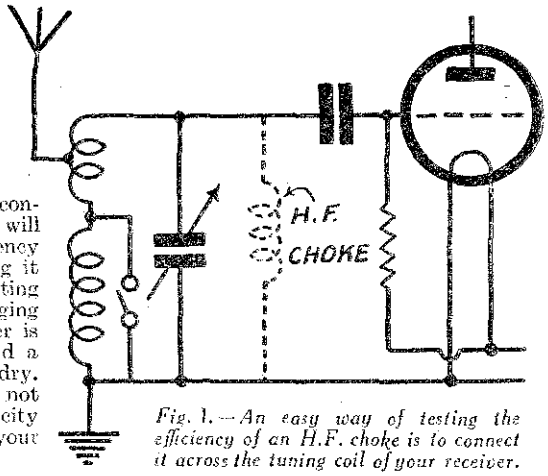


Fig. 1.—An easy way of testing the efficiency of an H.F. choke is to connect it across the tuning coil of your receiver.

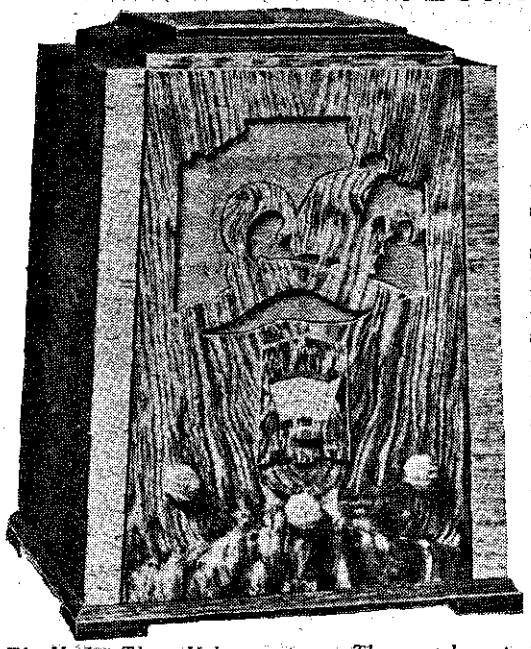
A WEEKLY FEATURE

Tested ON OUR AERIAL

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

TEST REPORTS OF COMPLETE RECEIVERS

BY THE TECHNICAL STAFF



The Varley Three Valve receiver. The escutcheon is raised and lowered for short or long waves, thus exposing the appropriate tuning scale, which is graduated in frequencies.

THE VARLEY D.C. RECEIVER

WE recently undertook a very thorough test of this receiver under rather difficult conditions—in the heart of London, with a small indoor aerial. This particular receiver is supplied with an external voltage regulator and this, in addition to the actual set, has to be adjusted to suit the voltage of the mains being used. The receiver is housed in a cabinet of unusual design, the moving-coil loud-speaker being fitted in the top of the cabinet, and directed upwards instead of in the more usual position. A fretted opening forms the top of the cabinet, and this is protected by a lid. This lid lifts to an angle of about 45 degrees, in which position a switch is operated to bring the valves into circuit, and the under side of this lid reflects the sound from the speaker in a forward direction. This is a novelty which we have not met in any other receiver.

The circuit consists of S.G., Detector and Output Valves, which are of Mazda manufacture, S.S., A.C./H.L. and P.1. (These it will be noticed, are of the 4-volt type usually fitted to A.C. sets.)

One dial tuning is employed, two condensers being ganged, with a "balancing" device, giving partial rotation of the stators of each condenser to compensate for differences in the tuning circuits. A volume control and a reaction control, complete the panel lay-out, so that no difficulty should be experienced in handling the set. A log chart was supplied with the receiver, on which twelve stations were logged, provision being made for other stations to be entered.

At the actual test the London stations were easily tuned-in at the readings given on the log, and ample volume was obtained. The tone, as was to be expected from a M.C. speaker fed by a P.1 valve, was nice and full. The cabinet resonance, due to the small size of the cabinet, was very low indeed and served to give a fullness to the tone. On the long-waves, even on the very inefficient aerial, many stations were received. Radio-Paris was loud, and judging by the strength and the poor results usually obtainable on the aerial, there is no doubt that a good aerial would provide an even greater selection of stations.

Provision is made at the rear of the receiver for the addition of an extra loud-speaker, and a gramophone pick-up, and with two alternative aerial connections the receiver will be found to meet every possible requirement.

The price of the complete receiver is 24 guineas, and with workmanship and finish up to the standard usually associated with Varley products, this receiver may be purchased with every confidence.

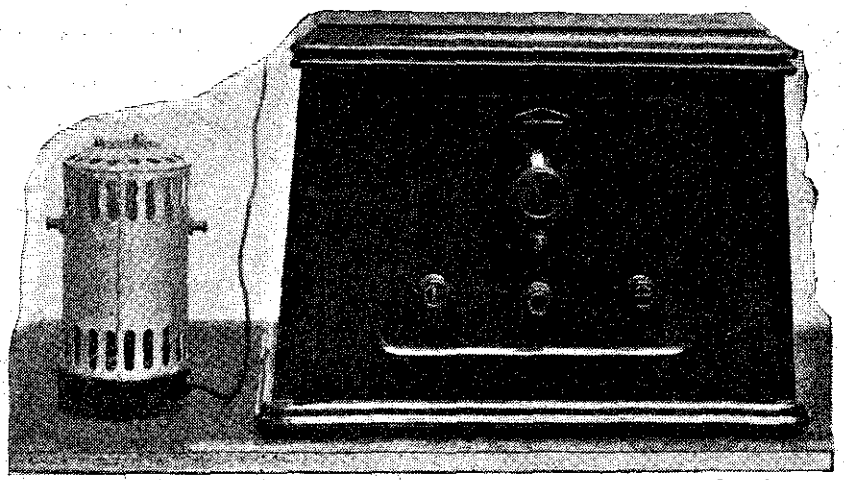
A gramophone pick-up may be used with this receiver, appropriate terminals with the necessary indications being fitted on the terminal panel at the rear. The volume control which is fitted to the front panel will not be in circuit when the pick-up is being used, so that a separate volume control will be necessary. In the working instructions supplied by the manufacturers on the back of the log chart this fact is mentioned, together with three possible causes of breakdown with the appropriate remedy.

The full instructions relating to working and aerial conditions should enable even the most inexperienced to obtain the very maximum from this interesting receiver.

A further point which attracted our attention was the detailed information concerning the undistorted output and the current consumption. In the case of this particular instrument, the undistorted output is 600 milliwatts, and the total consumption is 250 watts. The A.C. model of the same instrument takes 36 watts, and is, of course, much cheaper to run, whilst it also has the great advantage of giving an output of 1,000 milliwatts. This serves once again to bring home the benefits which accrue to the listener who is fortunate enough to have an A.C. supply to hand, as apart from the cheapness of the running costs, a much greater output is available. The new D.C. valves will, of course, assist in reducing the current consumption, but the power output will still be favourable to the A.C.-fed receiver.

None the less, it is certain that it will be many years before A.C. is general throughout the country, and it is indeed fortunate that the listener whose mains are D.C. has available such a splendid receiver as the Varley here reviewed, and illustrated at the foot of this page. It is not an easy matter to design an efficient D.C. receiver, and the fact that Varley have done so is further tribute to the thoroughness which characterises this firm's products.

NEXT WEEK:
THE G.E.C. MUSIC MAGNET THREE



The Varley D.C. receiver and the regulating resistance in its container reviewed on this page.

RESISTANCE-CONTROLLED VOLUME

An Article Describing Some Novel Uses for a Variable Resistance

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

UNDOUBTEDLY all those readers who interest themselves in wireless matters will have realised that present-day efforts appear to be devoted more to the refinement of existing circuits and components than to the discovery of some startling feature which would bid fair to alter known practice. This offers ample scope to the experimenter for trying out ingenious schemes which, in their successful accomplishment, give to the radio user a sense of satisfaction and make him feel quite at home with the wireless set and its performance. To quote just one instance, has it ever occurred to you how a good variable resistance can serve a number of useful purposes? Essentially it acts as a form of control, and provided the variable resistance purchased is of good quality, with a smooth action, then its applications are multitudinous.

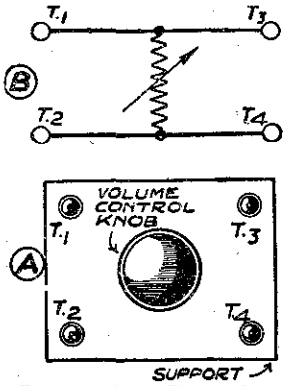


Fig. 1.—(A) The volume control, and (B) its circuit arrangement.

Variable Resistances

In this short article it is proposed to deal mainly with the variable resistance as a form of volume control, leaving uses in other directions to a future article. You are then in a position to adapt your reception to any occasion, for in effect you are providing the loud-speaker with soft and loud pedals in just the same manner as a piano. About the best value of *continuously* variable resistance for this purpose is one that adjusts from zero to 100,000 or 200,000 ohms, the alteration in resistance being continuous, smooth, and silent with a complete absence of jerkiness. Such resistances can be purchased from several radio firms such as Claude Lyons, Varley, Watmel, Regentone, etc., and it is nearly always best to mount them up as a separate little unit, as then it is available at will for several different purposes.

An Easily-made Unit

To achieve this procure a piece of ebonite, the exact size being governed primarily by the size of the variable resistance, and mount the component on it with four terminals. Two pieces of wood can act as feet to raise the resistance from the table or bench, and Fig. 1 A and B show clearly the method of mounting and wiring. It is necessary merely to link terminals T_1 T_3 and T_2 T_4, joining the resistance across the wires as illustrated.

Now to put the little unit to good service. Naturally, for volume control, the most satisfactory way is to use the control as near as possible to the aerial end of the set. One of the simplest solutions is, therefore, to join terminals T_1 and T_2 either across the aerial and earth terminals of the set or in series with the lead in. Both these are shown in Fig. 2 A. Adjustments may then be made on the resistance knob to give the required control of volume. Incidentally, this arrangement brings about an improvement in the sensitivity of the set and is especially desirable when situated close to a powerful transmitting station.

Another effective form of volume control is to connect your home-made unit across the secondary terminals of the *first* low-frequency transformer in the set. The scheme is portrayed diagrammatically in Fig. 2 B. The refinement used in this way flattens out the frequency response curve of the transformer if this happens to be somewhat "peaky."

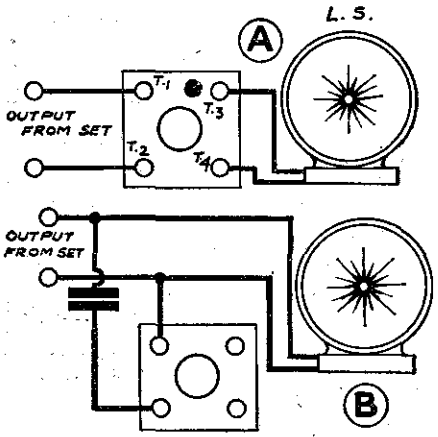


Fig. 3.—(A) Using the control to modify the volume at the speaker, and (B) converted as a tone control.

Control at Output

A third way to control volume is indicated in Fig. 3 A. Here the loud-speaker terminals of the set are joined to terminals T_1 and T_2 of the unit, while the loud-speaker itself is connected across T_3 and T_4. In many cases this method is not so good as the previous two, but readers can test for themselves to ascertain which best

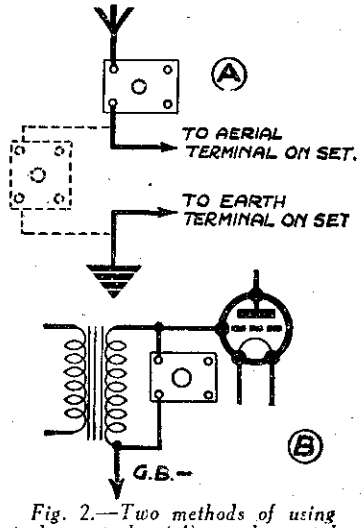


Fig. 2.—Two methods of using the control: (A) on the aerial circuit, and (B) across a transformer.

suits their requirements. With the addition of a fixed condenser the resistance unit forms an excellent tone control. It will be appreciated that, whereas for speech the reproduction should be sharp and crisp, with music a softer and more mellow tone is desirable. The simplest way of putting this into operation is shown in Fig. 3 B. T_1 of the resistance unit is connected to one loud-speaker terminal of the receiver, while T_2 is taken to a terminal on a 0.1 mfd. fixed condenser, the other terminal linking to the second loud-speaker terminal of the set, the loud-speaker itself occupying its normal position.

It is clear, therefore, that this easily-made-up unit has a variety of applications, and no doubt other ways and means of applying it to the set will occur to readers. By mounting the resistance in the manner suggested it can be kept near at hand, "at your elbow," in fact, and adjustments made without having to touch the set itself, a feature which is particularly convenient on many occasions.

NEW SETS FOR OLD

THE relief afforded to motorists, whereby they can obtain a generous allowance for an old car when purchasing a new one, has proved a great boon, but it is now possible to secure similar advantages as far as radio sets are concerned. This is one of the many features offered by the newly formed Radialaddin Club, whose headquarters are situated at Berners House, Berners Street, W.1. A shilling weekly subscription is the only fee to be paid, and for this the member is assured of a constant change of his set, with a knowledge of its exchange value at any period. Used sets are available for cash or hire purchase at a fraction of original costs, whilst technical advice is given on all problems. The wireless experimenter who is constantly building up sets will welcome this scheme, as it provides him with a ready means for exchanging his apparatus without accumulating large and obsolete stocks. Furthermore, the ordinary radio man can keep his set right up to date at a small outlay. Many other advantages are open to club members, especially local organisers, and existing or prospective radio users will find it worth while to write to the secretary at the address mentioned for full particulars.

"OUR BEST WISHES"—

A Further Selection of Congratulatory Messages which the Editor has Received from Leading Manufacturers

From A. F. Bulgin (Director, A. F. Bulgin and Co., Ltd.)

"When broadcasting first commenced it is questionable whether anyone visualized the extraordinary rapidity with which it would capture the whole world.

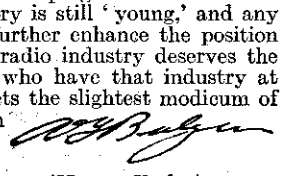
"It is not more than a decade that I, like many of my confrères, was enthusing over the first 'Writtle transmissions,' and it is therefore amazing that radio should have presented the world with one of its greatest industries in so short a space of time.

"That the British radio industry should lead the realm of Radio is a matter for the greatest satisfaction to all employed in the manufacture of British products, whether it be an inexpensive gadget or a 100 guinea radio-gram.

"It is, therefore, but common justice to acknowledge the part the actual listener plays in every stride made by radio. No manufacturer can exist without the support of the public, and in personally tendering our sincere thanks let us also include the Press.

"A new paper affords new scope and marks still further progress.

"The industry is still 'young,' and any effort to still further enhance the position of the British radio industry deserves the support of all who have that industry at heart or extracts the slightest modicum of enjoyment from the ether."



From J. G. M. Rees (Messrs. Varley)

"Congratulations on your new publication! There is no doubt that the man who builds his own set and uses sound components will get the maximum of satisfaction and entertainment if he follows the practical advice contained in your columns. Moreover, the amateur can build his set *exactly* to his own requirements, and can remodel it at any time in accordance with the latest radio practice at a cost of a few shillings for new parts.

"Good luck to you."

From L. E. Tillmore (Jackson Bros.)

"There is room for a paper like PRACTICAL WIRELESS, with a 'Queries and Enquiries' column run by experts, and technical articles written in simple language that all can understand. If your new paper has the success which it deserves, there will soon be an end to the confusion in the public mind between the mystic microfarad and the still more mysterious micro-microfarad!"

From H. Freeman (Parr's Advertising, Ltd.)

"The writer welcomes the practical editorial policy set out in the printed matter he has received from the publishers of PRACTICAL WIRELESS.

"Approximately 5,000,000 licences have been issued to the public, and there is, in his opinion, a wide field open for PRACTICAL WIRELESS, which from its very name is evidently going to appeal to the ever-growing number of constructors.

"My first receiver was a commercially-constructed one, but since 1920 I have built several others. Set-construction is a most interesting hobby, and not like other hobbies, because it invariably brings pleasure to *all* in the home.

"I wish every success to your publication and await with great interest a copy of your first issue."

From A. W. Hambling, A.M.I.R.E. (A. W. Hambling, Ltd.)

"First of all I would like to congratulate the publishers on the occasion of No. 1 of PRACTICAL WIRELESS, which will undoubtedly be welcomed by the Trade and Public alike. As a very early member of this Industry, one reflects on the great help given by the Press to the public in explaining the mysteries of radio and the general spread of radio knowledge. At the present time the public has arrived at the stage of knowing what results to expect from different classes of sets. Also they are aware of the shortcomings of the 'mass production' type of circuit one usually sees put forward as new. I feel sure that PRACTICAL WIRELESS, as its excellent name implies, will be of great value to the constructing public, by placing before them the best tested and proved designs with practical constructional articles that can easily be followed. By this token readers will be certain of results. One can look forward to PRACTICAL WIRELESS each week with certain knowledge that it is based on sound experience, and its pages will be full of really interesting notes covering every phase of radio."

From E. Leete (London Electric Wire Co.)

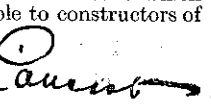
"It seems to me that the ever-increasing interest that Britain's population shows in wireless matters will create very much more than a niche for your paper. I am sure that you will receive a very warm welcome from those thousands of heads who are always craving for new conquests in the wireless world, and from twice as many hands who restlessly wait to build new circuits, and even from humble folks such as ourselves, who will be prepared to spare no pains or expense in making good components that will back worthily and successfully the imagination and ingenuity of your Engineers. Therefore, I look forward with great interest to your new publication and again may I wish it great success."

From E. S. Lancaster (Colvern Ltd.)

"Every success to PRACTICAL WIRELESS!

"If you cater fully for the needs of constructors, we are confident you will succeed.

"There is no limit to progress, and Colvern will continue to improve and embody new features in their coils which no doubt will be available to constructors of PRACTICAL WIRELESS receivers."



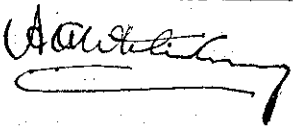
From Norman Goldsworthy (Managing Director Scientific Publicity, Ltd.)

"From what we have seen of your plans for PRACTICAL WIRELESS we judge that your new publication will make a very strong appeal to the home constructor who is a critical judge of quality and performance and we shall, therefore, welcome its pages as an excellent medium for the components marketed by our own clients."

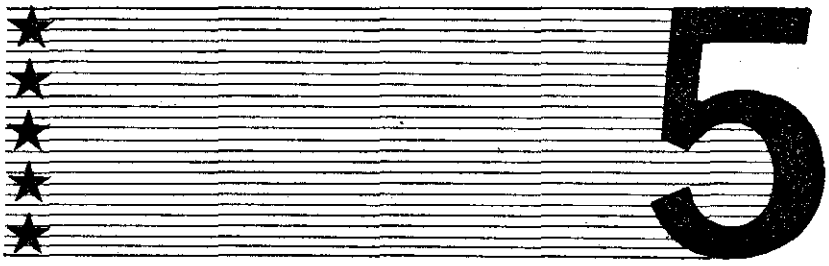
From A. H. Whiteley (Whiteley Electrical Radio Co.)

"The scope for the amateur constructor in radio to-day is remarkable. He may start with no more technical knowledge or skill than how to use a screwdriver, and put together a set that in appearance, in technique, and in performance is absolutely up to date—even to having a moving-coil speaker. Under your wise guidance he soon will venture, and *succeed*, in more elaborate achievements which manufacturers are making easier and surer for him.

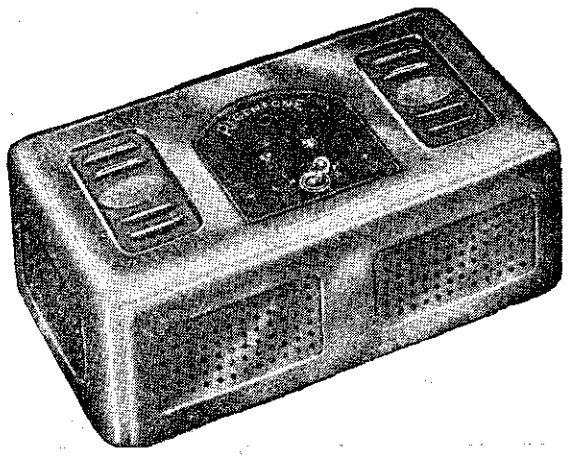
"Therefore we offer you our most cordial goodwill and best wishes."

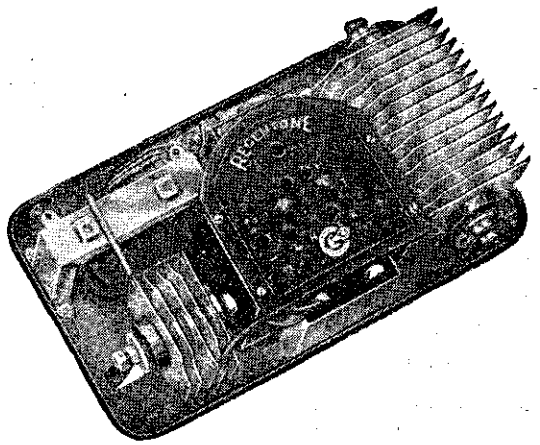


THE NEW RANGE OF REGENTONE MAINS UNITS



5 STAR FEATURES





ONLY ON REGENTONE

The incomparable range of Regentone Mains Units entirely redesigned. Each Mains Unit now incorporates these five star features.

Each model is housed in a solid drawn steel case, of most attractive design having a Florentine bronze finish.

Each and every model is provided with tappings divided into three main groups; SCREEN GRID, DETECTOR AND POWER. The Screen Grid and Detector supply each have high, medium and low outputs. The power supply has one output only. SEVEN VOLTAGE TAPPINGS ARE COMMON TO ALL MODELS. All mains units incorporate a LINE VOLTAGE REGULATOR, by means of which voltage fluctuations in the main supply line can be compensated.

The Line Voltage Regulator and voltage tappings are carried by a specially moulded distributing block; the sockets carrying voltage are sunk into the insulating medium.

For supply and voltage as follows 200/250 volts, 100/120 volts, at 40/100 cycles. Dual frequency 25/50 cycles at an extra charge of 10/-. Prices from 39/6 or 8/- down.

Change from battery to mains but change with Regentone —and follow the experts

If you have a battery operated receiver, make it all-electric with one of the new Regentone Mains Units. Regentone Mains Units are specified by famous set manufacturers for their sets; experts choose them for star circuits, the Press pays tribute to their efficiency and reliability. Choose Regentone—the one the experts all recommend.

REGENTONE

THE SYMBOL OF INDIVIDUAL CRAFTSMANSHIP

Regentone, Ltd., Regentone House, 21, Bartlett's Bldgs., Holborn Circus, E.C.4. Tel. Central 8745 (5 lines). *Irish Free State Distributors: Kelly & Shiel, Ltd., 47, Fleet St., Dublin.*

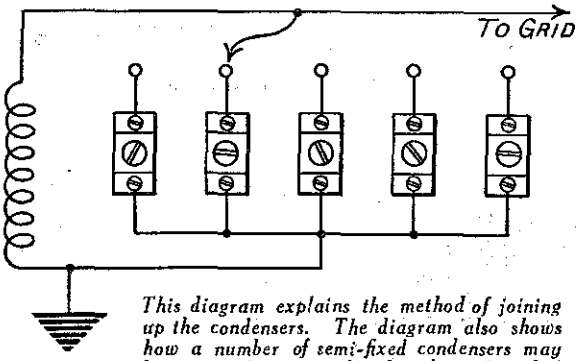
PRESS THE BUTTON

Existing Receivers, says Mr. D. James, may be Converted to Automatic Sets in Quite a Simple Manner

SEVERAL receivers were seen at the recent Radio Exhibition in which the customary tuning arrangements had been disposed of, and some form of automatic selection installed instead. One receiver had a number of small buttons which could be labelled, and the depression of a button tuned the receiver to the station indicated on that button. In another the centre of the loud-speaker fret was fitted with a knob, and disposed round the fret were small windows bearing the names of the more powerful European transmitters. Rotation of the knob tuned the receiver to fixed points, the indication being provided by a travelling light behind the windows. Devices such as these tend to make radio much simpler, and a receiver may be adapted to a similar automatic selecting device by the following means.

Varying the Capacity

The tuning of practically all receivers is effected by the variation in the capacity of a condenser connected across a tuning coil. As the value of the condenser is increased, so is the wavelength to which the entire circuit is tuned. If the condenser (or tuning) dials were graduated in capacity values instead of degrees you would find that a capacity of, say, .0002 mfds. tuned to the London National and a capacity of .00035 mfds. tuned to the Regional. Obviously then a fixed condenser of one of these values could be connected across the coil in place of the variable condenser with the same result, but the reason that the variable condenser is employed is that the value necessary for the different stations does not unfortunately work out to a simple figure, and furthermore, where many stations are wanted it is much simpler to have a rotatable dial to vary the capacity. However, the small, semi-fixed type of condenser may be usefully employed to convert an ordinary receiver into an "automatic" one, and quite a useful range can be covered by using a number of these condensers.



This diagram explains the method of joining up the condensers. The diagram also shows how a number of semi-fixed condensers may be connected up to enable the scheme described in this article to be carried out.

If you examine the wiring of your tuning circuit you will find that there are two wires leading from the tuning coil to the tuning condenser. One of these wires is "earthed" and the other is joined to the grid of the first valve—either direct or through a grid condenser. If these two wires are disconnected from the variable condenser, *but left connected to the other parts of the circuit*, the following additions will make the set tunable by means of a selector switch.

The Conversion

A number of the semi-fixed condensers should be obtained, the exact number depending upon the number of stations it is desired to receive. Obviously, only those stations which are received at good strength should be chosen. Screw these condensers to the baseboard of the receiver as close to the tuning coil as possible, and join all the terminals on one side of the condensers together and connect this "common" lead to the lead from the tuning coil which is earthed. The remaining terminals of the condensers should then be taken to the selector device which is chosen, and this may be of the type having a rotatable arm travelling over a series of small studs, or a number of sockets mounted on the panel. In the case of the rotating arm device, the condensers would be joined to the studs, and in the other arrangement they would be taken to the sockets. The lead which joins the tuning coil to the grid of the valve would then have to be joined to the rotating arm in the first device, or to a flexible lead provided with a plug in the second arrangement. The diagram attached should make the idea quite clear. Each condenser should be individually adjusted to a station, and an indication provided so that the appropriate condenser may be brought into circuit as required. Where a reaction control is fitted, this will, of course, have to be operated separately, but the idea of plugging-in to the required station will no doubt appeal to the older members of a family, and a very simple and at the same time stable receiver may be built up on these lines.

If care is taken it may also be possible to arrange that the Reaction condenser can be controlled by a similar method.

A NEW RADIO FACTORY

Progress

IT is always a pleasure to record progress, especially when it is well merited, and I was therefore delighted to form one of a party which visited the new works of Belling & Lee Ltd. My friend, Mr. E. M. Lee, is a director of this company, formed ten years ago, and from its inception the specialisation has been in the manufacture of terminals, wander plugs, in fact, anything that bears a relation to radio connections. The new building covers 22,000 square feet of floor space, and has been constructed with a view to obtain flexibility so that new developments and new ideas can be put into practice with the minimum delay or disorganisation. Partitions have been kept to the absolute minimum, and are so constructed that they can be moved to another position very quickly. The whole factory is ready to be expanded at any moment by building further bays on to the south side, and then removing the temporary south wall as soon as the new bays are ready for occupation.

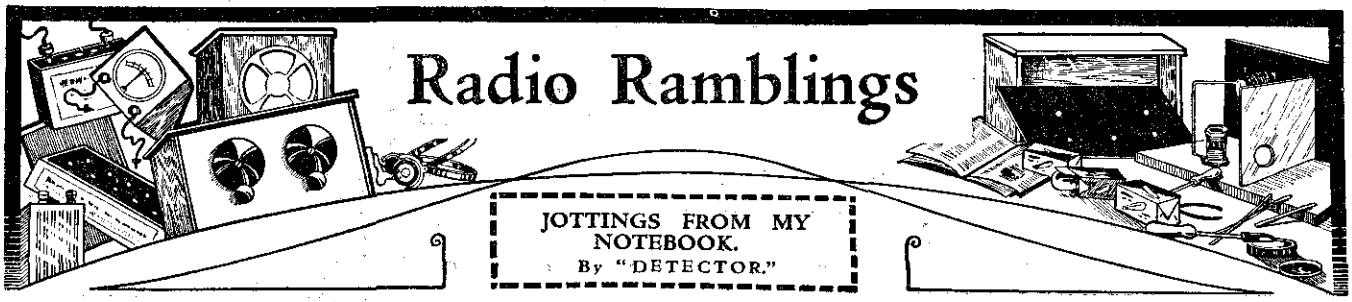
Automatic Machinery

THE machinery consists mainly of high-speed automatic lathes, and is capable of turning out almost any shaped part in either metal or insulation material. The principal materials worked are brass and casein rod, this latter being made from milk by first extracting the pure casein, which is rather like cheese, and then dyeing it and adding suitable fillers, and hardening with formaldehyde to produce the very attractively-coloured substance from which so many small wireless parts are made. Many parts have to be polished, which is done mainly by automatic methods, and a dust-extracting plant prevents dust getting into the air from these machines. Metal parts are mostly sent to the nickel-plating department, where they are first freed from all dirt and grease by means of the latest chemical processes, including a de-greasing plant, which uses the chemical trichlorethylene in the form of vapour for removing the last traces of oil. All the oil removed is refined and used again, while all the waste metal and brass dust is sent back to the makers to be melted down.

Press Work and Fuse Wire

THE press section includes a special type of press, which Belling & Lee Ltd. have developed for producing the permanent lettering on their terminals, plugs, etc. From the press work we proceeded to the hand assembly and finished inspection. In one corner of the assembly department some exceedingly fine wire was being handled in the production of radio fuses. This wire is so fine that it melts before the filament of a valve could be damaged in the event of any fault in the receiver. Some of the wire is only one-twentieth of the thickness of the human hair, and it takes some months of training before the operators are able to handle it safely and speedily. Altogether this was a most interesting visit, which afforded ample proof that a real industry has been built up round the "bits and pieces" of radio.

H. J. B. C.



Radio Ramblings

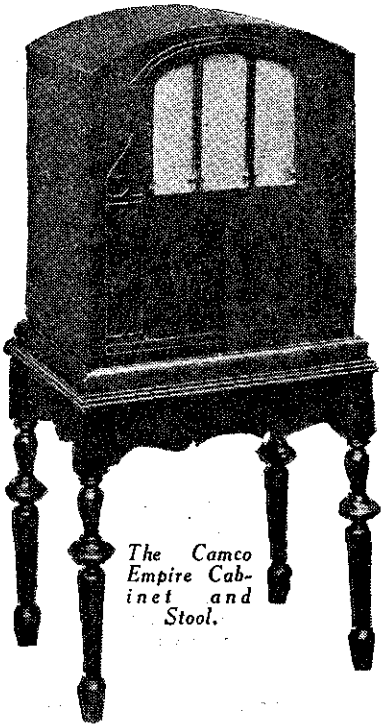
JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

Tracking Interference

IN a report recently issued by the research department of the Post Office, it is stated that over 10,000 cases of electrical interference with wireless sets have been dealt with during the past twelve months. Most of the interference has been caused by electric motors, flashing signs, trams, and medical apparatus, and it has been found that, while it is possible for motors to cause trouble to a wireless set 200 yards away, a modern motor rarely offends at more than fifty yards. High frequency medical apparatus can, however, offend up to 300 yards. Now you know! If you are troubled with weird noises in your speaker, draw (as the old school joke about the Equator has it) a "menagerie" line around your house at about 200 to 300 yards radius, and then go on an interference hunt. Your hunt would be very much simplified if you could get hold of a frame aerial and notice from which direction the unwelcome signals were strongest, remembering that these signals come in a direction at right-angles to the plane of the frame. Having done this you have cut down the district to be investigated to a long slice of ground in a straight line, but you can locate the offending machinery even to closer limits, if you attack the problem even more scientifically! Get a conveniently situated wireless friend living in some other part of your locality, and take your frame aerial to his house, and notice the direction of the offending signals on his set. Draw a rough chart of your part of the world, and on it mark the positions of your houses, and the directions of the signals relatively to each. Theoretically where these lines cross is the source of the interference, though it is quite possible you may be a little wide of the mark at first. Still, you will have narrowed your field considerably, and if your rough map of the district is not too inaccurate, you should come within fifty yards of the trouble. I do not propose to tell you what to do now! That is a matter for your own tact and judgment, and the experience of telling a deaf and elderly spinster all the bother her artificial sunlight apparatus is causing you will stand you in good stead in later years. Sufficient to say that the Post Office engineers recommend that offending apparatus of a medical nature should comprise a closed non-radiating secondary circuitor—*A METAL SCREEN OF LARGE ENOUGH DIMENSIONS TO COMPLETELY ENCLOSE BOTH PATIENT AND APPARATUS!!!* Now tell that to your elderly spinster! At the great risk of flogging a dead horse, however, I would like to whisper in your ears. Before you set out on this drastic business, just go over your own set and that of your friend's, and make sure you have no loose connections! They make more row as a rule than a dozen modern electric motors.

A Question of Psychology

A FOREIGN firm of electrical equipment manufacturers in advertising a refrigerator they make, announce that anyone buying a machine within so many days will receive a free present of enough electricity to run the thing for three months. Isn't it strange that the sale of this refrigerator has gone up considerably since the advent of this announcement? Particularly when you consider that the cost of three months' electricity for quite a hefty cold-producing machine would be amply covered by half a sovereign? And yet, if the concern in question had announced a discount of one per cent., I don't suppose anybody would have taken the least notice. There's psychology for you!



The Camco Empire Cabinet and Stool.

And there's a tip for British all-main radio manufacturers, free, gratis, and for nothing. Can't you imagine it? "Run your radio set for two years at our expense!" In other words, knock five shillings off the selling price.

Radio for Fire Fighting

THOSE of you who have at any time lived in the great lumber belts of North America will know the great dread in which forest fires are held by the inhabitants and the forestry authorities, and I retain vivid recollections of a visit paid to the scene of desolation after such a fire had passed by. As in most conflagrations, time is of paramount importance, and preventive measures taken in time will often save the situation. To deal with such calamities a new radio receiver-transmitter set has been developed for use by the fire-fighting patrols in the forests of North America, and which allows the alarm to be given to all the patrols in the vicinity. The set weighs about ten pounds—the weight depends on the capacity of the dry batteries used—and the set can transmit or receive at will by the flick of a switch. Three valves are used, and by a very ingenious circuit they are used for both the receiving circuit and for transmission. A common wavelength and fixed tuning is used so that there is no tuning control, and a standard aerial of 70ft. of insulated wire is carried and slung up on to bushes or trees when required. Reliable speech transmission and reception is obtained up to ten miles and Morse can be used up to twenty-five miles.

B.B.C. Birthday Broadcast

EVERY programme innovation of the B.B.C. comes in for a lot of criticism, and the "Farewell to Savoy Hill" broadcast of last May had its fair share. If I may be allowed to add my voice I should say that the affair was very well done, and was quite interesting, even if it was much too drawn out. Also, the ceremonial accents of the gentleman who did all the talking flavoured rather much, I thought, of the days of "Good Queen Bess." Whatever you thought of it, anyway, you will be sure to "register" surprise when you learn that we are to have another affair of similar nature. This will be in the birthday celebrations of the B.B.C. in November, and listeners will be taken in turn to every studio in the new Broadcasting House. I make but one comment! Savoy Hill had nine studios—Broadcasting House has twenty-two!

Colliery Radio

MARCONI has again been in the limelight due to his work in mid-ocean on the ultra-short waves. It is at once a tribute and an ironical commentary that the inventor of this most wonderful science should be compelled to seek the solitude of ocean wastes in order to obtain the minimum of interference from the wide-spread ramifications of the child of his brain. Meanwhile, a little band of experimenters are working in a Yorkshire colliery to still further cause the name Marconi to be blessed whenever the alleviation of human suffering or the saving of human lives come to be considered. I allude, of course, to the attempts that are being made to provide a really dependable form of communication underground in times of disaster. A fair success has already been attained and research work is going ahead, thanks to the generosity of the colliery owner who has placed his mine at the disposal of the experimenters for tests. The transmitter used has an output of 0.25 kW and is used

in conjunction with an aerial fixed to 35ft. masts at the pithead. Those of you who saw the German mining film *Kameradschaft* will recall how miners endeavoured to effect some form of communication by rapping on the pipe lines, and it needs very little imagination to realise the boon of a dependable radio link with the surface of the mine. Of course, many modern pits have telephonic communication throughout the workings, but when the unexpected happens telephone wires are among the first things to be fractured and torn up.

Sparking Dangers in Mines

A CERTAIN prejudice exists as regards the use of electrical apparatus in mines owing to sparking dangers in volatile gases, and one of the major problems in providing radio service underground is that of obtaining spark proof apparatus. For various reasons reception is vastly inferior as a rule to that obtained above ground, and blind spots are often found in the region of metalliferous veins in the geologic structure.

Experiments in the Severn Tunnel

YOU may remember the attempts made to receive the Cardiff station by members of a Radio Society whilst travelling by train through the Severn Tunnel—Britain's longest tunnel. The reception was worst at the deepest part in the middle of the tunnel, a gradual improvement being noticed as the train neared ground level. While this is perhaps not an exactly parallel case, it serves to illustrate that the difficulties of wireless communication underground are many. We hope that the difficulties will not be too many to discourage those who are seeking to further lighten the burden of the members of the mining industry—men who earn every penny of the small wages they get.

Every wireless enthusiast who reads PRACTICAL WIRELESS will have long since realised that the wonders of radio are legion. Every day we hear of some new development, every day some untiring worker discovers some new aspect of this young-old science. Probably, apart from television, the problem of broadcasting light and heat and power by means of the ether has most engaged the thoughts of experimenters, and it has been left to an American body to demonstrate that cooking by wireless is possible. The Americans, with their old-world attitude toward their women folk, have a happy knack of harnessing most of their new-found industrial processes to the alleviation of domestic drudgery, though it is a debatable point whether our less sophisticated wives and mothers will take kindly to meals cooked by means of dials and knobs. Well, I have seen socks, dusters, and other domestic oddments hanging from an aerial to dry; will I live to see cakes, pastries and other edibles supported from the self-same wire to cook? I think not, for by then the consumption of heavy meals will probably be nothing but a spectre of the horrible past, and we will all be fed by wireless or by some form of tabloid food that remains as yet the dream of our most progressive dietetic scientists.

Concerning Variable Condensers

(Continued from page 79.)

turer he had complaints that there was, with this new condenser, an apparent station crowding at the top end of the scale.

The outcome of all this was the appearance on the market of what might be termed a happy medium, namely, the log mid-line condenser. The shape of the plates followed what is known as a logarithmic law, and in the calculation and resulting plate shaping, allowance was made for an average capacity value of the stray capacities introduced in the set. The advantage of this type of condenser can perhaps be more readily appreciated if we think of modern wireless practice. In the early days when two or three tuning operations had to be carried out before a station was received properly, difficulty was experienced by the person handling the set unless he was skilled.

Matching the inductance of the tuning coils was a big step forward and reduced these dial differences considerably, but with a log condenser even perfect matching was not absolutely necessary. This is brought about by the fact that when two or more circuits are tuned to any one wavelength the resultant alteration in the dial setting when tuned to another wavelength is the same for each condenser.

That is to say, equal wavelength changes coincide with equal dial setting changes, say, 10 to 30, with one condenser and 14 to 34 with another. It was therefore possible to set each tuning condenser to give the same dial reading when a station had been tuned in accurately merely by releasing the grub screw securing the dial to the moving plate spindle. The simultaneous tuning of all the circuits then became a relatively easy matter and paved the way for the ganging of condensers.

In conclusion, let me say a word on a popular fallacy which existed some time ago. It was often said that this or that type of condenser brought about added selectivity.

The dial separation for stations working on wavelengths fairly close to one another is certainly altered with the different types of condensers that are used, and a better distribution of the stations round the dial results from the use of the square law or log types. This is really only a psychological effect, however, and the ability to separate the stations one from the other so that they can be listened to without interference is a function of the set itself and the aerial with which it is employed.

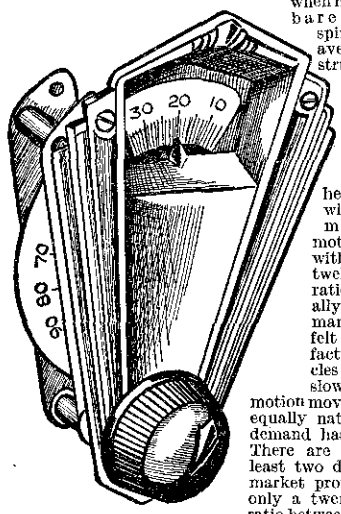
Sound Sales Mains Transformers.

IN addition to correct design, the actual construction of a mains transformer can play an important part in its operation. A badly clamped core, for instance, can give rise to hum caused by the vibration of the laminations. Sound Sales Ltd., appear to have paid particular care to all details in the design and manufacture of their mains transformers. Silicon steel core; screened primary windings, heavy gauge screening case, and fuses, are all embodied in these products, resulting in very efficient components. The insulation test is carried out at 25,000 volts, and a leakage test at over 2,000 volts, enables the transformers to be used for all ordinary purposes with confidence. We are using one in our Mains Express Three to be described next week.

A CHAT ABOUT THE LATEST COMPONENTS

SLOW-MOTION WIRELESS DIALS

THE designers of the popular short-wave sets have discovered that while *they* may be such wizards with the "knobs" that they can bring in Australia when handling the bare condenser spindles, the average constructor finds it quite beyond him to capture the distant stations (whose "whistles" he can hear), with the normal slow-motion dial, with its ten or twelve to one ratio. Naturally, the demand has been felt in manufacturing circles for an even slower slow-motion movement; and equally naturally that demand has been met. There are already at least two dials on the market providing not only a twenty to one ratio between the gears, but also so designed that the scale can be illuminated very easily, thus still further simplifying tuning operations. These dials are of the disc type, and their mounting is extremely simple. For those who are keen on distance-searching, whether on the short or normal broadcast wavebands, they provide a new accuracy that is very valuable. Telsen Electric Co., Ltd., Aston, Birmingham.



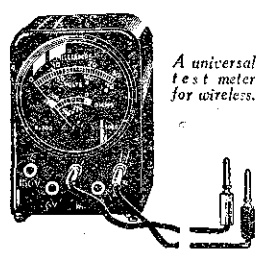
A slow-motion dial with a 20 to 1 reduction ratio.

A UNIVERSAL TEST METER FOR WIRELESS

THE instrument shown on this page is a wireless test meter giving four readings on one dial, including direct measurement of resistance. It may be used to test H.T. and L.T. voltage, current consumption, valves, transformers, coils, condensers, short circuits, resistance, distortion and bad connections. It is fitted with a battery for valve and circuit testing. The readings are up to 150 volts for H.T., up to 6 volts for L.T., 30 milliamps for current, resistance up to 2,000 ohms. An interesting book on testing is included with each instrument, which costs 12s. 6d. Standard Battery Co., 184-8, Shaftesbury Avenue, W.C.2.

A SCREWDRIVER AND SCREW-HOLDER

A WELL-KNOWN firm of screw manufacturers has recently marketed the combined screwdriver and screw-holder shown in the illustration in the next column. It grips the screw whilst it is being turned, and it can therefore be used with one hand only. It will be found ideal for working in awkward places, as the blade cannot slip out of the screw-slot. Additionally, it dispenses with the need for a gimlet or bradawl hole in ordinary woods and it is suitable for metal or wood screws. It is made in three sizes: No. 1 accommodating Nos. 0 to 6 gauge wood screws, 10 to 4 BA screws, and Whitworth screws 1/16in. to 9/64in. diameter; No. 2 size suits 4 to 9 gauge wood screws, 5 to 3 BA screws, and ¼in. to 5/32in. Whitworth screws; No. 3 caters for 8 to 14 gauge wood screws, 2 to 0 BA screws, and 3/16in. to ¼in. Whitworth screws. No. 1 size is suitable for wireless or model purposes, and is made in all-steel, No. 2 is a householder's model, and No. 3 a carpenter's and engineer's model. Guest, Keen and Nettlefolds, Ltd., Heath Street, Birmingham.



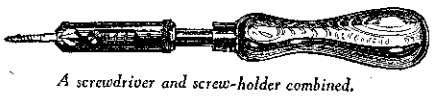
A universal test meter for wireless.

A SPECIAL PAIR OF PLIERS

THE special pair of pliers shown in the illustration in this column will rapidly and neatly form eyes in the ends of wire, and of a diameter to suit the terminal or bolt they are intended to pass over. Eyes formed with ordinary pliers are seldom neat or satisfactory, nor do they always make good electrical contact. The pliers provide eight standard sizes of loop-forming ends which make perfectly circular loops. These range from 1/16in. to 5/16in. in diameter. The inner faces of the pliers meet in perfect contact along a line 1in. in length. The tool may also be used for other small bending jobs. The usual side cutters are incorporated. Volute Pliers Co., 19, Victoria Square, S.W.1.

POLARITY INDICATOR FOR WIRELESS

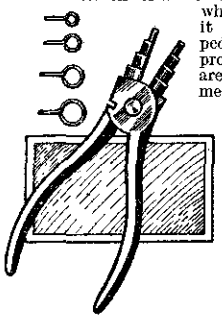
HERE is a neat little polarity indicator which will be found useful by radio enthusiasts, car-owners, and others interested in electrical matters. It will instantly indicate the negative polarity of any source of current from a few milliamps to much higher currents and up to 500 volts. It is convenient in size, for it can be carried in the waistcoat pocket. It will show alternating current or direct current wiring as well. It costs by post 3s. 6d. from I.C.A., Ltd., 28, Park Road, Nottingham.



A screwdriver and screw-holder combined.

TEST PRODS FOR WIRELESS AMATEURS

WHEN wireless sets which have given satisfactory results fail to function, the first thing the amateur does is to search for a broken circuit. This is a somewhat lengthy process, but it can be considerably expedited by means of two test prods. In use, the prods are connected to a voltmeter and a small battery in series with the ends of the length of wire to be tested. Working along the wire with the prods (the needle points, of course, will readily pierce the insulation) at intervals of ¼in. or so the break is soon located. It is sold by J. J. Eastick & Sons, 118, Bunhill Row, London, E.C.



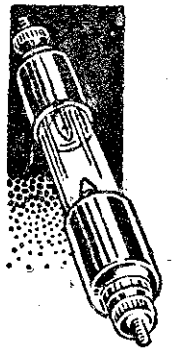
A useful pair of loop-forming pliers.

MINIATURE WIRELESS TESTING INSTRUMENTS

WIRELESS becomes much more fascinating when you have a set of instruments by means of which you can measure voltage, current, resistance, etc. For best results it is desirable to have these incorporated on the panel, so that by pressing a button readings may be taken. Miniature instruments for panel mounting having 2in. diameter dials are now available at 6s. 6d. each (postage 4d.), nickel plated; they may be obtained to read 5, 6, 10, 12, 15, 25, in volts or amps. They are sold by J. J. Eastick and Sons, 118, Bunhill Row, London, E.C.

CHAKOPHONE UNIVERSAL TUNING UNIT

THE Eagle Engineering Company have improved their well-known Chakophone Tuning Coil, and under the name of the Chakophone Universal Aerial Tuning Unit it is complete with rotary magnetic reaction coil and wave-change switch. This new tuner takes the place of the old de luxe model, the manufacture of which has now been discontinued. It is built on a bakelite moulded former and a push-pull switch in the base is used for wave-changing. The switch is arranged so that several tuners can be ganged. A panel plate is included to indicate the increased volume and switching movements. The tuner can be used as an aerial tuning inductance and as aerial or anode coils in screen-grid circuits.



A vest pocket polarity indicator.

NEW LISSEN LINES

NEW Lissen lines produced this season are the triple Short-wave coil, which covers the useful short-wave range from 12 to 85 metres by means of a simple switch (no coil-changing), the astatic choke, which can be supported by the wiring or fixed down to the baseboard and occupies very little space, and the anti-break-through choke, specially designed for insertion in series with the aerial to eliminate "break-through" of medium-wave stations when receiving on the long waves. Lissen will also list many new valves, including the variable-mu S.G. 2v., the S.G. 215, which has a very high amplification factor and a low impedance.

FERRANTI PRODUCTS

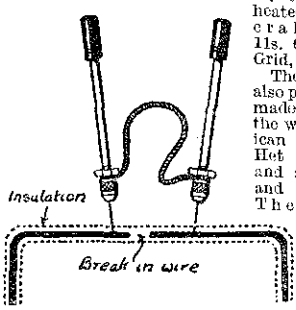
THE constructor on the look-out for a reliable measuring instrument would do well to obtain a copy of the latest catalogue of Ferranti Radio Meters, which contains a complete range of high-grade instruments suitable for either D.C. or A.C. measurements, for audio-frequency current, and instruments for use in radio-frequency circuits.

Other recent catalogues which we have received from this firm show a complete range of Ferranti components and one confined to mains components only, including anode feed resistances, chokes, mains transformers and safety boxes. Separate leaflets are also available dealing with moving coil speakers, including Ferranti Inductor Speaker, push-pull transformers, audio-frequency transformers, chokes and condensers, and the Ferranti seven valve mains consolette, a fine A.C. operated superhet set. Readers can obtain a copy of any of these lists from Messrs. Ferranti, Ltd., Hollinwood, Lancashire.

PIX VALVES

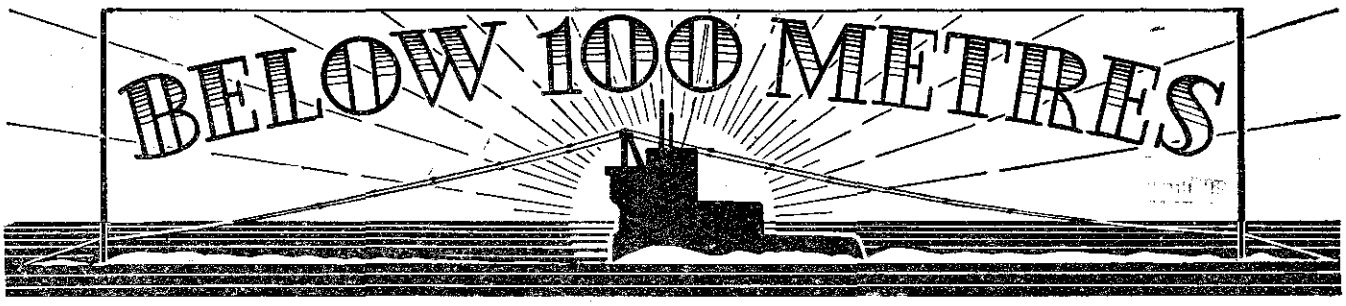
THE prices are: General purpose, 4s. 6d.; Power, 6s. 6d.; Super-Power, 8s. 6d.; Screened Grid, 11s. 6d.; 2 and 4 volt range Full Wave Rectifier, 8s. 6d.; indirectly-heated types—General purpose, 11s. 6d.; Screened Grid, 15s. 6d.

The company is also producing British-made versions of the well-known American Crossley Super Het Sets, with long and short waves, and British valves. The "Goodwood," a seven-valve model, sells at 20 guineas, and the five-valve "Ascot" Model, sells at 16 guineas.



Test prods for wireless constructors.

(Continued on page 116.)



SHORT WAVE RECEIVER DESIGN

By Mander Burnett

RADIO receivers for use on the short-wave bands below 100 metres require to have special attention paid to a number of points which do not usually occur in the ordinary broadcast receivers. The short-wave receiver does not differ from a normal wave receiver in fundamental principle and the general circuit design remains the same in most cases. Differences occur whereby we have to deal with such matters as body capacity troubles, tuning arrangements, etc., whereby we can overcome the extraordinary sharp tuning experienced in a short-wave receiver. If the receiver is to be used for reception which will be as consistent as possible, we shall have to strive for a generally higher level of volume, owing to the weakness of the average short-wave signal. We have to decide in the first place whether the receiver shall be used for headphone or loud-speaker operation. Even in short-wave work it is nowadays customary to use only a loud-speaker, and so we find that the general trend of short-wave receiver design is to use a larger number of valves, four or five being used in the most useful types of receivers.

Metal Chassis

It is nowadays customary and practically essential to use a metal foundation for the short-wave receiver, if it is to have a reasonable degree of efficiency. This is necessary, not only to provide sufficient stability in the amplifying stages but to ensure that little or no body capacity shall be present. This trouble can exist in a short-wave receiver in various forms and generally makes itself known by the fact that if the hands are brought in close proximity to the tuning controls, the frequency to which the receiver is tuned will alter to some extent. This, of course, prevents tuning the receiver with any degree of accuracy and it can be overcome by careful circuit design and construction. Shielding alone will not necessarily cure it, and it is generally necessary to incorporate a number of high frequency filter and by-passing arrangements in the receiver itself before the trouble is completely cured. Aluminium is probably the most satisfactory metal to use for a screening material, and it can quite easily be shaped and drilled by the home constructor.

An Efficient Two-valve Circuit

In Fig. 1 we have the circuit of an average two-valve short-wave receiver of a type used by amateurs all over the world. It will give satisfactory headphone reception on a number of stations and inter-continental reception is easily accomplished. It consists, of course, of the usual detector valve followed by a single low frequency stage. A number of such stages can be added if required, whilst a carefully designed screened grid H.F. amplifier can also be added ahead of the detector. The inductances L^1, L^2 and L^3 may consist of any one of a number of types of short-wave coils designed to cover the required bands. If the receiver is to be used solely for short-wave reception, the three coils may well be wound on one former and built into the receiver as a permanent unit. If a commercial type of dual wave coil is used, the wavelength covered will generally be from about 15 to 80 metres. On the lower band, from about 15 to 35 metres, the coil L^2 is not used, being shorted out of the circuit by the switch S. Sufficient reaction to cover the whole band with one coil can be obtained if the coil L^3 is of the correct size and a compromise has to be struck whereby the coil will be of sufficient size for both wavebands. The tuning condenser C^5 will have a capacity of about .00025 mfds., and owing to the enormous range of frequencies to be covered, tuning, even with a condenser of this capacity, will be very sharp indeed and a high ratio vernier dial will be necessary for easy tuning.

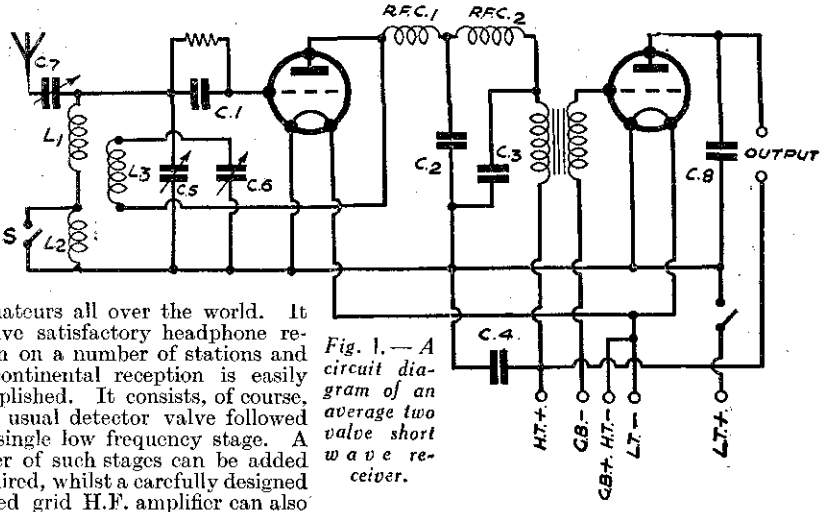


Fig. 1.—A circuit diagram of an average two valve short wave receiver.

The high frequency filter composed of the chokes RFC^1 and RFC^2 and condenser C^2 and C^3 is necessary in order to prevent high frequency currents passing into the low frequency amplifier. This filter may take various forms but it is essential that the condensers remain of small value, otherwise the low frequency response characteristics of the receiver will be considerably altered.

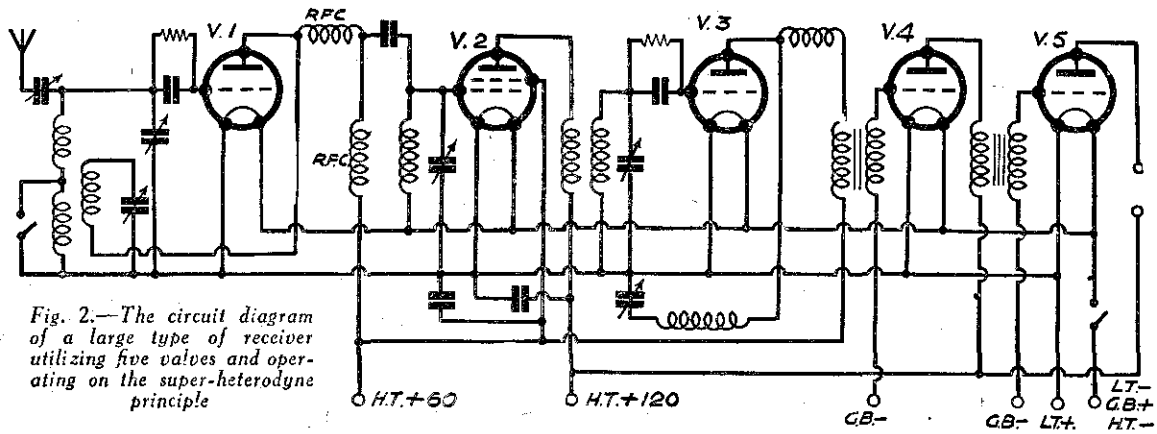


Fig. 2.—The circuit diagram of a large type of receiver utilizing five valves and operating on the super-heterodyne principle

A Five-valve Super-Het. Circuit

Finally, in Fig. 2 is given the circuit of a larger type of receiver utilizing five valves and operating on the super-heterodyne principle. This is without a doubt the most satisfactory type of receiver for short-wave work where powerful signals are required. By means of the super-heterodyne system (conversion of the

received frequency to a lower one before final rectification and amplification) we can use a very high degree of amplification without the use of powerful low frequency amplifiers. The first valve, V^1, is a combined detector and oscillator—a separate oscillator is not required when the difference between the received frequency and the local beat frequency is only a low percentage of the original frequency, thus—assume that we are receiving a signal with a frequency of 10,000 kilocycles (30 metres) and our intermediate frequency is 150 kilocycles, then our I.F. is only a very low percentage of the original frequency of 10,000 kilocycles. Tests have proved that a single valve is capable of dealing with both the original and the beat frequency quite efficiently with only one tuned circuit. Thus in our short-wave super-heterodyne we are able to get true single dial operation without the use of any complicated ganged circuits. This does not apply of course to normal broadcast receivers where the difference between the received and the intermediate frequency represents a high percentage of the original frequency. Two valves are necessary here for both operations.

Amplifier Stages.

The second valve, V^2, is the screened grid I.F. amplifier, and further stages may be added here before the second detector, if required. This super-heterodyne system of reception is generally made use of in the transatlantic telephone receivers and has proved very satisfactory.

The third valve, V^3, is the second detector, and signals are then again amplified by the low frequency amplifiers. This type of short-wave receiver has a further very big advantage over other types in that the tuning is very much more simple. Reaction is introduced at the intermediate frequency instead of at signal frequency, thus it is possible to have a reaction control which has practically no "reaction-tuning" effects, and it is also possible to set the I.F. detector just below the point of oscillation and tune in all the short-wave stations without hearing a single "chirp" or whistle. Thus critical control of reaction is not required.

Screened-Grid Amplification.

Finally we come to the type of short-wave receiver which makes use of one or more screened-grid amplifiers which amplify the original signal before rectification. Quite appreciable amplification can be obtained from a single screened-grid valve down to about 15 metres if the circuit is carefully designed, but, of course, each amplifying stage of this type generally means another reaction control as the task of ganging H.F. circuits in a short-wave receiver is not one to be tackled lightly. However, quite satisfactory results can be obtained from a receiver incorporating a S.G. high frequency stage, detector and L.F. amplifier, and the somewhat more simple type of construction of this type of receiver undoubtedly makes it an attractive proposition for the average user.

In the above remarks the writer has, of course, been using battery models as examples of short-wave receiver design. A. C. operation of a short-wave receiver is to-day quite an attractive proposition, and in the majority of cases no trouble will be experienced down to 20 metres if ample smoothing arrangements are incorporated; the superior characteristics of the modern A. C. valves resulting in a general overall increase of volume, compared with a battery model of the same type.

VOLTS AND VALVES

About a Little which Often Escapes Attention

IF you examine the chart or instruction sheet accompanying a valve you will find certain values of H.T. and grid bias are specified. Now these values are really important, and it is not only a question of plugging a valve into its socket and then adjusting the grid bias until signals are clear. When you want to get the best from a set, the correct valves should be chosen for each stage, and then the value of the H.T. which should be applied at the H.T. terminal should be ascertained. (Of course, if you are making up a receiver described in these pages, the correct potentials will be quoted.) It is too often overlooked that all resistances in the anode circuit of a valve reduce the potential which is eventually applied to the valve.

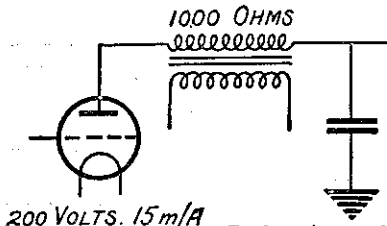


Fig. 1.—A typical anode circuit.

Ohm's Law

The elementary formula known as Ohm's Law tells us that a current passing through a resistance causes a voltage drop, and this formula is represented by the equation $I=\frac{E}{R}$, I being current in amps, E being voltage in volts, and R being resistance in ohms. Now from your valve, curves you will see that there is a certain anode current at a given H.T. and G.B. value, and if therefore you wish to apply the maximum H.T. to the valve, it is essential to ascertain the voltage drop through all the components in the anode circuit, and then *add* this figure to that required at the anode.

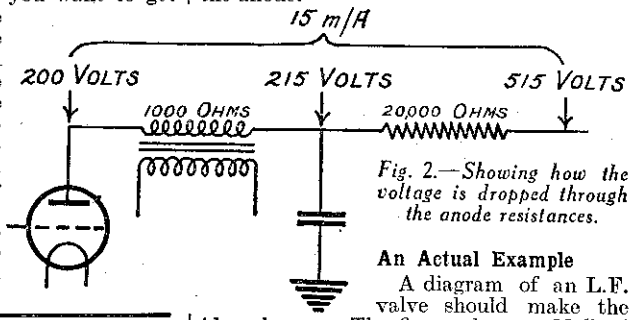


Fig. 2.—Showing how the voltage is dropped through the anode resistances.

An Actual Example

A diagram of an L.F. valve should make the idea clearer. The figure shows a Mullard 254 valve with a transformer and a decoupling resistance in the anode lead. The valve makers give the maximum voltage as 200 volts, at which figure (when correctly biased) the anode current is 15 m.a. We will assume the transformer primary has a D.C. resistance of 1,000 ohms, and the decoupling resistance a value of 20,000 ohms. There is therefore a current (at correct maximum voltage) of 15 m.a. traversing a total resistance of 21,000 ohms, which, by the above formula, we find will give a drop of 315 volts. Therefore, to enable 200 volts to be applied at the anode a source of 200+315, or 515 volts would be required.

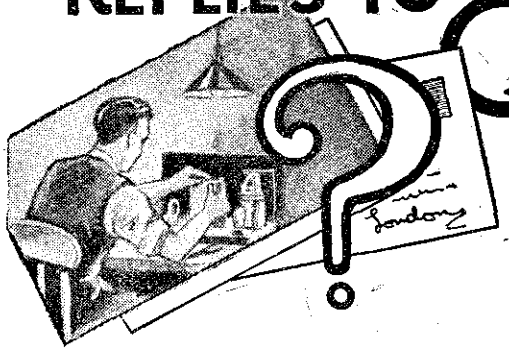
This is made up as shown in Fig. 2, and this fact must be borne in mind when working out the values of decouplers or grid bias. Remember, the grid bias must be decided by the voltage on the actual anode, *not* at the H.T. positive tapping.

Care and Upkeep

(*Continued from page 75.*)

A Valve's Length of Service

The valves are the most important items in the set. The life of a battery valve is naturally governed by the number of hours of use, and it is generally taken that 1,000 hours represents one year of service, after which the valve begins to deteriorate, commencing very slowly at first until distortion becomes perceptible to the human ear, gradually getting worse. The limit to a valve's life can, therefore, be taken as approximately two years. It may still continue to be used, but only with decrease in amplification and an increase in running cost. Fig. 4 illustrates this deterioration.



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ATTACHING AN OUTSIDE AERIAL TO A PORTABLE

"I have a 3-valve Portable Receiver, which gives fairly good reception from the local stations, but is very poor on any others. There is no provision for connecting an outside aerial, but I am told that the set could be modified in some way so that an aerial could be used when greater volume was required on more distant stations. Will you please advise?"

The simplest way to connect an aerial would be to take it to one terminal of a .0001 mfd. pre-set condenser of which the other terminal was joined to the grid terminal of the first valve-holder. An earth connection would also be desirable, and should be made to L.T. negative. This method would certainly give increased volume, but it might not afford sufficient selectivity to enable the "local" to be eliminated. A better way is to wind two or three turns of 24's gauge double cotton-covered wire round the frame aerial, and connect the ends to aerial and earth respectively. The optimum position for the winding will be somewhere between the long and medium-wave aerial windings, but it can best be found by trial. A position should be obtained which will give a balance between maximum volume and maximum selectivity. In this case also stability will probably be improved by taking a lead from the "earth" end of the new winding to L.T. negative.

USING ELECTRIC SUPPLY MAINS AS AERIAL

"I notice that a number of commercial all-mains receivers can be used without an outside aerial, being specified as having a 'mains aerial' connection. I take it that this means that the supply mains can in some way be used as an aerial, and wonder if I could alter my home-made A.C. set to operate in a similar manner, because, living in a flat, I am unable to erect an aerial. Is the mains aerial as good as an outside one?"

The supply mains can be used as aerial with any receiver merely by connecting the aerial terminal to one mains-lead through a small fixed condenser. The condenser should have a capacity of from .0001 mfd. to .0005 mfd., and it is essential that it should be a really good one of no less than "400 volts D.C. working." You might be interested to know that Messrs. Dubilier make a special condenser with lamp plug fitting, and designed principally for use with battery sets. Generally speaking a mains aerial is less efficient than a normal outside one, although better than the average inside aerial. The efficiency depends principally upon the characteristics of individual mains supply leads.

FRAME AERIAL WINDINGS

"I am building a 4-valve portable receiver of my own design, but am at a loss to know how many turns are required on the frame aerial. Is there any simple method of determining the correct number of turns without using advanced mathematics?"

Yes, there is! It is sufficiently accurate for frames from about 1ft. to 3ft. square to allow a winding length of 240ft. of wire for long waves and 75ft. for medium waves. Tuned by a .0005 mfd. condenser, windings of these sizes will cover tuning ranges of from approximately 1,000 to 2,000 and 250 to 500 metres. In practice it is found best to arrange the windings in two parts, one of 75ft. and the other of 165ft. For long-wave reception both windings are connected in series, but for medium waves the larger winding is short circuited by means of a push-pull switch. The medium-wave winding should for preference consist of side-by-side turns, whilst the larger winding can be accommodated in three sections placed in convenient slots or notches. (See Fig. 1.)

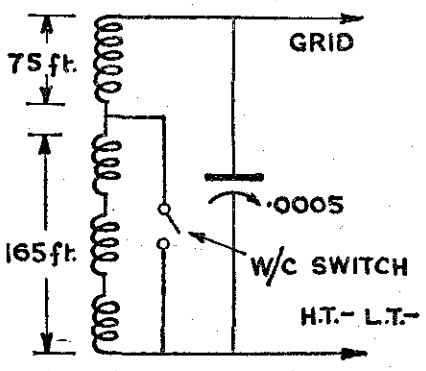

Fig. 1.—Diagram illustrating reply concerning frame aerial windings.

MICROPHONIC VALVES

"I have a 3-valve receiver, which has given very good service for the past two years, and recently decided to convert it into a cabinet radio gramophone, but immediately the speaker was put in the same cabinet as the set all music was drowned by a terrific yell. What is wrong, please?"

This is a fairly common source of trouble, and is due to the detector-valve being microphonic. That is, when subject to vibration, it causes a musical note to be emitted by the speaker (due to vibration of the electrodes). When the speaker is not very near to the valve all is well, for the note dies away immediately the vibration ceases. But when the speaker and valve are close together sound-waves return to the valve and cause still more vibration. This process goes on indefinitely until the sound reaches maximum intensity, after which the note remains at a loud and steady pitch. The most obvious cure is to fit a new valve, but this is not always essential, because it is sometimes possible to "damp-out" vibration by fitting the valve in a sprung valve-holder or by wrapping it in thick felt. During the past year or so manufacturers have paid great attention to this particular valve fault, with a result that very few present-day valves suffer from the defect. Even so, one does seldom come across a new valve which is microphonic, as did the writer only a few weeks ago. This particular valve was, however, immediately replaced on returning it to the makers.

PRACTICAL WIRELESS Data Sheet No. 2

COPPER WIRE DATA

Cut this out each week and paste it in a notebook

GAUGE (S.W.G.).	LENGTH PER OHM.	SAFE CURRENT CAPACITY
	YDS.	AMPS.
16	134.6	13
18	53.4	7
20	42.4	4
22	25.6	2.5
24	15.8	1.5
26	10.6	1.0
28	7.18	.7
30	5.03	.5
32	3.82	.4
34	2.77	.25
36	1.89	.15
38	1.18	.1
40	0.75	70 m/a

PICK-UP VOLUME CONTROL

"I recently bought a pick-up of well known make with the intention of using it on my 3-valve receiver, which is provided with pick-up terminals and a quarter megohm potentiometer volume control. When I attempted to use the pick-up, however, reproduction was very shrill, and constant high-pitched whistle could be heard above the music. Now the peculiar thing is that the pick-up worked perfectly well on my friend's set and his pick-up (of different make) gave fairly good results on my set. Can you kindly explain the reason for this apparently peculiar behaviour?"

The peculiarity is explained by the fact that your pick-up is of a low-resistance pattern, whilst your friend's is a high-resistance one. Generally speaking, a low-resistance pick-up must be used in conjunction with a volume control of low resistance, and *vice versa*. Now your volume control has a high resistance, and therefore probably matches the high-resistance pick-up. On the other hand, your friend's volume control is of lower resistance, and therefore suits the low-resistance pick-up. The remedy in your case lies with the substitution of a low-resistance volume control for the quarter megohm one at present fitted. The correct resistance will be found on the makers' instruction sheet, and will probably be in the region of 20,000 ohms. In most cases the exact value is not critical, but should not differ from the specified value by more than 100 per cent. or so. If the resistance is too high, reproduction will be "screechy," as you have discovered, but if too low, the higher musical frequencies will be lost.

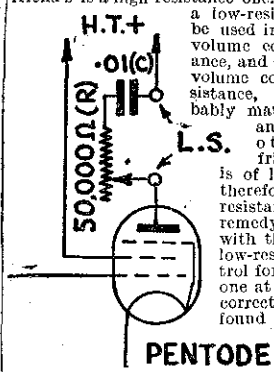

Fig. 2.—How tone is regulated by fitting a resistance and condenser across the loud-speaker terminals.

TONE CONTROL WITH PENTODE

"With the object of increasing the volume from my two-valve battery set I have just fitted a pentode in place of the three electrode power valve. Volume is certainly greater, but reproduction is higher pitched and less natural. Is this inevitable when a pentode is employed, or is there some simple cure?"

A pentode always does give emphasis to the higher frequencies, but it is not a difficult matter to regulate the tone by fitting a resistance and condenser across the loud-speaker terminals, as shown in Fig. 2 given herewith. The resistance (R) should have a value of about 50,000 ohms, and may be either fixed or variable. If variable the tone can be controlled as desired. The condenser (C) should be of about .01 mfd. capacity. When the speaker is fed through a transformer the tone control should be put across the primary winding of the transformer. If choke-capacity feed is employed the correct position is in parallel with the choke.

FITTING A VARIABLE MU VALVE

"I understand that a number of advantages are to be gained from the use of a variable mu valve, and contemplate the substitution of one in my S.G.-Det-Pen. battery set in place of the ordinary S.G. valve at present in use. I would be obliged if you could give me particulars of any alterations which would become necessary."

It is worth while to use a variable mu valve, especially when the receiver is used near to a powerful transmitter. The necessary alterations are of a simple character, but vary slightly with different receivers. Different methods are shown at (a) and (b) in the accompanying diagram (Fig. 3). At (a) a single-circuit aerial tuner is employed, and the grid of the S.G. valve has been connected to H.T.—, through the tuning coil. To make the circuit suitable for a V.M. valve a grid condenser and leak have been added. The condenser breaks the circuit between the grid and H.T.—, and the leak, being connected to a potentiometer in shunt with the grid bias battery, carries the variable

(Continued Overleaf)

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Queries and Enquiries—continued

grid bias. Notice to which side of the battery switch the positive grid bias lead is connected. If it were joined to the other switch terminal the battery would soon become exhausted, due to the potentiometer continuously drawing current from it. With the connections shown the potentiometer load is removed immediately on switching off the set.

At (b) a slightly different method is illustrated, this one being suitable where a band-pass tuner is employed. The by-pass resistance (R) which was previously taken to H.T.—, is now connected to the slider of a 50,000-ohm potentiometer, which is in parallel with the normal grid bias battery. Here again operation of the potentiometer allows a variable bias voltage to be applied to the grid of the V.M. valve. In this case it has been assumed that the connections of the G.B. battery shown at (a) were not convenient, and the usual two-pole battery switch has been replaced by one of the three-pole type which isolates G.B.+ from the potentiometer when in the "off" position. In each of the examples given use is made of the same grid bias battery as is used for the L.F. valves.

REDUCING VOLTAGE OF TRANSFORMER WINDING

"Could you please tell me if there is any way of reducing the A.C. voltage given by the secondary winding of a mains transformer? I ask this question because I have bought (very cheaply) an old type of mains transformer which is designed to give, in addition to 250 volts H.T., 6 volts at 1 amp and 7.5 volts at 3 amps. I wish to use this in a four-valve A.C. receiver which requires a heater voltage of 4, at 3 amps, and one of 6, at 1 amp. If I could alter the 7.5 volt winding, therefore, the transformer would suit my purpose very well."

The suggested alteration can be made fairly easily, although it might entail dismantling the whole instrument. The method is as follows: Remove the 7.5 volt winding, carefully counting the number of turns. By dividing this number by 7.5 you can find the number of turns per volt (this will probably be from 6 to 8). A new winding must now be put on consisting of four times as many turns as were allowed per volt.

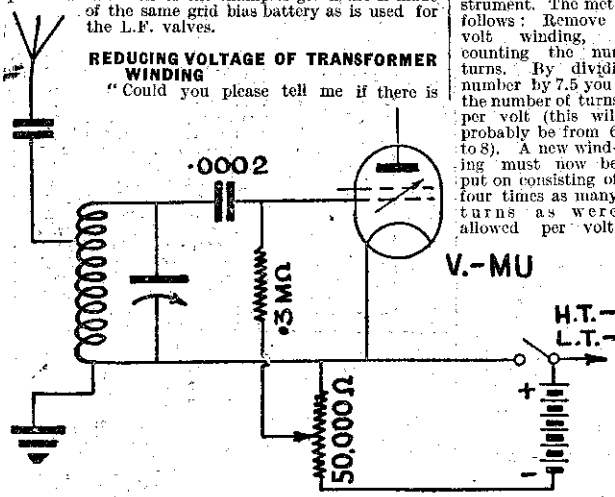

Fig. 3A.—The substitution of a variable mu valve in a single circuit aerial tuner.

The same wire will do as was previously removed since the current in each case is the same. Had the 7.5 volt winding been designed for a lower current, though, a different gauge of wire would have been necessary. For 3 amps, 20's gauge is suitable, and either enamelled or double cotton-covered wire could be used.

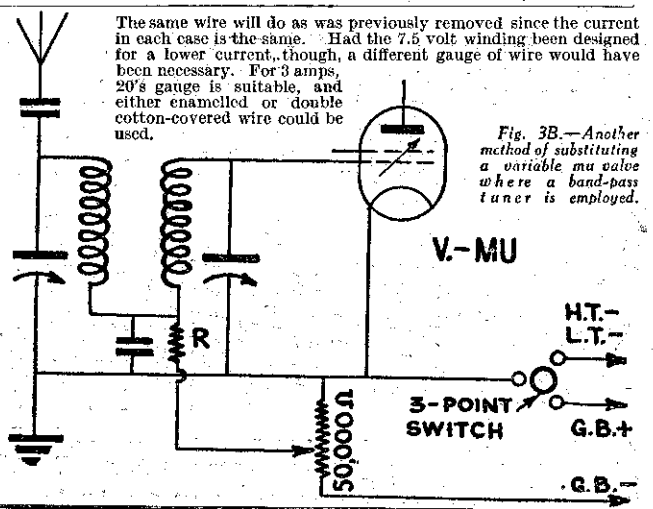

Fig. 3B.—Another method of substituting a variable mu valve where a band-pass tuner is employed.

CATALOGUES RECEIVED

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"MOTOR" SPEAKERS

The popularity of the permanent magnet moving coil speaker is largely due to the marked advance made in these instruments during the last two or three years, as a result of patient research work and careful testing. The excellence of design and performance of some of the modern instruments leaves their predecessors of two or three years ago far behind, and the fine range of "Motor" permanent magnet moving coil speakers by Tekade Radio and Electric, Ltd., are no exception. Several types are shown in a neat folder issued by this firm, including the "Motor Minor," a sturdy little speaker with cobalt magnet and cast aluminium chassis selling at 39s. 6d. A balanced armature type of unit and chassis is also listed, together with some well-designed cabinets with speakers, and ranging in price from 52s. 6d. to 60s. 6d. complete.

POLAR CONDENSERS

The development of single knob control in radio sets during recent years has resulted in a demand for gang condensers having a high degree of accuracy. The demand has been well met by a new range of "Polar Star Condensers," of the two, three and four gang type. These condensers are precision instruments, and are capable of working to very fine limits, the vanes being of aluminium, and the rotors and stators machine assembled. Full particulars of these condensers, and various other Polar components, including slow motion disc and drum drives, variable condensers for panel mounting, short wave condensers and L.T. and H.T. accumulators, are given in a booklet just issued by Wingrove and Rogers Ltd., Polar Works, Old Swan, Liverpool.

HARLIE PRODUCTS

An interesting little booklet entitled: "Discovery" has been received from Messrs. Harlie Ltd., Cambridge Arterial Road, Enfield, Middlesex. Among the items mentioned in this book are microphones, pick-ups, switches, motors, tone controls, etc. In addition, very interesting technical details are given at the end of the book, explaining how to connect up pick-ups, volume control at pick-ups, switching from radio to gramophone, etc. The tone selector is the latest device to be marketed by this firm. This is a small device to connect across the terminals of a loud-speaker, and it is provided with a knob giving variations of tone from low to high. It may also be used in conjunction with a pick-up to eliminate scratch.

LEWCOS.

The London Electric Wire Co. and Smiths Ltd., at Church Road, Leyton, E.10, are well known as manufacturers of all gauges of instrument wire. In addition, however, such items as Spaghetti Resistances, all types of tuning coils, and transformers are also manufactured. The catalogue issued by the above firm gives details of these, as well as of the latest sets of coils for the super-heterodyne circuits.

HOME RECORDING

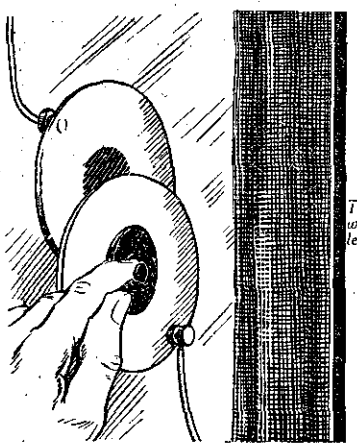
There is a great deal of interest to be obtained in making your own records. To amuse friends at a party, to send a spoken message to friends in distant parts, and many other uses can be found for records made at home. The "Fay" Home Recorders are complete radio-gramophones, containing an electrical recording outfit. Details may be obtained from 121 Victoria Street, S.W.1

A CHAT ABOUT—

(Concluded from page 109)

WEARITE EARTH TUBE AND LEAD-IN

THE earth tube manufactured by Messrs. Wright and Weaire is now well known, and there is no need here to mention its novelties, such as the easy and ingenious scheme which permits of the soldering of the earth lead without the use of a soldering iron. The latest novelty from this firm, however, is the lead-in device. This consists of two discs of aluminium, covered with a cellulose-coloured coating, one disc being red and the other blue. Each disc is provided with a termial of the Fahnstock type, and has a hole in the centre through which a rubber suction cup may be fixed. The two discs are intended to be used as the plates of a condenser, the dielectric being furnished by the glass of the window pane. The red



The Wearite window-pane lead-in device.

disc is stuck outside the window, and the lead-in attached to the clip on this disc, whilst the other disc is fixed inside the window, and a lead taken from this to the aerial terminal of the receiver. The device thus saves drilling a hole and at the same time serves as a series aerial condenser. The capacity may be varied by adjusting the relative positions of the two discs. The price of this neat device is only 1s.

AN INVISIBLE AERIAL

THE question of satisfactorily concealing an indoor aerial has been dealt with by the well-known firm of Pix. Flat strip aluminium foil, having a length of 30ft., is mounted on a length of adhesive tape, and a rubber-covered lead is attached to one end for connection. The tape is supplied in a roll, and it may readily be stuck to walls, stairways, etc. If only required temporarily, the aerial may be rerolled, leaving no holes or marks to be obliterated. This is, of course, a new idea in aerials, and should you unfortunately cut or otherwise damage your land whilst erecting the aerial, a length of the plaster may be removed and used in place of the usual sticking plaster. The price of this aerial is 2s., and it may be obtained from any radio dealer.

NEW COMPONENTS—LISSEN SHORT-WAVE COIL

THE key to the successful operation of a short-wave receiver or adaptor is undoubtedly an efficient coil, and bearing this in mind constructors will welcome the new Lissen Triple Range Short-Wave Coil, which covers the whole of the short-wave band and entirely eliminates the inconvenience of coil-changing. In the new component, which is very compact, the tuning and reaction windings are set rigidly in three sections on the grooved ribs of a well-finished bakelite former, and stray capacities are reduced to a minimum. The coil can be used in any type of circuit—in a straight detector circuit, in a superhet, or in an H.F. amplifying stage. The tuning range with a .0002 mfd. variable condenser, is 12 to 85 metres. The coil is priced at 4s. 6d.

The Wearite self-soldering earth tube.

PIX AT MANCHESTER EXHIBITION

THE British Pix Co. Ltd., on Stands 85 and 86, will be showing the famous Pix and Pix Clips, also the British Pix Valve, manufactured from British materials, which embodies all the latest improvements in design and construction, the Pix valve has a *triple-coated neodymium filament.*

Broadcast Query Corner

—THE LATEST COMPONENTS

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

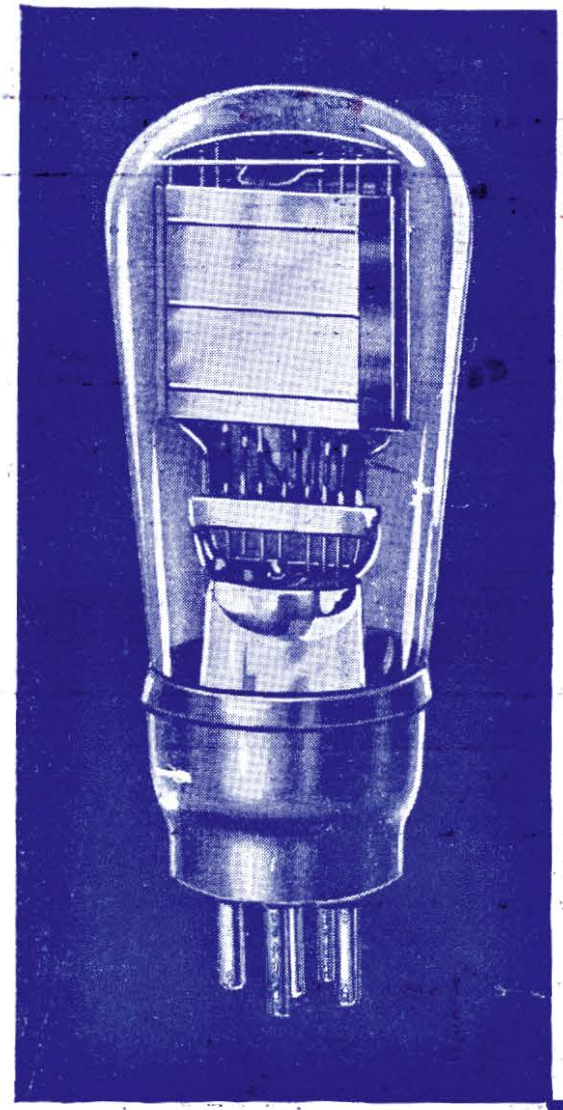
In order that a careful search may be made it is essential that certain data should be supplied to the best of the inquirer's ability and knowledge. When sending such queries to the Editor the following rules should be followed :—

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

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

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

ADVERTISEMENT INDEX



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.

THE HL2, an outstanding example of Mazda sensitivity, is an excellent cumulative grid detector. Amp. Factor: 31. Imped: 20,000 ohms.

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.

Mazda Valves are fitted by all leading receiver manufacturers. All good radio dealers stock them.

LOOK FOR "EDDY" IN YOUR DEALER'S WINDOW

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100% BRITISH—Designed by British Engineers

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Mazda Radio Valves are manufactured for The British Thomson-Houston Co. Ltd., London and Rugby.

V.168

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WHAT IS THE SONOTONE? (See Inside)

Practical Wireless

3D

Published every Wednesday by
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OCTOBER 8th, 1932
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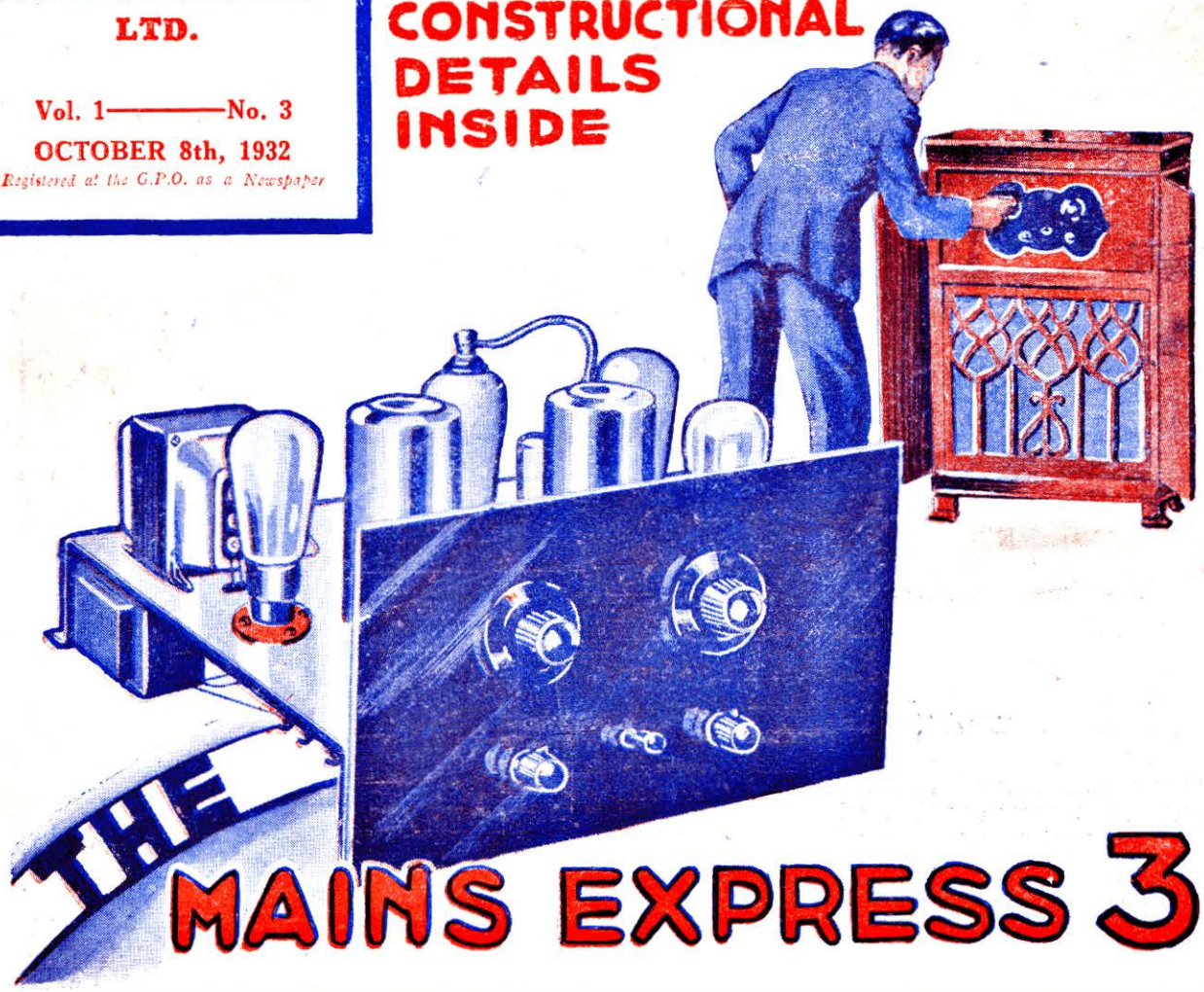
CONSTRUCTIONAL DETAILS INSIDE



THE MAINS EXPRESS 3

how to bring in more stations

fit COSSOR S.G. VALVES

FOR EVERY SET — *there's a*
PILOT AUTHOR KIT

EVERYTHING RADIO

CARRIAGE PAID TO YOUR DOOR.

THIS YEAR'S WINNER

"LISSEN SKYSCRAPER 3." Chassis model with (Lissen) S.G., Detector and Pentode valves. Cash Price £4/9/6. Carriage Paid. Balance in 11 monthly payments of 8/3. Send **8/3** only

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BLUE SPOT PERMANENT MAGNET MOVING COIL CHASSIS. Type 99 P.M. Including matched transformer. Cash price, £2/19/6. Balance in 11 monthly payments of 5/6. Send **5/6** only

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BLUE SPOT SPEAKER UNIT AND CHASSIS. TYPE 100U. Cash Price £1/12/6. Carriage Paid. Balance in 6 monthly payments of 5/2. Send **5/2** 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

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

"HOW TO BUILD 4 SHORT-WAVE SETS"

Edited and written by Mr. G. T. KELSEY the famous Short-Wave Expert, "Popular Wireless." The only book exclusively devoted to Short Waves. Describes 4 efficient sets with full working instructions and operating notes, 48 pages and 4-colour cover. Sold in thousands at Olympia. Obtainable from all Bookstalls and shops, W. H. Smith & Sons or direct.

1/-

IMMEDIATE DELIVERY—KITS OR PARTS

LONG RANGE EXPRESS 3

Described in "Practical Wireless" September 24th, 1932.

KIT "A" Complete PILOT AUTHOR KIT of specified parts with *Ready-drilled Panel and Chassis;* excluding valves and Cabinet

CASH or C.O.D. Carr. Paid. **£5-11-6**

or *12* monthly payments of *10/3.* Carr. Paid.

	£	s.	d.
1 Peto-Scott Cabinet in Oak ..	1	5	0
1 Celestion Soundex Moving Coil Loud-speaker	1	7	6
3 COSSOR Valves: (1) 220 V.S.G., (1) 210 H.F., (1) 230 P.T. ..	2	1	0

IMPORTANT *Any items supplied separately for "Practical Wireless" Sets. If value over 10/- sent C.O.D. Carriage Paid. We pay all post charges.*

DOLPHIN STRAIGHT THREE

Described in "Practical Wireless" September 24th, 1932.

KIT "A" Complete PILOT AUTHOR KIT of Specified Parts with *Ready-drilled Panel;* excluding valves and cabinet

CASH or C.O.D. Carr. Paid. **£3-7-6**

Or *12* monthly payments of *6/2.* Carr. Paid.

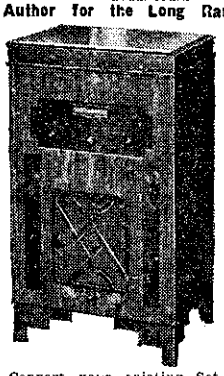
	£	s.	d.
3 Mullard Valves: P.M. 2 D.X., P.M. 1 L.F., P.M. 2.	1	2	9
1 Clarion "Dolphin Three" Cabinet, without chassis	0	19	9
1 "MOTOR" S.40 Super Power Unit with Cone Chassis	1	19	0

IMPORTANT *Part Kits, miscellaneous components or accessories are available under our own Easy Way H.P. System. Send us list of your wants. We will quote by return without any obligation.*

1933 WALNUT ADAPTAGRAM

Trade Mark

Specified by the Author for the Long Range Express 3.



Dimensions: Height, 38½in.; width, 21? in.; depth, 15½in.; panel size: 18 x 8in.; baseboard depth, 14in.; Speaker Compartment, 17 x 19½ in.; Clearance Between motor board and underside of lid, 4in. Ready fitted with back Baffle Board 3/6 extra if required.

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

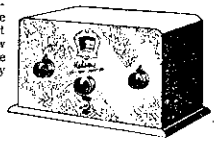
MODEL B with Garrard Double Spring Motor, 12" Turntable. Automatic Stop. B.T.H. Tone-Arm with Pick-up, and Volume Control complete. Automatic Needle Cup. Cash or C.O.D. or 12 monthly payments of 12/-. **6 GNS.**

MODEL C with Collaro Induction Electric Motor with Tone-Arm, Pick-up and Volume Control in one Unit. 12" Turntable. Automatic Stop. Automatic Needle Cup. (For A.C. Mains). Cash or C.O.D. or 12 monthly payments of 13/9. **7 GNS.**

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. "How to Hear the Short-Wave Stations," specially compiled by an expert.

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



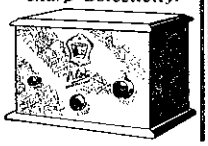
CASH or C.O.D.

45/- Or 9 monthly payments of 5/6

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.



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ADDRESS.....

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YOUR LAST CHANCE OF OBTAINING THE "WIRELESS CONSTRUCTOR'S ENCYCLOPÆDIA." See Below

ROUND THE WORLD OF WIRELESS

Instantaneous Success of "Practical Wireless"

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

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

Further Evidence

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

Half-guineas for Readers

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

The Wireless Constructor's Encyclopædia

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

NEXT WEEK!

FREE 1/- BLUEPRINT

of the

SONOTONE FOUR

The very latest four-valver for the home constructor.

Selective, Cheap, and a Station Getter!

Aluminium Chassis or Wooden Baseboard?

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

The One-hole Fixing

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

Criticisms of Programmes

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

Recording Plant for German Transmissions

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

Round the World of Wireless (continued)

Exchanged Wavelengths of Dutch Stations

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

New Austrian 100 kW. Station

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

Danish Exchange of Programmes

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

Picture Transmissions from Paris

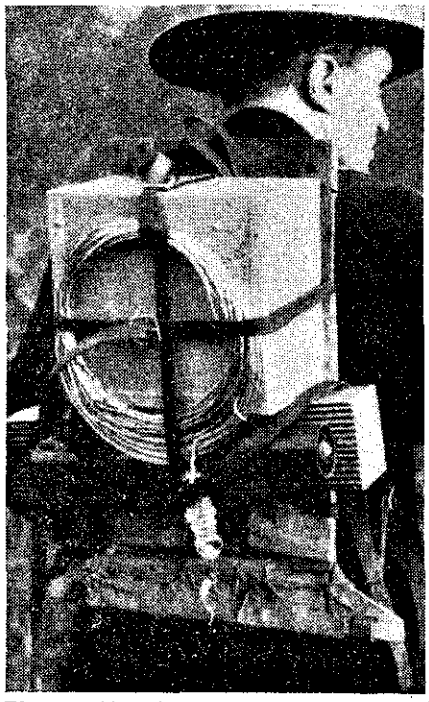
PICTURE transmission as distinct from television has not yet died out, although but little is mentioned in the Press of any striking new developments. On 1,190 metres, however, towards 10.0 p.m., the Bélin Laboratory at Rueil-Malmaison (Paris) occasionally transmits experimentally interesting pictures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

Radio Normandie Transmissions

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

INTERESTING & TOPICAL PARAGRAPHS

A REAL PORTABLE



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

Germany's New 5 kW. Station

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

SOLVE THIS!

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

SOLUTION TO PROBLEM No. 2

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

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

German Exchange of Broadcasts

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

Broadcasts in Hebrew and Arabic

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

Hungarian High-Power Station

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

New Belgian Station

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

League of Nations Broadcasts

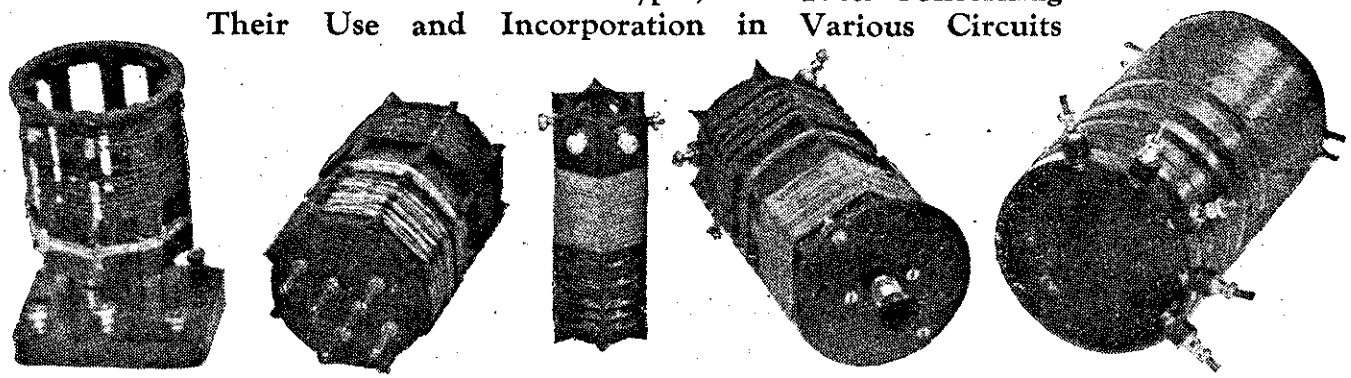
ON September 26 the League of Nations' short-wave station at Prangins (Switzerland) started its broadcasts of official news relating to the workings of its various commissions. The channels used are 20.74 metres and/or 403 metres. Transmissions are made in the French, English and Spanish languages.

Ecole Supérieure's Identification Fanfare

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

MAKING AND USING TUNING COILS

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



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

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

The First Essentials of Coil Design

By now I hope my readers have become sufficiently interested in this subject as to inquire how to set about the construction of a tuner. Before deciding upon such vital factors as the number of turns, gauge of wire required and so on, let us consider the primary requirements of tuners for different purposes. In designing a tuner for a simple non-S.G. receiver of the Det.-L.F. class the size of the complete unit is not of great consequence, but in a set having one or more screened-grid stages it is very desirable to keep each tuning unit to the smallest dimensions compatible with efficiency. The reason for keeping down dimensions is not merely to obtain compactness in the receiver, but to avoid interaction and feed-back between the various tuning circuits. As many readers are aware, the magnetic field created

By FRANK PRESTON, F.R.A.

by a coil can easily extend to six times the size of the coil itself. And it will be clear that when the "fields" of two coils overlap each other there will be a feed-back or reaction effect between the coils concerned. The reaction might not in all cases be harmful, but in many it will cause uncontrollable oscillation; at any rate, it will not be under direct control, and should therefore be avoided. Of course, we can prevent the magnetic field from "running wild" as it were, by enclosing the coil within a metal screening compartment, but even then the small coil has the advantage of enabling the receiver to be made more compact. It might be argued that a larger coil is more efficient, since it can be wound with heavier gauge wire having a low resistance. Whilst this is true of a coil to be used in, say, a crystal set where reaction cannot be applied it is not so in any other case. Let me explain further. The application of reaction (by which is meant legitimate reaction which is fully under control) gives to a coil a result equivalent to "negative resistance," and so when reaction is employed a comparatively high initial resistance is of little consequence. When a coil is screened its measured efficiency is reduced, but, as we have already seen, screening is often a practical essential. Even this factor does not cause us to experience any qualms, because the loss can again be restored by the use of reaction if necessary. This is not always necessary, however, because we do not generally want a coil which is "too" efficient, paradoxical as this may seem. One which is too efficient, if used in a highly efficient S.G. circuit, will provide too great an amplification, which will result in instability.

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

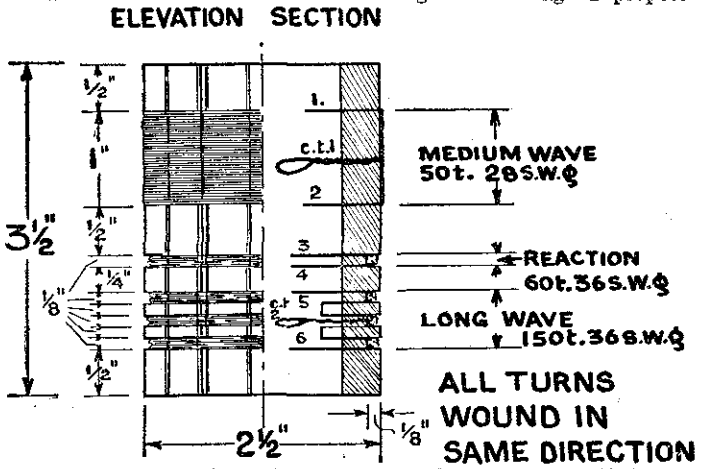


Fig. 1.—Constructional details of a tuner made on an eight-ribbed 2½in. diameter ebonite former.

A Tuner for Det.-L.F. Sets

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

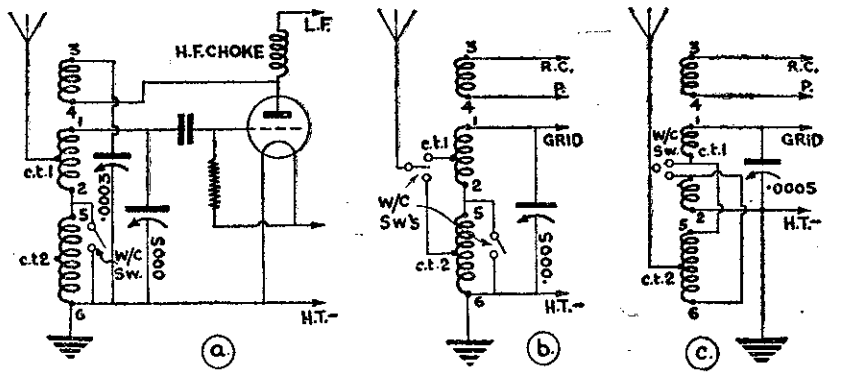


Fig. 2.—Three methods of connecting the tuner shown in Fig. 1 into a detector circuit.

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

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

Alternative Tuning Circuits

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

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

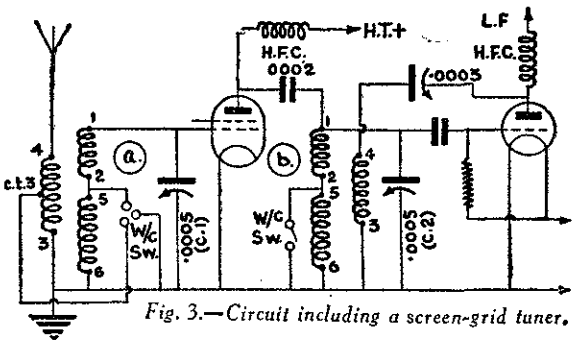


Fig. 3.—Circuit including a screen-grid tuner.

A Tuner for S.G. Receivers

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

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

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

Tuner Connections for S.G. Sets

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

Band-pass Circuits

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

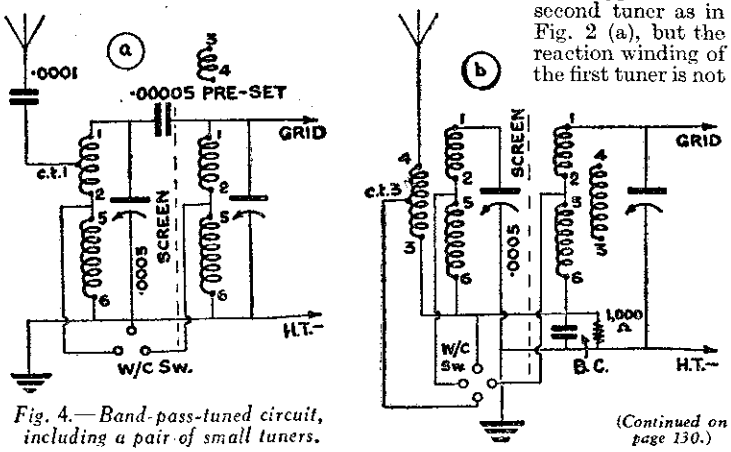


Fig. 4.—Band-pass-tuned circuit, including a pair of small tuners.

(Continued on page 130.)

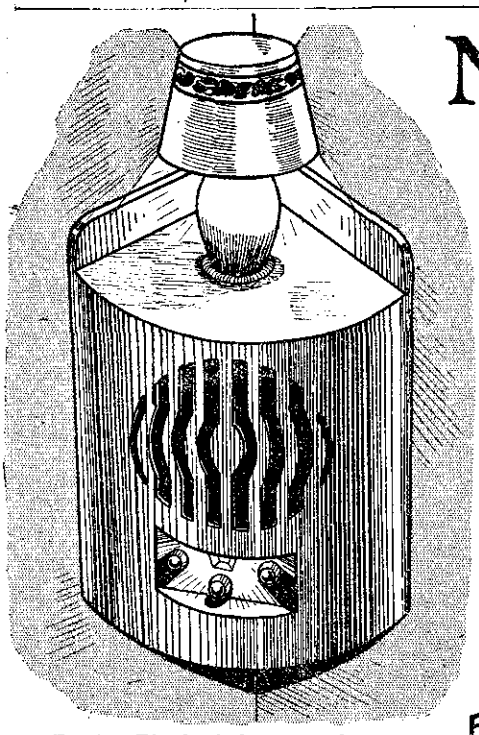


Fig. 1.—The finished corner cabinet.

NEW IDEAS IN CABINETS

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

By W. B. RICHARDSON

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

Simple Construction

Fig. 1 illustrates the finished cabinet. It is made up of a simple framework to which is nailed a thin plywood panel curved to form the round front, while the back is enclosed with two flat panels and doors. First of all build up the frame as in Fig. 2. The uprights are 1in. square and are nailed and glued to the quarter circles of wood which form the top and bottom. These latter should be about half an inch thick. A similar piece of wood to the top and bottom pieces, but with the corners cut away to fit the uprights, is fixed as a shelf for the batteries. Since the front is curved, it is necessary to fix up a small baffle board on which to mount the speaker. This is shown in Fig. 2, and a plan is given in Fig. 3. If the board is placed a little way back, sound waves from the back of the speaker as well as from the front will pass out through the fret. When the frame is complete you should cut out the front. This is made from a sheet of $\frac{1}{16}$in. plywood. If this is veneered with mahogany or some nicely marked wood the appearance is much enhanced. Veneered plywood is quite inexpensive. Now cut out a suitable design, such as the one shown, for the speaker fret, and another opening for the panel. This work is best done with a fret machine, but if the design is simple, a key-hole saw can be used. To fix the front, it is simply bent to conform to the curved frame and nailed on. The heads of the nails should be punched in slightly and the holes filled with stopping. Before adding the back fit the loud-speaker in position. The construction of the back and doors will be apparent from Fig. 6. The two holes in the doors allow you to reach the catches which are fixed on the inside so as not to stick into the wall. The set, composed of the usual panel and baseboard, slides in position with the panel opposite the opening in the front. If the baseboard is cut to the shape shown in Fig. 4 more room will be available for the components, and it will slide in or out easily between the uprights of the frame.

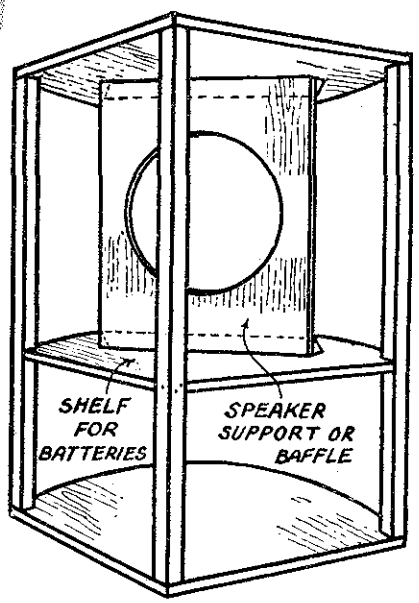


Fig. 2.—The main framework of the corner cabinet.

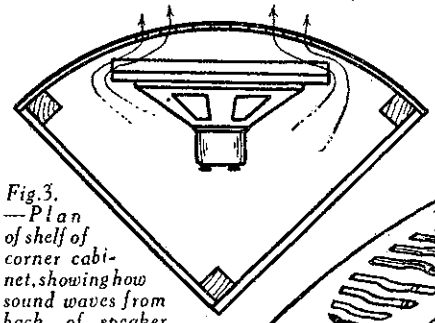


Fig. 3.—Plan of shelf of corner cabinet, showing how sound waves from back of speaker pass round the baffle.

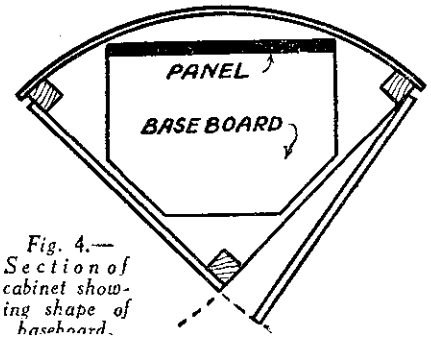


Fig. 4.—Section of cabinet showing shape of baseboard.

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

Another Wall Cabinet

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

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

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

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

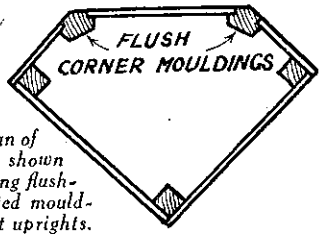


Fig. 9.—Plan of the cabinet shown in Fig. 8, using flush-fitting rebated mouldings for front uprights.

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

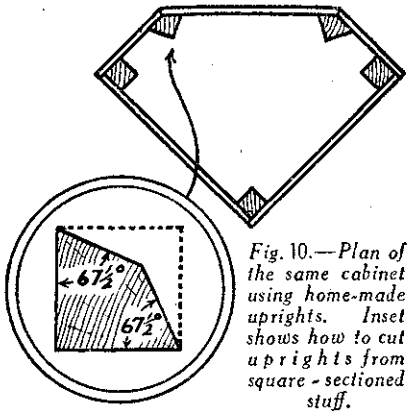


Fig. 10.—Plan of the same cabinet using home-made uprights. Inset shows how to cut uprights from square-sectioned stuff.

this if you wish to do the final polishing yourself.

A Distinguished Radio-gram Cabinet

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

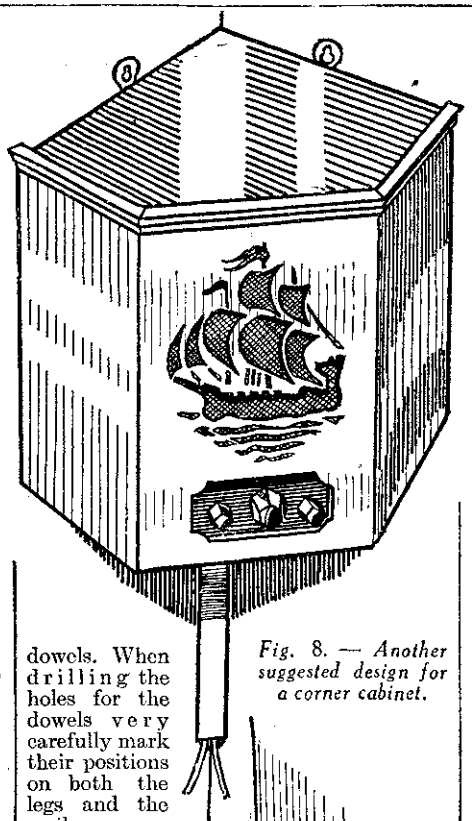


Fig. 8. — Another suggested design for a corner cabinet.

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

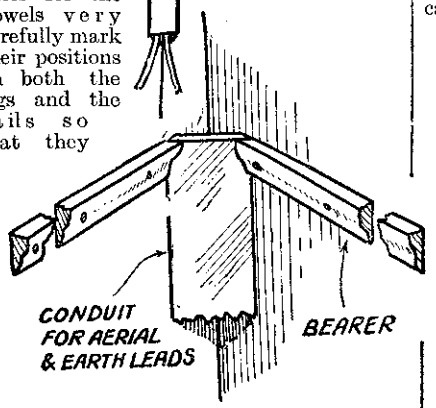


Fig. 7.—Wall bearers support the base of the cabinet—and aerial and earth leads are concealed by a wooden strip in the corner.

Housing the Gramophone

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

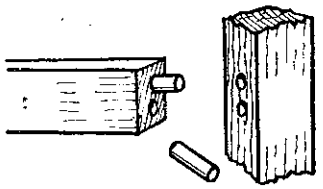


Fig. 15.—The framing rails are fixed to the legs with dowels.

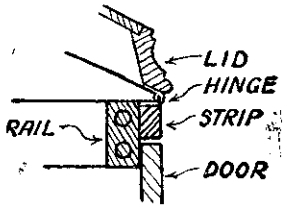


Fig. 16.—How the lid is hinged.

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

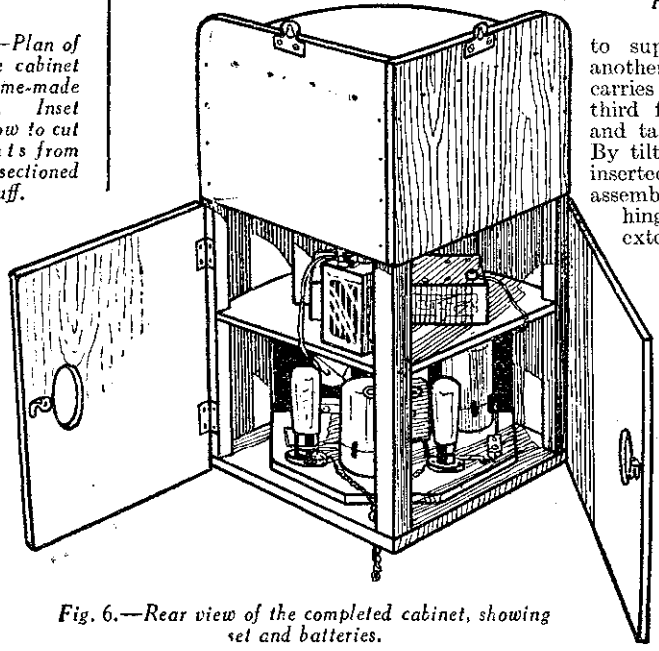


Fig. 6.—Rear view of the completed cabinet, showing set and batteries.

FIXING THE OUTDOOR AERIAL

Some Practical Advice About an Important Link in Wireless Reception

By W. H. DELLER

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

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

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

Points About Mast Erection

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

Supporting Aerial at House End

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

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

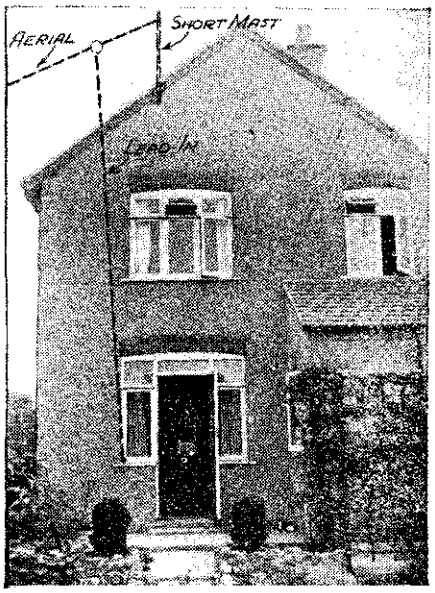


Fig. 2.—Using a short mast for anchoring the house end of aerial.

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

Alternative Methods

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

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

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

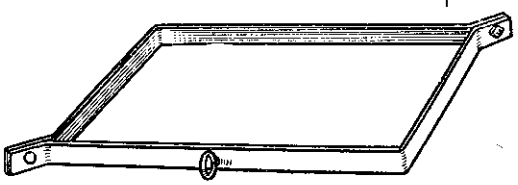


Fig. 7.—Clip for attaching a pulley direct to a chimney.

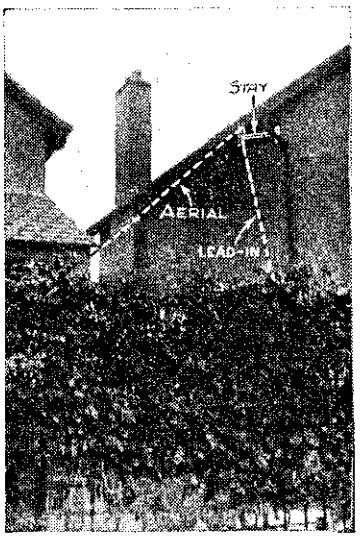


Fig. 3.—A stay can be used for keeping the lead-in away from the house wall.

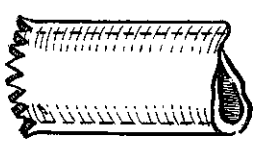


Fig. 9.—The cutting end of a wall drill.

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

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

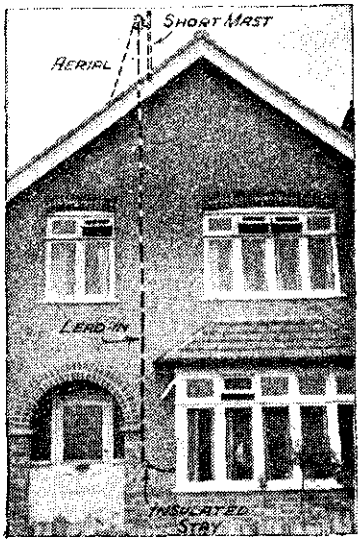


Fig. 5.—A short mast can be used where the aerial is taken over the top of roof.

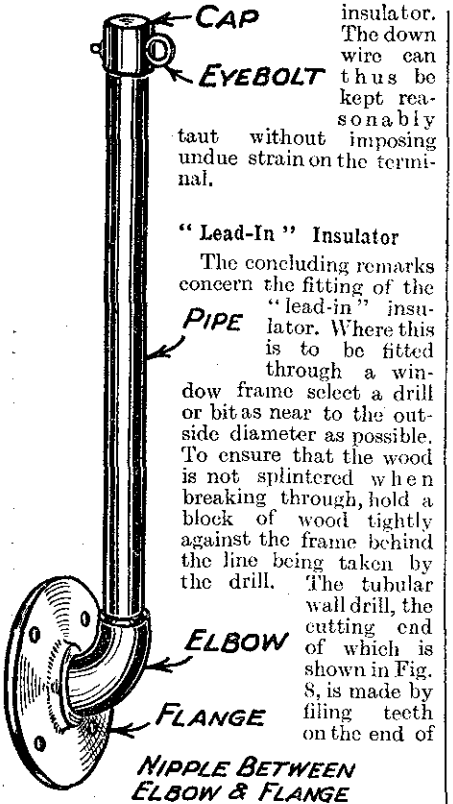


Fig. 8.—Showing metal fittings for making a short mast.

"Lead-In" Insulator

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

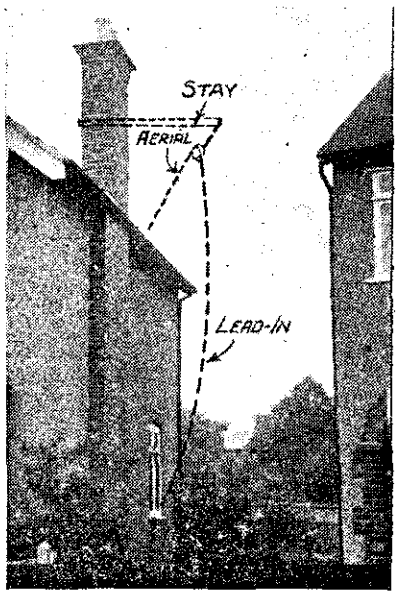


Fig. 4.—Supporting the aerial from a short stay fixed to a chimney.

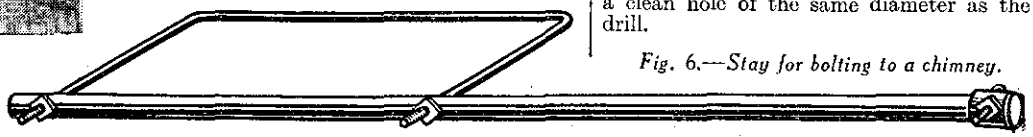
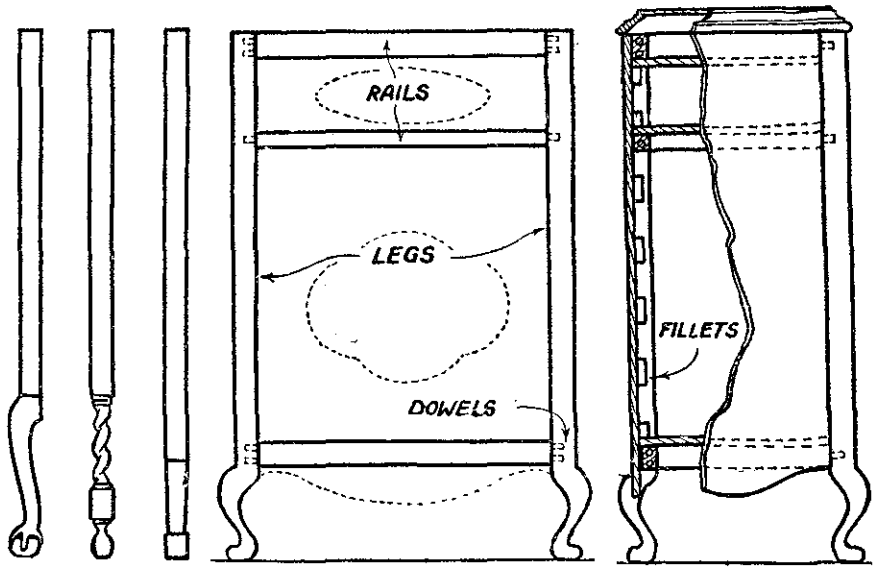
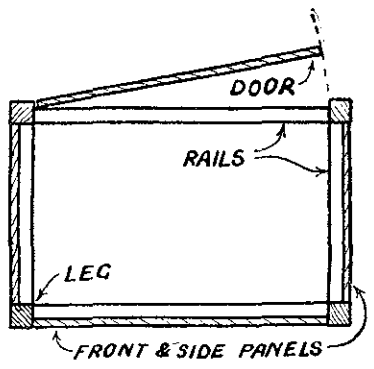


Fig. 6.—Stay for bolting to a chimney.

SOME NEW IDEAS IN CABINETS

For Explanatory Text see Pages 125 and 126





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

IN QUEST OF QUALITY

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

By W. J. DELANEY

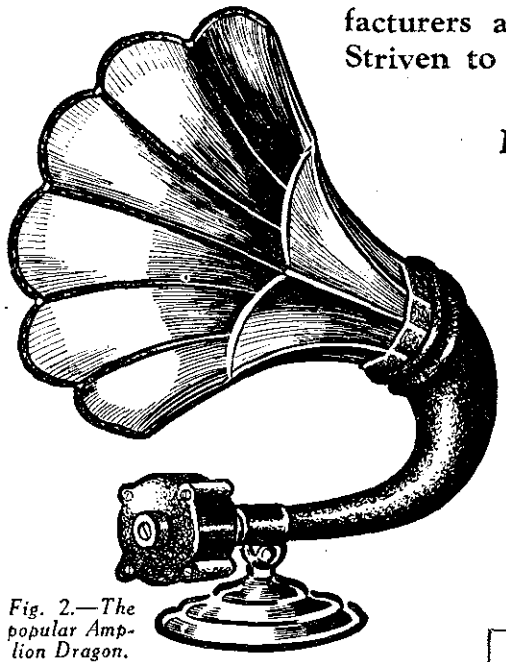


Fig. 2.—The popular Amplion Dragon.

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

At the Talkies

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

Loud-speakers

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

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

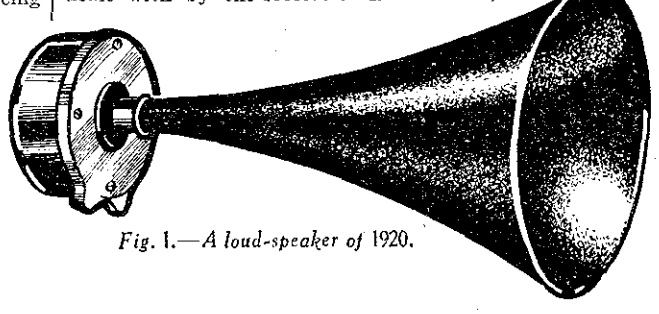


Fig. 1.—A loud-speaker of 1920.

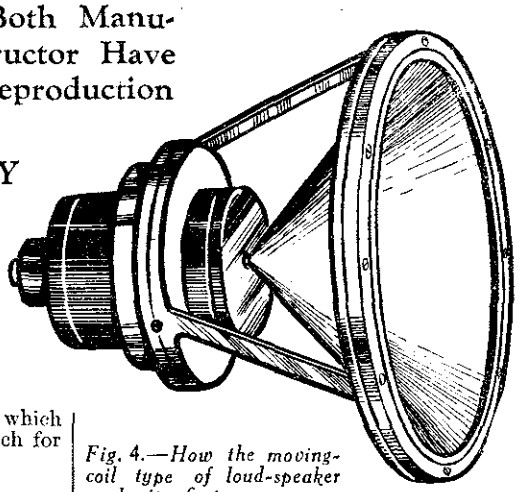


Fig. 4.—How the moving-coil type of loud-speaker made its first appearance.

Cone Units

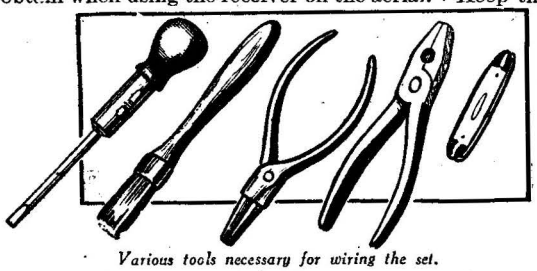
Broadcasting steadily improved, and as the speakers could now put up such a good show the components in the receiver began to improve. With an improvement also in valves the horn type of loud-speaker began to show up its deficiencies, and so once again the designers got to work. The horn was considered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

(Continued on page 164.)

How to Wire Your Set

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

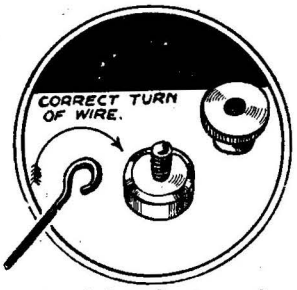
NEATNESS in laying out and wiring up your receiving set will reflect itself in the results you ultimately obtain when using the receiver on the aerial.



Various tools necessary for wiring the set.

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

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



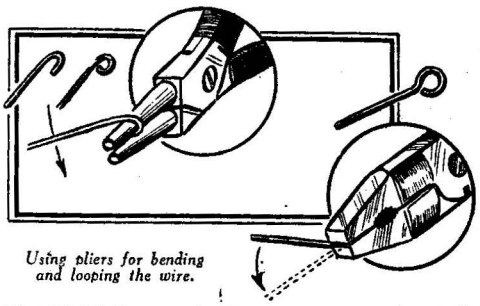
Bend the wire in a clockwise direction, as shown, and the terminal nut will then grip the wire tighter round the thread.

How to Commence

Begin on the left-hand side of the baseboard (facing panel) and, treating this as the aerial side, work across to the right and, where possible, arrange similar components in line, for the wiring can then be made parallel to the baseboard edges, and this always looks neat. Provided you keep one or two simple rules uppermost in your mind, you cannot go wrong.

(1) All "grid" connections should be as short as possible. (2) When you have two tuned circuits in your set, separate as widely as possible and place the coils at right-angles (this assumes an absence of screens). (3) Keep the filament wiring distinct from the H.T. wiring. (4) Take advantage of any earth points on your set in order to save long leads, *i.e.*, do not join every "earth" wire to the earth terminal, but to the nearest point on the one wire which ultimately passes to the earth terminal. (5) Keep H.F. wiring well away from L.F. wiring.

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



Using pliers for bending and looping the wire.

The Right Gauge of Wire

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

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

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

Keep the Wire Insulated

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

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

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

MAKING AND USING TUNING COILS

(Continued from page 124.)

used at all. A three-point W/C switch acts on both tuners. Tuning may be accomplished by means of two separate .0005 mfd. condensers or by a two-gang condenser; the former method is safer, because this circuit does not always tune too accurately.

Fig. 4 (b) shows a band-pass circuit consisting of a pair of the smaller tuners. The arrangement is suitable for either S.G. or non-S.G. receivers; the reaction coil in the second tuner will only be used in sets of the latter type. The band-pass coupling condenser B.C. should be a non-inductive one of .05 mfd. Here again a screening plate should be fitted between the two tuners. This circuit gives very accurate tuning, and it is quite safe to employ a ganged condenser for tuning simultaneously the two circuits. When used in an S.G. receiver, this band-pass arrangement might well be followed by a tuned-grid coupling as in Fig. 3 (b). In that case tuning could be controlled by a three-gang condenser.

Other Circuits

It is not possible here to give particulars of every circuit for which the tuners described may be used, but the circuits that have been suggested will give sufficient information to enable any experimenter to adapt them to almost any circuit in current practice. As a guide to those constructors who wish to employ formers of other diameters than those dealt with, the following table is given.

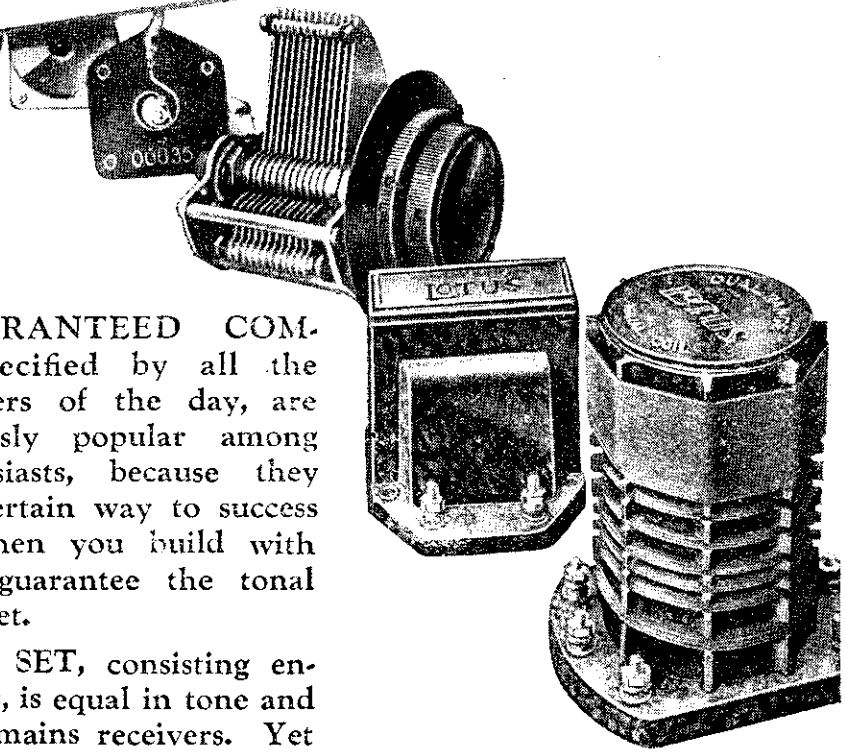
Diameter of former	Medium-Wave Winding		Long-Wave Winding	Reaction
	Gauge of enamelled wire	Number of turns	Number of turns 36's gauge enamelled wire	36's gauge enamelled wire
3 in.	28	40	130	45
2½ "	28	50	150	60
2 "	30	58	174	75
1½ "	36	80	220	84
1¼ "	36	86	240	90

NO GUESSWORK

WITH

LOTUS

COMPONENTS



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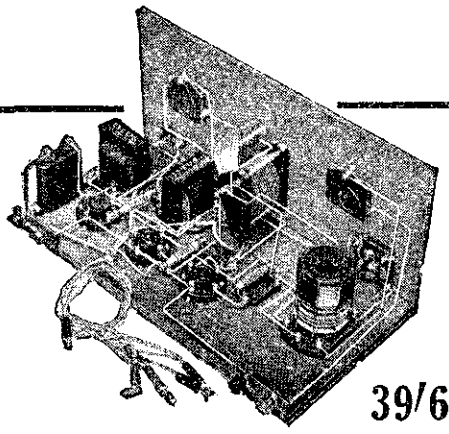

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LANDMARK THREE KIT SET

THE HEART OF YOUR SET

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

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

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

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

Why "Valve"?

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

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

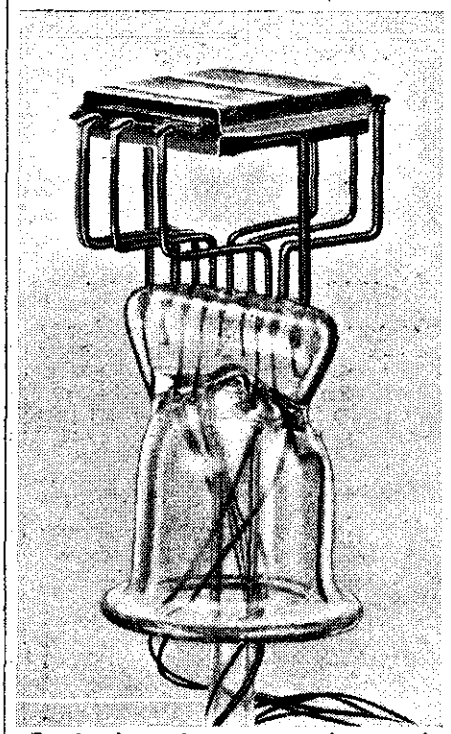


Fig. 1.—Internal construction of a typical battery-heated three-electrode valve.

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

The Construction of a Valve

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

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

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

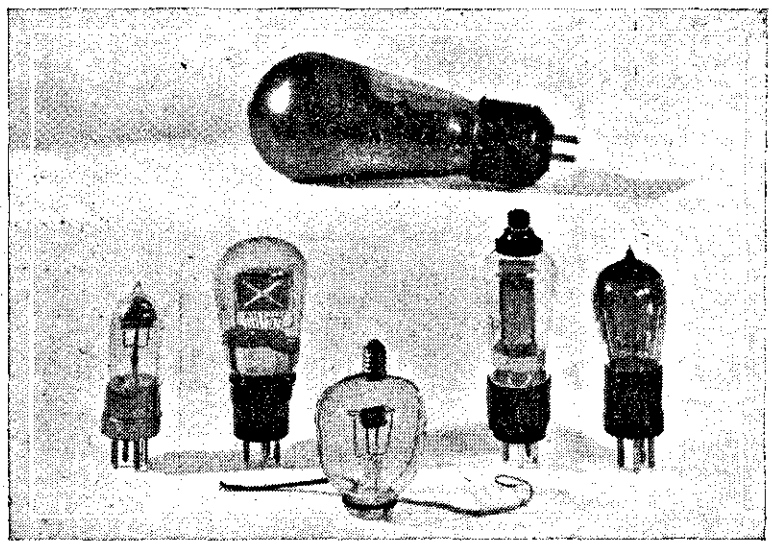


Fig. 2.—A group of Cossor valves indicating various stages in development. Top: Super-power valve of 60-Watt dissipation. Bottom row (left to right): (1) 1921—.6 power valve, Stentor class. (2)—Modern pentode. (3)—1916 valve of peculiar construction. (4)—Modern mains S.G. valve (5) 1923—.3 amp. kalenised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

How a Valve Operates

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

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

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

The Action of the Grid

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

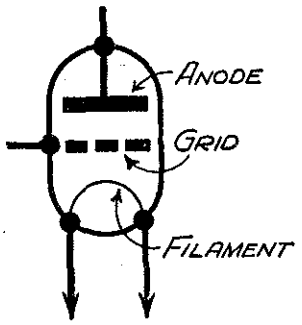


Fig. 3.—Conventional diagram of a three-electrode valve, indicating the essential parts.

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

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

CONTROLLING TONE

By HAROLD DOWNING.

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

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

The "Mellow 'Cello" Tone

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

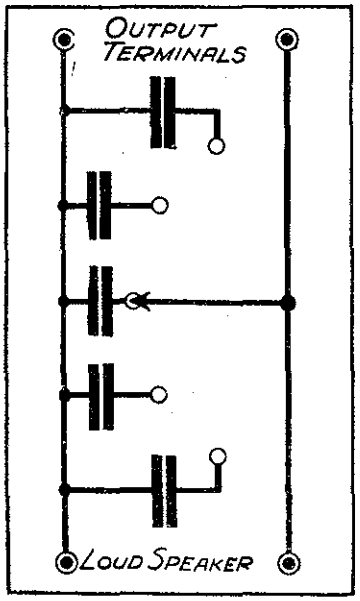


Fig. 1.—How to arrange a number of fixed condensers across the output terminals to vary the tone.

Getting Rid of High Notes

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

The Multitone Transformer

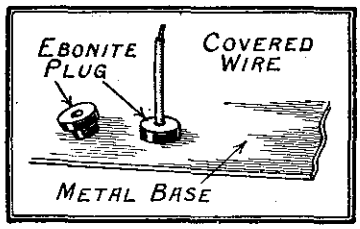
The problem of tone control has been tackled by one firm in quite an efficient manner, and the result has been the production of a special low-frequency transformer known as the Multitone Transformer. This is provided, apart from the four usual terminals, with two additional terminals across which a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

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

Metal Baseboards

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



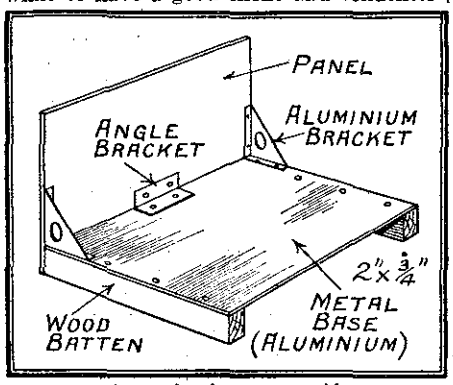
Ebonite plugs for protecting leads where they pass through the chassis.

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

H.F. Choke Losses

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

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



A simple chassis assembly.

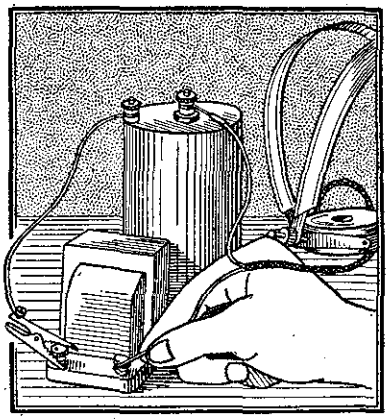
THAT DODGE OF YOURS!

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

Circuit Testing With 'Phones

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

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



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

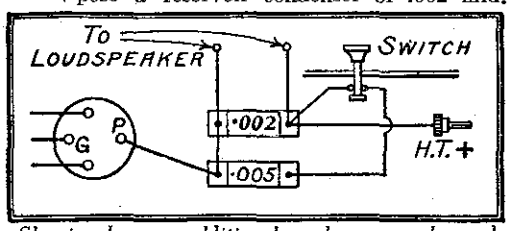
A fault in a coil holder, for instance, such as a break between the terminal and the plug or socket to which it is connected, may now easily be detected, since if one flex lead is connected to the terminal and the other to the side of the holder to which the terminal should make connection, absence of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

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

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

Tone at the Output

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

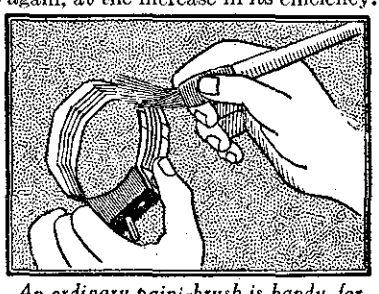


Showing how an additional condenser can be used for smoothing purposes.

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

Keep Your Set in Good Condition

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



An ordinary paint-brush is handy for dusting coils.

An Interesting Article Which Tells You All About—

COUPLING AND DECOUPLING

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

By PERCY RAY

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

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

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

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

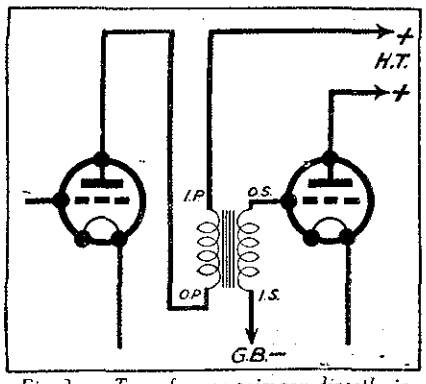


Fig. 2a.—Transformer primary directly in anode circuit.

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

Resistance Capacity

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

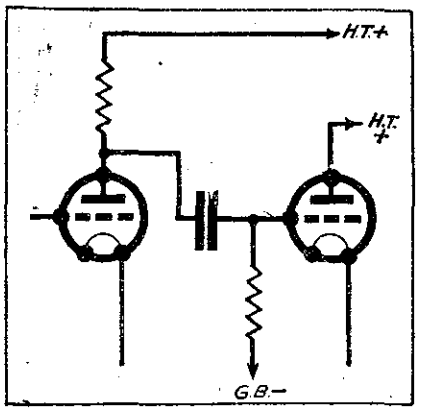


Fig. 1.—R.C.C. coupling.

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

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

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

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

TABLE No. 1

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

VALUES CORRECT TO NEAREST VALUES LISTED BY MAKERS.

Transformer Coupling

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

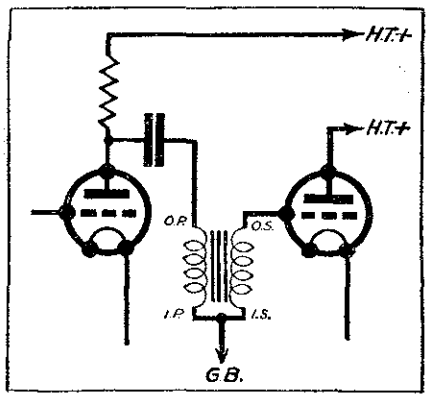


Fig. 2b.—Parallel-fed transformer. With this arrangement no battery current passes through the primary.

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

(*Continued on page 139.*)

TABLE No. 2

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

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

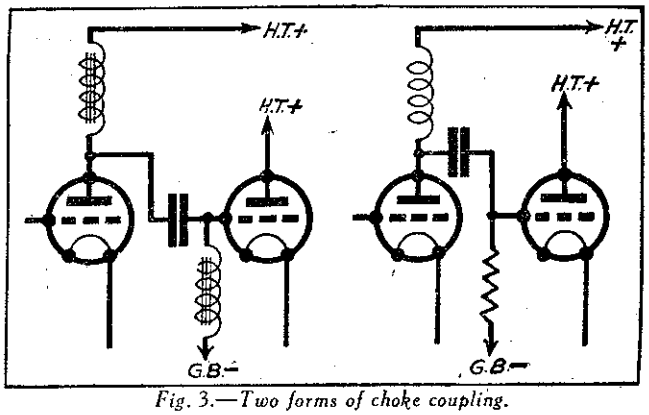


Fig. 3.—Two forms of choke coupling.

(*Continued from page 136.*)

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

Choke Coupling

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

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

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

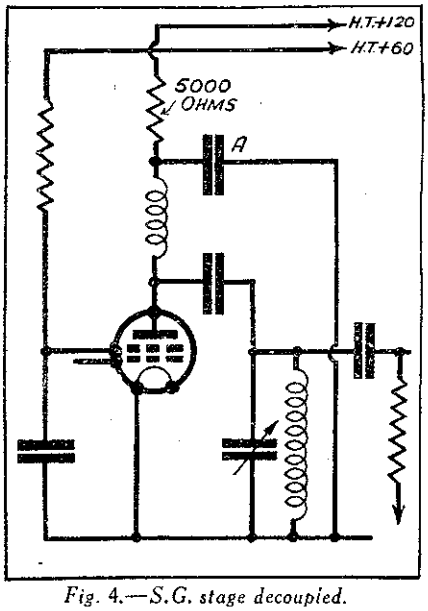


Fig. 4.—S.G. stage decoupled.

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

Decoupling

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

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

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

(*Continued on page 162.*)

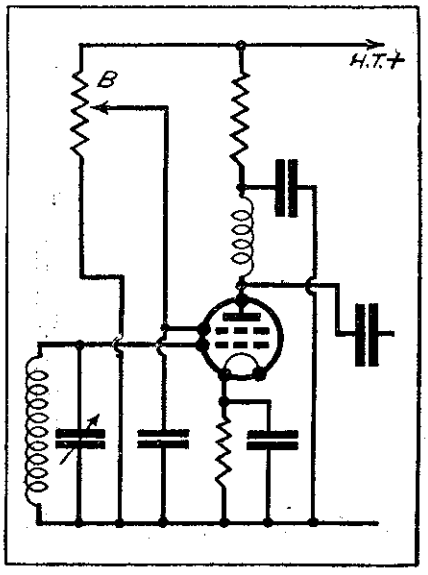


Fig. 5.—With the usual arrangement of a mains set the potentiometer acts as a decoupler.

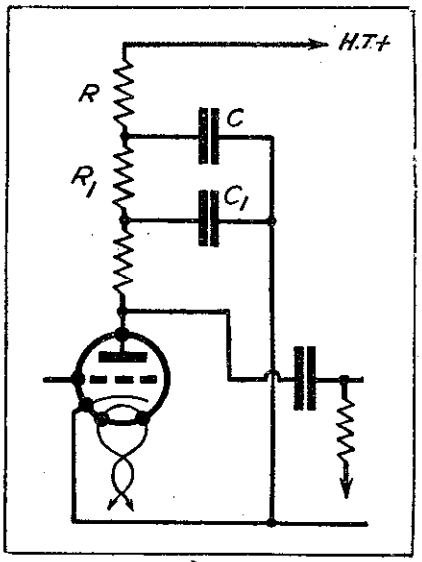
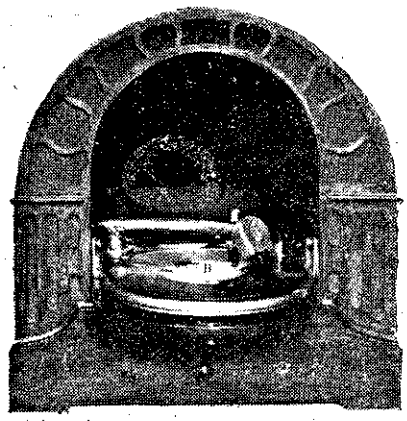


Fig. 6.—R.C.C. stage with double decoupling by resistance R and R_1, C and C_1.

MAKING THE MAI

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



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

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

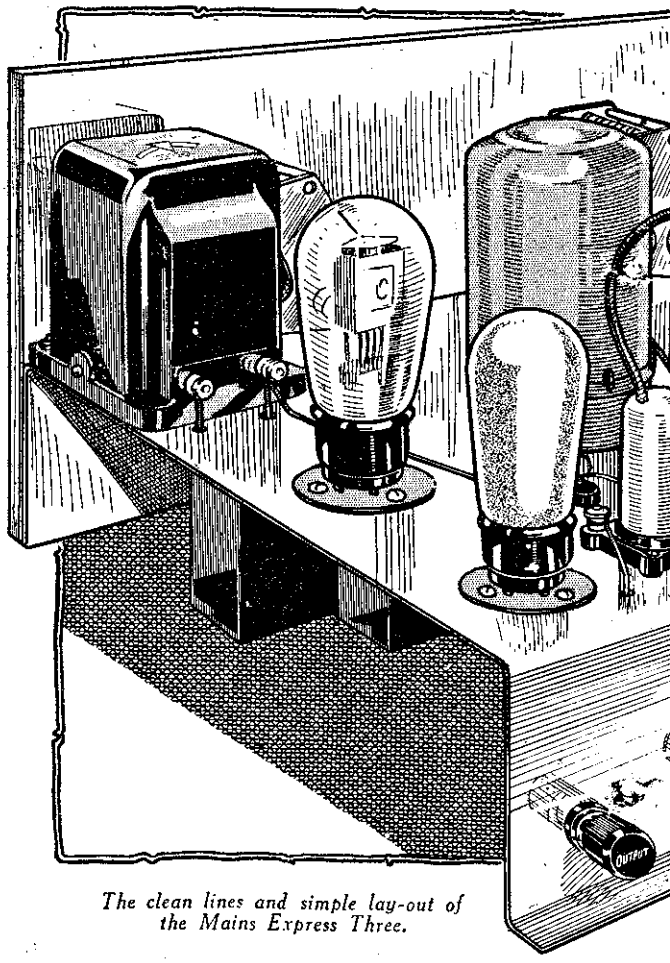
There is definitely a need for a three-valve all-mains set, free from the trouble of frequent accumulator recharging and the expense of H.T. battery renewals, which, although of well-tried principles, embodies the very latest developments of radio technique and at the same time has been designed as a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

Special Equipment

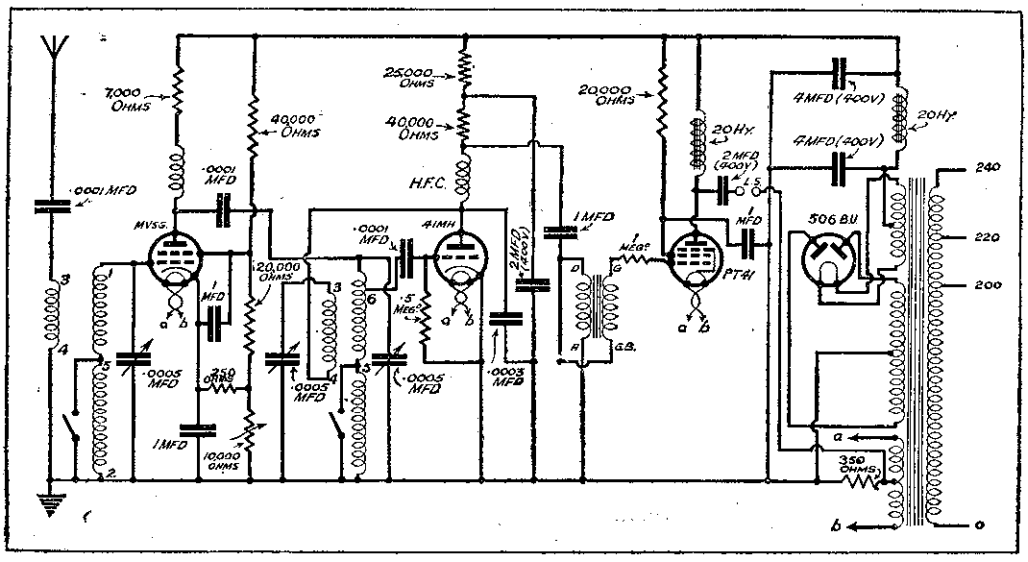
It has been pointed out that modern coils leave much to be desired from a mechanical standpoint; therefore special coils have been designed, equipped with plated brass screening-cans provided with really rigid fixing, while ready-soldered leads do away with the nuisance of tiny terminals working loose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

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

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



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



Theoretical Circuit of the Mains Express Three.

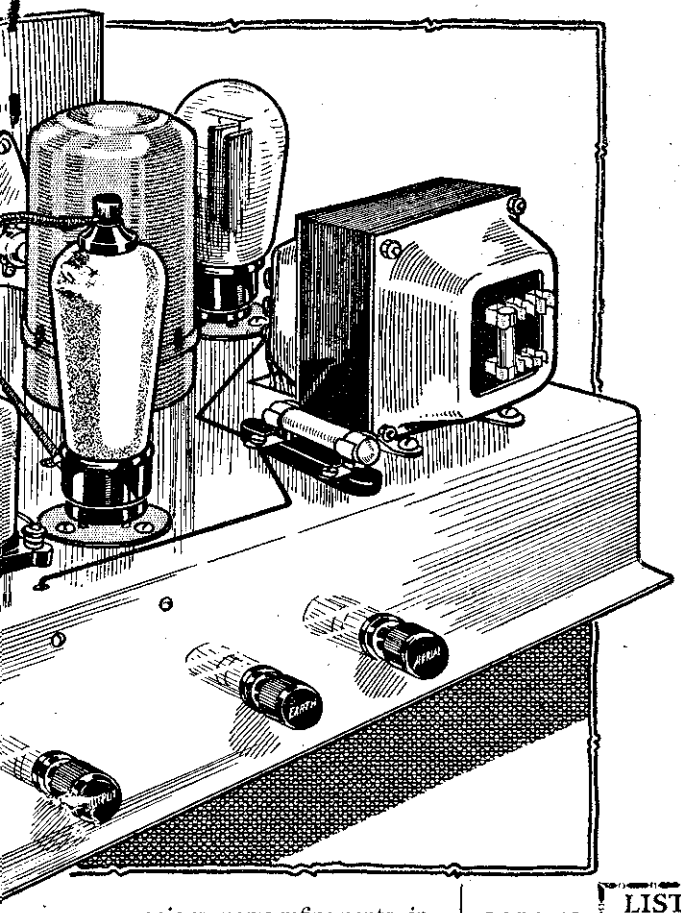
Reference to the photographs will show that a special type of H.F. choke is used having a screened lead already attached, which does away with an unsightly lead to the S.G. valve and at the same time effectively earths the metal covering without the use of a special clip. It is absolutely essential that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

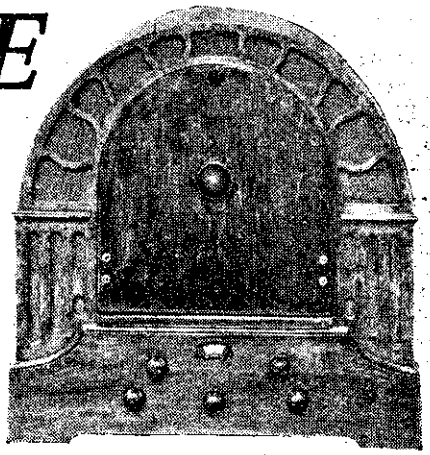
Selectivity Control

The Mains Express Three

VS EXPRESS THREE

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





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

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

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

Construction

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

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

Insulating Aerial and Output Terminals

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

LIST OF COMPONENTS FOR THE MAINS EXPRESS THREE

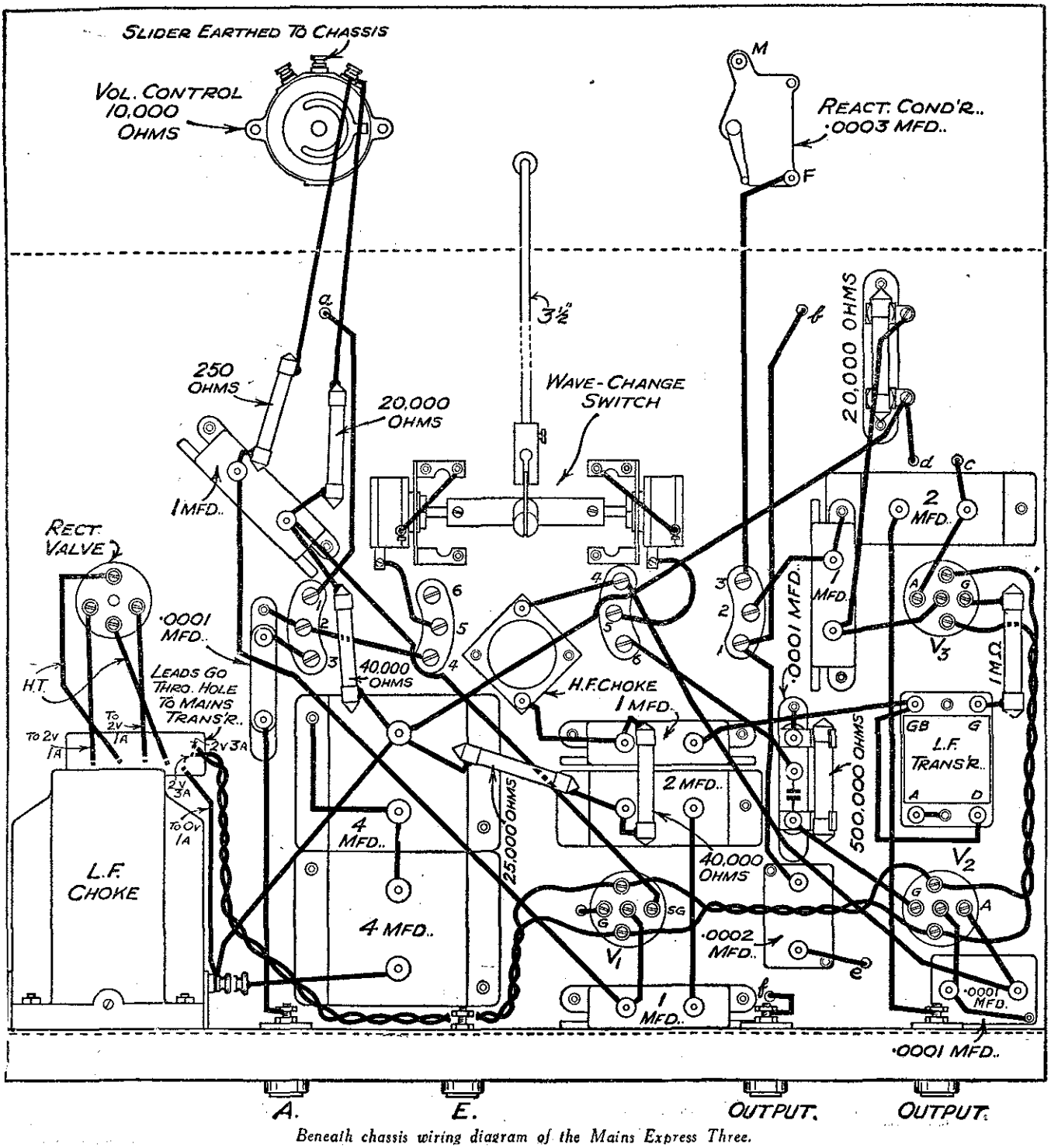
2 variable condensers, type No. 2, .0005, Polar.
1 reaction condenser, Compax type, .0003, Polar.
1 fixed condenser, type "S" .0001, T.C.C.
1 fixed condenser, upright type .0001, T.C.C.
1 fixed condenser, three-terminal upright type .0001, T.C.C.
1 fixed condenser, type "S" .0003, T.C.C.
4 fixed condensers,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

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

Points About the Wiring

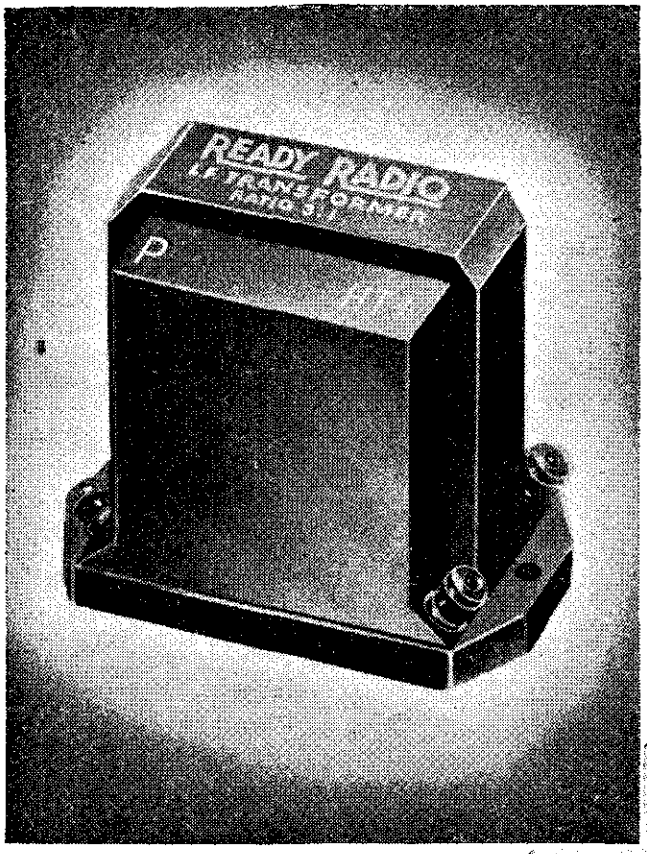
The Dubilier resistances are already provided with connecting wires, so it is only necessary to cut them to the required length, slip on a piece of systo-flex, loop the ends, and place it in position. It is, however, advisable not to fit these until the major portion of the wiring has been accomplished,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

(*Continued on page 144.*)



Beneath chassis wiring diagram of the Mains Express Three.

Quality Reproduction for the 'SONOTONE 4'



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

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

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

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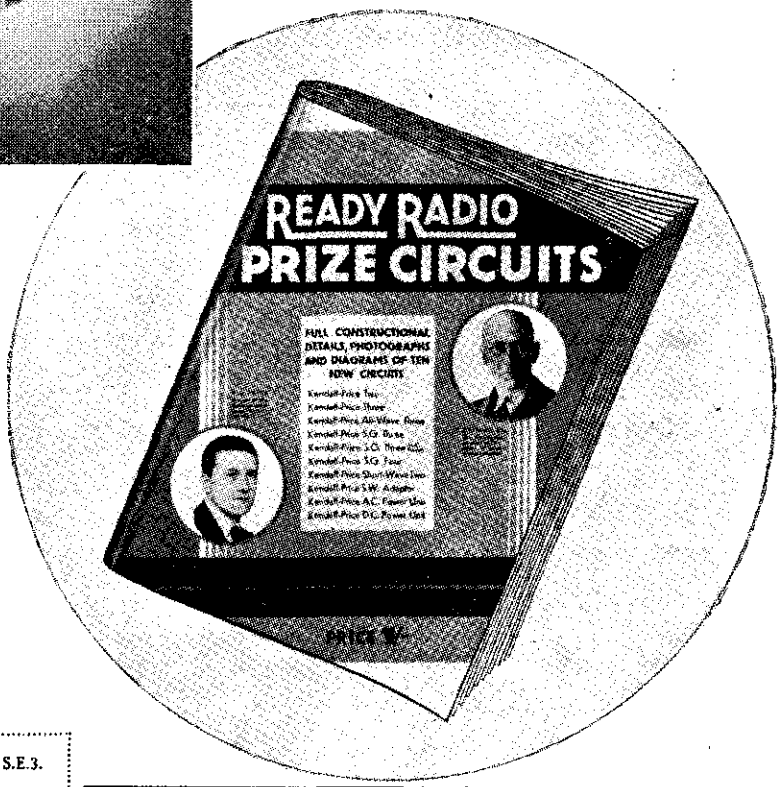


To READY RADIO LTD. (Book Dept.), Eastnor House, BLACKHEATH, S.E.3.
Please send me the Kendall-Price Book of the ten circuits—free.

Name.....

Address.....

.....

If you wish to have, with your free book, ten full-sized blue prints, enclose 1/- in stamps with this coupon. Prac. W. 3.

READY RADIO

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

Making the Mains Express Three

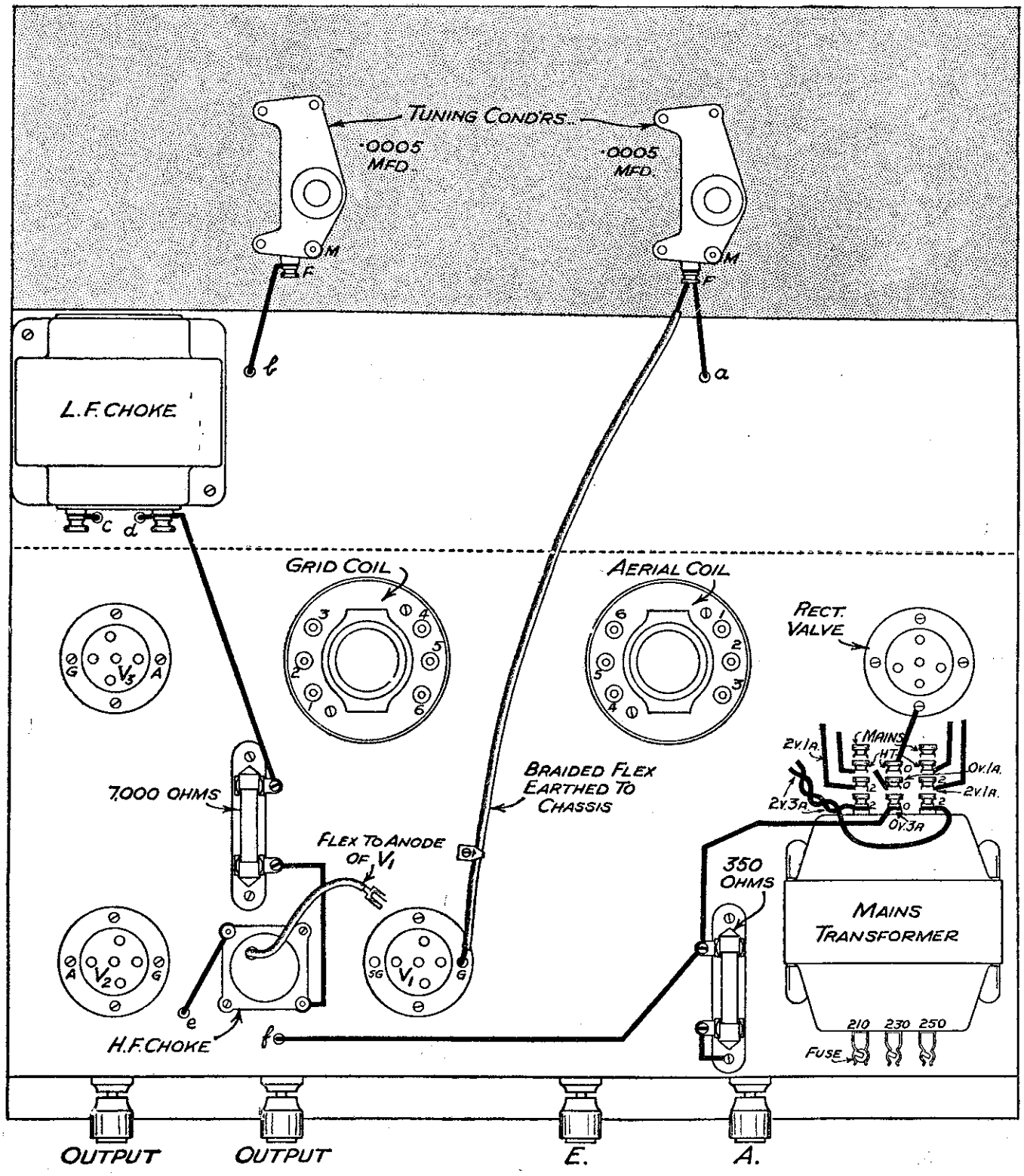
(*Continued from page 142.*)

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

Connecting the Mains Lead

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

(*Continued on page 162.*)



Above—Chassis Wiring Diagram of the Mains Express Three.

INTRODUCING—

THE SONOTONE FOUR

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

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

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

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

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

LIST OF COMPONENTS FOR "SONOTONE" FOUR

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

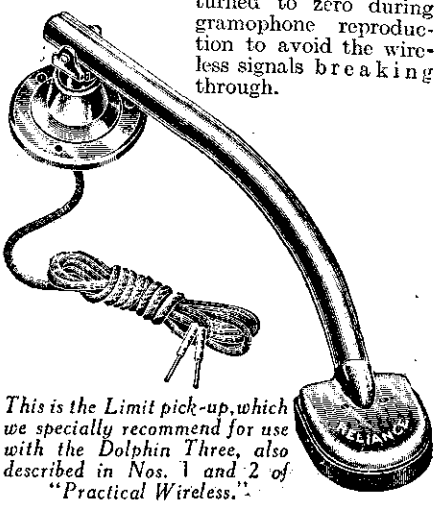
ADDING A PICK-UP TO THE DOLPHIN AND THE LONG-DISTANCE EXPRESS

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

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

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

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



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

THE LATEST KITS REVIEWED

NEXT WEEK!
THE LOTUS LANDMARK 3

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

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

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

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

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

THE OSRAM THIRTY-THREE MUSIC MAGNET

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

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

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

4.—Screen-grid detector gives great sensitivity.

5.—Tuning by one knob only.

6.—Single tuning dial calibrated in wavelengths.

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

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

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

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

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

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

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

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

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

16.—Connections for gramophone pick-up.

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

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

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

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

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

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

DO YOU KNOW?

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

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

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

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

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

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

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

KIT:
Osram Thirty-Three Music Magnet.

MAKERS:
General Electric Co. Ltd.

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

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

THE WHY AND THE WHEREFORE—3

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

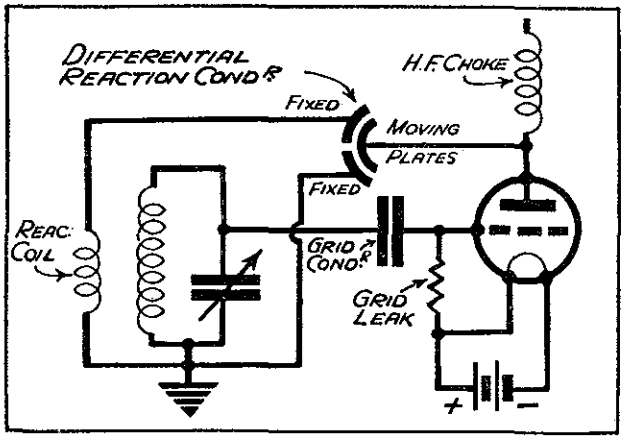
AS I pointed out last week, before the received oscillations will operate the headphones or loud-speaker, it is necessary that they shall be "detected"—or more correctly, rectified. There are in common use, two ways of carrying out this process, one being known as the anode bend method, and the other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

Anode Bend Rectification

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

Leaky Grid Rectification

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



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

Reaction

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

Controlling Reaction

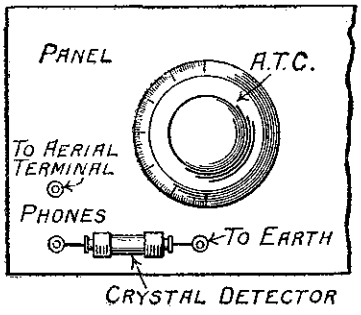
The degree of the reaction may be controlled by either varying the distance separating the anode and grid coils, or by arranging the coils close together to get the maximum coupling, and then providing an alternative path for the currents to earth instead of through the anode coil. This latter method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

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

A Stand-By Crystal Detector

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

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



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

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

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

The "Arithmetic" of Wireless—1

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

By G. V. COLLE.

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

Ohm's Law

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

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

Law Relating to Resistances and Condensers

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

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

Tuning Coils and Condensers

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

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

Wavelength and Frequency

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

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

INTERACTION: ITS CAUSES—AND EFFECTS

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

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

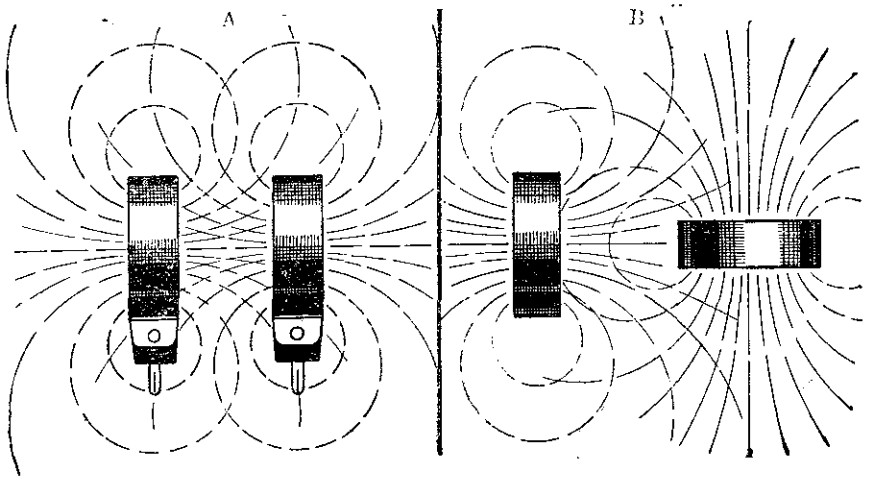


Fig. 1.—Showing the shape of the electro-magnetic field of coils of the usual plug-in type.

Conventional Layouts

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

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

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

Screening

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

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

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

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

Interaction Between Transformers

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

(*Continued on page 154.*)

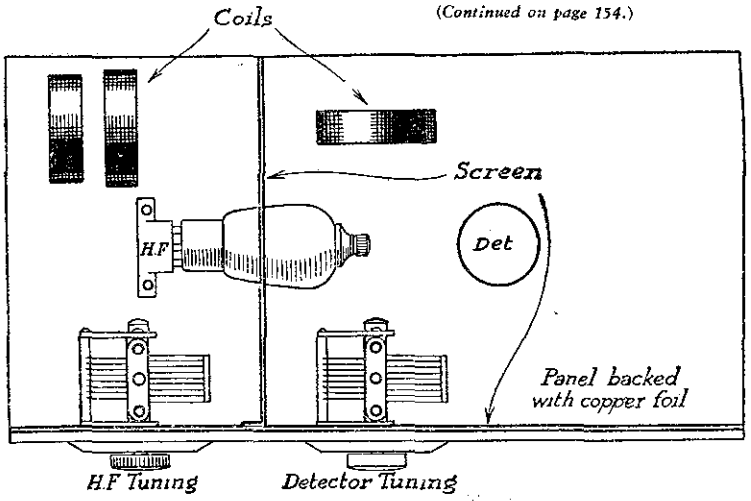


Fig. 2.—A screen the same depth as the baseboard is used for "partitioning off" the H.F. stage.

(Continued from page 152.)

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

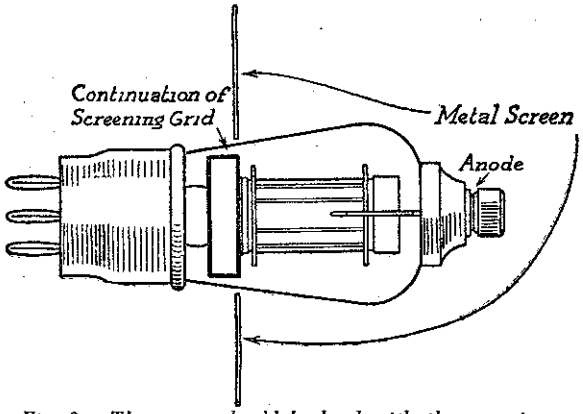


Fig. 3.—The screen should be level with the screening grid of the valve.

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

Points about Wiring

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

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

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

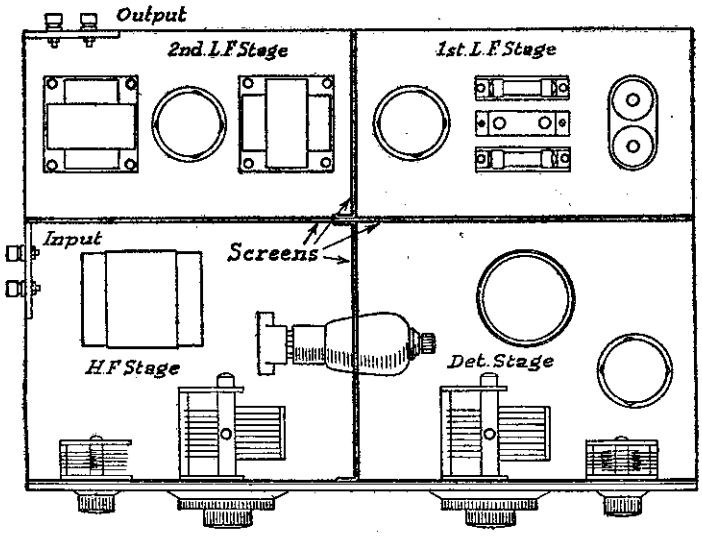


Fig. 4.—When the input and output ends of the receiver come close together the set should be screened as shown.

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

Making Good Soldered Connections

By W. H. D.

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

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

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

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

(Continued on page 161.)

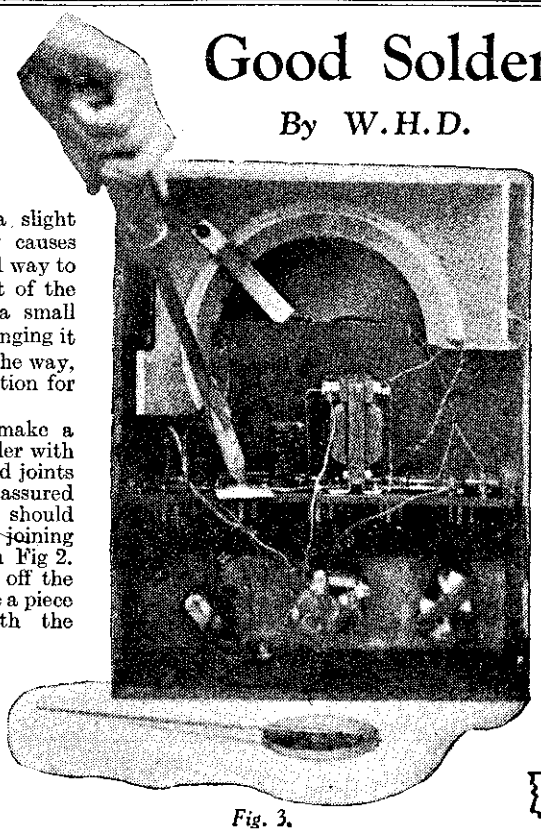


Fig. 3.

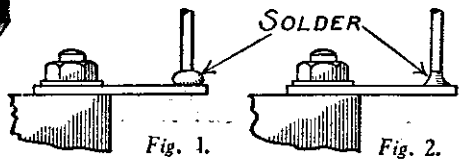
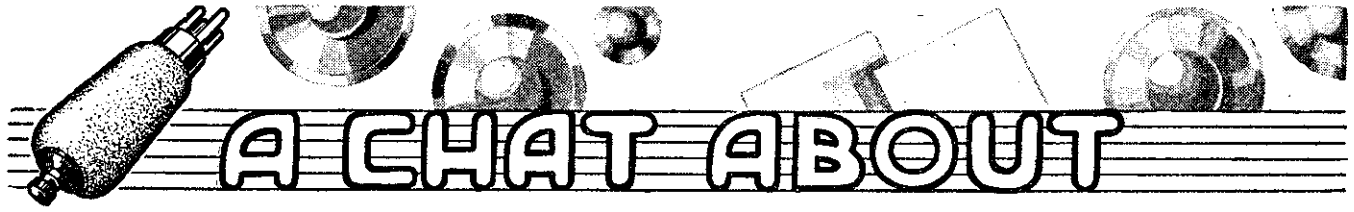


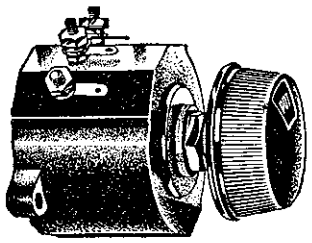
Fig. 1. *Fig. 2.*



A CHAT ABOUT THE LATEST COMPONENTS

AN EFFICIENT WIRELESS VOLUME CONTROL

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



One of the new Wearite variable potentiometers or volume controls.

THE MULTITONE TRANSFORMER

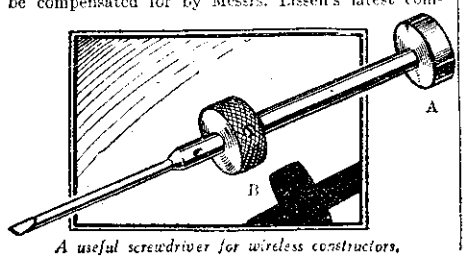
THE modern tendency of tone control has resulted in many devices to make the scheme simple. The Multitone Transformer is a compensated L.F. transformer designed for use in conjunction with a high resistance potentiometer—a value of 4 megohms being actually used. The primary of the transformer has an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

A SCREWDRIVER FOR WIRELESS CONSTRUCTORS

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

LISSEN TONE COMPENSATOR

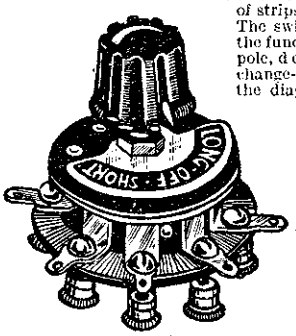
WITH the present congestion in the ether, heterodyne whistles are to be heard all round the tuning dials; modern sharply-tuned circuits result in side-band cut-off, or loss of high notes. These and many other imperfections in reproduction can all be compensated for by Messrs. Lissen's latest components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



A useful screwdriver for wireless constructors.

AN ALL-ROUND WIRELESS SWITCH

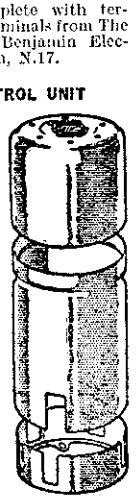
THE multi-purpose wireless switch shown in the sketch below is rotary in action, and has two balls in the extremities of the bakelite arm. The balls snick securely into the spaces between the contact strips, making low-resistance contacts between two pairs of strips simultaneously. The switch performs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



An all-round switch for wireless sets.

GANGED CONDENSER TUNING CONTROL UNIT

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



A neat wireless valve screen and base.

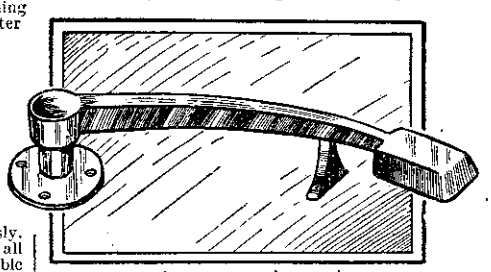
ALUMINIUM WIRELESS VALVE SCREEN AND BASE

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

A NEAT GRAMOPHONE PICK-UP

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

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



A neat gramophone pick-up.

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

AN INGENIOUS SCREWDRIVER FOR THE WIRELESS CONSTRUCTOR

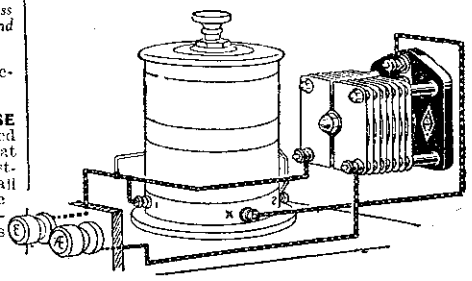
EVERY home constructor is aware of the difficulty of inserting small screws in awkward places, where the fingers cannot easily hold the screw in place. The screw usually drops into an inaccessible corner from which it cannot be retrieved. Many devices have been marketed to facilitate the operation, not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

A WIRELESS VOLUME CONTROL

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

CLIX TERMINALS

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



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

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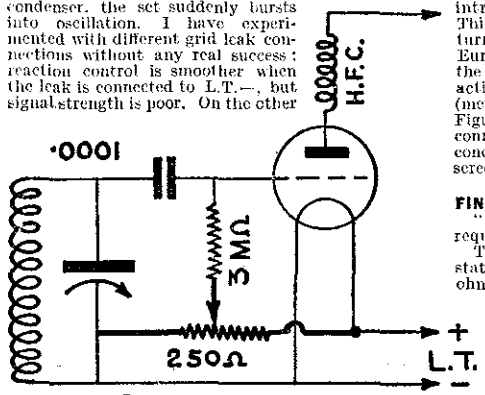
The coupon below must be attached to every query.

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.

UNSTABLE REACTION CONTROL

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



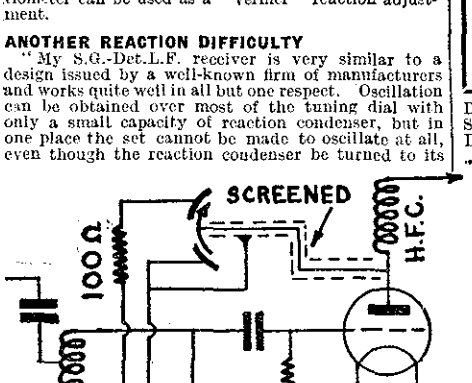
Curing unstable reaction control.

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

ANOTHER REACTION DIFFICULTY

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

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



Reaction difficulty.

FINDING THE VALUE OF RESISTANCES

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

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

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

DATA SHEET No. 3.

COPPER WIRE DATA (Continued).

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

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

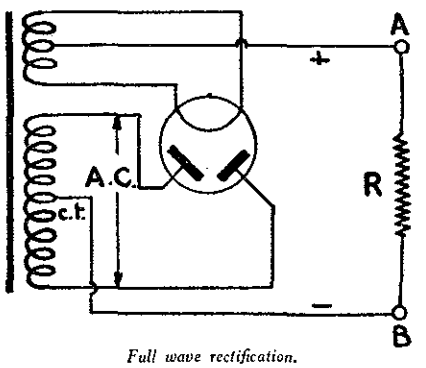
FULL WAVE RECTIFICATION

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

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

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

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



Full wave rectification.

EXTERNAL VOLUME CONTROL

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

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

BEST ARRANGEMENT FOR AERIAL

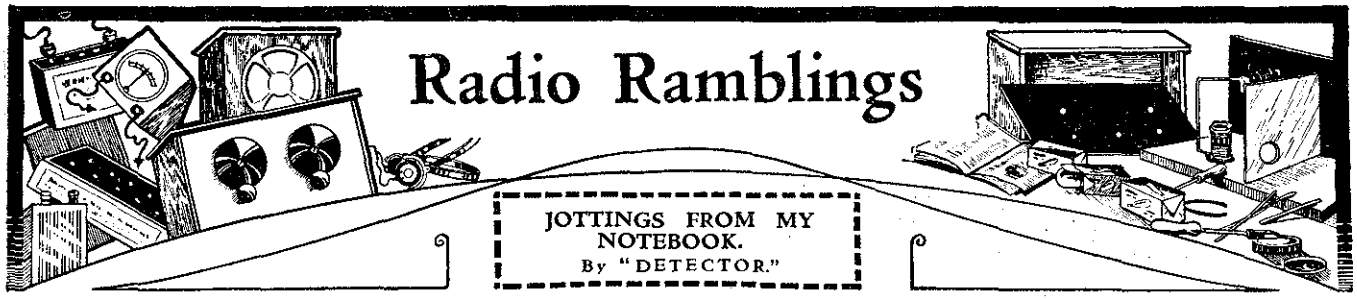
"Having removed to a house in the busy part of the town I am rather cramped for space to erect an aerial. The greatest horizontal length which I can possibly obtain is 20 feet, so, to make the best use of this, I propose to employ a "sausage" aerial consisting of six strands arranged round two strong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

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

FREE ADVICE BUREAU
COUPON

This coupon is available up to Oct. 15th, 1932, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 8 10/32



Radio Ramblings

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

A Cure

SHORT waves breaking through on the long waves may be overcome by inserting a suitable choke in series with the aerial lead. The choke should offer a high impedance to signals on the 200-600 metre waveband, but not to those on wavelengths above 1,000 metres or so. In addition, the choke should be of small dimensions to avoid magnetic coupling with other components. A suitable "stopper" choke, as it is called, can be made roughly by winding 300 turns of 40 gauge enamelled or silk-covered wire round a short end of pencil. There is no need to keep the turns even; indeed, it is better to pile them up so as to reduce the length of the winding. A neater job can be made by putting the windings in a couple of slots turned in an ebonite rod. Use $\frac{1}{8}$in. diameter rod and make two slots $\frac{1}{8}$in. deep, $\frac{1}{16}$in. wide and $\frac{1}{16}$in. apart. The choke must be short-circuited for medium-wave reception, so this will in some cases involve the fitting of a two-pole switch in place of the normal single-pole one used for wave-changing. In other cases it might be possible to modify the wiring to the existing switch to make it serve both purposes.

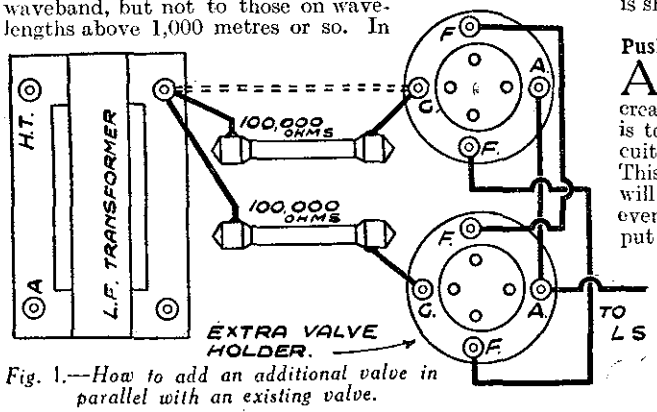


Fig. 1.—How to add an additional valve in parallel with an existing valve.

Power Valves in Parallel

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

Push-pull Amplification

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

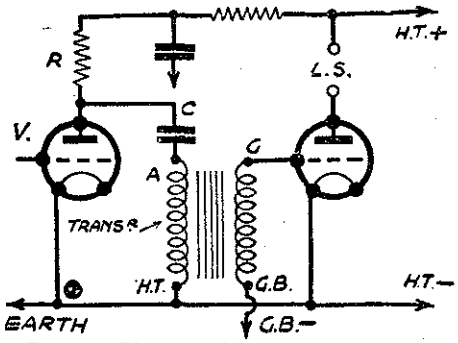


Fig. 2.—The method of parallel-feeding a transformer.

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

Power-grid Detection

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

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

Metallised Valves

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

(Continued on page 160.)

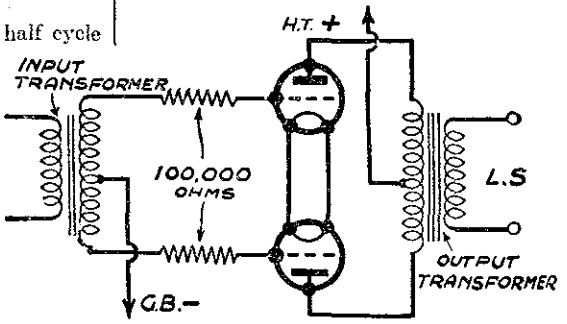


Fig. 3.—The circuit arrangement of push-pull valves, showing the resistances arranged for ensuring stability.

Radio Ramblings

(Continued from page 158.)

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

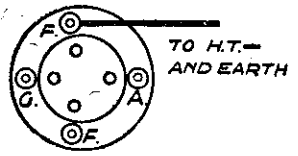


Fig. 4.—Always earth the filament terminal shown so that valves of the metallised type may be interchanged.

Calibrating a Receiver

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

(Continued on page 161.)

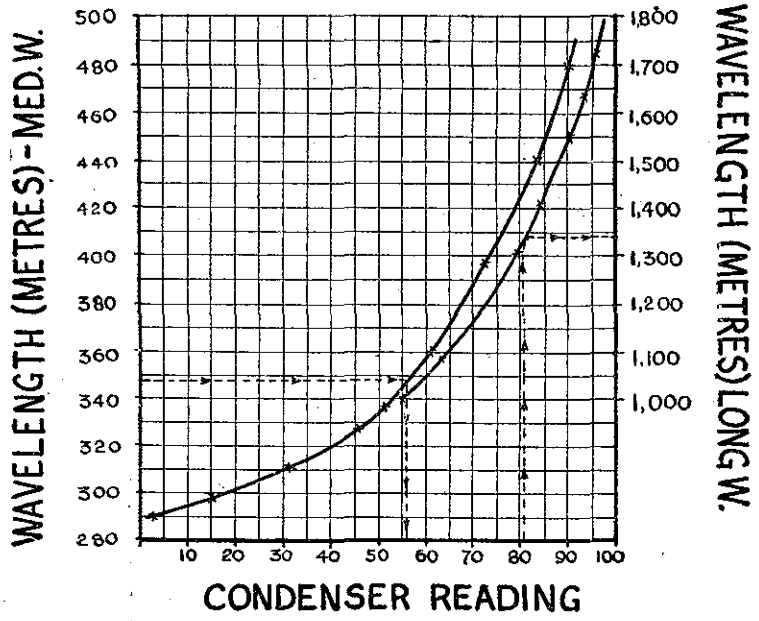


Fig. 5.—How to draw a calibration chart.

Radio Ramblings (*continued from page 160*)

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

Using a Calibration Chart

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

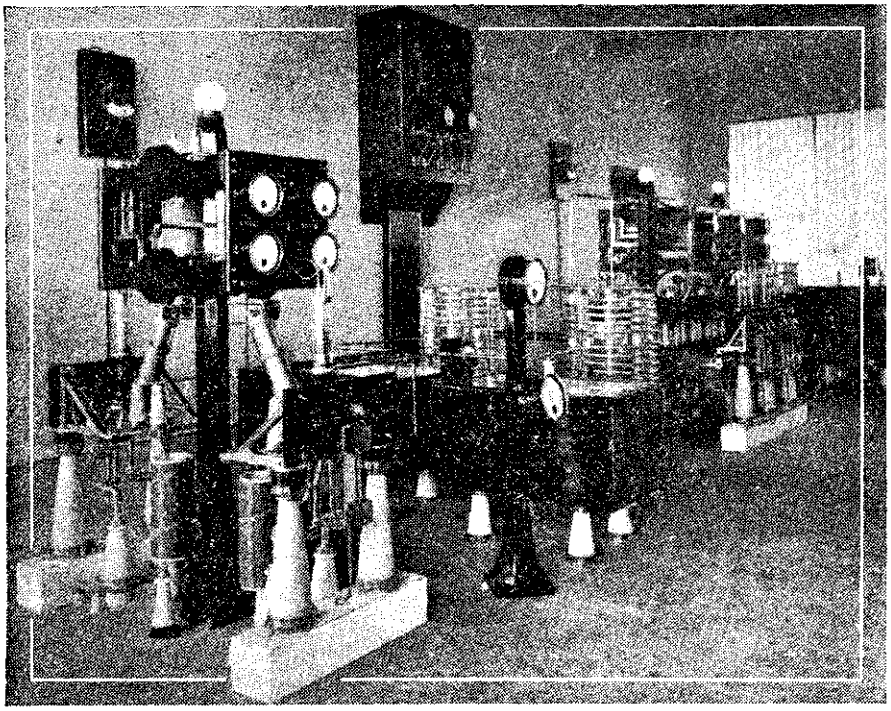
MAKING GOOD SOLDERED CONNECTIONS (*continued from page 154*)

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

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

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

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



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

Coupling and De-coupling.

(*Continued from page 139*)

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

Returning to the question of actual values, it has been indicated what the two decoupling components should total, and it would appear at first sight that the cheapest method would be to use 400,000 ohms with 1 mfd., but unfortunately such a value of resistance will often throw away too much of the high-tension voltage. The amount of voltage lost over the resistance is extremely simple to arrive at, it merely being necessary to multiply the resistance by the number of milliamps passing and knock off three noughts. For example, if the anode resistance were only 30,000 ohms, and the current 3 milliamps, multiply these two together and the result is 90,000; knock off three noughts and it will be seen that the loss of voltage would be 90. Thus the matter has to be approached in the following manner. Decide first of all what voltage it is desired to apply to the detector stage and subtract this from the H.T. battery voltage, which will leave the amount that may be sacrificed in the interests of decoupling. Say 80 volts is required on the detector, and the battery voltage is 120, then 40 volts can be spared. Now reference to the valve curve or the use of a milliammeter will show what current the valve is taking. Suppose it is taking 3 milliamps; it is now desired to find what resistance will drop 40 volts when 3 milliamps is flowing. This is arrived at by dividing the milliamps into the voltage, when the answer will be the number of thousands of ohms required. Continuing with our example, if we divide the 3 milliamps into the 40 volts, this goes approximately 13 times, and as the answer is in thousands of ohms, the resistance will be 13,000 ohms. The nearest value obtainable will be 15,000 ohms, which will have to be associated with a 4 mfd. condenser in order to reach the 40,000 which we have indicated as being a general figure for safety.

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

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

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

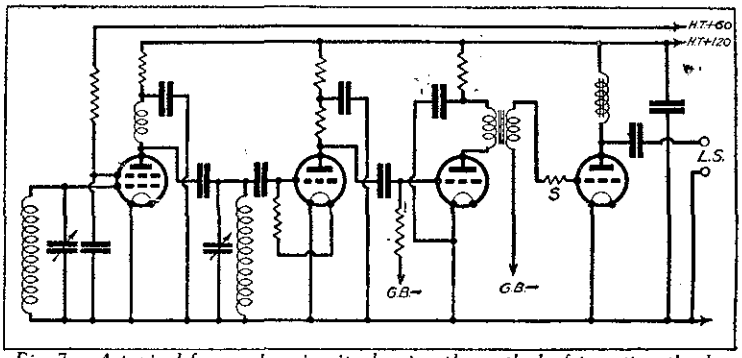


Fig. 7.—A typical four-valve circuit showing the method of inserting the decoupling resistances.

The Mains Express Three

(*Continued from page 144*)

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

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

Trying Out the Set

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

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

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

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

CATALOGUES RECEIVED

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

TUNEWELL COMPONENTS

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

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

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

HEAYBERD MAINS APPARATUS

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

Broadcast Query Corner

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

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

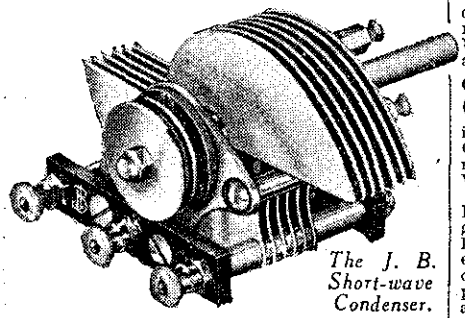
1. Write *legibly*, in ink. Give your full name and address.
2. State type of receiver used, and whether transmission was heard on headphones or on loud-speaker.
3. State approximate wavelength or frequency to which receiver was tuned, or, alternatively, state *between* which two stations (of which you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

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

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

JACKSON BROS., SHORT-WAVE CONDENSER

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



The J. B. Short-wave Condenser.

to avoid, as far as possible, closed loop effects. Obtainable in 5 capacities from .00005 to .00025, the price is 3s. 9d. The overall dimensions of the .00015 size (including sweep of vanes) is 3⅜in. by 2⅜in. by 2½in.

MAGNACORE TRANSFORMER

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

AROUND THE TRADE

OSRAM VARIABLE-MU TWO-VOLT VALVE

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

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

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

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

LOTUS

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

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

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

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

IN QUEST OF QUALITY

(Continued from page 129)

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

Power

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

ADVERTISEMENT INDEX

Printed by NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, Ladbroke Grove, W.10, and published by GEORGE NEWNES, LTD., 8-11, Southampton Street, Strand, W.C.2. Sole Agents for Australia and New Zealand: GORDON & GOTCH, LTD. South Africa: CENTRAL NEWS AGENCY, LTD. *Practical Wireless* can be sent to any part of the world, post free, for 17/4 per annum; six months, 8/8. Registered at the General Post Office for Transmission by Canadian Magazine Post.

FREE INSIDE! 1/- BLUEPRINT OF THE SONOTONE

Practical Wireless

3D

Published every Wednesday by
GEORGE NEWNES LTD.

Vol. 1——————No. 4
OCTOBER 15th, 1932
Registered at the G.P.O. as a Newspaper

THE MOST UP-TO-DATE 4

THE SONOTONE

SEE INSIDE

A 40-STATION RECEIVER!

SELECTIVE, ECONOMICAL AND EASY TO MAKE.

FOR EVERY SET—*there's a*

PILOT AUTHOR KIT

How animated cartoons are made

The October number of HOME MOVIES *and Home Talkies* contains an extremely interesting article by Ern Shaw, in which he explains, fully and simply, how animated cartoons may be made at home by anyone possessing a ciné outfit. The animated cartoon is, as everyone knows, one of the most popular features of the professional screen and is a form of movie-making which, perhaps more than any other, holds out opportunities for the display of humour and originality. This article opens up a field full of possibilities for the making of new, effective and very entertaining pictures. Read it!

A charming study from the film "Cries of Old London," recently shot in Clifford's Inn, off the Strand. These old-world backgrounds should not be ignored by the amateur.

If you haven't bought your ciné camera yet, here is a reason for getting one! Don't forget that films like this can now be taken with artificial light indoors.

6D.

Even if you do not yet possess a movie camera and projector you will find a wealth of interesting reading in the October number, including: The Heart of a Schoolgirl; Editing Your Summer Shots; The Gentle Art of Faking; A Typical Scenario, by Adrian Brunel; A New Competition.

SEND POST-CARD TO-DAY FOR SPECIMEN COPY

Obtainable from all Newsagents, Bookstalls and Dealers, or post free 7½d. (Subscription rates: Inland and Abroad 7/6 per annum; Canada 7/- per annum) from George Newnes Ltd., 8-11, Southampton Street, Strand, London, W.C.2

Geo. Newnes, Ltd.

FOR EVERY SET — *there's a*

PILOT AUTHOR KIT

CASH — C.O.D — or H.P.

EVERYTHING RADIO

CARRIAGE PAID TO YOUR DOOR.

THIS YEAR'S WINNER

"LISSEN SKYSCRAPER 3." Send
Chassis model, with (Lissen) S.G., Detector and Pentode Valves. Cash Price £4/9/6. Carriage Paid. Balance in 11 monthly payments of 8/3. **8/3** only

"LISSEN SKYSCRAPER 3." Send
Cabinet Model. Complete with Lissen Speaker and Lissen S.G., Detector and Pentode Valves. Cash Price £6/5/0. Carriage Paid. Balance in 11 monthly payments of 11/6. **11/6** only

COSSOR MELODY MAKER. Model 335. Send
Complete with valves, speaker and cabinet. Cash Price, **£7/17/6.** Carriage Paid. **10/-**
Balance in **11** monthly payments of **14/10.** only

COSSOR ALL-ELECTRIC MELODY MAKER. Send
Model 336. Complete with valves, cabinet and speaker. Cash Price, **£11/15/0.** Carriage Paid. **21/7**
Balance in **11** monthly payments of **21/7.** only

COSSOR MELODY MAKER. Model 334 with Send
metallised variable-mu S.G. and detector valves, power valve and cabinet. Cash Price, **£6/7/6.** **10/-** only
Balance in **11** monthly payments of **11/10.**

SLEKTUN SCOUT S.G.3.—S.G., detector and Send
power. Pilot Author Kit "A" (less valves and cabinet). Cash or C.O.D., **£4/8/6.** Carriage Paid. **8/1** only
Balance in **11** monthly payments of **8/1.**

R & A "VICTOR" PERMANENT-MAGNET MOVING-COIL SPEAKER DE LUXE. With
6-ratio input transformer and protecting grill. Cash Price, **£3/10/0.** Carriage Paid. **6/5** order
Balance in **11** monthly payments of **6/5.**

EASIWAY

NO DEPOSIT. Strict Privacy. No third party collections. We deal with you direct

EPOCH "20 C" PERMANENT MAGNET MOVING-COIL SPEAKER. (New Edition). Send
With 3-ratio input transformer. Cash Price **£1/15/0.** Carriage Paid. **6/6** only
Balance in **5** monthly payments of **6/6.**

W.B. PERMANENT MAGNET MOVING-COIL SPEAKER. Type P.M.2. Complete Send
with 3-ratio transformer. Cash Price, **£4/5/0.** Carriage Paid. **7/9** only
Balance in **11** monthly payments of **7/9.**

BLUE SPOT SPEAKER UNIT AND CHASSIS. TYPE 100U. Cash Price **£1/12/6.** Carriage Send
Paid. **5/2** only
Balance in **6** monthly payments of **5/2.**

BLUE SPOT UNIT AND CHASSIS TYPE 99 PP.M. Including matched Send
Transformer. Cash Price, **£2/19/6.** **5/6** only
Balance in **11** monthly payments of **5/6.**

ATLAS ELIMINATOR. Type A.C.244. Three Send
tappings. S.G., detector and power. Output: 120 volts at 20 m/a. Cash Price **£2/19/6.** **5/6** only
Carriage Paid.
Balance in **11** monthly payments of **5/6.**

GARRARD INDUCTION GRAMOPHONE MOTOR. For A.C. mains. **Model 202.** Send
Mounted on 12-inch nickel motor plate with fully automatic electric starting and stopping switch. Cash Price, **£2/10/0.** Carriage Paid. **4/7** only
Balance in **11** monthly payments of **4/7.**

REGENTONE W.I.F. H.T. ELIMINATOR for Send
A.C. mains, tapped S.G., detector and 120/150 v. at 12 m/a. Cash Price **£2/15/0.** Carriage Paid. **5/1** only
Balance in **11** monthly payments of **5/1.**

IMMEDIATE DELIVERY — KITS OR PARTS

SONOTONE 4

EXACT TO SPECIFICATION

As described in this week's issue.

COMPLETE KIT PRICES.

KIT "A" Author's Kit of specified components with Ready Drilled Panel, but less valves and cabinet.

CASH OR C.O.D. CARRIAGE PAID £6 : 1 : 0

Or **12** monthly payments of **11/1.** Carriage Paid.

These are the parts the Author used

		s.	d.
1	**LISSEN** two-gang shielded coil with combined filament switch	17	6
1	**UTILITY** .0005 mfd. variable condenser, two-gang, type 312/Air	19	6
1	**READY RADIO** .0005 mfd. reaction condenser	2	6
1	**SOVEREIGN** .0005 mfd. pre-set condenser	1	3
1	**T.C.C.** type S.P. .0002 mfd. fixed condenser	2	4
1	**T.C.C.** type "S" .0001 mfd. fixed condenser	1	3
3	**T.C.C.** type No. 50 2 mfd. fixed condensers	11	6
1	**SLEKTUN** standard H.F. Choke	4	0
1	**BULGIN** Standard Screened H.F. Choke	3	6
1	**READY RADIO** ratio 3—1 L.F. Transformer	8	6
1	**BENJAMIN** Transfeeda	11	6
4	**LOTUS** 4-pin Valve holders	2	0
1	**R.I.** output choke type DY. 25	12	6
1	**LEWCOS** 600 ohms Spaghetti fixed resistance		9
1	**LEWCOS** 10,000 ohms Spaghetti fixed resistance	1	6
1	**COLVERN** 25 ohms filament variable resistance Type FR.	3	6
1	**SOVEREIGN** 500,000 ohms volume control	4	6
1	100 m/a Microfuse	1	0
3	**BELLING & LEE** Terminal Blocks	2	0
6	**BELLING & LEE** marked Terminals	1	3
1	**BELLING & LEE** Five-Way Battery Cord	2	0
2	Coils Glazite	1	0
1	Panel 14 x 7 ins., **ready drilled**	4	0
1	**PETO-SCOTT** Baseboard, 14½ x 9 ins.	1	8
	KIT "A," CASH OR C.O.D.	£6	1	0
4	*Valves as specified*	£2	2	6
1	*CAMCO Ambassador Cabinet (Walnut)*	£1	15	0

KIT "B" As Kit A, but WITH VALVES, less cabinet CASH or C.O.D. Carriage Paid.
£8 : 3 : 6
Or **12** monthly payments of **15/-** Carriage Paid.

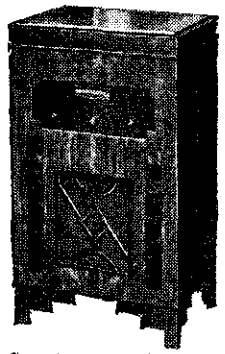
KIT "C" Complete Author's Kit, with valves, cabinet CASH or C.O.D. Carriage Paid.
£9 : 18 : 6
Or **12** monthly payments of **18/2** Carriage Paid.

IMPORTANT *Part Kits, miscellaneous components or accessories are available Cash, C.O.D. or under our own Easy Way H.P. System. Send us list of your wants. We will quote by return without any obligation. Orders value over* **10/-** *Carriage or C.O.D. Charges Paid.*

1933 ADAPTAGRAM

Trade Mark

Constructed in Walnut with inlaid Walnut Veneers.



Dimensions: Height, 38½in.; width, 21½in.; depth, 15½in.; panel size: 18 x 18in.; baseboard depth, 14in.; Speaker Compartment, 17 x 19½ in.; Clearance Between motor board and underside of lid 4in. Ready fitted with back Baffle Board, 3/6 extra if required.

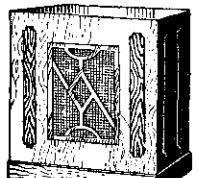
MODEL A Convert your existing set to a Radio-gram. Comes to you with vignetted front as illustrated and motor board, ready to take your own Set, Gramophone Motor and Pickup. No skill or expensive tools are required to transform your Radio into a combination instrument, presenting the professionally-finished appearance of the most luxurious Radio Gramophone money can buy. 12 monthly payments of 5/9. **63/-**

Carriage and Packing 2/6 extra, England and Wales.

MODEL B with Garrard Double Spring Motor. 12in. Turntable. Automatic Stop. B.T.H. Tone-Arm with Pick-up, and Volume Control complete. Automatic Needle Cup. Cash or C.O.D. or 12 monthly payments of 12/-. **6 GNS.**

MODEL C with Collaro Induction Electric Motor with Tone-Arm, Pick-up and Volume Control in one Unit. 12in. Turntable. Automatic Stop. Automatic Needle Cup. (For A.C. Mains). Cash or C.O.D. or 12 monthly payments of 13/9. **7 GNS.**

PETO-SCOTT CABINET SPEAKER



FITTED TO CHOICE BLUE SPOT 100U or Peto-Scott P.M. Moving-Coil Speaker.

In handsome Walnut cabinet with contrasting Walnut inlaid veneers. Hand French polished. Carefully designed of specially chosen wood to provide the perfect acoustic conditions necessary for the correct rendition of the upper and lower musical frequencies. Eminently suitable for 3 or 4-valve receivers.

CASH or C.O.D., or by **12** monthly payments of **4/6.** **47/6**

PETO-SCOTT CO. LTD. 77, CITY ROAD, LONDON, E.C.1

West End Showrooms: 62, High Holborn, London, W.C.1. Holborn 3248

Dear Sirs,—Please send me C.O.D./CASH/H.P.....

for which I enclose £ s. d. CASH/H.P. Deposit. *Send me your FREE 1933 Catalogue.*

NAME.....

ADDRESS .....

PR.W. 15/10/32.....

Buy by Post—it's Quicker

Here's the Set for YOU!!

Amazing Reception—40-50 Stations

SLEKTUN

A Triumph of Easy Construction

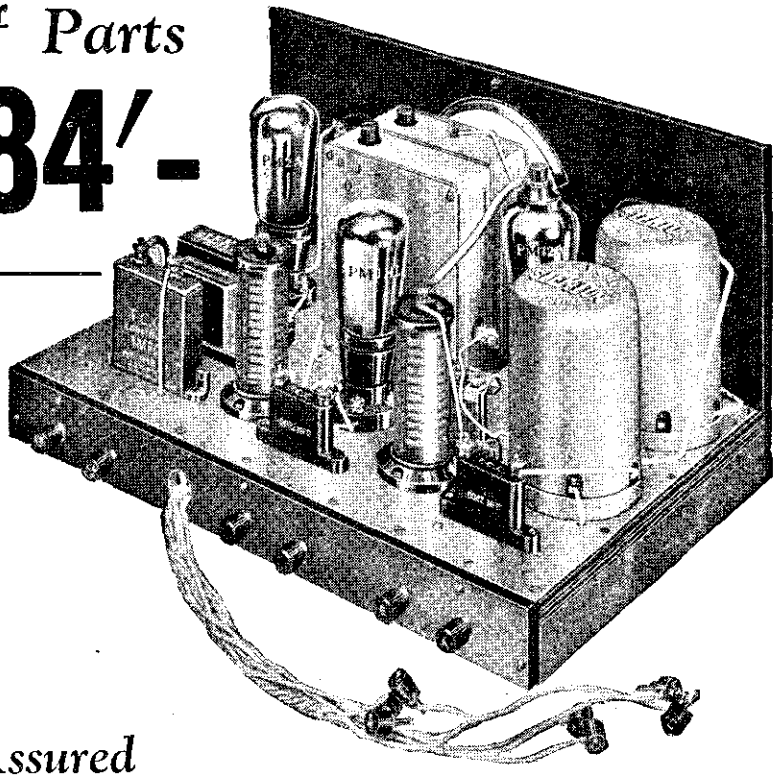
SCOUT S.G.3

Complete Kit of Parts

84/-

Simplest of all sets to build

- ★ Kit includes the famous Slektun Super Transformer.
- ★ Slektun Dual Range Coils.
- ★ Cyldon Ganged Condenser with Sector Vision Escutcheon.
- ★ T.C.C. Fixed Condensers.
- ★ W.B. Valve Holders and Switches.
- ★ Ready Drilled Panel and Terminal Strip of "Permcol" non-discolourable Ebonite.
- ★ Baseboard Assembly covered with "Konductite" metallic screening material.
- ★ All necessary screws, terminals, connecting wire, wander plugs and flex.



Perfect Results Assured

This super set has been designed so that the amateur can build as good a receiver as the radio engineer. All you have to do is to put it together. Every component has been carefully chosen for easy construction and perfect results. Amazing range and selectivity are obtained, and powerful, distortionless performance is assured by the use of Slektun Dual Range Coils and the Slektun Super Transformer. 40-50 stations can be tuned in at full loudspeaker strength—including even Fecamp, a station almost impossible to get with most receivers.

The entire set can be built in an evening by anyone—at very moderate cost. Ask your dealer or write for the FREE Constructional Book.

FREE ***Blueprint and Constructional Book***

The Book of the Scout S.G.3 is the most comprehensive Radio Set Construction book ever printed. Ask your dealer or write for a FREE copy.

Use the Coupon

To SLEKTUN PRODUCTS LTD., 21 Douglas St., Westminster, S.W.1

Please send me the FREE illustrated Book of the Scout S.G.3, together with the full-size Blueprint. I enclose 1½d. stamp to cover cost of postage.

Name .....

Address .....

PR.W. 2 .....

SLEKTUN PRODUCTS LTD., 21 DOUGLAS STREET, WESTMINSTER, S.W.1

National

Let Us Solve Your Radio Problem! See Page 210

ROUND THE WORLD OF WIRELESS

The West Regional

I UNDERSTAND that the West Regional Station at Watchet is growing by leaps and bounds. Both of the 500ft. lattice masts were completed some time ago and the building work is well in hand. It is hoped that the roof will be on by the beginning of November, and after that the heavy machinery will be installed without delay.

The B.B.C.'s Anniversary

NEXT week (commencing November 13th) will signalize the tenth anniversary of the B.B.C., and all plans have been made for the broadcast of appropriate programmes. A special feature of one programme will be a tour of the twenty-two studios at Broadcasting House. Vaudeville will also figure prominently on the "bill of fare," and judging by the names of the artists, these should be as good as any similar items ever broadcast.

When is a Fuse not a Fuse?

THE above title was recently adopted in an advertisement of a well-known firm of manufacturers, but the answer they gave was not the same as that I gave to a man who fitted a 5-amp. mains fuse in the H.T. lead to his three-valve set. He couldn't imagine how his valves could possibly have been burnt out—and leave the fuse still intact!

Tone Control Transformers

IF you have not yet tried one of the new tone control transformers I would advise you to do so at the earliest opportunity. Besides making it possible to regulate the loud-speaker reproduction from a "bright" to a "mellow" tone, the tone control transformer allows you to cut out the high-pitched heterodyne whistle caused by two stations working on very close wavelengths. A transformer of this type can be used to replace a normal one in any kind of set without altering the wiring beyond adding two new leads, which must be joined to a variable resistance mounted on the panel.

Dark Nights

IF you are a long-distance fan you will have noticed the steady improvement in reception conditions during the last few weeks as the days have shortened. Quite a few weeks ago I found many of the Continentals as loud as ever they were last winter, and this seems to agree with the forecast that reception conditions this winter are going to be better than they have been for the last six or seven years.

Bottled Programmes

THE B.B.C. engineers working in their Research Laboratory at Nightingale Lane, Clapham, have been able to obtain much better quality from the new type Blattnerphones with which they are now experimenting. The Blattnerphone is a recording machine with which sounds are impressed on a magnetic tape. You will remember that the B.B.C. have made good use of the Blattnerphone on the occasion of the New Year's Eve broadcasts, when excerpts from the past year's programmes have been re-broadcast. The new machines are being used to enable the B.B.C. to "bottle" programmes sent out from their studios so that the sound can later be impressed on wax discs which will be sent out to the colonies for re-transmission. We hope that this is not going to take the place of a really high-power S.-W. station, for which our colonial cousins have been asking so long.

Russian Broadcasts for Night Workers

OCCASIONALLY Leningrad, Moscow and Kharkov broadcast special concerts for workers on night shifts, and these transmissions may be heard until about 1.30 a.m. G.M.T. At 3.30 a.m. they are daily on the air with physical exercises and the early morning gramophone concert.

Wavelength Changes of Radio Normandie

OWING to morse interference from Boulogne and by French coastal shipping, Radio Normandie (Fécamp) is frequently compelled to make alterations in its wavelength. It will be found that it varies between 222 and 226 metres, and a slight adjustment of the dials is necessary for tuning in these broadcasts,

The World's Listeners

STATISTICS recently published by the International Broadcasting Union at Geneva show that the total number of receiving sets in the world to-day is computed at 26,000,000, thus representing a daily audience of over 100,000,000 listeners.

The Highest Aerials

DURING the past year many American stations have considerably increased the height of their transmitting aerials, and WSM, Nashville (Tenn.), claimed that, with the exception of the Eiffel Tower, Paris, which holds the record (300 metres), its mast was the highest in the world. Germany, however, contests that Nauen holds second place with 280½ metres. The world's record, however, is likely to be beaten by the students of the Polytechnic School at Moscow, who propose to install a short-wave transmitter on the summit of Mount Elbrous, some 4,135 metres in height!

British Military Band Concerts in Holland

FOLLOWING the visit of the Scottish "pipers" to the Copenhagen Exhibition, it is now stated that the Band of the Royal Horse Guards will give a series of concerts in Holland during October.

The A.V.R.O. broadcasting association has made arrangements for the relay of one of these performances and re-transmission through the new 20-kilowatt Hilversum station working on 296.1 m.

New Gramo. Records Only for Prague

PRAGUE, contrary to the principle adopted by French studios, has decided that, in future, only newly issued gramophone records are to find a place in its daily radio programme.

Round the World of Wireless (continued)

How Summer Time Affects Foreign Time

ON October 2, Great Britain, Belgium, France and Holland reverted to Winter or Greenwich Mean Time. On that date Central Europe jumped one hour, Eastern Europe two hours, and Moscow local time three hours ahead of our clocks. Holland, which worked to Amsterdam time, is twenty minutes in advance. Exceptionally, this year Rumania adopted summer time, but changed over to Eastern European standard on October 1. This puts Bucharest two hours in front of us. Spain and Portugal have made no change.

Land-line Relays for Mediterranean Station

ACCORDING to the French technical press, the 60-kilowatt transmitter which the State authorities intend to erect at Biot to act as the Mediterranean Regional station will be linked up to new studios at Nice, Cannes and Monte Carlo. They will be connected to the transmitter by modern pupinised cables in order to obtain a faultless relay of musical concerts from these popular resorts.

Leipzig's High-Power Transmitter

THE bringing into operation of Leipzig's 150-kilowatter has been somewhat delayed by technical difficulties, but readers may possibly have picked up its hefty signals by the time these notes are in print. As Leipzig and Frankfurt-am-Main were to exchange wavelengths, the latter's 17-kilowatt station could not take the air before its big brother was ready to work. No delay has been incurred in the completion of the Munich (75 kw.) transmitter which, it is hoped, will start up on October 15.

New Irish and Russian Stations

THIS month may also see the arrival on the ether of Athlone (60 kw.), which ceased its temporary operations during the Eucharistic Congress at Dublin. In addition, we may expect to hear powerful broadcasts on the opening of the Noghinsk (U.S.S.R.) 500 kw. station, which has been in the hands of Soviet engineers for over fifteen months.

Polish Relays for America

FOR the benefit of their nationals residing in the United States, the Polish authorities have concluded arrangements for the relay of wireless programmes from Warsaw to America for transmission through stations in the National Broadcasting Company's net.

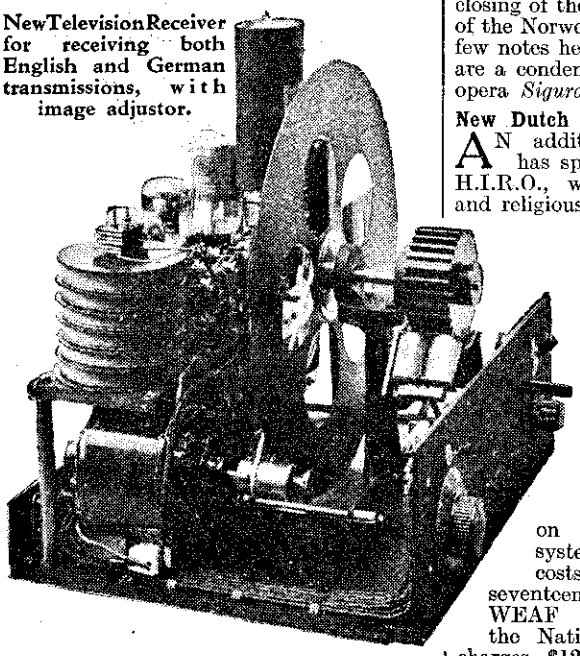
Fire Detection on Ships

AN appliance for the detection of fires on board ships has been recently demonstrated in Great Britain. The apparatus uses a selenium cell of a pattern similar to that utilised in the reproduction of sound in "talkie" films. When influenced by a variation in light the cell operates a relay causing an electric alarm to be rung, and at the same time flashes a visible signal in a convenient part of the ship. By the same means fire extinguishing chemicals can be released automatically at the point where the outbreak has occurred.

Italy Completing Land-lines

FAILING the proper land-lines, up to the present, Italy has not been able to take part in the all-Europe Concerts which, by arrangement with the International Broadcast Union, are given at regular intervals throughout the year. Work is now being carried out to remedy this defect, and on January 13, 1933, almost all British and Continental stations will link up for the relay of a special concert or operatic performance broadcast from Rome.

INTERESTING & TOPICAL PARAGRAPHS



New Television Receiver for receiving both English and German transmissions, with image adjustor.

Additional Wavelengths for Spain

FROM a report received from Madrid, it would appear that the International Broadcasting Union is endeavouring to obtain twenty-three extra wavelengths comprised in the bands 555-810 metres and 1,050-2,000 metres. As these channels are mainly used by shipping and aviation, it is doubtful whether this concession will be granted to the broadcasting stations. In connection with this request, the Italian representatives at Madrid have put forward a proposal to the effect that listeners in the interested countries should bear the cost incurred by the change-over, should it come to pass, of shipping and aviation to other wavelengths. This would mean, no doubt, a slight increase in the cost of the licence.

Oslo's Interval Signal

THE musical box which is used at Oslo (Norway) for the opening and interval signals was designed by the Hungarian Engineer who devised the original apparatus adopted by the Budapest studio. The signature tune used for the opening and closing of the station consists of a few bars of the Norwegian national anthem, and the few notes heard between programme items are a condensed theme taken from Grieg's opera *Sigurd Jorsalfar*.

New Dutch Broadcasting Company

AN additional broadcasting company has sprung up in Holland; it is the H.I.R.O., which includes various social and religious bodies. It has been allotted a few hours weekly, and will broadcast through the Huizen station on 1,875 metres. In addition to propaganda relating to the aims of the organisers, we may hope to receive from this source entertainment in the form of gramophone recitals.

Sponsored Broadcasts in U.S.A.

REVENUE derived from sponsored broadcasts is the mainstay of most American studios. One hour's programme on the Columbia Broadcasting system of eighty-two transmitters costs the advertisers approximately seventeen thousand dollars. The WEAF (New York) chain run by the National Broadcasting Company charges $12,886 for the same period of time, and if it links up with WJZ (Boundbrook) coast-to-coast unit a further expense of $11,740 is incurred. For the transmission of a publicity concert through all the main networks the fee amounts to roughly $35,000. In addition to this large sum, the artists must be paid separately by the firm taking the air, and an announcer specially engaged.

Matched Tuning Assemblies

IT is very noticeable this season how the component manufacturers are using their utmost ingenuity to simplify the task of the home constructor. For instance, there are now two or three firms, including Colverns and Formo's, who supply a complete tuning assembly consisting of the necessary matched coils mounted on an aluminium baseplate, with a ganged condenser already accurately "trimmed." This latter point is particularly good, because it saves the constructor an infinite amount of trouble, and he has the assurance that the job of trimming and matching has been done precisely by the use of instruments not available to the average amateur.

Radio-Gram Switch as Well

THE first-mentioned firm has carried the simplification even a step further by including, with the wave-change switch, another for bringing the pick-up into circuit. Thus, when the switch points to the left the set is in the medium-wave position. Turning it through sixty degrees (it is then upright) operates the pick-up switch, whilst turning it over to the right sets the tuning to long waves.

(Continued at foot of page 184.)

SOLVE THIS!

PROBLEM No. 4.

Smithkins had made a three-valve receiver, using the usual S.G. detector and power-valve arrangement. Signal strength was very much below that expected, and when tested all wiring was in order and all components were O.K. Tests with a milliameter showed that the anode current of the first two valves was correct, but that for the output valve was higher than it should have been. The valve was not defective, and H.T. and G.B. values were correct. What was wrong?

SOLUTION TO PROBLEM No. 2

The sections of the windings provided resonant circuits which accounted for the break-through.

The following readers received books in connection with Problem No. 2: W. J. H. Webb, 84, High Street, Blackwood, Mon.; E. A. Randerson, 358A, Upper Town Street, Bramley, Leeds; Alfred Laurenson, 81, West End Road, Haydock, Nr. St. Helens, Lancs.

CURING COMMON RECEIVER FAULTS

How to Track Faults in Your Receiver, and the Remedies to Apply.

By FRANK PRESTON, F.R.A.

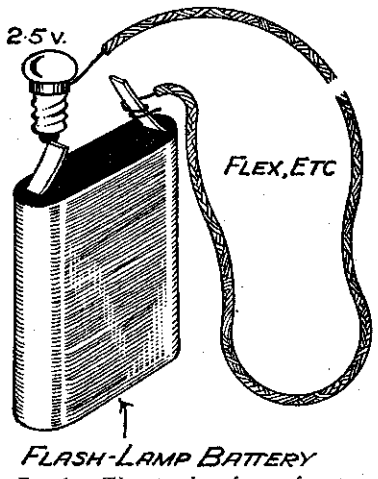


Fig. 1.—The simplest form of tester.

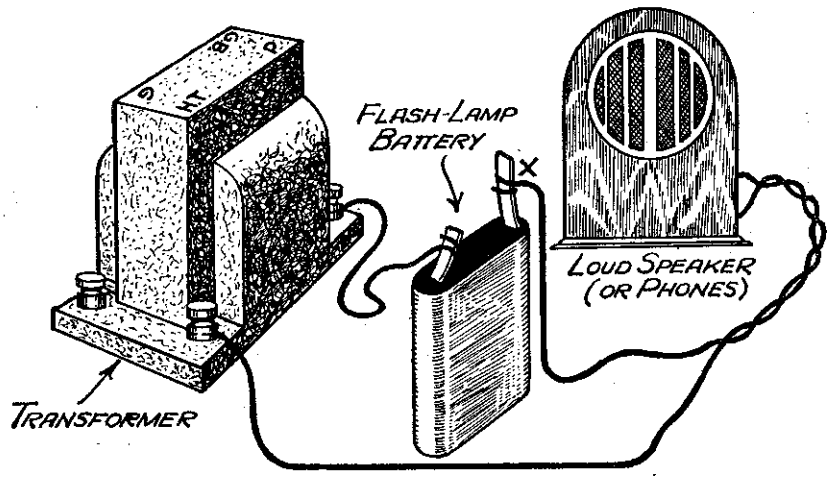


Fig. 2.—The way to test a transformer winding.

THANKS to the very explicit and easy-to-follow wiring plans, such as are frequently given in this paper, the construction of a radio receiver is so simple that it can be undertaken with confidence by any person of reasonable mechanical inclination. This is all to the good, so far as making a receiver is concerned, but trouble sometimes follows due to the set "going wrong." Most frequently the cause is something quite trivial, but is nevertheless difficult to trace without a knowledge of the correct procedure to adopt. It is the *system* of tracing faults which is most important, for once a correct one is established it is not usually a difficult job to locate any kind of fault. There are four distinct classes into which most of the more likely faults are divided; these are (1) a complete cessation of signals, (2) a falling off in signal strength, (3) intermittent reception and (4) reception accompanied by crackling sounds, and the procedure varies slightly in each case.

When Reception Fails Entirely

It is generally fairly easy to find what is wrong when reception fails entirely. First, suspect the aerial and earth wires if these are fairly old; ascertain that the down-lead is not broken and that it makes good contact with the lead-in tube. Trace the wire from the lead-in tube to the aerial terminal and make sure there is no break. This sounds very elementary, but the writer has come across more than one case where a flexible wire has been broken, although the break could not be seen, due to the insulation covering it. If any doubt exists therefore, it is well to remove the wire and test it for continuity with a flash-lamp battery and bulb (see Fig. 1). Failure of the bulb to light, or an intermittent light, indicates a broken wire. A bad earth connection is hardly likely to stop reception entirely, but it can do so in some cases. With a "buried plate" kind of earth, the wire usually comes adrift just where it is soldered to the plate. Should the aerial and earth wires prove to be in order, test, in a similar manner, the loud-speaker and battery leads, replacing any doubtful ones. The state of the batteries can generally be judged by the time from which they were last charged or replaced, but they occasionally come to an untimely end by being short-circuited, so it is as well to test them before looking at the set itself. A voltmeter or flash-lamp bulb is most useful for this purpose, but the tests must be applied whilst the set is switched on, or in other words, whilst the batteries are "under load" because run-down batteries will often give a fairly good voltage reading when disconnected from the set. Connect the voltmeter or bulb across the accumulator terminals first; there should be a steady reading of 2 volts per cell or a constant light in the bulb. The most satisfactory way to test a high-tension battery is to measure the voltage between each 6-volt tapping, since one faulty cell can spoil the performance of the whole battery. If the voltmeter is a low-resistance one, do not keep it in contact for more than a second or so; the same thing applies when testing the cells with a 6-volt bulb. Any faulty section of the battery may be short-circuited with a piece of flex and two wander-plugs. If an eliminator is employed for H.T., the voltage at its terminals can be measured with a *high-resistance* voltmeter. When the batteries have been checked, test the loud-speaker with a 2-volt accumulator. Connect one lead to an accumulator terminal and touch the other lead against the second terminal; there should be a distinct "plop" both as the connection is "made" and "broken." Next, look to the set and make sure that there are no loose connections, and that the valves are firmly in their holders. Try changing over two of the valves as a further check on their contacts. To make sure that high-tension current is passing through the output valve take out the H.T. wander-plug and replace it; two distinct clicks should be heard in the speaker. If the clicks are not heard there is a break in the anode circuit or else the valve is faulty. To decide whether or not the valve is wrong connect a high-resistance voltmeter between the negative filament terminal and the anode terminal of the valve-holder. If the voltage is normal the valve must be wrong, or else it is not receiving the proper L.T. current. Test for the latter possibility by connecting a voltmeter or flash-lamp bulb across the filament terminals. If the current is not reaching these points there must be a break in the wiring or the filament switch is not making proper contact.

A Burnt-out Transformer or Choke

If no reading, or even a low one, is obtained between the anode and H.T.— the fault is more likely to be elsewhere. In sets employing a choke or transformer in the anode circuit one of these components is probably "burnt-out." To test, connect a loud-speaker (or phones) and a battery across each winding in turn as shown in Fig. 2. When connection X is made and broken a distinct plop should be heard in the speaker. Do not mistake a feeble single "click" for the double "plop" because the former will probably be heard even if there *is* a break in the windings. Having made sure that the last valve is functioning correctly, pass on to the preceding one and apply similar tests. If decoupling resistances are connected in the anode circuit they will, of course, reduce the anode voltage, so a lower reading must be expected. Low-frequency transformers, chokes and resistances can be tested in exactly the same manner as the output transformer, but in the case of resistances the sound from the speaker will be less in proportion to the resistance value. Proceed with these tests until the detector valve is arrived at. The high-frequency amplifying valves can be tested in a similar manner, but it will be found quicker first of all to put them out of circuit by removing the aerial lead from its normal terminal and connecting it to the anode terminal of the valve immediately preceding the detector.

Where screened-grid valves are employed the lead normally going to the anode terminal on the glass bulb must be left in place. The detector and L.F. stages should then work by themselves, giving good reception of the nearer stations. Once it is established that the fault is in the H.F. amplifying portion move the aerial lead to the anode terminal of the first valve (when two H.F. stages are included). This will show whether the first or second valve is not functioning, so after deciding this point the anode circuit tests can be carried out on the valve not working as

explained for the L.F. valves. A further test is necessary in the case of S.-G. valves; the voltage on the screening-grid (connected to the "anode" pin) must be checked. This can only be measured with a *high-resistance* voltmeter. If there is no voltage reading disconnect the by-pass condenser wired between the screening-grid and

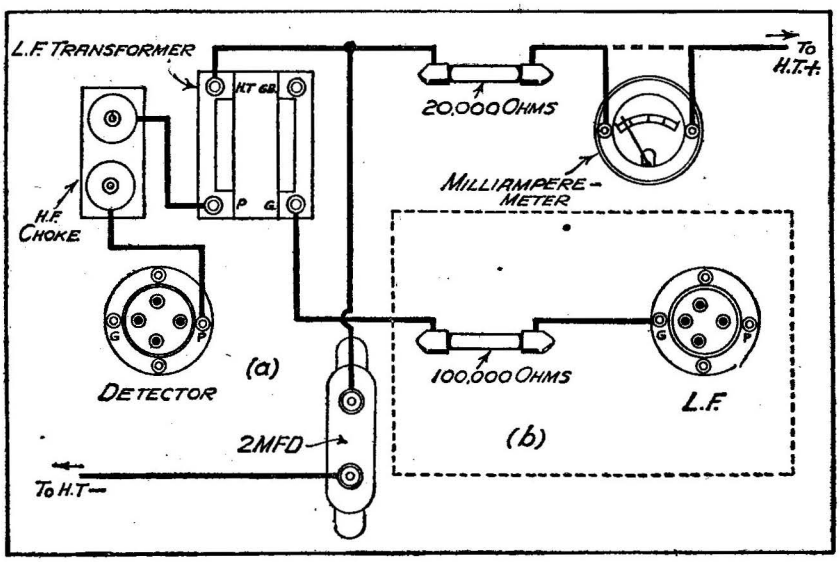


Fig. 3.—A decoupling resistance in the anode lead, and a resistance in the grid lead to cure instability.

earth, and repeat the voltage test. If the voltage is normal in the latter case the condenser must be short-circuiting the H.T. supply. The correct way to test any condenser is as follows: connect a battery to its two terminals for a few seconds, disconnect battery and allow the condenser to stand for some time. Then touch its terminals with a pair of loud-speaker leads; a distinct click should be heard in the speaker, showing that the condenser has held its charge. In carrying out such tests the condenser terminals must not be touched with the hands or the charge will leak away. The battery voltage should vary from about 100 volts for capacities of .0001 mfd., to 4 volts for 4 mfds.

Should it be found that the anode circuits are right, the tuning coils and condensers should receive attention. Coils can be tested in the same way as transformers, resistances, etc. (Fig. 2). The same apparatus is required for testing variable condensers, but in this case there should *not* be a click; rotate the vanes to make sure that they do not short-circuit at any point. Before leaving the tuning system see that the contacts of the wave-change switches are properly opening and closing. This is especially important when using ganged coils with self-contained switches, because it is often found that a switch blade in one of the coils has become jammed or strained, with a result that it does not move with the others. When testing any component it should be disconnected entirely from all others and preferably be removed from the set. All the above tests have been referred to battery receivers, but most of them apply equally well to mains sets. In testing the filament or heater supply in sets of the latter type a flash-lamp bulb is most convenient, but if a voltmeter is preferred it must be of a pattern suitable for alternating current.

Weak Reception

Generally speaking, the cause of weak reception can be traced in the manner just outlined, but there are a few additional tests which are sometimes necessary. The most important of these is to measure the anode current to each valve in turn. A milliammeter is required for this purpose, and one showing a full scale deflection on 10 milliamps. is most convenient. Measure the anode current to each valve by breaking the connection between H.T. + and the anode component (resistance, transformer primary, choke, etc.) as shown in Fig. 3. The current passing can then be compared with that given on the maker's instruction sheet for the particular H.T. voltage in use. Remember that it is the voltage between the *anode of the valve* and H.T.— which counts and not the total battery voltage. Too low a current indicates (1) too much grid bias; (2) run-down accumulator; (3) defective valve. In the case of all-mains receivers it might also indicate that the rectifier valve is losing its emission, but the H.T. voltage would then be low. An unduly high anode current indicates (1) insufficient grid bias (probably a burnt-out resistance, if an all-mains set); (2) a break in the grid circuit; (3) valve oscillating; or (4) if an S.-G. or Pentode, screen voltage too high. To check for (3) touch anode terminal with damp finger; the current will change if valve is oscillating. If the anode current fluctuates when signals are not being received there must be a bad contact in either anode or grid circuit. To check, first short-circuit the anode components in turn to find which, if any, is wrong. Then do the same with grid circuit components. When the anode current to every valve is normal and yet reception is impossible it is fairly safe to assume that a component in either the grid or anode circuit is short-circuited.

Intermittent Reception and Crackling

These two forms of trouble are often confused one with the other, so it might be well to explain the difference. Intermittent reception, that is when signals come and go without there being any noises, are generally caused by a fault in the aerial or tuning circuits, whilst crackling is more often due to a bad contact in an anode circuit. The method of testing anode circuit components has been dealt with previously and the tests described apply in this case. If the crackling can be provoked by lightly tapping the panel it is quite clear that a connection must be loose, but if it is unaffected by this treatment a transformer or similar component is probably defective. In the former case make sure that all the valves fit tightly in their holders and that the pins are clean. Also take the same precautions in respect to the high-tension wander-plugs. Crackling noises are very frequently caused by a run-down high-tension battery or by a faulty cell. A new battery would, of course, put things right, but a temporary remedy might be effected by connecting a 2 mfd. or 4 mfd. condenser between H.T. negative and one of the positive tappings. Intermittent reception is often caused in a very sharply-tuned set by the aerial lead-in blowing to and fro and so changing its capacity to earth. The same effect would be noticed if some wires or components were free to move inside the set. Although this particular form of trouble is most common in short-wave receivers, it does sometimes occur in broadcast instruments.

Other Common Faults

Another cause of much exasperation is low-frequency reaction. This sometimes manifests itself as a constant whistle which accompanies all reception, and sometimes as a peculiar spluttering noise commonly referred to as "motor-boating." It is more common in older sets and becomes particularly troublesome when the high-tension battery begins to run down. The fault can often be cured by the well-known method of fitting a decoupling resistance in the detector anode lead and by-passing this with a 2 mfd. condenser. Figure 3(a) illustrates this point.

When two transformer-coupled L.F. valves are employed, the trouble can often be remedied by reversing the leads to the secondary terminals of the second transformer. Sometimes the howling is caused when the speaker is near to the set, by inter-coupling between the loud-speaker leads and the first valve. In that case the

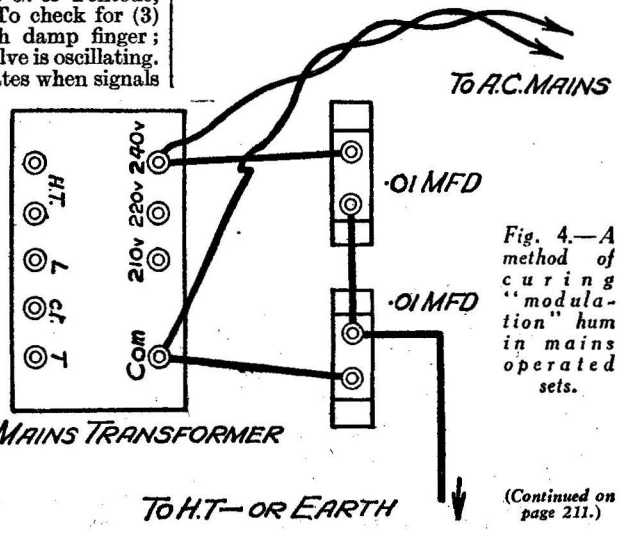


Fig. 4.—A method of curing "modulation" hum in mains operated sets.

(Continued on page 211.)

Mains Hum—and How to Cure It

By GILBERT E. TWINING

Hum is Frequently the Bugbear of Mains-operated Sets. Our Contributor Here Explains Some Simple Methods of Curing It.

HUM is sometimes difficult to remove entirely from sets working off alternating current; a great deal may be done, however, to rectify this fault. A good earth connection is essential, reception may be stronger with less mains noises. If a new mains-driven set hums badly when it is first switched on, the smoothing can generally be taken as being inadequate and the fitting of an additional smoothing condenser in the filter circuit will doubtless improve matters. Rectifier hum can be cured by wiring two .1 microfarad fixed condensers between the two rectifier anodes and high tension negative, see Fig. 1.

Very often where a speaker is built into the same cabinet with the set and mains unit, ripple is caused by inductance of the speaker leads, especially if it is of the moving-coil pattern. The leads must be kept as far from the mains side of the set as possible. In some cases the detector valve is fitted too close to the speaker and the valve will be affected by the sound waves, causing noises which may be taken as mains trouble. Shielding may be resorted to, but it is better and often a necessity to move the valve somewhat. The speaker can be tested by temporarily working it away from the set. With any type of speaker connected to a mains set it is advisable to isolate it from the anode current by either a transformer output or choke-filter circuit. The anode current of the last valve is then prevented from flowing through the windings.

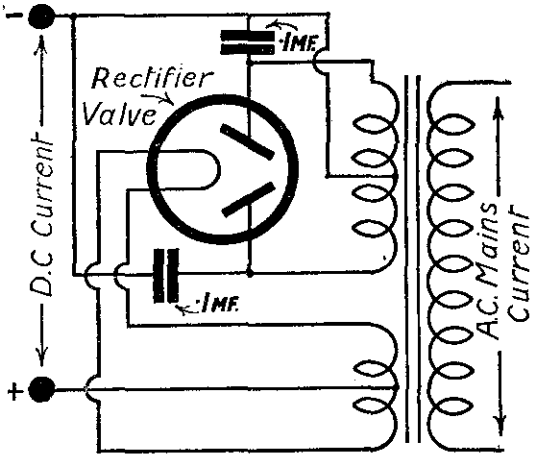


Fig. 1.—Rectifier hum can be cured by connecting two .1 mfd. fixed condensers between the two rectifier anodes and high-tension negative.

Only the low frequency signal currents pass through the loud-speaker. This fact not only eliminates all chances of shock if the L.S. terminals are accidentally touched, but also greatly helps in decreasing hum. It may be necessary to alter the position of the low tension A.C. heater wires which run to the filaments of the valves from the power transformer. They should be kept as far as possible from the grid circuit.

Another point to look into is poor contact at the grid pin of the detector valve in its holder. The grid circuit of the valve is very sensitive, and the pin must therefore make proper contact with its socket; a lower value of grid-leak may also be found beneficial.

Using Alternating Current

A few words regarding converting alternating current to direct current may not be out of place here, for if one is to correct the faults of mains hum the "why and wherefore" should first be known. In utilising alternating current from the mains for high tension, the A.C. has first to be converted to D.C. Instead of the current rising and falling in one direction and then rising again in the reverse direction—in other words changing its polarity—some fifty times per second, as it does in alternating current, it has to be made to rise and fall in one direction only. This is the work of the rectifier. There are two distinct types of this piece of apparatus in use at the present time, one the valve and the other the metal rectifier.

To operate a wireless receiver it must be supplied with a smooth direct current. Therefore before the rectified A.C. can be utilised, it must first be filtered, that is to say, smoothed, for, although the rectified current flows now in only one direction, it still is changing in intensity, *i.e.*, pulsating. To eliminate ripple it is made to pass through condensers and a choke. Across the D.C. leads are shunted fixed condensers of several microfarads capacity. In series with these condensers is a low-frequency choke; this is placed between the first condenser which is known as the rectifier condenser, and the last or reservoir condenser, see Fig 2.

The first condenser receives the pulsating D.C. from the rectifier, so that owing to the reservoir action of this condenser the current which flows through

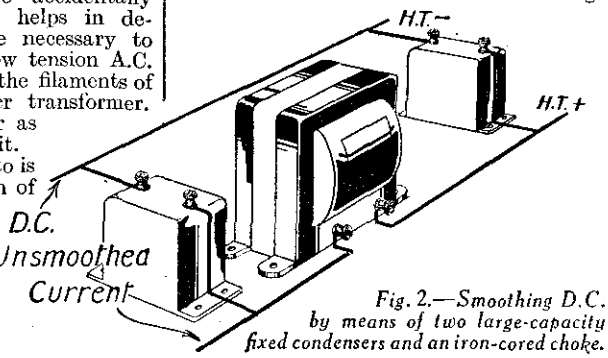


Fig. 2.—Smoothing D.C. by means of two large-capacity fixed condensers and an iron-cored choke.

to the choke is a great deal more smooth. The choke in its turn does the work of opposing current fluctuations, passing on a still more steady flow to the second condenser; this is the final reservoir from which the high tension is derived for the set. Usually the inductance value of the choke is not less than 30 henries and the capacity of condensers at least four micro-farads each.

Spacing Components in Mains Sets

Great care must be taken when building a mains set to see that all of the components are in their correct positions; place the power transformer as far away from the receiving side of the set as possible, also the smoothing choke, in fact, it is better to keep the whole of the mains unit at least six inches from the rest of the set, and, if possible, below the base-board.

Often what is supposed to be mains hum is actually L.F. oscillation. Some battery sets work perfectly with dry batteries on voltages in the neighbourhood of 100, but when they are connected to an eliminator giving voltages of 150 to 180, a hum is very noticeable. The obvious cure for this is the fitting of de-couplers in the L.F. circuits and possibly in the H.F. circuit as well, especially in the case of a screen-grid valve. De-coupling tends to stop varying currents from entering or leaving the transformer and valve circuits and ensures a steady flow from the supply.

FADING

A PHENOMENON which is experienced by all listeners, whatever kind of receiver they use, is that of fading, which occurs principally when listening to distant stations. Fading is inevitable and incurable, but it is nevertheless interesting to learn how it is caused. When wireless waves are sent out from a transmitting aerial they divide into two portions, and each one travels in a different way. One part, called the "ground wave," follows the curvature of the earth and in time is all absorbed by metallic objects. The other part travels upwards at an angle to the ground until it encounters the Heaviside Layer. This layer, which is estimated to be about fifty miles above the earth, consists of ionised atmosphere and acts as a reflector to the waves. The upward waves are therefore reflected back again just as light waves are reflected by a mirror. But as the Heaviside Layer presents an uneven surface and is in constant motion, the reflection is uneven. Thus the reflection is at one time "favourable" to any particular aerial, and at another, "unfavourable"; hence the fading. The same general theory explains why reception of distant stations is always better after dark than in daylight.

NOISES: THEIR CAUSE

An Article in which Every Listener will be Interested. to Wireless are Caused, and Also Describes Some

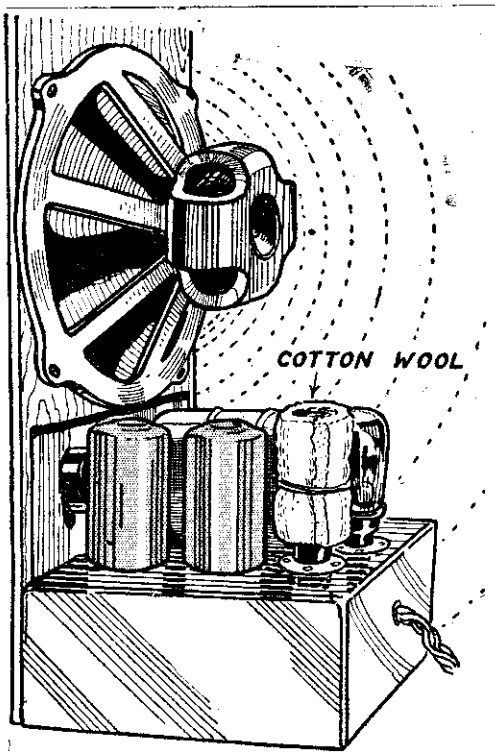


Fig. 1.—A jacket of cotton wool round the detector valve, so as to prevent sound waves from the speaker impinging on it, will often stop a microphonic howl.

THE subject of extraneous noises in reception is such a large one that it is impossible to deal with it anything like fully in the space at my disposal. I shall therefore enumerate some of the more frequent types of disturbances and endeavour to explain their causes, and, more especially, suggest some practical remedies.

Noises may be roughly divided into two classes — those which come from some cause within the set, such as motor-boating, microphonic noises, and certain crackling noises, and those which arrive via the aerial or the mains, such as atmospherics, mains hum, etc. I will deal with the internal noises first.

Microphonic Feed-back

This particularly vicious form of disturbance practically disappeared with the improvement in valves, but, unfortunately, has returned to a certain extent with the introduction of so many self-contained sets.

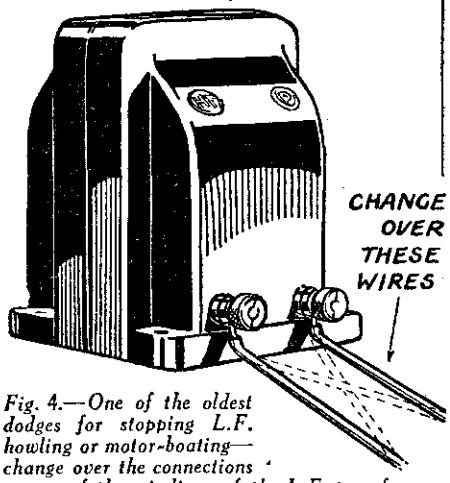


Fig. 4.—One of the oldest dodges for stopping L.F. howling or motor-boating—change over the connections to one of the windings of the L.F. transformer as shown by dotted lines.

It is chiefly caused by the sound waves from the speaker impinging on the detector valve. If the electrodes of this are not absolutely rigid, it will act as a microphone, as can be demonstrated by tapping the valve sharply with your finger. A microphonic valve will give out a ringing sound from the speaker. In the same way sound from the speaker itself, on striking the valve, will set it vibrating. This in turn causes the ringing sound in the speaker, and in bad cases this ringing sound gradually builds up to a volume which drowns everything. The fitting of anti-microphonic valve-holders is obviously the first step towards a cure. Try also fitting a rubber ring round the bulb of the valve, or placing a jacket of cotton gauze round it, as in Fig. 1. If the trouble still persists, the cause may not lie only with the valve, but may be due to the vibrations from the speaker setting up sympathetic vibrations in the vanes of the variable condensers. In this case the building-up usually occurs only when the set is tuned-in to a heavy carrier. Condensers without supports to the tips of the moving vanes (see Fig. 2) are usually the cause, and the remedy lies either in their replacement by more rigid types or the mounting of the speaker or the baffle on felt or sponge rubber pads as in Fig. 3.

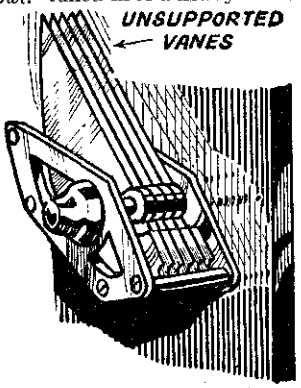


Fig. 2. — Vibrating condenser vanes may cause a microphonic howl.

L.F. Howling and Motor-boating

Most home constructors have encountered this at one time or another. It is usually a loud and pronounced howl which is quite independent of the tuning of the set, but often affected by the reaction coupling. It varies in pitch from a shrill note down to so low a one that each separate beat can be distinguished, thus producing a regular "Plop, plop, plop!" In this latter form it is known as motor-boating. It may be due to a variety of causes, such as interaction between components resulting from bad spacing, feed-back caused by a worn-out H.T. battery, overloaded mains unit, etc. Fortunately, it is not difficult to overcome if tackled systematically. One of the oldest and simplest dodges is that of changing over one pair of leads to the L.F. transformer. Simply reverse the connections to either the primary or the secondary, *but not to both*. In the case of two transformer stages, only one should be altered. Failing that, fit a decoupling resistance and condenser in the anode circuit of the detector valve as in Fig. 5. Also try a choke and condenser output filter if one is not already present. This is an almost certain cure where the trouble emanates from the mains unit. Fig. 6 shows the usual arrangement. In the case of receivers which derive their grid bias from the mains, decoupling should be included, as is also shown in Fig. 6.

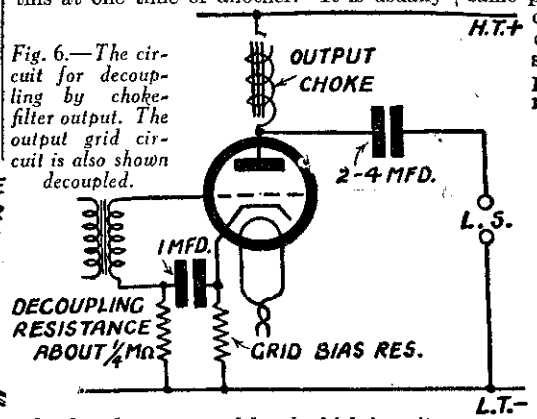


Fig. 6.—The circuit for decoupling by choke-filter output. The output grid circuit is also shown decoupled.

H.F. Oscillation

Unsuitable components, bad lay-out, and inadequate screening all contribute towards instability in the H.F. stages, resulting in uncontrollable oscillation. Of course, with home-constructed sets built up according to the designer's specification the trouble is not likely to occur, since such troubles are cured before the design is offered to the public. Naturally, a few cases do occur where trouble arises through some unseen cause, such as exceptional local conditions or a "dud" component; but it is more often the set which is not to specification, or which has been altered from time to time, which causes most bother.

As regards a cure, I can only repeat what everyone has heard time and again—namely, pay particular attention to lay-out and wiring. Unshielded coils should be placed with their windings at right angles to minimise interaction. The same applies to H.F. chokes, which should not be placed with their windings in the same plane as those of an adjacent coil. Fig. 7 shows the proper way to mount them.

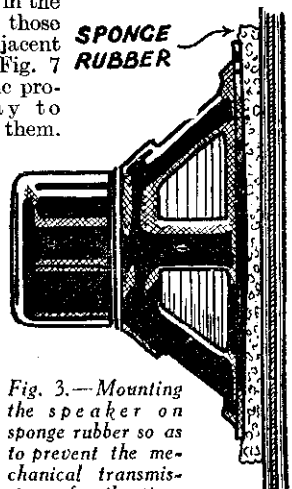


Fig. 3.—Mounting the speaker on sponge rubber so as to prevent the mechanical transmission of vibrations to the set itself.

—AND REMEDY—1

It Explains How the Majority of Noises Common Simple Remedies.—By W. B. RICHARDSON.

Non-inductive-type condensers should be used where possible, especially for decoupling band-pass coils. Keep the connection from the grid of the detector valve to the grid condenser as short as possible, as in Fig. 8. The substitution of metallised valves for ordinary ones in the S.G. and detector stages also helps where screening is inadequate.

Crackling Noises

Some of the causes of intermittent crackling noises produced by the receiver itself are as follows:—Worn-out batteries, bad connections, "burnt out" transformer windings, and faulty resistances. If you know definitely that the H.T. battery is the cause, the remedy is obvious, but if you are not certain, the voltmeter will give you some idea. Usually, if the voltage has dropped by 25 per cent., the battery is well on the way home, and more than likely to crackle. If the battery is O.K., it is quicker to test the receiver stage by stage than to try and guess the cause. Disconnect the loud-speaker and join it, or a pair of 'phones would be better, in the anode circuit of the detector valve, as in Fig. 9. If the cracklings are apparent in the 'phones, then the trouble lies in the H.F. or detector stages. Tighten all terminals and examine all soldered joints very carefully. A soldered connection may be cracked right across without the crack being visible until pulled apart. Test the valves in their holders and open each valve leg slightly to ensure its making proper contact. Short the switch with a piece of wire while it is in the "on" position, as in Fig. 10. If the crackling ceases, the fault lies in the switch. Any spaghetti resistances present may be the culprits, especially if twisted or stretched. Of course, if you have others handy, you can replace them, but sometimes moving them about or refitting them so as to avoid kinks or twists will prove whether or not they are the cause. Test the grid leak in the same way. Here is a tip worth while—if you haven't any spare grid leaks or resistances for comparison when making these tests, you can always borrow any from the idle L.F. stages. The values may not be quite the same, but they will be quite all right for the purpose of locating the crackling.

If no crackling is heard in the 'phones when placed in the detector anode circuit (across A and B in Fig. 9), alter the connection to include the primary of the transformer. If the crackling appears, the transformer is the trouble. If the set is still silent, and there is a decoupling resistance fitted, join the 'phones across A and E, so as to include the resistance as well. The commencement of crackling would indicate that the resistance is the cause. If there are still no results, pass on to the next stage by connecting the 'phones (or rather the loud-speaker, as the signals will be louder in this stage) in the anode circuit of the next stage. If this is also the last stage, then, naturally, you will join the speaker to its usual terminals. Now test for loose terminals, faulty resistances, etc., in this part of the circuit, as in the previous stages. In the case of R.C.C. coupling, the coupling condenser is unlikely to give trouble, but the simplest way to test it is to replace it with another. The same applies to decoupling condensers.

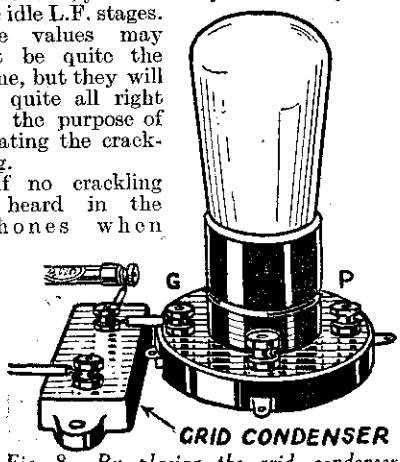


Fig. 8.—By placing the grid condenser close to the valve-holder the lead from grid to condenser is kept short—which makes for stability.

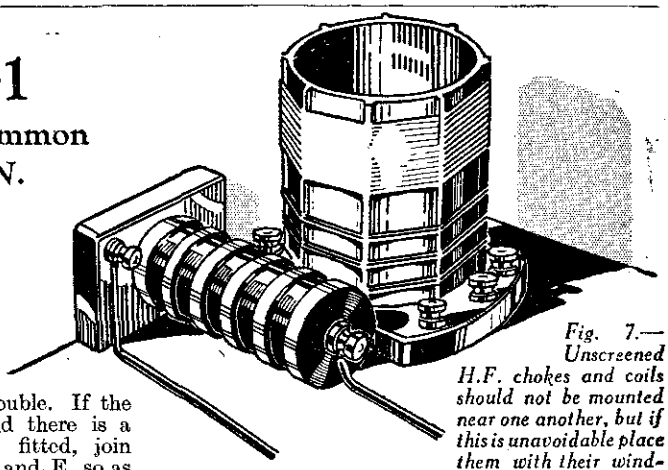


Fig. 7.—Unscreened H.F. chokes and coils should not be mounted near one another, but if this is unavoidable place them with their windings at right angles to prevent interaction and H.F. howling.

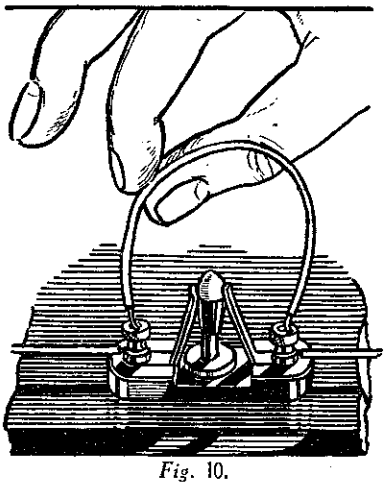


Fig. 10.

Faulty Mains Unit

In this stage-by-stage testing I have more or less assumed that the set under test is battery-operated. In the case of a mains set, procedure is the same except that there is just the possibility of the trouble being caused by a partial breakdown in the mains unit. In this case you would not get beyond the first stage, since, whatever test you tried, the crackling would persist. Fortunately, this is of fairly rare occurrence. The cure is obviously an overhaul of the mains unit and the replacement of any defective parts. Another rather rare cause of crackling noises is due to a defective L.T. accumulator. The positive plates of old accumulators of the block plate type, are inclined to break up. Only intermittent contact occurs between the two parts. A broken lug will have the same effect.

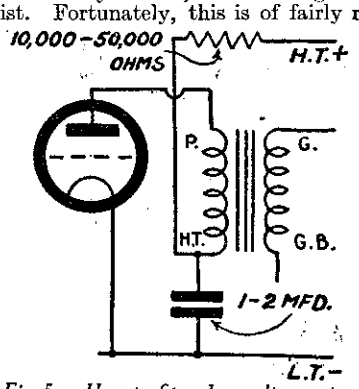


Fig. 5.—How to fit a decoupling resistance and condenser to stop motor-boating.

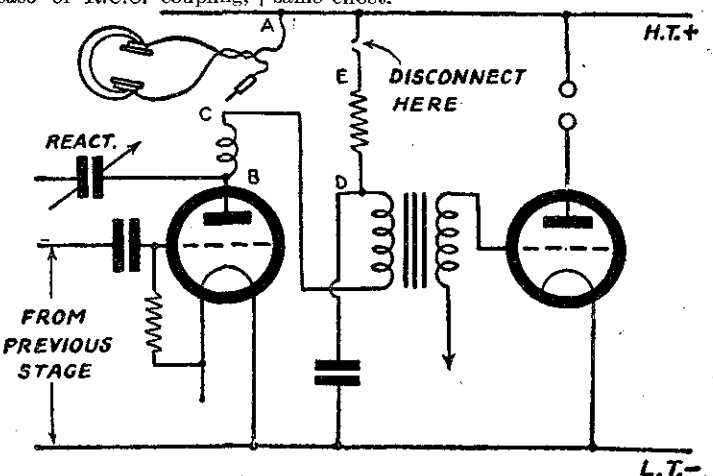
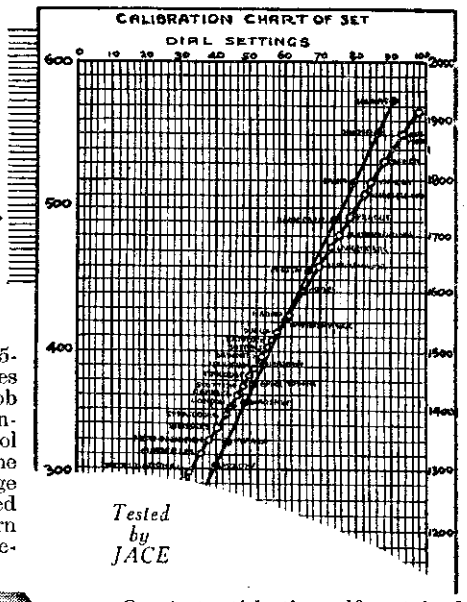


Fig 9.—How to test for "crackling" noises. To test the H.F. and detector stages disconnect H.T. from E and join 'phones across A and B. To test H.F. choke as well join 'phones across A and C. To include transformer join them across A and D. To include decoupling resistance join across A and E.

Receivers and their Records

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

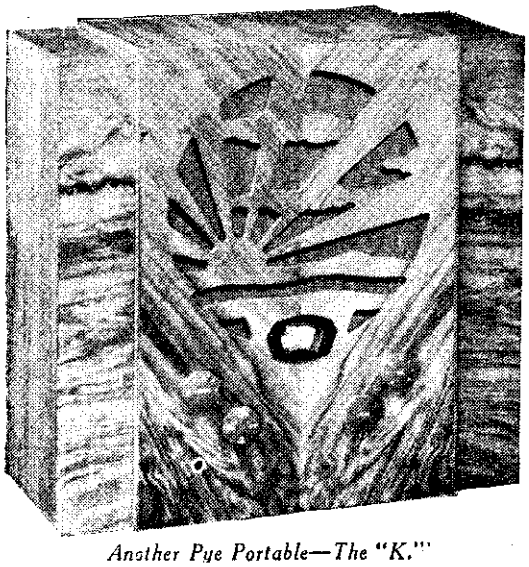


Tested by JACE

TO the man whose house or flat is not equipped with electric-light mains the Pye "Q" Portable should prove an ideal receiver. It is undoubtedly one of the best-designed four-valve battery sets we have had on our test bench. The circuit is a straight one offering no complications and thus not likely to give any trouble to its owner. The valves used are of the latest Mazda type, consisting of a screened grid, detector and low-frequency transformer coupled to a fully tone-compensated pentode output stage. The low price of 14 guineas "all in" is particularly attractive, as the receiver is entirely self-contained, including frame aerial, accumulator and 126-volt combined grid-bias and high-tension battery of liberal dimensions. Although already equipped with an efficient loud-speaker provision has been made for a second one, if desired, and the output of the set is amply sufficient to feed both instruments adequately. It is essential, of course, that the extra speaker should be matched to the Pen 220 pentode valve fitted in the receiver and a suitable one is specially recommended by the makers. Should the purchaser, however, desire another type, a Pye pentode output transformer, Type 675 P, should be used for connecting it to the set. It is a triple-tapped transformer, giving ample range for many models of speakers. The controls have been very cleverly placed at one end of the cabinet and are of a simple nature; they can be mastered in a few minutes by a mere novice. They do not mar, as is the case with many makes, the good appearance of the cabinet.

The Model "Q" Portable, test report of which is given here.

The change-over from "short" (225-550 m.) to "long" (900-2,000 m.) waves is made by means of the right-hand knob which also acts in both positions as an on-and-off switch. The main tuning control almost underneath it, which operates the ganged condensers, is of the milled-edge type. As the scales are directly calibrated in wavelengths it is an easy matter to turn the dial to the particular wavelength required. For finer tuning and, at the same time, extra volume, in consequence, the small left-hand trimming condenser—also a milled-edge—is used. Opposite the on-off and wavelength change switch, but in the top left-hand corner, you will find a knob marked in progressive numbers. This is the volume control. By turning this slowly clockwise, sensitivity may be increased up to oscillation point, and in this way gives a perfect control of volume when dealing with more distant transmissions. If a powerful local station is received the knob should be turned back to position "1" or even to the point marked "Vol." in special circumstances. Critical adjustment can be made with this control in conjunction with the trimming dial. In order to take full advantage of the directional properties of the frame aerial the receiver is fitted with a turntable. Provision has also been made for the connection of an outside aerial and earth, if desired; this will be found of great value in the capture of weak and distant broadcasts.



Another Pye Portable—The "K."

On test with the self-contained frame aerial alone, the Pye "Q" Portable proved highly efficient. Perfect reception was received of the two London programmes, and Daventry National, Midland and Northern Regional transmissions at full loud-speaker strength. During daylight hours no trouble was found in tuning-in Radio-Paris, Huizen (1,875 m.) and the two Brussels broadcasts as well as Petit Parisien, Eiffel Tower and three German stations. Later, some twenty transmissions, including Radio Normandie, Bordeaux-Lafayette, Breslau, Strasbourg, Radio Toulouse, Sottens, Stockholm, Rome, Beromünster, Langenberg, Prague, Vienna and Budapest, were added to the log; and such was the calibration of the scale that the tuning within a hair's breadth coincided with the exact metre readings. On the "long" waves, Leningrad, Oslo, Kalundborg, Moscow (T.U.), Motala, Warsaw and Zeesen furnished ample signals on two loud-speakers. Judicious use of the volume-control, trimmer and turntable allowed a *complete separation* of *Königs Wusterhausen* from Radio-Paris and Daventry National. The addition of an aerial and earth brought in a number of weaker broadcasts but on this particular evening also added interference by atmospherics.

Although not specially designed for the connection of a gramophone pick-up, to secure this further advantage no alteration in the wiring of the receiver is necessary. All that is needed in addition to the pick-up is a valve adaptor and an external potentiometer of suitable value as volume control.

The Pye SQ4E battery is of generous proportions; it supplies 126 volts high-tension and the necessary grid-bias. The setting up of the receiver is exceedingly simple and full instructions are given in the booklet supplied with it. All leads are traced by a wiring colour code and no mistake can be made.

The PYE "Q" Portable is simple to operate, possesses all the attributes of a much more expensive receiver, is economical in its high- and low-tension battery consumption and, in view of its reduced price and excellent all-round performance, can be recommended in full confidence to our readers.

SOME FACTS ABOUT—

THE SCREEN-GRID AMPLIFIER

By L. F. THOMAS

Methods of Arranging a Screen-Grid-H.F. Stage, with Means for Adjusting the Voltage on the Screening-Grid

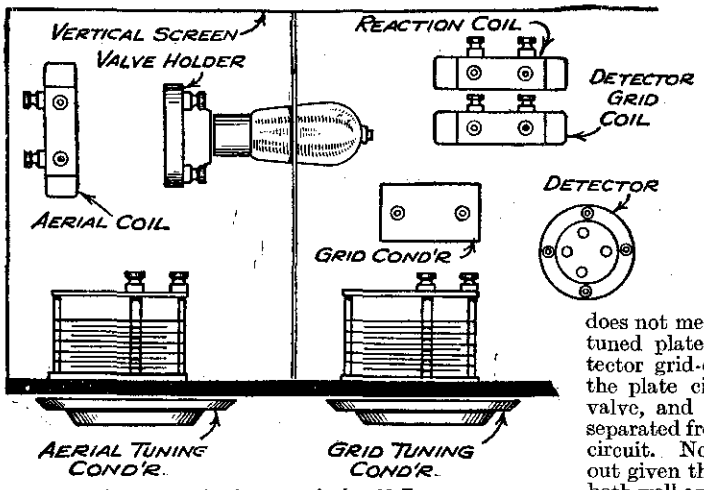


Fig. 1.—The layout of the H.F. stage.

IN dealing with the design of amplifiers, the L.F. amplifier may be dealt with first, as this part of a receiver may be left intact, and added to a new receiver. There are a number of facts which have already been dealt with in the pages of PRACTICAL WIRELESS, and it will therefore be assumed that the reader has a fair knowledge of the principles underlying the design of the low-frequency stages, whilst we will now discuss the H.F. amplifier.

The L.F. amplifier needs to be correctly designed, once and for all. When it is finally "passed" as being satisfactory, there is very little point in making any alterations to it. The detector, on the other hand, is always a good field for experiment; and the H.F. amplifier comes still further into this category. One definitely cannot build an H.F. amplifier and say "This amplifier is now as good as it is possible for me to make it." It is so difficult to tell what one *ought* to be getting from it.

The Screened-Grid Valve

Let us deal first with the simplest form of H.F. amplifier—the screened-grid valve and its associated circuits. The input, or grid circuit of the amplifier receives, from the aerial, a relatively small signal. This has to be amplified, and it will appear, in its amplified form, in the plate circuit, thence to be handed on to the following valve—probably the detector. It is of paramount importance that it *should* all be handed on in this way, and that none of it should find its way back into the grid circuit; for if this happens the amplifier will become unstable and useless.

There you have, in a nutshell, the big practical point to watch in any H.F. amplifier. Now for some hints on the subject of achieving this state of affairs. First and foremost, let it be understood that the two circuits *must* be screened from each other. This does not merely mean that the two coils concerned should be placed on opposite sides of a piece of metal—it means also that the plate end of the screened-grid valve must be separated from the grid end in the same way. The easiest and most frequently-used method of doing this is to mount the valve horizontally, through a hole in a vertical screen. Fig. 1 shows an excellent layout of parts for this purpose, and Fig. 2 shows one of the best circuits to employ for the purpose. Although the plate of the screened-grid valve is connected to the positive H.T. through a choke, this does not mean that there is no tuned plate circuit. The detector grid-circuit is virtually the plate circuit of the H.F. valve, and must therefore be separated from the latter's grid circuit. Note that in the lay-out given the two circuits are both well away from the metal screen, and that the coils are mounted at right angles to minimise the risk of interaction between their fields.

If our first valve were of the ordinary three-electrode variety, it could oscillate when the two circuits were tuned to the same wavelength, *even if there were no coupling whatever* between them. The

"coupling" in this case would be provided by the grid-plate capacity of the valve itself, and it is this effect that brought about the invention of the screened-grid valve, with its screen between the electrodes and its low internal capacity.

Parallel Feeding of the H.F. Valve

Now let us deal with a few more practical points. One has already arisen without being definitely mentioned—that is, the practice of "parallel-feeding" the H.F. valve in the manner shown in Fig. 2. In the writer's opinion, this is always preferable to series-feed (*i.e.* the method whereby the second tuned circuit is placed actually between the plate of the S.G. valve and the positive H.T.). But a good choke *must* be used. If you make it yourself, take as much care over its construction as you would over that of a low-loss coil. Regarding the voltage used on the screen of the valve, there is little to say except that you will generally find it as well to keep to the makers' instructions. With battery-operated sets you will probably use a separate tapping for this purpose. In the case of a mains-operated set it is more usual to arrange a potentiometer across the H.T. supply to allow for finding the best voltage.

Controlling Screen Voltage

A little-used, but excellent, scheme is to arrange a "fixed potentiometer" for this purpose. This consists simply of two fixed resistances in series, the extremes being connected to positive and negative H.T., and the "joint" to the screening electrode. The total resistance should be between 50,000 and 100,000 ohms. As an example, 30,000 ohms to earth and 60,000 ohms to positive H.T. will give you one-third of the total H.T. voltage on the screen. 50,000 ohms "in each direction" will naturally give you half the voltage. A good rule, for most types of screened-grid valves, is to give the screen five-eighths of the full plate voltage. 50,000 ohms to H.T. negative, and 30,000 to positive will, of course, give this state of affairs.

Since so many separate problems arise out of the design of a good H.F. amplifier with a three-electrode valve, this subject is being kept for the next article in the series.

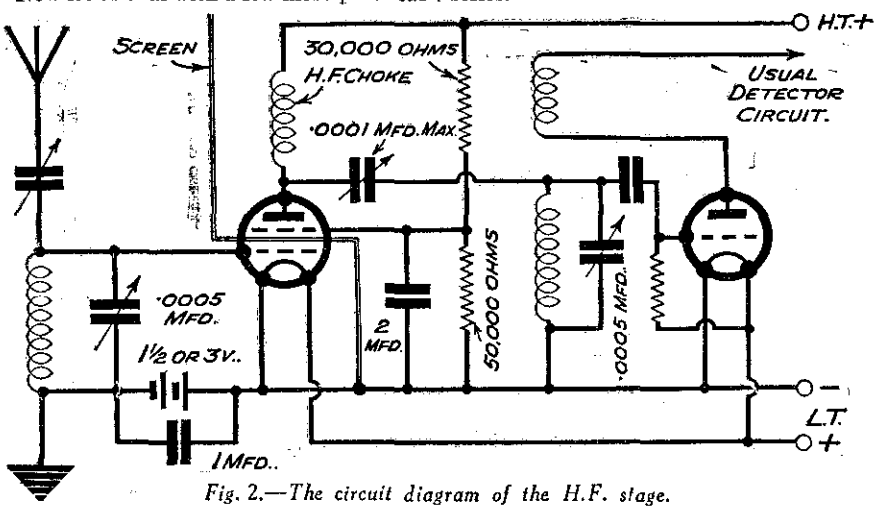


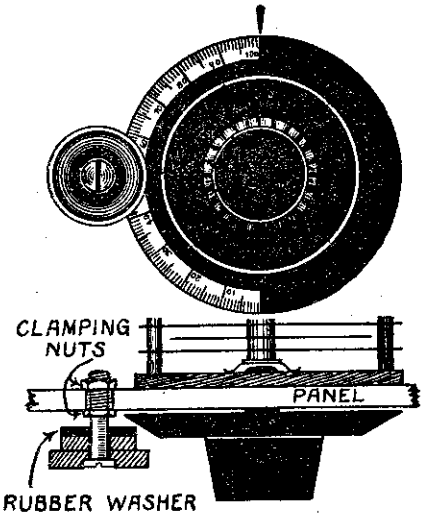
Fig. 2.—The circuit diagram of the H.F. stage.

Radio Wrinkles FROM READERS

THE HALF-GUINEA PAGE

A Handy Slow-Motion Knob

THERE are thousands of wireless sets in use to-day that are not provided with a slow-motion dial, and those readers who own such sets will find this idea particularly useful. A small knob (a large terminal head will do) with a hole through the centre, a rubber washer, and a bolt which passes easily through the hole in



The above sketch shows a simple method of attaching a slow-motion device to the dial of a condenser.

the knob are all that is required. The illustration explains the rest. The rubber washer, of course, is stuck to the inside face of the knob. This does not interfere with the dial being turned in the usual manner, and by pressing the small knob against the dial, much more accurate tuning may be accomplished. —A. DENTON (Southampton).

For Frayed Cords

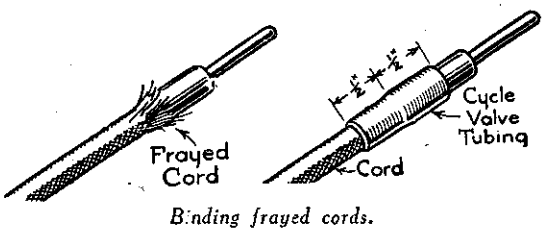
WHEN cords such as those used for battery and speaker leads become frayed, it is a good plan to cover the frayed ends as shown in the accompanying sketches. Procure a pennyworth of cycle valve-tubing and cut this into 1in. lengths. Bind the frayed cord with cotton and then slide a piece of valve tubing over the cord so that it overlaps the cord about 1in. This method is cleaner than insulating tape, which is liable to become sticky.—S. HARDING, (Manchester).

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 first batch which has been selected are 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*.

How to Fix a Dial Light

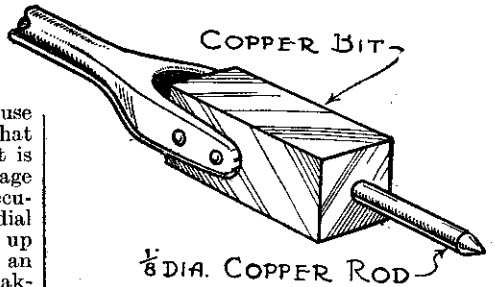
IF your set is near a window—placed there with the object of keeping your aerial and earth wiring short—it is probably back to the light and the dials are difficult to read. It is a good plan to place tiny spots of white enamel against the readings of your usual programmes, and also on the pointer on the panel. Tuning in to the locals is then a very easy job, as there is no need to look for numbers. But what is required generally is some kind of artificial illumination. There are several alternatives. You can take a couple of wires to your L.T. battery, and use a pilot light. This has the advantage that it gives visible indication that your set is switched on, but it has the disadvantage that it is helping to run down your accumulator. A better plan is to instal a dial light and a switch, so that you can light up for tuning in and then switch off. Use an ordinary flash-lamp bulb and battery, making the wiring independent of the wireless connections. If your set is a home-made affair, here is a good way of making a neat job of it. Many sets are housed in a cabinet which has a fretted front, the baseboard and panel sliding in from the back. Sacrifice half an inch of your baseboard and insert between the panel and the fretted cabinet front a piece of 7-ply wood similarly fretted. The effect is an improvement in the appearance of the set, as the dials appear to be set back in the cabinet. This 7-ply lining should have sections cut away above the dial or dials to accommodate the tiny lamps and holders, and be permanently fixed in the cabinet. House an ordinary lamp battery on the inside of the cabinet, and a switch on the side, completing the simple wiring so that the whole lighting plant is on the cabinet and quite independent of the set. If two lamps are used, wire in series, breaking one wire at the switch. A suitable switch is the tiny tumbler type to be had for a few pence. The cutting of the wood may be done with an ordinary fretsaw, using a stout saw, as there is a good thickness of wood. The edge which is visible must, of course, be sandpapered and stained to match the cabinet, and the job is simple to any handyman.—R. A. BOOTH (Cambridge).



Binding frayed cords.

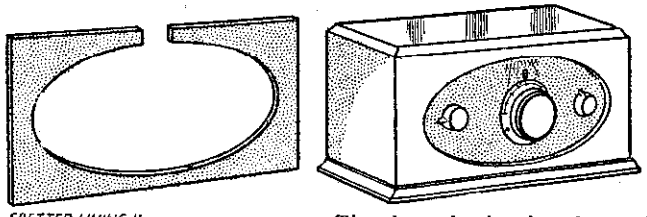
Soldering in a Restricted Space

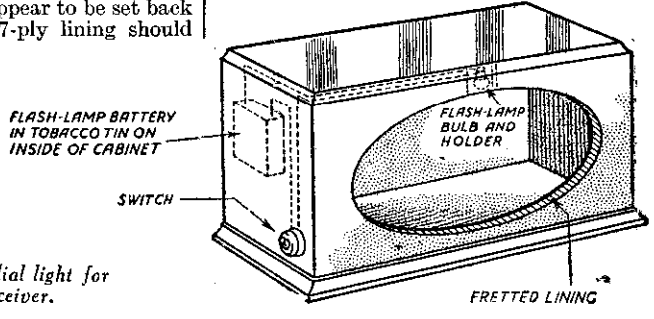
IT is sometimes necessary to use a very small bit on a soldering-iron owing to restricted space. The bit may only be about ⅛in. diameter. Such a small bit by itself loses its heat very quickly, and the following idea will be found to help considerably. A small soldering-iron is made in the usual manner, the end of the bit being made square. A piece of ⅛in. diameter copper rod is fixed in the end either by screwing the rod and drilling and tapping the hole, or by caulking the rod in the hole. It will be found that the main mass of the copper will hold a considerable amount of heat, and the rod can be bent into any required position and can be used in a very restricted space.



How to fit a small bit to your soldering iron.

Solder of the blowpipe type should be used for soldering the wire connections, and, for preference, resin should be used for the flux. In no case should spirits of salts be used, as it is corrosive, and unless the work is thoroughly cleaned afterwards there is risk of corrosion.—S. BEAUFOY (Ipswich).





The above sketches show how to fit a dial light for illuminating the panel of your receiver.

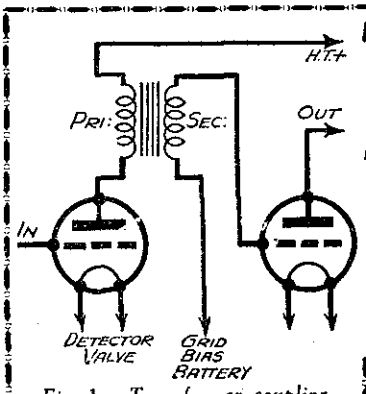


Fig. 1.—Transformer coupling.

THE WHY—AND THE WHEREFORE

A Series of Weekly Articles Dealing With the Functions of the Various Components of a Broadcast Receiver

By JACE

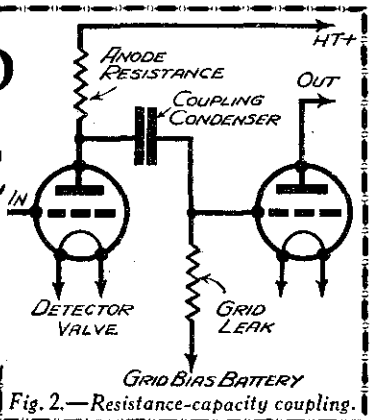


Fig. 2.—Resistance-capacity coupling.

OUR examination of the receiver has so far taken us from aerial to the anode circuit of the detector valve, and we have seen how there is present in this part of the circuit an oscillating current exactly similar to that in the aerial circuit, only now much stronger, and of what we described as a "one-way character." This signal may, if we choose, be employed to operate a pair of headphones by simply joining the 'phones between the anode of the valve and the source of high tension. As, however, we are trying to analyse the functions of all the components in a wireless receiver, it will be necessary for us to add some low-frequency stages, and so discover the use of low-frequency (or L.F.) transformers, etc.

Low-frequency Transformers

An L.F. transformer consists of a core of iron around which is wound two windings, one being larger than the other. Elementary electricity will tell us that an oscillating current passed through one winding of a transformer will result in a similar current being generated in the other winding. If the former winding is the smaller of the two, then the induced current will be increased in strength, and vice versa. The winding through which the current is passed is known as the Primary, and the winding in which the current is induced is known as the Secondary. For L.F. amplification the primary of the transformer is joined between the anode of the detector valve and H.T. +, so that the signal oscillations pass through the primary. The result of this, as we have just seen, is to induce into the secondary a similar current, and as L.F. transformers are made with a larger secondary than primary—in other words, have a step-up ratio—the result is that across the secondary terminals we will have our signal oscillations once more, with a still further improvement in strength. One of the secondary terminals is connected to the grid of a valve and the remaining end of the secondary is joined to a small battery known as the Grid-bias Battery.

The Grid-bias Battery

The purpose of this battery is to provide the grid of this L.F. valve with a negative potential so that the oscillations applied will cause equal differences in anode current, a rather difficult point to explain without going into deep technical explanations. However, it is sufficient to imagine that the oscillations must be allowed to work over an even part of a scale, and to do so the grid must be provided with a bias, the exact value of which is fully stated on the small pamphlet which accompanies the valve when bought.

Resistance-capacity Coupling

An alternative method of L.F. coupling is known as R.C.C. or Resistance-capacity Coupling. For this, two resistances and a fixed condenser are employed, and the process is not so simple to understand as the transformer. In place of the primary of the transformer a resistance has to be connected, and therefore as there is a current flowing through this resistance there is a difference in potential at opposite ends of it. Joined to the anode end of the resistance is a fixed condenser, and, therefore, the variations in potential are applied to one side of the condenser, resulting in similar but opposite variations being induced to the other side of the condenser, which is joined to the grid of the following valve. To enable the grid of this valve to be biased a further resistance is joined between the grid and the biasing battery. With this method of L.F. coupling there is obviously no increase in strength, except that given by the amplification of the detector valve, and therefore in order to obtain as much amplification as possible from a single stage of R.C. coupling, great care has to be taken in the choice of the various values of resistances and condenser. In general, the anode resistance should have a value about 3 or 4 times as great as the impedance of the valve which it follows, whilst the grid leak should be about 4 times the value of the anode resistance. The condenser is usually of .01 mfds. capacity, although larger values up to .1 may be used if the grid leak is kept low in value. (The foregoing explanations may seem rather complicated to the reader with absolutely no technical knowledge, but it is obviously very difficult to explain the functions fully in the scope of a short weekly article, and those readers who are still at a loss are advised to study some small manual of electricity before trying to understand the full theories of wireless.) Figs. 1 and 2 show respectively a transformer coupling and a resistance-capacity coupling between a detector valve and the subsequent valve, and from what has been said previously it will be obvious that there is now present in the anode circuit of the latter valve a signal many times stronger than was received at the aerial, but exactly similar in characteristics. It may, therefore, be used to operate a loud-speaker, or a further stage of amplification may be added to still further increase its strength, such additional amplification being carried out exactly on the same lines as the ones described.

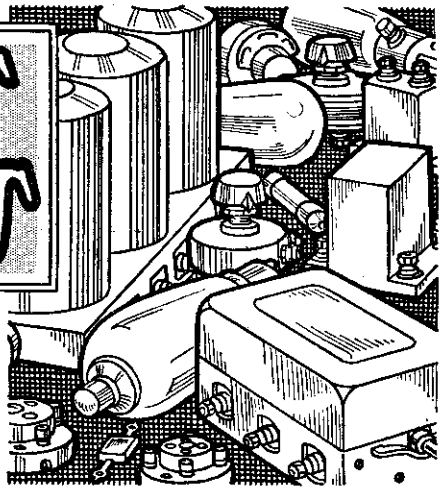
Further Information

Further information on the various parts of a wireless receiver will appear in these pages from time to time, so that by closely studying the various articles which we shall give, the different terms and functions will become familiar, and we feel sure, wireless will lose its horrors and become a simple and at the same time interesting hobby.

Screening in the Wrong Place

I DON'T know whether you have observed the screening effect that some buildings can have upon wireless reception. A particularly noteworthy example happened to come my way whilst I was on tour with a portable last summer. The set I was using was not a very pretentious affair, having only three valves, but when I first tried it out results were extremely gratifying, as you can judge when I say that both North Regional and North National were received at fair speaker strength on the South Coast. Needless to say Daventry, Midland Regional and the London stations were well received in addition to several French and German transmitters. In London results were very similar, and in the North of England there was nothing to complain of until one day I happened to switch on the set in an office situate in a large newly-built block. The set seemed to be quite dead, for even the North Regional was too weak to be worth listening to. On moving the set to a table near an open window results were much better so far as some stations were concerned, but the improvement was not general. Later I took the set outside, and it worked pretty much as usual and most B.B.C. stations came in at reasonable strength. This proved that the walls of the building were acting as a screen, and there was little wonder, for inquiry revealed that they were built around a series of steel girders. In places like this a portable set is of little use, unless it has some provision for connecting an outside aerial.

REVIEWS of LATEST KITS



THE LOTUS LANDMARK THREE

IT is obvious that the designers of the "Lotus Landmark Three" had in mind the needs of the amateur who, whilst not greatly blessed with this world's goods, yet aspire to receive a fair number of foreign stations at good volume and low cost. That they have achieved the latter point speaks for itself, for at the very low price of 39s. 6d. it would be difficult to find better value in the kit market. The circuit consists of the popular detector and two L.F. stages, the first stage employing resistance-capacity coupling, and the second stage ordinary transformer coupling. In addition, an output filter circuit is included, so that the circuit is certainly comprehensive in spite of the price.

The photograph reproduced on this page shows that the vertical panel and wooden baseboard favoured by so many home constructors forms the basis of the "Lotus Landmark Three," and the arrangement of the parts provides a simple, and at the same time neat lay-out. The fact that its constituent parts are of Lotus manufacture should set the reader's mind at rest on the score of quality, for as no doubt all our readers are aware Lotus have been making quality components for many years.

Here is a kit which, being assembled from one make of component, at once rids home construction of one of its greatest bugbears. You start off with a very complete point to point wiring diagram, and in the course of a couple of hours it has guided you from the unpacking point to the listening point. Only ordinary household tools are required, and you cannot make a mistake; in addition, there can be no trouble due to using unsuitable components. The kit which we tested was picked at random from stock. It is necessary to point this out lest the reader think that we were provided with a specially-tuned and assembled set. An efficient type of dual-range coil is utilized for the aerial-tuning circuit, and the unique rotary wavechange switch manufactured by this firm, is employed for changing over from short to long waves. Special types of grid leaks, fitted with terminals, are employed, so that, in addition to short wiring leads, all soldered contacts are avoided. It was assembled by a junior member of our staff and sent into our test room.

KIT:
Lotus Landmark Three.

MAKERS.
Lotus Radio Ltd., Mill Lane, Liverpool.

SPECIFICATION:
Metal panel and wooden baseboard, detector and 2 L.F. circuit with output filter, dual-range tuning coil, all components of Lotus Manufacture.

PRICE:
£1 19s. 6d.

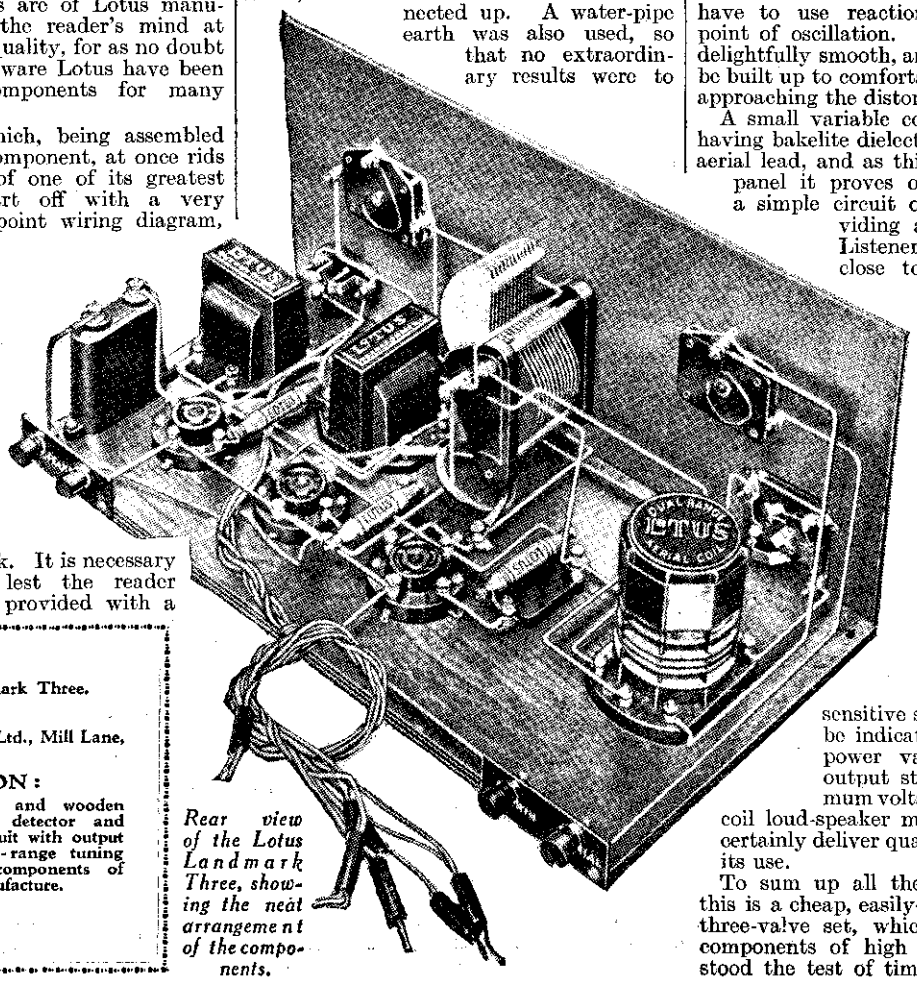
Results

To ensure that the receiver was tested under conditions which resembled as nearly as possible those met with in the average home, a small inefficient aerial was connected up. A water-pipe earth was also used, so that no extraordinary results were to be expected. Our normal aerial and earth system is, of course, rather more elaborate than can be erected in the average home, and it was therefore considered that a kit of this type which is intended for the man-in-the-street, should be tested under conditions which as closely as possible resembled his listening conditions. As was to be expected, the National programme came in at a volume which more than comfortably filled the room, as also did Daventry, and Radio-Paris. Prague, Langenberg, Rome, and Fécamp were also received at very good volume, and in all a total of twenty-two stations was received. In no instance did we have to use reaction pushed up to the point of oscillation. This latter control is delightfully smooth, and weak stations can be built up to comfortable strength without approaching the distortion point.

A small variable condenser of the type having bakelite dielectric is included in the aerial lead, and as this is mounted on the panel it proves of great assistance in a simple circuit of this type for providing a selectivity control. Listeners who are situated close to a powerful station will find it very handy, and at the same time interesting, to improve the selectivity—which of course reduces the volume—and then adjust the reaction control to strengthen the desired station. In this manner quite a number of distant stations are received at quite a good volume.

The type of loud-speaker which is employed with this set will, of course, affect the results. A very sensitive speaker will naturally be indicated, but if a super-power valve is used in the output stage, and the maximum voltage applied, a moving coil loud-speaker may be used, and will certainly deliver quality which will justify its use.

To sum up all the foregoing remarks, this is a cheap, easily-constructed, efficient three-valve set, which includes one-make components of high quality which have stood the test of time.



Rear view of the Lotus Landmark Three, showing the neat arrangement of the components.

THE HEART OF YOUR SET—2

THE VALVE AS AN AMPLIFIER

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

A FULLER explanation of the operations described last week must be reserved for future issues of PRACTICAL WIRELESS.

Principles of Action

For the moment let us summarize the principles of valve action by defining a valve as a piece of apparatus in which a steady current in one direction is produced by a heated filament and a positively-charged plate enclosed in an exhausted bulb, the power for heating the filament being provided by a low-tension battery, and the power in an anode circuit by a high-tension battery. (In some types of valves both the low and the high-tension supplies are derived from electric light mains.)

This steady anode current may be varied by applying a varying charge to the grid situated between the filament and the anode. The varying charge on the grid may be a radio signal, or an audio-frequency signal supplied by a detector or gramophone pick-up, or a microphone. By the use of suitable associated circuits, radio-frequency or audio-frequency grid voltages may be reflected as greatly amplified variations in the anode circuit, or the valve may be used to rectify or detect radio signals, converting them into amplified audio-frequency signals.

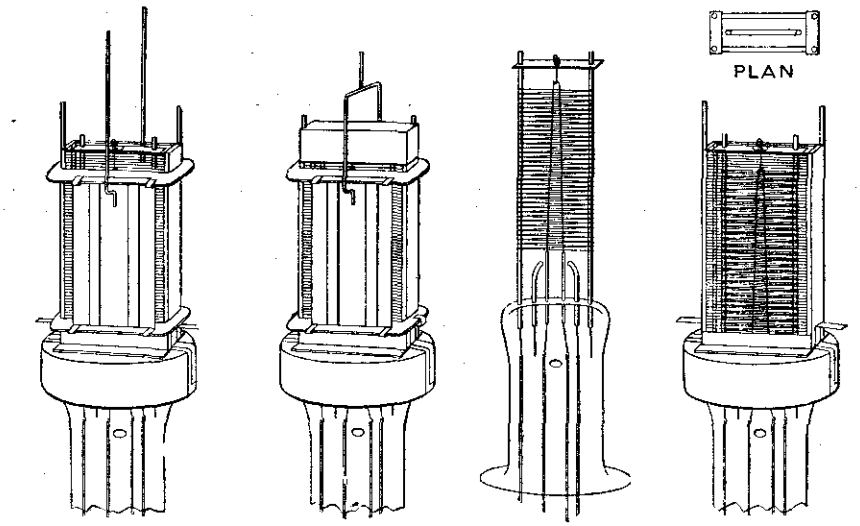
It was shown last week that a varying voltage applied to the grid of a valve produces corresponding variations in the current flowing through the valve and in the external anode circuit. It should be noted that a rise in signal voltage increases the anode current and a decrease in signal voltage decreases the anode current. One other factor may cause an alteration of the anode-current—namely, a variation of the high-tension voltage applied to the anode. Normally, a steady high-tension voltage is applied, but it is obvious that if the anode voltage did vary, a one-volt alteration would have a much smaller effect on the anode current than a one-volt change in grid voltage, because the grid is so much nearer the emitting filament than the anode.

Voltage Amplification of Valve

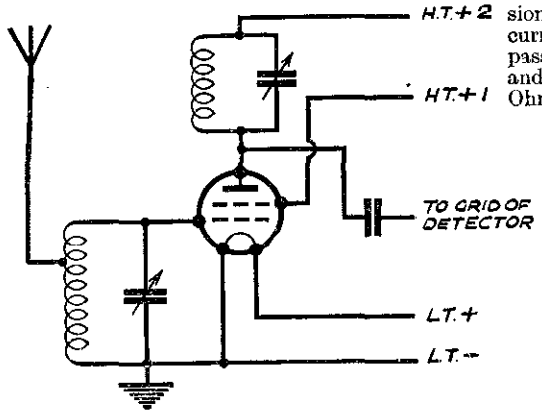
The number of volts change in anode voltage which would have the same effect on anode current as a one-volt change in grid voltage is termed the amplification factor of the valve. This does not mean that a valve having an amplification factor of 40 will increase the signal to 40 times its original strength, but it does indicate that, correctly applied, a valve having an amplification factor of 40 will give double the voltage amplification obtainable from a valve having an amplification factor of only 20.

The amplification in a valve is obtained in the following manner:—A "load"—that is to say some piece of apparatus having a fairly high impedance—is included in the anode circuit of the valve, between the anode and the high-tension battery. The anode current will, of course, pass through the load, and, in accordance with Ohm's law, there will be a drop of electrical pressure (voltage) in the load. Because the anode current is varying under the influence of the signal applied to the grid, the voltage across the load will vary in sympathy with the instantaneous values of the anode current, and if the value of the load is suitably chosen, the alternating voltage drop across the load will be much greater than the signal voltage applied to the grid. It is the task of the valve maker to produce valves giving the greatest powers of amplification, and the task of the set designer to arrange the circuit values so that the amplification factor of each valve is utilised to the greatest possible extent.

The amplified voltage in the anode circuit may be employed to excite the grid of a further valve, and thus obtain additional amplification, or the audio-frequency power in the anode circuit of a low-frequency amplifier may be utilised to operate a loud-speaker. Different types of valve are required for voltage amplification and for power output, and these must be described in greater detail.



Steps in the construction of a modern screen-grid Cossor valve.

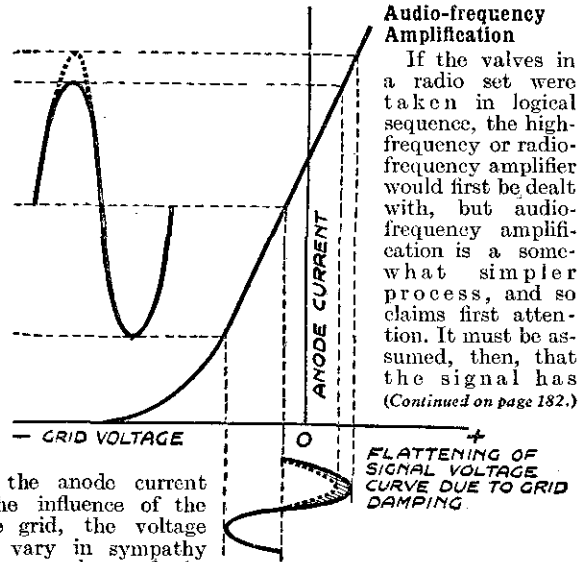


A circuit diagram of a screen-grid-H.F. stage.

Audio-frequency Amplification

If the valves in a radio set were taken in logical sequence, the high-frequency or radio-frequency amplifier would first be dealt with, but audio-frequency amplification is a somewhat simpler process, and so claims first attention. It must be assumed, then, that the signal has

(Continued on page 182.)



Indicating the result of under-biasing an amplifying valve. The grid becomes positive with respect to the filament during a part of the alternate half cycles. Grid current flows and reduces the effective signal, as shown by the shaded area, while the effect on the anode current is shown at the top left of the diagram.

The Heart of Your Set

(Continued from page 180.)

passed the detector stage, and is now in the form of an alternating voltage of musical frequency. It is desired to amplify this voltage further before passing the signal to the loud-speaker. In order to achieve distortionless amplification it is necessary that the variations in anode current shall be strictly proportional to the variations in grid excitation voltage. In any amplifying valve this will occur so long as the grid signal does not exceed a certain maximum value and as long as the negative grid bias is so adjusted that, during negative halves of the grid signal wave, the grid does not exceed a certain maximum negative potential, and during positive half waves it does not become positively charged.

If at instants during each wave the grid becomes excessively negative, partial rectification due to unequal amplification of the two half waves will occur, while if the grid becomes positively charged during a portion of each wave, grid current will flow and there will again be partial rectification and consequent distortion. In operating a receiver employing low-frequency amplifying stages, therefore, it is essential to maintain the negative bias at the figure recommended by the valve maker, and to choose a valve which will handle without distortion the signal voltage which it is intended to apply to its grid.

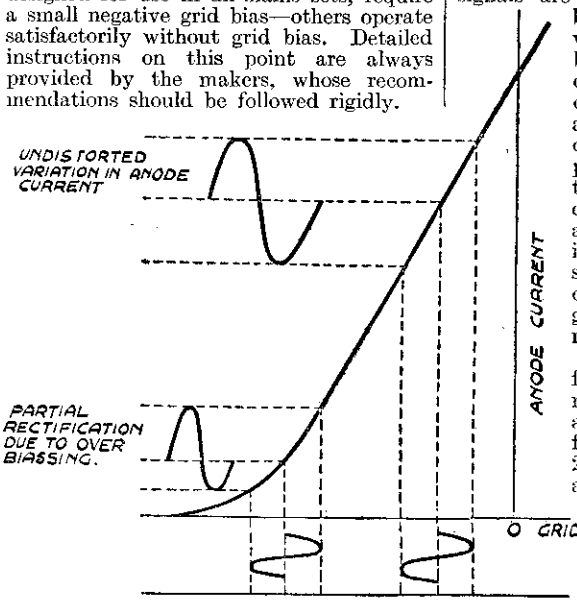
Low-frequency amplifying valves (other than output valves, which will be dealt with separately) fall roughly into two classes—high-amplification valves, having amplification factors of the order of 40 to 50, and medium-amplification valves, the amplification factors of which range from about 10 to 30. Generally speaking, high-magnification valves can handle only comparatively weak signals, while the valves with lower amplification factors deal with more powerful signals. All valve makers publish the correct negative grid bias which should be applied to each type of valve, and the peak value of the grid input signal must not exceed half the grid bias voltage.

In very many instances nowadays, the coupling between one low-frequency valve and the following valve is a transformer, and in such cases medium-amplification valves are more suitable. As there is a definite step up of voltage in the transformer, the lower amplification factor is not of great consequence. For certain special purposes, resistance capacity coupling is employed between stages. Here, the amplification obtainable is limited to that provided by the valve itself, and the high-magnification valves are of particular value.

Radio-frequency Amplification

In present day receivers, the ordinary three-electrode valve is seldom used as an amplifier of radio-frequency signals. The reason is that with this type of valve the electrodes themselves act as small condensers and transfer part of the energy in the anode circuit back to the grid circuit. If no steps were taken to counteract this effect, the energy so fed back would be re-amplified, again fed back and again amplified, the cumulative result being that the valve would fall into violent electrical oscillation, and reception become impossible.

A device known as "neutralizing," whereby the unwanted feed-back is opposed by a carefully adjusted feed-back of equal value but of opposite phase, overcomes this difficulty to a great extent, but a still better solution to the problem has been provided in the "screened-grid" valve. In this valve, feed-back is prevented by the introduction of a second grid, between the normal or control grid and the anode. The screening grid is charged by a high-tension voltage of approximately half the anode voltage, and is also maintained at earth potential relative to the radio-frequency signal. Screened-grid valves give considerably higher stage gains than neutralized triodes, and are quite stable in operation. Some types, principally those designed for use in all-mains sets, require a small negative grid bias—others operate satisfactorily without grid bias. Detailed instructions on this point are always provided by the makers, whose recommendations should be followed rigidly.



Showing relation between the grid voltage and the anode current in a valve and indicating correct biassing and how distortion is introduced by over-biassing.

In the case of a high-frequency valve, it is, of course, impossible to employ an iron-cored transformer as the "load" in the anode circuit. The most efficient load is a tuned circuit the tuning condenser of which may, if desired, be "ganged" with the condenser tuning the aerial circuit. When a triode is used as high-frequency amplifier, as is sometimes adopted in portable receivers, space and weight may be economized, with considerable sacrifice of overall amplification and selectivity, by employing a resistance or a choke as the load.

The Multi-mu Screened-grid Valve

The chief disadvantage of the original screened-grid valve is that it can only handle without distortion comparatively small input signals, the permissible grid swing or "acceptance" for linear amplification being subject to severe limitations. As a result, when local stations are being received, partial rectification is liable to occur, while if another station is working on a wavelength close to that to which the set is tuned, another phenomenon, termed cross-modulation, occurs, the carrier of one station being modulated by the signal of the other. In order to avoid the distortion occasioned by these effects, a modified type of screened-grid valve, called the "multi-mu" valve, has recently been introduced. The screen of the multi-mu valve is of graded pitch, with the result that the valve is extremely sensitive, and gives a high effective amplification when a small grid bias is applied, but will handle only small signals, and is less sensitive when a large grid bias is applied, and can then handle comparatively large signal voltages without distortion.

Bias Voltage

The multi-mu valve is connected in a precisely similar manner to a screened-grid valve, but provision is made for applying grid bias in such a way that the biassing voltage is continuously variable over wide limits. When weak or distant transmissions are being received, the grid bias is reduced to the minimum value, and maximum amplification is obtained; but when powerful or local stations are tuned in, the grid bias is increased, so that the strong signals are amplified without distortion, but to a lesser extent. The variable bias is also capable of being used as a smooth and convenient method of volume control, and possesses many advantages over other methods of volume control. In the first place, it does not affect the tuning as will occur if a differential condenser is employed as an input volume control, and it does not increase the noise-signal ratio and thus create a comparatively noisy "background" when volume is reduced.

The maximum bias required for most battery-heated multi-mu valves is about 15 volts, and variable bias may be obtained from a potentiometer of from 25,000 to 50,000 ohms connected across the normal grid bias battery of the receiver. Most mains-operated multi-mu valves require a maximum grid bias of the order of 40 to 50 volts, and this is best obtained automatically by a variable bias resistance.

How to Choose the Correct Amplifying Valve

It will have been gathered from the foregoing that the choice of an amplifying valve should be governed by several factors—the frequency of the signals it is required to amplify (*i.e.*, whether audio-or radio-frequency), the initial strength of the signal, and the type of coupling.

Dealing first with audio-frequency amplifiers, prime consideration should be given to the anode impedance of the valve, for this determines its suitability or otherwise for any given application. For maximum amplification there should be a correct proportionality between the impedance of the valve and that of the external anode circuit, the external impedance being as large as is practicable compared with that of the valve. Usually the impedance of the valve should be from one-half to one-fifth of that of the external circuit. Thus, in a resistance capacity coupled stage employing a resistance of from 100,000 to 250,000 ohms, it is necessary to choose a valve having an anode impedance of from 40,000 to 50,000 ohms.

For transformer-coupled stages, a somewhat lower value of anode impedance gives better results, as the impedance of the average transformer is less than that of the resistances employed in R.C. coupling. Most valve makers supply more than one type of valve suitable for transformer-coupled amplifying stages, and these fall into two fairly distinct classes—namely, the "L" class, having an impedance of about 12,000 ohms, and the "H.L." class, with impedances of approximately 20,000

(Continued on page 211.)

AUTOMATIC GRID BIAS

An Explanation of the Various Methods of Obtaining Grid-bias Voltages from the Anode Current, for Both Battery- and Mains-operated Valves

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

EVERY wireless set user either recognizes the necessity of applying negative grid bias to all low-frequency amplifying valves and to certain types of high-frequency valves, or alternatively is instructed to do so without appreciating the true value. It is pointed out that, only when such valves are biased to the correct point, that is to say, to the middle of the straight portion of their characteristic, can they amplify, without distortion, signals having an amplitude equal to the maximum acceptances of the valves. The normal method of applying negative bias, that is by means of a small

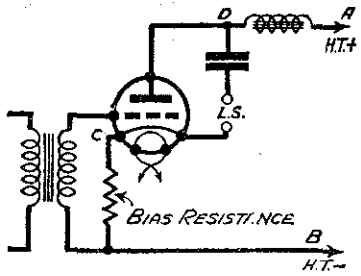


Fig. 1.—A resistance inserted in the cathode lead of an indirectly-heated valve.

dry battery, generally is fairly well understood. There are, however, certain disadvantages which arise when using battery bias. In the first place, the bias battery frequently is tucked away in an obscure corner of the set, and in consequence forgotten. Although the battery is never called upon to pass actual current, its life is not indefinite, and sooner or later—in six or twelve months—it runs down, and the actual bias applied to the valve is very far from the nominal bias as indicated by the figures stamped upon the side of the battery.

Again, a plug may work loose and drop out of its socket, and a very short period of operation without bias may ruin an expensive valve. There is also the temptation to alter the bias without first switching off the set, another cause of deterioration in the valve.

Principle of Self-biasing

During recent seasons, since the introduction of efficient A.C. mains sets, it has become the practice to bias valves "automatically." The principle of self-biasing is really quite straightforward, but puzzles many listeners, and I hope, therefore, that the following simple explanation, with some practical biasing arrangements, will be welcomed by readers of PRACTICAL WIRELESS. The object of biasing a valve is, of course, to render the potential of the grid less than that of the cathode, that is, the filament in battery-fed valves. With ordinary battery bias, the cathode is at a potential equal to the potential at the negative end of the high-tension supply, and by connecting the positive pole of the grid-bias battery to the same spot, the grid potential is equal to the voltage of as much of the grid battery as is included in the grid circuit. In order to bias the valve, it really does not matter in the least whether the cathode is at zero voltage and the grid at some negative potential, or whether the grid is at a zero potential and the cathode at some positive potential. This latter condition is that which usually obtains when automatic bias is used. In most of these arrangements, the grid is maintained at the same potential as the negative terminal of the high-tension supply, while the cathode is raised to a higher potential by the inclusion of a resistance in the lead connecting the cathode to the high-tension negative terminal.

Voltage Drop

This will be made clear by a reference to Fig. 1, which shows the essential connections for automatic bias to an indirectly-heated low-frequency output valve. In this diagram, certain refinements, such as the decoupling arrangements, are omitted for the sake of simplicity. It will be seen that the full high-tension voltage exists between the points A and B, the point B being at zero potential. It is obvious, therefore, that there will be a drop of voltage, equal in all

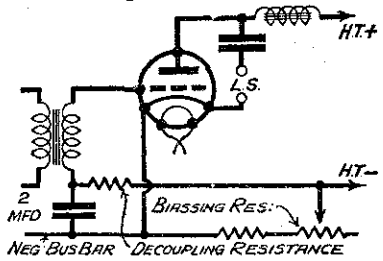


Fig. 3.—An alternative arrangement of Fig. 2, in which the cathode is maintained at the normal negative potential.

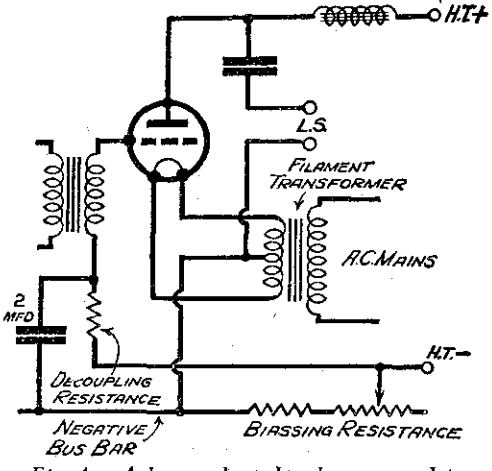


Fig. 4.—A battery-heated valve arranged in the same manner as Fig. 3.

to the total high-tension voltage, along the complete valve circuit. This drop of voltage will consist of three portions—(1) the drop across the load in the anode circuit (*i.e.*, the output choke), (2) the drop across the cathode-anode path of the valve (*i.e.*, between the points C and D), and (3) the drop across the biasing resistance (*i.e.*, between the points C and B).

Thus, the point A is at a higher potential than point D; D is at a higher potential than the point C; and C is at a higher potential than point B. But the grid of the valve is connected to point B, so that the point C, the cathode, is at a higher

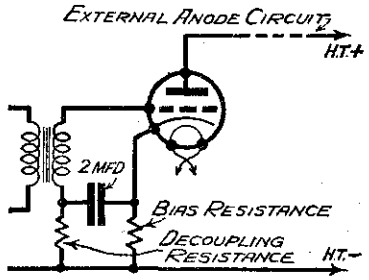


Fig. 2.—The arrangement of Fig 1 with a de-coupling circuit added.

potential than the grid, or, in other words, the grid is at a lower potential than the cathode, which is the condition desired for successful operation.

Advantages of Automatic Bias

The advantages of automatic or self-biasing are many. In the first place, if the value of the biasing resistance is correctly calculated, there is no possibility of under- or over-biasing the valve. Also the biasing resistance automatically controls the value of the anode current, for should the anode current rise, due, perhaps, to an increase in anode voltage, the drop through the biasing resistance will rise in proportion, the negative bias will be increased, and the anode current again reduced to its normal value. Further, the biasing resistance does not deteriorate as does a grid-bias battery, does not vary in value, and needs no replacement. If desired, the biasing resistance can be made variable, or semi-variable, so that adjustments can be made while the set is in operation, without any risk of an abnormal rise in anode current.

There is, of course, one slight disadvantage. Any biasing voltage applied in this way is definitely subtracted from the total H.T. voltage. However, this makes no practical difference to the efficiency of the average mains set where 200 or 250 volts H.T. is available from a mains unit, and the maximum bias voltage required does not exceed 20 or 30 volts. In the case of some of the bigger output valves, however, which are designed to operate at about 400 volts on the anode, as each valve requires over 100 volts grid bias, the loss, if this amount of bias were sub-

tracted from the available 400 volts H.T., would be serious. In this case, therefore, it is necessary to design the high-tension unit to give an output voltage equal to the normal anode voltage plus the bias voltage.

Biasing Resistance

Biasing resistances generally should be of the wire-wound type, and must be capable of carrying the full anode current of the valve continuously without overheating. In the case of early stage low-frequency amplifiers and screened-grid valves, ordinary spaghetti resistances are quite suitable, but for output valves, where a certain amount of preliminary adjustment of grid bias is usually necessary, it is advisable to use a variable resistor, or, preferably, a fixed resistor and a variable resistor in series. This allows of adjustment, but at the same time prevents the valve from being run entirely without bias if, by mistake, the variable portion is reduced to zero. For variable-mu valves, where continuously adjustable bias is required, the resistance must naturally be of the variable type. The calculation of the correct value of biasing resistance is a simple matter, and is merely the application of Ohm's law. The formula is :—

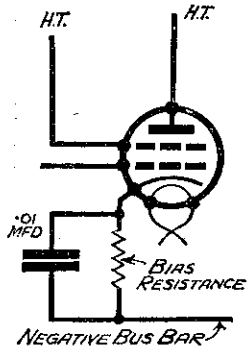


Fig. 5.—The biasing resistance arranged in the cathode lead of an S.G. valve.

$$\text{Value of biasing resistance in ohms} = \frac{\text{Desired bias in volts}}{\text{Anode current in amps.}}$$

As the anode current is usually expressed in milliamps, the value of the biasing resistance is found by multiplying the desired bias voltage by 1,000 and dividing by the anode current in milliamps.

As an example, we will take an output valve requiring a grid bias of 32 volts at full anode voltage, the anode current being 30 milliamps. The correct resistance for self bias would be 32 multiplied by 1,000 and divided by 30, or 1,066.6 ohms. Actually, a total resistance of 1,250 ohms would be used, consisting of a 750-ohm fixed resistor in series with a variable resistor of 500 ohms maximum.

Decoupling Resistance

In addition to the biasing resistance itself, certain additional apparatus is usually required, by way of decoupling. If the anode supply is not efficiently smoothed, and a bad mains ripple is present, there is a risk that this may be transferred to the grid by the bias arrangement, when the anode current will be correspondingly modulated, and serious mains hum result. Moreover, there is always a chance that the biasing circuit may pick up mains hum from some other part of the apparatus, while any other low-frequency component in the anode current will have a similar effect. To reduce this risk, a grid decoupling or smoothing circuit may be employed. This consists of a high resistance, usually of about 50,000 ohms, included in the grid return, and by-passed to the cathode through a condenser which, in the case of most low-frequency valves, should be of 2 mfd. capacity.

Such decoupling is not essential, but should be added without hesitation if serious hum is noticed. The condenser value of 2 mfd. is ample, and in many cases, especially in early low-frequency stages, 1 mfd. may be sufficient. On the other hand, where a very bad hum is present, especially if the output valve is a pentode, it may be necessary to use a 4 mfd. condenser for decoupling the bias to the last valve. Different designers prefer different arrangements of the auto-bias circuit, but the circuits given with this article are tried arrangements, and quite suitable for the types of valves for which they are recommended. Fig. 2 is the complete arrangement for an early stage indirectly-heated L.F. amplifier, such as the input valve of a gramophone amplifier. It may also be employed where the detector valve of a receiver is required to act also as first low-frequency amplifier with a pick-up.

Precisely the same arrangement may be used for a pentode output valve of the indirectly-heated type, but for three-electrode output valves a slightly different system is preferable. For a triode, the value of the biasing resistance is usually of the same order as the resistance of the load, and the loss of power in the biasing resistance, if this resistance were included in the load circuit, would be serious. This is avoided in the circuit shown in Fig. 3, where the cathode is maintained at the common negative potential of the set, and a negative potential given to the grid by the biasing resistance connected between the common negative wire and the H.T. terminal.

Fig. 4 gives the variant of this circuit for use with a directly-heated triode or pentode output valve, a connection between the common negative wire and the centre-tap of the filament winding taking the place of the cathode lead in Fig. 3. For screened-grid high-frequency valves, the circuit is as shown in Fig. 5. This arrangement is similar to that in Fig. 2, but the decoupling arrangement for the high-frequency valve consists merely of a .01 mfd. high-grade fixed condenser.

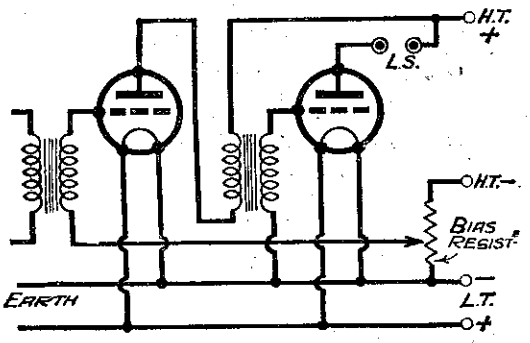


Fig. 6.—A common resistance connected up to provide bias for two battery-heated valves.

For Portable Sets

It should not be forgotten that automatic bias can just as simply be applied to battery-operated receivers. In general it is not economical, for the bias is definitely subtracted from that of the H.T. battery. Still, for portable sets and other special purposes, it has the advantage of compactness and light weight. The essential circuit is shown in Fig. 6. Here a wire-wound resistance capable of carrying the total H.T. current of the set is connected between H.T.— and L.T.—, and thus biases the output valve. It may be made variable for purposes of adjustment, and may also be suitably tapped to provide bias to other stages. The value of the total resistance and of the intermediate tappings can be calculated in the way already described, and any handy reader should be able to construct a suitable resistance unit, either by connecting spaghetti resistors in series, or by winding his own resistance with high-resistance wire.

Round the World of Wireless

(Continued from page 168.)

A Screened-Grid Detector.

IN a sensitive receiver, especially one of the Det.—L.F. types, results can often be improved by replacing the normal detector valve by a screened-grid one. A few alterations must be made to the wiring, but these are very slight and can be carried out in a couple of minutes. All leads going to the anode terminal of the detector valve holder must be removed, joined together (usually this can be done by connecting them all to one terminal of the H.F. choke) and attached to a flexible lead which can be connected to the anode terminal on the top of the S.G. valve. A separate H.T. connection is required for the screening grid of the new valve, so an additional battery lead must be provided for this purpose. The lead should be connected at one end to the anode terminal of the valve holder, which now corresponds to the screening grid, and the other end should be taken to the 20-volt or 30-volt socket of the battery. The usual by-pass condenser between the screening grid and earth is not essential, but does sometimes effect an improvement. Any capacity from .01 mfd. upwards will do quite well. A screened-grid valve provides a greater degree of amplification and makes tuning sharper due to its smaller damping effect on the tuned circuit.

A Short-Wave Manual

ALL short-wave enthusiasts will be interested in a "Short-Wave Manual" which has just been published by Messrs. Stratton and Co., makers of "Eddystone" short-wave components. This manual, which is priced at 1s. 6d., gives full and illustrated constructional details of a range of S.-W wireless receivers, adaptors, and wavemeters. Each description is accompanied by a clear wiring plan drawn to scale, and the exact cost of the various instruments is stated in all cases. In addition to the constructional articles there are others on "Logging Short-Wave Stations," "Trouble Locating," "The Short-Wave Variable Condenser," etc. On the last three pages are given the circuits of two S.-W. transmitters and a list of short-wave stations, accompanied by details of their working schedules. Altogether a refreshingly interesting publication. If you want a copy of this manual, the address of Messrs. Stratton and Co. is Eddystone Works, Bromsgrove Street, Birmingham.

Dr. F. W. Lanchester, LL.D., F.R.S.

THE SPEAKER SPEAKS

ON THE PENTODE VALVE

The First Article of a Short Series

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

FOR far too long the pentode valve has suffered from being a victim to excessive propaganda; its virtues have been overstated, and in consequence its introduction has led to disappointment in greater or lesser degree. But the pentode valve properly installed is capable of giving remarkable results, as indeed is generally recognised, and its only real competitor for pure undistorted volume is the well-known "push-pull" circuit.

Amplification Factor

The nominal amplification factor of a pentode is commonly in the region of 80 or 100, but this is entirely misleading to those who think in terms of the ordinary (triode) power valve. The slogan "saves a stage" which has sometimes been employed is equally misleading. The makers of the pentode tell us with one accord that the external impedance (speaker effective impedance) must be kept low, say one-fifth or less of the (A.C.) impedance of the valve itself: thus for a pentode such as the PT.425 whose amplification factor is given as 100, and whose published impedance is 50,000 ohms, the external impedance should not exceed 10,000 ohms. But equal prominence is not given to the fact that under these conditions the effective amplification factor is now only one-sixth of its declared value, namely:

$$100 \times \frac{10,000}{50,000+10,000} = 16.6$$

The external impedance suggested above, although satisfactory from the point of view of the valve maker, is still far too high for good reception. In our opinion a better value for the external impedance to be associated with the valve in question would be something in the region of 5,500 ohms. The corresponding value of the effective amplification factor will then be:

$$100 \times \frac{5,500}{50,000+5,500} = 10 \text{ approximately.}$$

External Impedance

The reason for this further lowering of the external impedance is in order that the *bass should come through without undue loss.* Even with the external (speaker) impedance brought down to this level the pentode valve requires the support of more inductance (henries) in the output transformer (or choke-filter circuit as the case may be) than the ordinary (triode) power valve. Whereas an output transformer with a primary inductance of 10 henries in round numbers is sufficient for an ordinary power valve, for a pentode with an external impedance of 5,000 or 6,000 ohms about twice this or 20 henries is required to give as good a rendering of the bass. For an external impedance of 10,000 about 40 henries would be required.

The question may fairly be asked why not stick to the 10,000 figure and provide an adequate transformer? The answer is *economic consideration.* A transformer of 40 henries to carry some 3 or 4 milliamps. current is not an expensive matter, in fact intervalve transformers up to 100 henries are common. But to take a current of 17 m.a. as required by PT.240, or 26 m.a. as required by PT.625, is another matter; for a given size of iron circuit the necessary number of turns results in oversaturation and diminished receptivity, so that piling on turns defeats its own object, and the only way out of the difficulty is a very great increase in the size and cost of the transformer. When the economic limit is passed the answer of the public and trade would be the abandonment of the pentode valve.

Cut down in the manner indicated above, the pentode is a very good valve, capable of giving a heavy output without distortion, in this respect better than the ordinary (triode) power valve, and comparable with a good push-pull power circuit. But as pointed out the amplification factor is then only in the region of 10, and thus only two or three times the effective amplification factor of a power valve such as P.625; there is no "saving a stage" or anything like it; all that one can say is that the pentode may occasionally make the difference between the amplification of a given set being adequate or otherwise.

Summary

1. In laying out a set for a pentode, the external impedance (speaker effective impedance) should be taken about one-ninth of the (A.C.) valve impedance as published.
2. The effective amplification factor is then approximately one-tenth of its nominal value.
3. The inductance of the choke in a choke-filter circuit or primary winding in the case of a transformer should be at least 10 henries, and, if full bass rendering is required, 20 henries is desirable.
4. In the case of a moving-coil speaker, the effective impedance of the speaker is its measured impedance (or calculated impedance) multiplied by the square of the transformer ratio. Thus, if the speaker impedance (ohms+reactance) be 20, and the O.P. transformer ratio be 17, the effective impedance, referred to above as the external impedance, is $20 \times 17^2 = 5,800$ ohms, and the said combination is suitable for a pentode valve. Parenthetically it may be observed that the same combination is equally suitable for an ordinary triode power valve whose impedance is less than 2,000 ohms; such for example as the P.625A or the P.M.256.
5. The maker's instructions relating to the pentode valve should be carefully studied, especially as concerns the danger of allowing such valves to be called upon to function on open circuit or with excessive impedance in circuit. The penalty of disregarding these warnings is commonly a break-down, often resulting in the destruction of the valve itself, owing to the excessive peak voltage generated under such conditions.

RADIO SCOTLAND

THE CAPITAL'S WIRELESS WEEK

IT is only two years since the Scottish National Radio Exhibition was inaugurated as an annual event, but when the third of the series opens in the Waverley Market (Wednesday, October 12th) it will come as a familiar and firmly-established institution.

Like the great Radio Exhibitions at Olympia, London, and at Manchester, which have preceded it, the Scottish Exhibition will place before its patrons absolutely everything that is new and up to date in British radio apparatus. The Exhibition is an all-British one—no apparatus of any kind which is not manufactured in Britain by British labour will be shown—and, following Mr. Bentley's invariable principle, it is an all-Radio one—nothing will be shown which has not a direct connection with radio reproduction.

With the opening of Scotland's powerful new twin-wave transmitter at Westerglen, there has naturally been a huge increase of interest in broadcasting in Scotland.

Of special interest this year will be an exhibit staged by the G.P.O. On a large stand the Post Office engineers are showing examples of the various electrical machines in common industrial or domestic use whose proximity affects and interferes with broadcast reception; and at intervals actual demonstrations will be given of the methods which the P.O. men employ in order to overcome the difficulties and smooth out the interference. This stand is sure to have a good audience—for comparatively few listeners at present realize how much electrical machines may affect their reception, and still fewer know that the Post Office will try to help them in any such difficulty they may encounter.

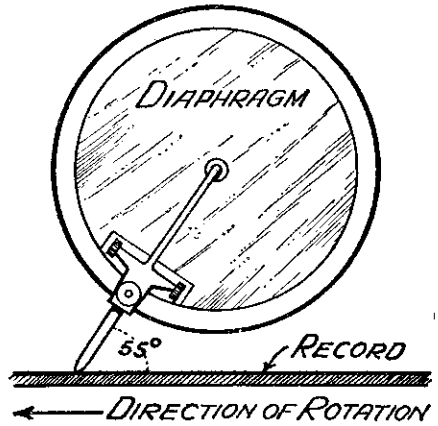
A model studio is being erected in the Exhibition in which certain of the programmes which would normally be put on in Scottish Broadcasting House in Queen Street, Edinburgh, will be staged on each day of the Exhibition.

Choice of Needle

THERE are a large number of different types of gramophone needle on the market, and each claims some special advantage. Steel needles are divided into three main types—soft, medium and loud; whilst there are several varieties of "permanent" needle in addition to those of the fibre type. The majority of needles, however, are designed primarily for ordinary gramophone reproduction and, therefore, when used with an electric sound-box, or pick-up, a little more care is needed in choosing the type of needle for your instrument. The writer always uses Columbia Talkie needles, as these have a nice, fine point, and are extremely hard. I use one for each record (both sides), and the wear when viewed under the microscope is very small indeed. Five records may be played with one of these needles without appreciable "cutting," but they are so cheap that one can afford to use one per record. If a permanent needle of the Tungstyle type is used, it must on no account be removed from the pick-up until it is worn out, as the thin point gets bent as it is used, and if removed it may be put back in such a position that the point will dig into the record. However, each pick-up seems to work best with one special needle, so it will well repay you to experiment with various types to ascertain the best one for your own apparatus.

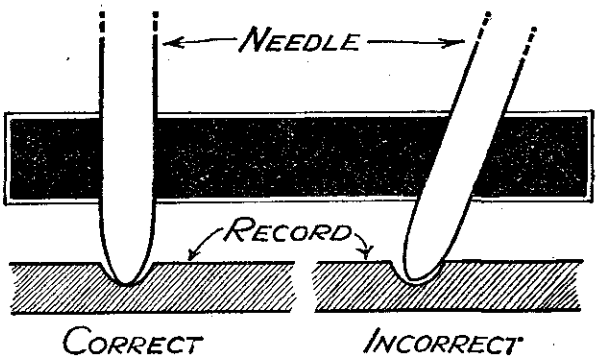
A Level Turntable

A fault which can result in a peculiar form of distortion arises from the radio-gram cabinet being stood on an uneven surface. If the apparatus is home-made, the motor-board may also be fitted so that it is not perfectly level. The effect of this is that the tone arm bears more heavily on one side of the groove than the other, and this results in uneven wear. After the record has been played a number of times distortion will be noticed, due to some of the smaller sound waves being worn off the grooves. To test whether your turntable rotates on a perfectly horizontal plane put a record on, and rest the needle on the clear space at the beginning of the record. The record should rotate for the complete playing time without the needle being thrown off.



The correct angle for a needle—with either ordinary acoustic sound-box or electric pick-up.

PARAGRAPHS OF INTEREST TO THE RADIO-GRAM USER



This illustration shows the effect of a needle which is not vertical.

Vibration Troubles

Most motors are provided with rubber washers which should be placed on either side of the motor-board. Where a powerful amplifier is installed with the motor-board attached to the cabinet housing the loud-speaker, these washers are of vital importance, as powerful low notes will cause the entire cabinet to vibrate, with the result that the pick-up is shaken, and both distortion and damage to the record can arise. If a moving coil loud-speaker is used with a mains-driven instrument and the amplifier is not adequately smoothed, hum from the mains can be transmitted to the pick-up in this way, and this fact should be borne in mind when trying to trace hum in an amplifier.

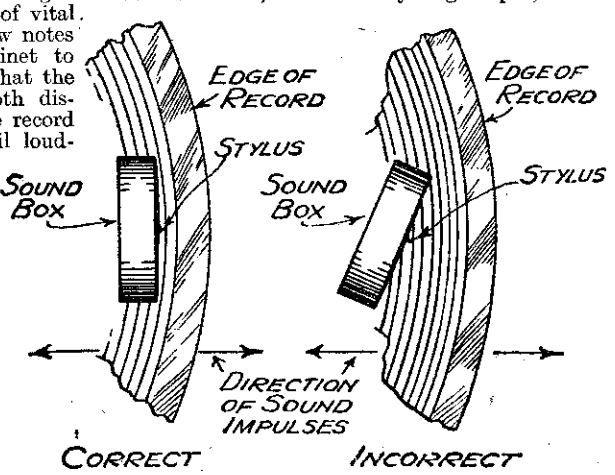
Balancing the Output

It is probably well known that the lower notes of the musical scale are not recorded at the same strength as the higher notes owing to the limitation imposed by the spacing of the grooves. The very high notes are also not present on a record because of the recording difficulty. The majority of pick-ups have the design so chosen that there is a compensation in the output curve, resulting in a reinforcement of the lower and high notes. If you feel that your pick-up still fails to do justice to these notes you can fit a tone compensator, which is an arrangement of chokes and condensers giving resonance points at various frequencies. Naturally, the design has to be chosen in conjunction with the pick-up, so that the output from the record becomes practically a straight line.

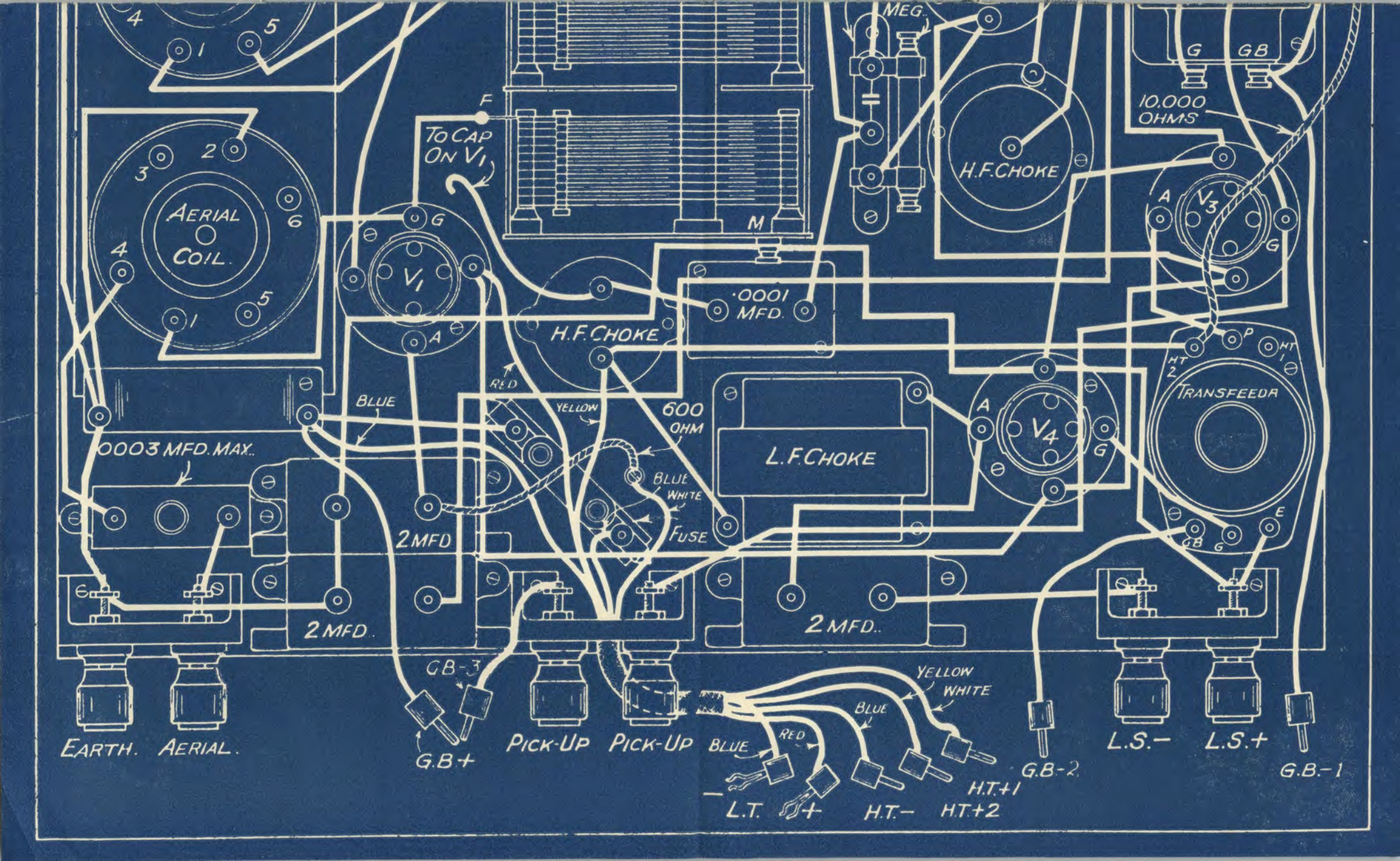
The Gramophone Pick-up: Does Yours Require a Volume Control?

Disappointing results with a gramophone pick-up may often be due to the non-use of a volume control in conjunction with the actual instrument. Quite a number of the modern pick-ups give a fairly large output, and if one of these is employed to play a very loud record it is possible to overload the valve in the grid circuit of which the pick-up is connected, unless such valve is of the low frequency or even small power type. Receivers which have not been designed for use with gramophone reproducers are often altered by the user in order that a pick-up may be used. This alteration commonly consists of breaking the grid lead of the detector valve, or inserting some switching device in this particular part of the circuit, and then relying only on the volume control which is included in the L.F. side of the receiver (if one is fitted) to reduce the volume from the speaker. The detector valve does not, as a rule, handle a very large input, and is very often of the type in which the application of the maximum H.T. and grid bias will not enable it to take a very large grid

(Continued on page 212.)



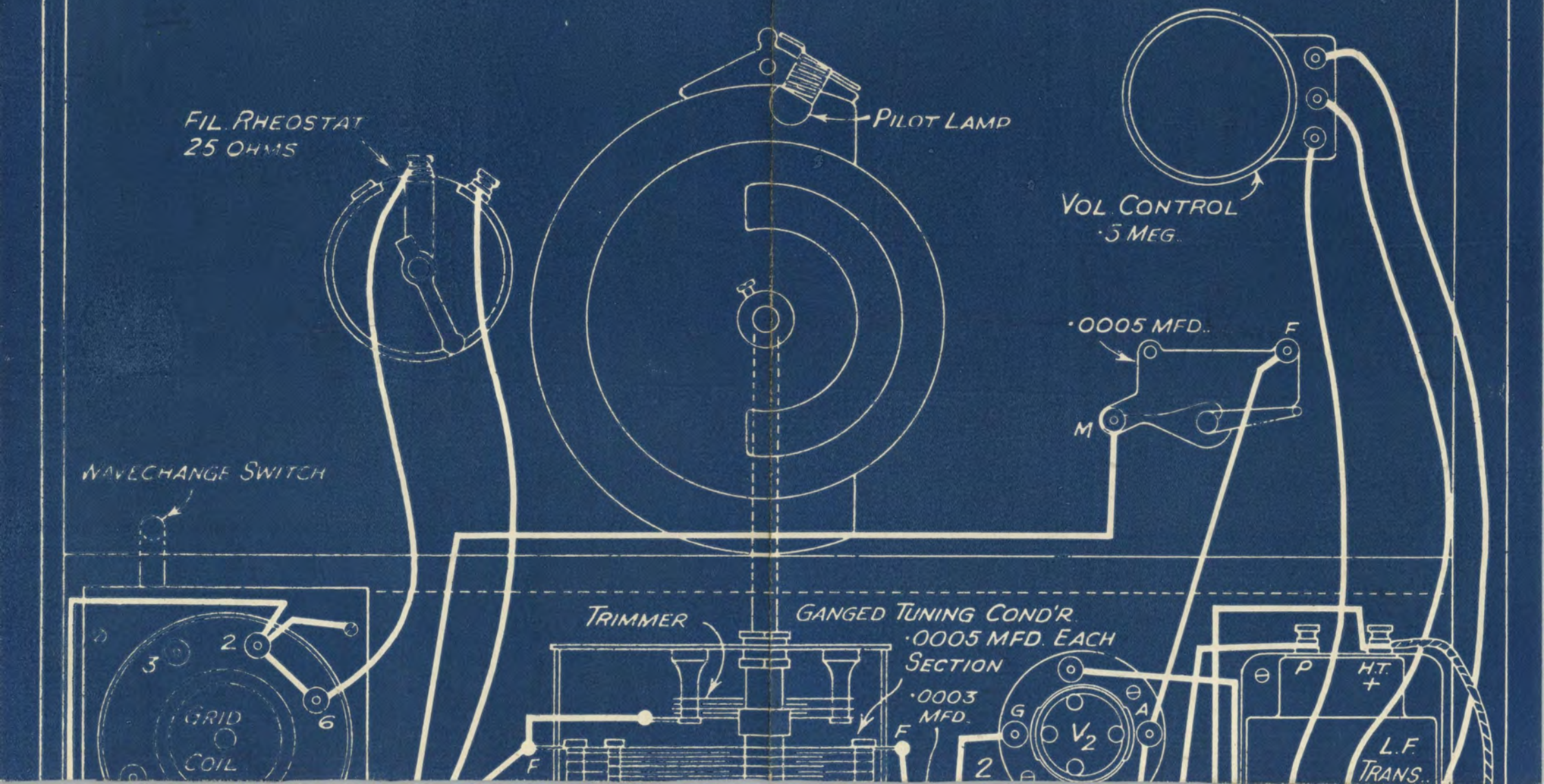
The "tracking" angle—which was fully explained in a recent issue. Note how the sound-box or pick-up must be parallel with the sound grooves.


AERIAL COIL.
TO CAP ON V1
F
M
V1
V3
V4
MEG.
H.F.CHOKE
10,000 OHMS
·0001 MFD.
H.F.CHOKE
L.F.CHOKE
TRANSFEEDA
·0003 MFD. MAX.
2 MFD.
2 MFD.
2 MFD..
600 OHM
FUSE
BLUE
RED
YELLOW
BLUE WHITE
YELLOW WHITE
EARTH.
AERIAL.
G.B.+
G.B.-3
PICK-UP
PICK-UP
L.T. —
L.T. +
H.T.-
H.T.+1
H.T.+2
G.B.-2.
L.S.-
L.S.+
G.B.-1

THE SONOTONE FOUR

GIVEN FREE WITH No. 4 OF PRACTICAL WIRELESS OCTR 15TH 1932

PUBLISHED BY:— GEO: NEWNES LTD



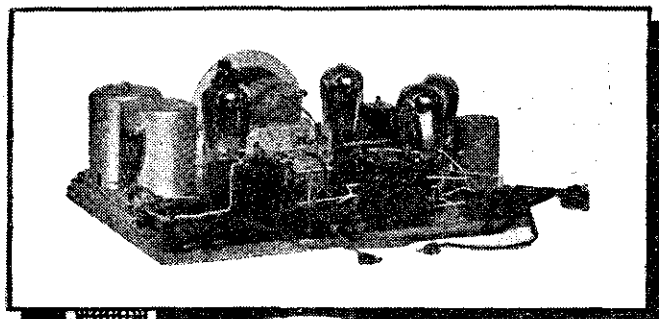
Full-Size Blue Print Wiring

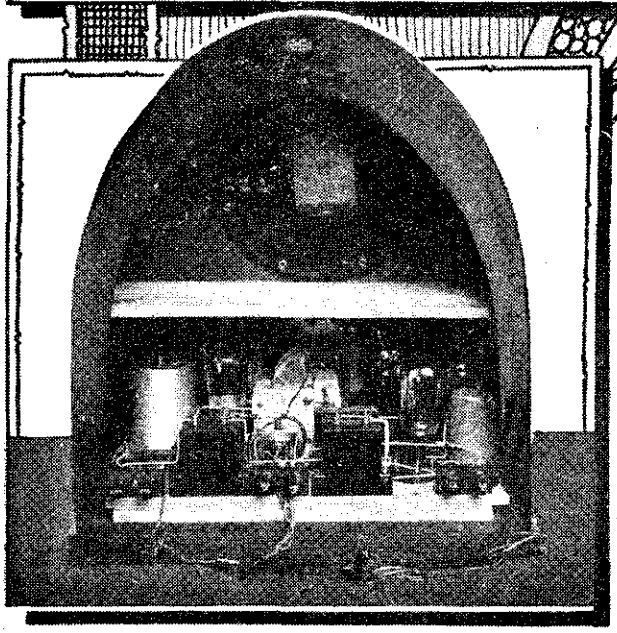
The SONO

THIS four-valver has been designed in response to many requests for a powerful battery set employing the ordinary type of screen-grid valve, as distinct from the variable-mu. As will be seen from the photographs the receiver is very compact, and, in view of the closeness of the various components, great care will have to be exercised in wiring, and the instructions must be carefully followed if this is the first receiver you have attempted to build. As a matter of fact this is a very suitable set for a beginner to try to construct, as, apart from the simple wiring, there are not very many constructional points which require attention, but these will be dealt with in their proper place. The circuit, as will be seen from page 190, consists of a S.G. valve with filament control, detector, L.F., and power valves. The detector is coupled to the L.F. by an ordinary L.F. transformer, but for the second inter-valve coupling a Benjamin Transfeeda is employed. This, as most readers are probably aware, consists of a transformer, coupling condenser, and wire-wound resistance. The detector valve is decoupled and an output filter is fitted. The result of this circuit arrangement is a perfectly stable, powerful receiver, and the quality is such that a moving-coil loud-speaker is recommended. The output valve will obviously be overloaded on a powerful station, and therefore a volume control is fitted before the first L.F. stage, and this, in conjunction with the volume control on the S.G. valve, will enable the signal strength to be regulated so that the detector valve is neither under- nor over-loaded, and the output valve also only receives a signal which it can properly handle. Having described the principal features of the receiver, we can now proceed with its construction.

Construction

Obviously, before construction can be commenced, all the components as specified in the shopping list should be obtained. It is unwise to attempt construction with only a few of the parts by you, as with all receivers, and especially with one so compact as this, it is advisable to arrange all the parts on the baseboard in the approximate positions they are to occupy, and move them about until absolutely certain that every one is correctly placed, and then pierce or otherwise mark the positions of all screws. By working in this manner there is no risk of finding, when the majority of the parts have been screwed down, that there is not enough space for such-and-such a component. Well, then, when all screw positions have been marked, remove all the components and drill the holes to accommodate the three screws which hold the variable condenser. The exact position of these is shown on the blue print. Before the coils can be attached it is necessary to reverse the positions of the two coils. It will be seen from the instructions accompanying the coils that this is done by simply removing two screws on each coil. Now attach the variable condenser, then the ganged coil assembly, the valve-holders, the transformer and Transfeeda, the grid leak and condenser, the small fixed condenser, the two chokes, and that is all for the time being. By leaving out the rest of the components wiring is simplified.





View of the completed receiver from the back, showing the battery shelf and loud-speaker fitted in the top section of the cabinet.

These illustrations give a good idea of the attractive layout and compact arrangement of the Sonotone. The extreme right- and left-hand views are from front and rear respectively, whilst the illustration above shows the completed receiver in its cabinet standing on the stool which is designed for it. The remaining illustration shows the baseboard viewed from above.

Wiring Up

These instructions for wiring should be carefully adhered to, in order that the various wires may occupy their correct positions, and neat cross-overs made at the correct points. The baseboard should be laid down, with the panel edge nearest to you, and then the various references to right and left hand will be correctly followed.

Terminal 1 of coil A to terminal G of the S.G. valve-holder.

Terminal G of S.G. valve-holder to fixed plates of first section of variable condenser.

Terminal 1 of coil C to fixed plates of second section of variable condenser, and a small wire from this latter terminal to the terminal on the small balancing section.

Attach a small soldering lug to the opposite side of

LIST OF

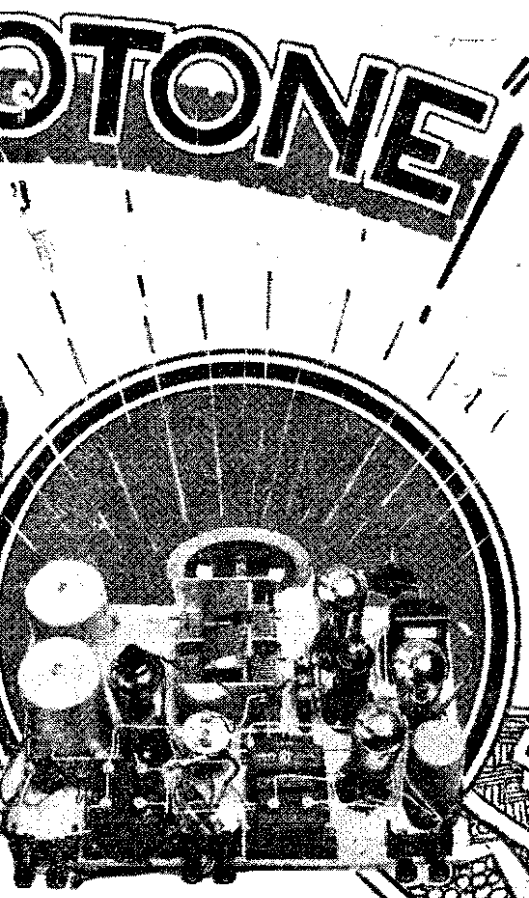
Received on the loud-speaker stren be given

Stations which were not s in signal strength, have r

Short Waves

Fécamp (Radio Normandie).
Trieste.
London National.
Turin.
Heilsberg.
Breslau.
Brussels No. 2.
London Regional.
Toulouse.
Midland Regional.
Katowice.
Stockholm.
Rome.
Beromünster.
Langenberg.

Diagram Given With This Issue



this section of the variable condenser, and run a wire to the centre terminal of the grid condenser.

From the latter terminal to the left-hand side of the .0001 fixed condenser.

Remaining terminal of the latter condenser to the left-hand side of the screened choke.

Terminal G of the detector valve-holder to the nearest terminal of the grid condenser.

Now join up the F terminals on the three valve-holders at the left-hand side of the baseboard, pressing the wires down so that they rest on the baseboard out of the way.

Terminal P of L.F. valve-holder to terminal P on the Benjamin Transfeeda.

Terminal G of the power valve-holder to terminal G on the Transfeeda.

Terminal A of the detector valve-holder to the lower terminal of the H.F. choke.

Top terminal of this choke to terminal P on the transformer.

Join together terminals 2 on the coils, and thence to the right-hand terminal of the switch on the coil base.

Right-hand side of switch to earth terminal.

Terminal 2 on coil C to the screw which holds the coil base to the baseboard.

Terminal 2 on coil C to terminal 6 on the same coil.

Remaining terminal on the grid condenser to F terminal on detector valve-holder.

Now the output choke and the three 2 mfd. condenser may be screwed down in their correct positions, and then the terminal blocks for aerial and earth and loud-speaker may be attached. Remove the microfuse from its base and screw the base in its position between the choke and fixed condensers, after which the wiring may be proceeded with.

Terminal E on the Transfeeda is joined to the left-hand L.S. terminal.

The latter terminal is joined to the F terminal of the output valve-holder which is nearest the panel.

From the latter terminal to the terminal on the end plate of the variable condenser, and thence to the right-hand terminal of the 2 mfd. condenser.

Join together the two right-hand terminals of the 2 mfd. condensers, and thence to the earth terminal.

Right-hand L.S. terminal to the 2 mfd. condenser.

Remaining terminal of this condenser to A terminal of output valve-holder.

Latter terminal to the nearest terminal on the output choke.

Remaining terminal of this choke to nearest terminal on the screened choke.

Latter terminal to terminal H.T. 2 on Transfeeda.

Left-hand terminal of the S.G. valve-holder to the F terminal of the output valve-holder.

Terminal A of the S.G. valve-holder to the 2 mfd. condenser.

Now attach one end of the 600 ohms spaghetti resistance to the latter terminal, and fix the opposite end to the baseboard with a small, round-head wood-screw.

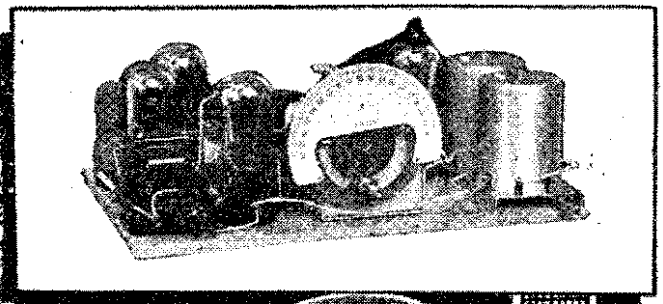
H.T. terminal of transformer to the left-hand terminal of 2 mfd. condenser.

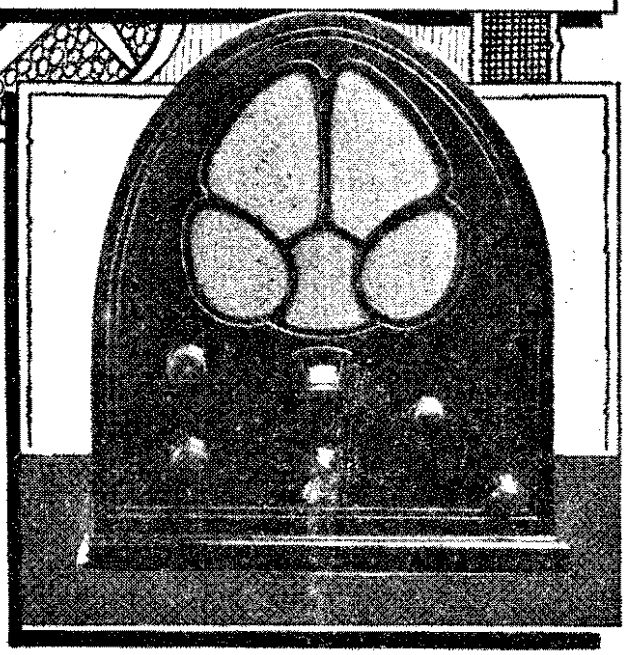
Attach the 10,000 ohms spaghetti to H.T. terminal of transformer, fixing the other end to H.T. 2 terminal of Transfeeda.

File a small hollow at the lower edge of the terminal block accommodating the pick-up terminals, and attach this terminal block to the baseboard, but, before driving the screws right home, slip the battery cords underneath so that they are gripped when the block is finally fixed. To the left-hand terminal of the switch on the coil base attach the L.T. — lead, a short length of flex, and a wire to the nearest terminal of the microfuse holder. The H.T. — lead is then attached to the remaining terminal of the microfuse holder. The L.T. + lead is attached to the left-hand F terminal of the S.G. valve-holder. A four-inch length of flex should now be fixed to the terminal on the screened choke which is nearest the panel.

Drilling the Cabinet

Before the wiring can be finished it will be necessary to drill the cabinet front, so this should now be marked out, and the holes drilled (see the diagram overleaf). Attach the escutcheon window to





Front view of the completed receiver. The two left-hand knobs are Volume Control and Reaction Control; the central knob on the right is the H.F. Volume Control, whilst the lower knob is the Wave-change on-off Switch.

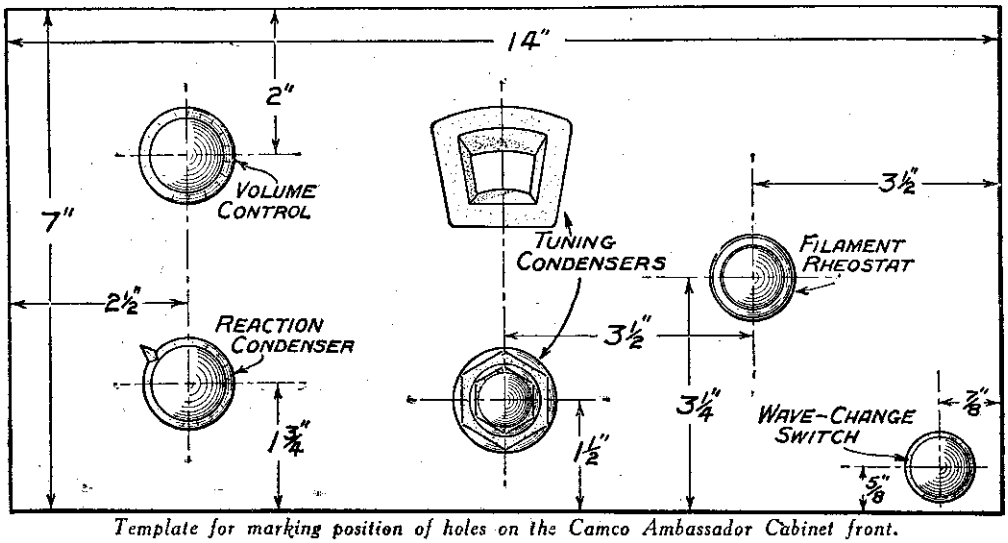
STATIONS

Sonotone at good gth. Full list will next week

ufficiently loud, or consistent ve been included in this list.

North Regional.
Prague.
Milan.
Brussels No. 1.
Vienna.
Budapest.

Long Waves
Huizen.
Königswusterhausen.
Daventry 5XX.
Moscow.
Eiffel Tower.
Motala.
Kalundborg.



Template for marking position of holes on the Camco Ambassador Cabinet front.

the front and then the 25 ohms resistance, the volume control and the reaction condenser, and then attach the remaining seven leads to the baseboard as follows. Three lengths of flex are attached to the G and G.B. terminals of the transformer and the G terminal of the L.F. valve-holder. One length of flex is attached to the right-hand F terminal of the S.G. valve-holder, and a further length of the terminal numbered 6 on Coil C. All these leads should be just long enough to reach the proper component on the front when this is finally attached. A length of glazite is now cut, one end being attached to terminal 5 of coil C, the wire passed along close to the variable condenser, and a loop made in the other end to attach to the small reaction condenser. A further piece of glazite is attached to terminal A of the detector valve-holder, and a loop provided to attach to the other terminal of the reaction condenser.

Before putting the set in its place, attach the dial to the variable condenser, and, if you wish the dial to be illuminated in use, you can also attach a short length of twin flex to the F terminals of the detector valve-holder, afterwards joining these leads to the lamp-holder on the back of the escutcheon window.

Final Details

Put the set into its place, and drive home the small woodscrews. Fit the knobs for the variable condenser, and then join up the flex and two glazite leads, after which the work is practically completed. The small preset condenser must be screwed to the baseboard between the aerial-earth terminal block and the coil base, and one terminal of it joined to the aerial terminal. The other terminal of this condenser is joined to terminal 4 on coil A. Three flex leads and one glazite lead will complete the receiver—one flex being joined to the right-hand pick-up terminal, and the glazite joining the remaining pick-up terminal and terminal G of the L.F. valve. The remaining two flex leads are joined to the G.B. terminals on transformer and Transfeeda. These flex leads must be provided with wander plugs, marked as follows: G.B.1 to the transformer, G.B.2 to the Transfeeda, and G.B.3 to the pick-up terminal.

Testing Out

The valves may now be inserted into their respective sockets, the batteries connected up, and the receiver tested out. H.T.1 should be inserted in a tapping between 60 and 80 volts, the best tapping being found by experiment. H.T.2, of course, will be plugged into the maximum voltage. G.B.1 is plugged in the grid battery at the 3-volt tapping, and G.B.2 into the 9-volt tapping. G.B. + of course, will be inserted into the socket bearing this marking, as will H.T. —. Join up the accumulator, attach aerial and

(Continued on page 192.)

LIST OF COMPONENTS FOR THE SONOTONE

CONDENSERS
Sovereign Pre-set .0003 mfds.
Wilkins and Wright W.312 (Two-Gang—.0005 mfds.).
Ready Radio .0005 mfds. Reaction Condenser.
Three 2 mfd. T.C.C. Type No. 50.
One .0002 mfd. T.C.C. Type S.P.
One .0001 ditto Type S. Flat.

COILS
Lissen Dual Gang.

CHOKES
Bulgin Standard Screened.
Slektun Standard.
R.I. Type D.Y.25 Output Choke.

TRANSFORMERS
Ready Radio L.F. 3—1.
Benjamin Transfeeda.

RESISTANCES
Lewcos Spaghetti 600 ohms.
Ditto 10,000 ohms.
Colvern 25 ohm. Variable.
Dubilier 2 meg. Grid Leak.

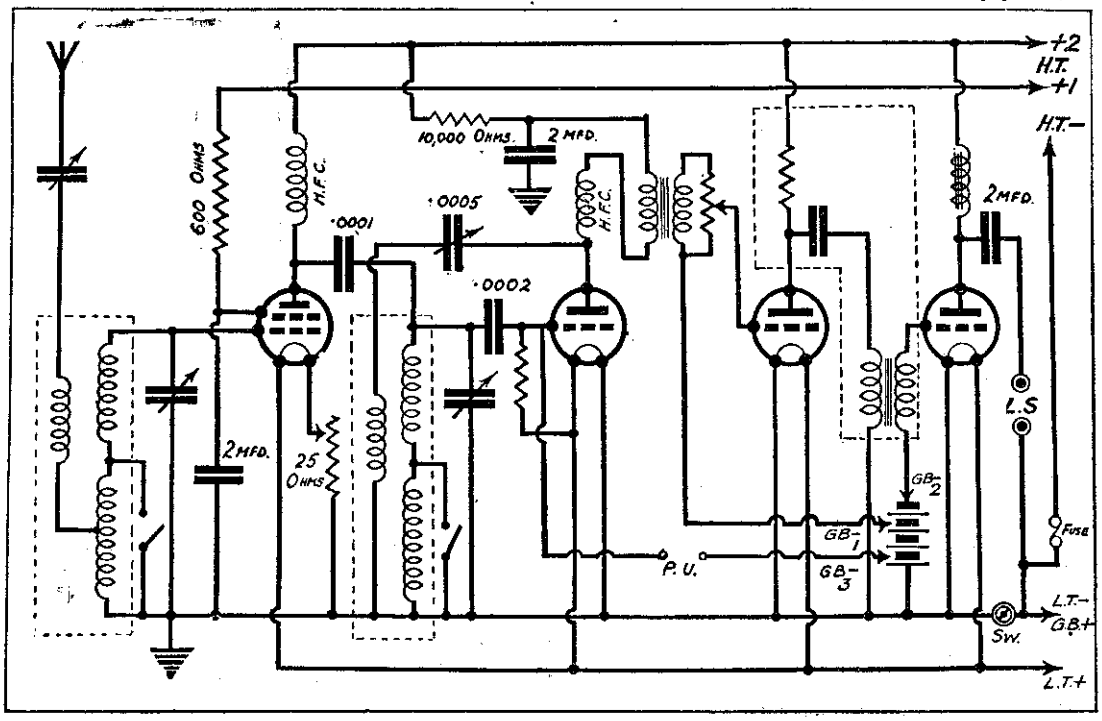
VALVEHOLDERS
Four Lotus 4-pin.

VALVES
Mazda SG.215; HL.210 (Metallised) L.2 and P.220A.

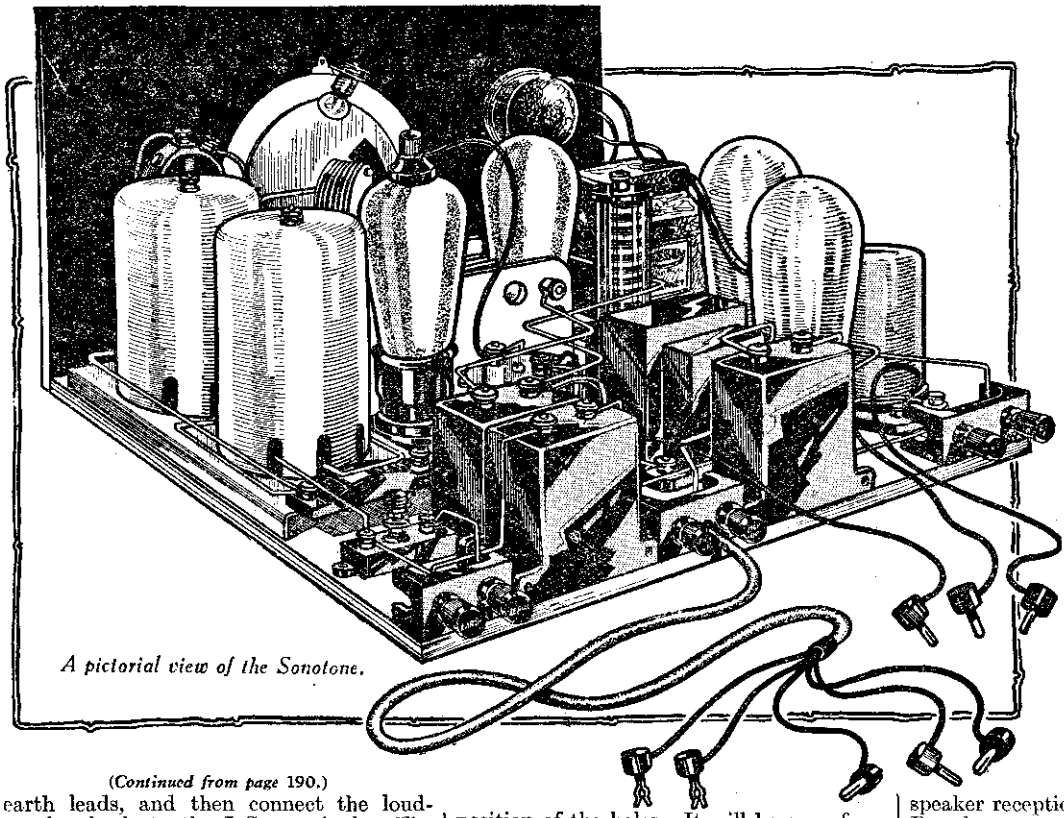
VOLUME CONTROL
Sovereign 500,000 ohms.

FUSE
Microfuse 100 m/A.

ACCESSORIES
Three Belling Lee Terminal Blocks.
Six Belling Lee terminals—Aerial, Earth, L.S.—, L.S. +, and two Pick-up.
Five-way Belling Lee Battery Cords.
Two coils Glazite connecting wire.
Short length of flex.
Four Wander plugs — G.B.+, G.B.1, G.B.2 and G.B.3.
One Tin of Filt.
Pertrix Batteries, 120 volt and 9 volt.
Camco Ambassador Cabinet.
Igranic D.9 Speaker.
One two-volt Accumulator.



The theoretical circuit of the Sonotone.



A pictorial view of the Sonotone.

(*Continued from page* 190.)

earth leads, and then connect the loud-speaker leads to the L.S. terminals. The small flex lead from the screened choke should be connected to the terminal on top of the S.G. valve, and the receiver switched on. This is carried out by means of the knob on the coil base, and, by rotating the knob to the left, the filaments are switched on, and the receiver will tune to the medium wave band, from 200 to 530 metres (or 1,500 kc/s to 566 kc/s). Rotating this knob to the right switches on the filaments, and the receiver will then tune from 800 to 2,000 metres (or 375 to 150 kc/s).

The Camco Cabinet

To enable the receiver to be mounted in the Ambassador cabinet, the front of the cabinet will have to be drilled out, as shown in the "panel layout," but a little care will have to be exercised in the actual disposition of the holes. It will be seen from the photos that strips of wood are fitted to the base of the cabinet to raise the baseboard of the set to such a level that the switch knob is not too low on the front. The most important holes are those for the tuning condenser knob and escutcheon and on-off switch. The remaining holes need only be relatively placed. The controls for these latter holes may be wired into the circuit and then pushed into position as the baseboard is slid home. As an alternative, the controls may be mounted on small metal brackets.

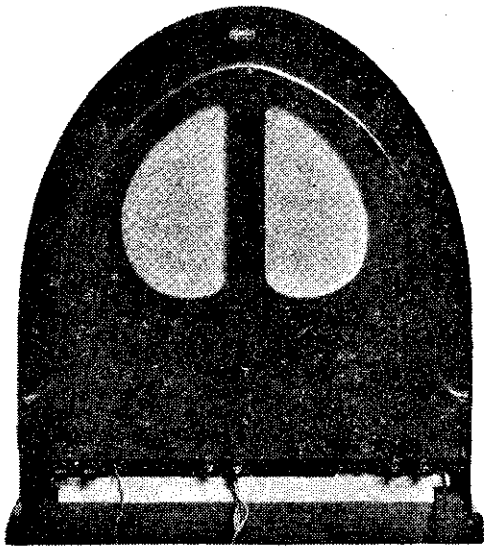
If desired, the set can be completely wired up outside the cabinet by screwing to the front of the baseboard a thin three-ply panel marked out in accordance with the special dimensioned panel layout diagram given on page 190. As mentioned before, this diagram is intended as a template for drilling the front of the case, and if the reader elects to complete the wiring of the set after it has been screwed down to the floor of the case, the cardboard template, carefully cut to the sizes given, should be laid over the front of the cabinet and the positions of the various holes carefully marked.

A template is supplied with the variable condenser, as mentioned earlier, and this should be carefully transferred to the cardboard template. It will be necessary, owing to the low position of the wave-change switch, to ensure that the holes are drilled a sufficient height above the bottom of the cabinet, otherwise, when the baseboard is pushed into the case, it may be found that the holes and the spindles do not coincide. This drilling operation, therefore, should be given careful attention.

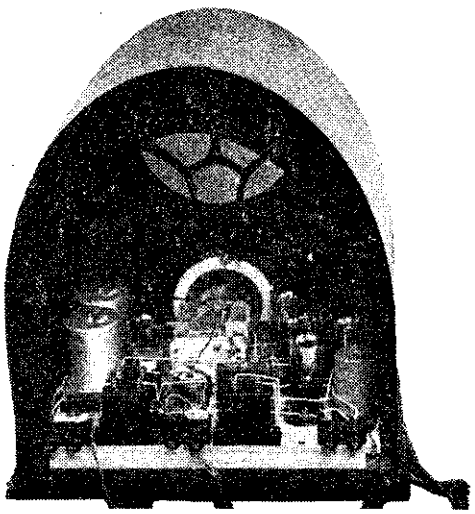
It will be found necessary to screw two battens to the underneath side of the baseboard to raise the wave-change switch to a sufficient height. These battens need to be about ⅜in. thick. If, however, the reader decides to use a dummy three-ply panel for erecting the controls (and this is, perhaps, the better system) the dummy can be used as a drilling template for the front of the case. The set should push into place easily; do not bend or distort the parts to get them to enter the holes, otherwise you will introduce troubles which it may be difficult to remedy.

Mount the knobs so that they just clear the polished surface, or unsightly marks will appear.

In conclusion, should the reader experience any difficulty in construction or operation, he should address a letter to the Queries and Enquiries Department, marking the envelope "SONOTONE."



The rear of the cabinet, showing how the lower edge of the back is cut away to clear the terminals.



An interior view with battery shelf and loud-speaker removed.

THE NEW TYPE OF MAINS VALVES

And How a Battery Receiver was Converted to "All Mains."

By PENTAMP.

MANY of my readers have no doubt heard of Ostar Universal Mains Valves which were introduced into this country a short while ago, but for the benefit of others, to whom they may be new, I wish to give here a brief explanation before passing on to a description of some simple experiments I made recently in converting a two-valve receiver to operate entirely from D.C. mains.

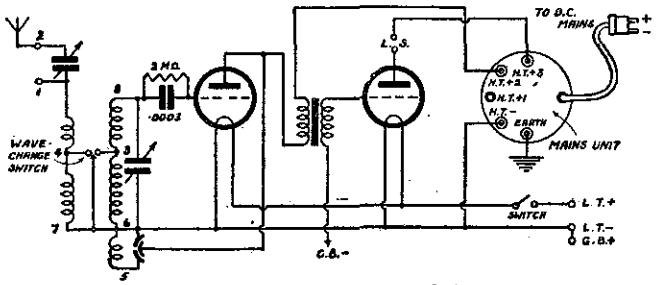


Fig. 1.—The circuit of the battery set before conversion.

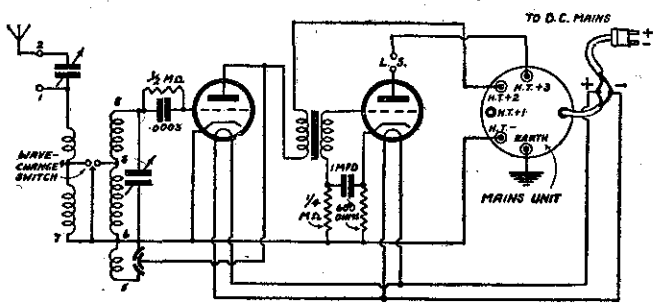


Fig. 2.—The circuit shown by Fig. 1 modified to suit the new Universal full mains voltage valves.

Valve Filaments that Stand 240 Volts!

The valves in question are of Austrian origin and in appearance they are much the same as the more conventional types. They are made for all-mains voltages and the voltage required should be stated when ordering. They have five-pin bases or alternatively what are called "adapter" bases. The latter are for use in existing sets and have the filament terminals brought out to the side of the base to avoid re-wiring. Their chief characteristic is that the filaments are designed to take the full voltage of the mains. This, in conjunction with indirectly-heated cathodes, renders them capable of operation direct from either A.C. or D.C. mains. In other words, both the filament current and H.T. current is supplied from the mains without the use of a transformer in the case of A.C., or breaking down resistance in the case of D.C. They are also very economical, using 5½ to 6 watts per valve for heating.

Circuits Used

Perhaps the best known circuit using these valves is that shown in Fig. 4. It is the one used in the Ostar Universal two-valve receiver (the third valve shown is a rectifier). This set will work from A.C. or D.C. mains (of the same voltage) by simply plugging in. No alteration to the set is necessary! However, if the set is intended exclusively for D.C. use, the rectifier can be omitted. If retained, as shown, the cathode-anode space merely acts as a series resistance of low value.

The H.F. and L.F. parts of the circuit are quite normal; there are, however, one or two interesting points with regard to the power-supply system. For instance, the H.T. current is filtered through a double choke and condensers. The choke is rather a special one and is obtainable, or will be shortly, in both R.I. and Igranic makes. Incidentally, when using D.C. a single choke is usually sufficient. A potentiometer is used to provide an artificial centre point when working from A.C., but this again is not necessary in the case of D.C. The valve filaments, or heaters, it will be noticed, are connected in parallel direct across the mains and therefore any number of valves may be used without causing the voltage to drop.

A Bold Claim

In one of the pamphlets issued by the makers they claim that "any old valve can be substituted by one of the new construction without any alteration of the set apart from the heating wiring." Of course, they do not mean that this will automatically convert a battery set into an all-mains receiver, but that the characteristics of the valves are such that they can be substituted for your old ones by just altering the filament wiring and you will be sure of equal results. You would still have to use an eliminator if you wished to discard the H.T. battery as well as the accumulator. Even so, this struck me as being rather a bold claim, so I decided to put it to the test by trying two of their valves in a battery-operated set which I happened to be using. This set I had recently fitted with a cheap D.C. mains unit for supplying the H.T. current, so that the substitution of Ostar valves should make it virtually an all-mains receiver, but anyhow, I merely altered the filament connections to see what happened.

A Simple Two-Valver

Fig. 2 is the original circuit and Fig. 3 shows it after the conversion. The first thing I did was to substitute five-pin valve holders for the four-pin ones fitted. The centre pins, or cathodes, I connected together and joined to H.T.—, also all connections which were previously joined to L.T.— I connected to the cathodes. This left the filament terminals separate from all other parts of the circuit and I

(Continued on page 196.)

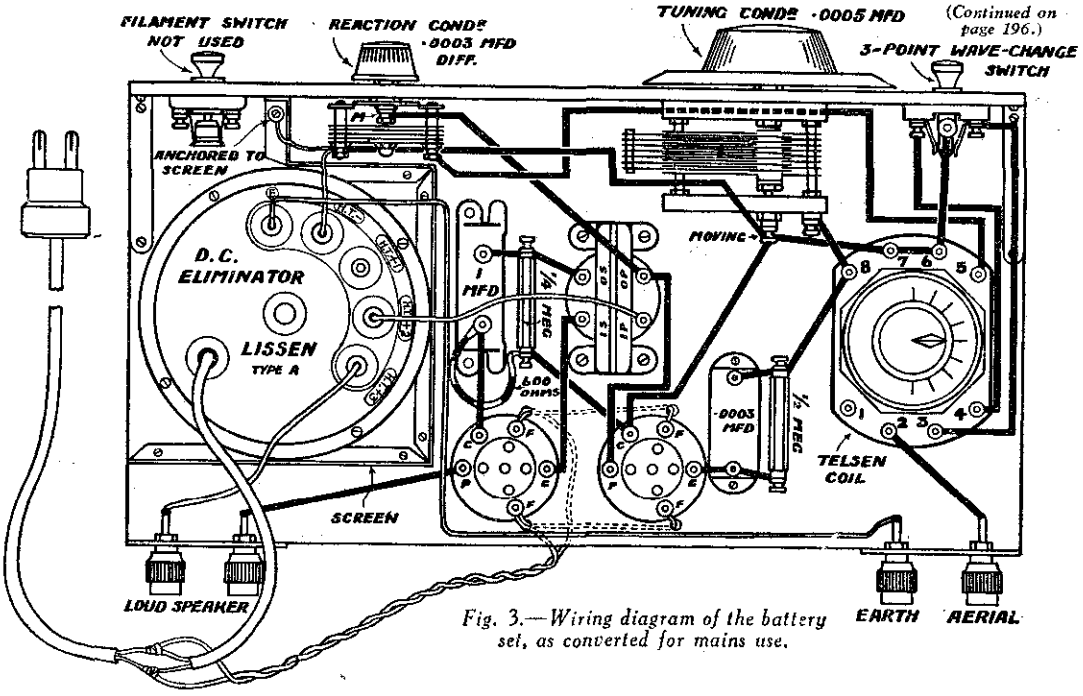


Fig. 3.—Wiring diagram of the battery set, as converted for mains use.

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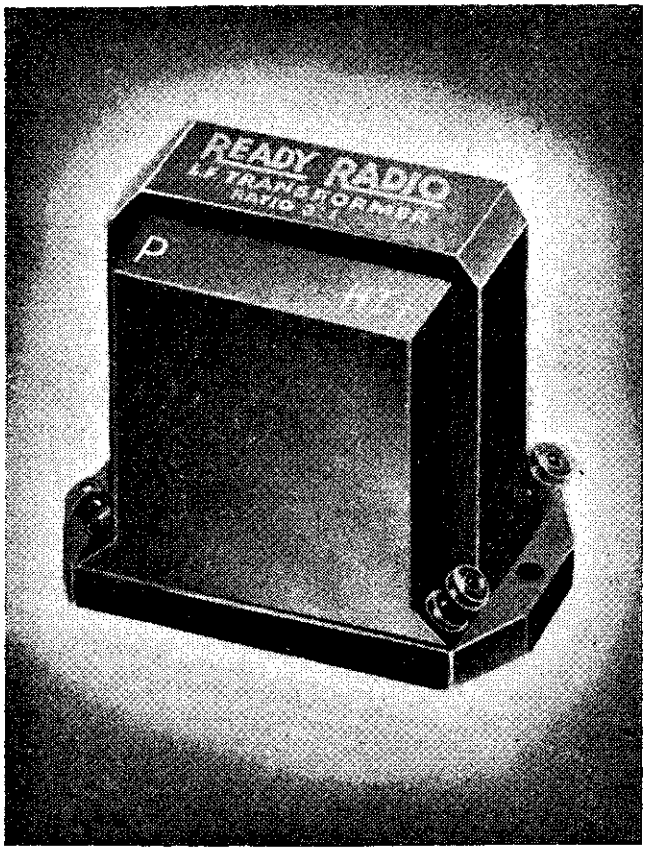

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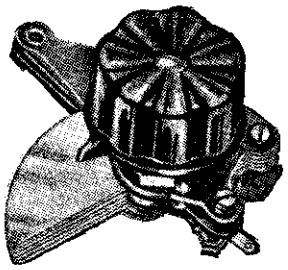

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(continued from page 194.)

then connected them by means of flex to the nearest lamp-socket. The old filament switch, being of robust construction, I left in the circuit for switching on. The mains unit and grid-bias batteries I left as they were. Then I plugged in the valves and switched on. As I expected, as soon as the valves had heated up there was a decided mains hum, which could be heard above the broadcasting. This was clearly due to the haphazard way I had wired the filaments, since I knew the mains unit was quite silent. I thereupon fixed a plate of zinc under the baseboard and drilled small holes right through the baseboard and the zinc at the side of each valve holder, and kept all heater wiring under the panel, the connections to the valve holders being made through the holes. The result was magical—the hum practically disappeared! Still not being quite satisfied, I had a look at the detector grid connections. Here I shortened the wire from the grid to the grid condenser by shifting the latter right up against the detector valve holder. This reduced hum to a minimum and, except for a slight building up just at oscillation point, would pass unnoticed. This I considered quite satisfactory, although it must be remembered that with the mains unit used the maximum plate voltage is only about 120. I rather think that with a voltage nearer the valves maximum of 240 the very slight hum present would be magnified somewhat. At the same time, it must be remembered that no smoothing devices whatever were used in the heating circuit. Altogether I felt that the makers' claim was quite justified and I was agreeably surprised at the way the set handled. It then remained to make the set truly "all mains" by providing automatic grid bias. This was easily done by the substitution of two resistances and a condenser in place of the grid-bias battery. A 600-ohm resistance gave the right bias for the amplifier valve at 120 volts on the plate, and a 1 mfd. condenser and a ¼ megohm grid-leak were included for decoupling purposes.

Good Reception

On the final test I found these valves to compare favourably with the normal type, the power derived from the set being slightly in excess of that obtained previously, with smooth reaction. The valves were anti-microphonic and no need was found for any decoupling devices in the anode circuits. In fact, the inclusion of an H.F. choke and decoupling resistance and condenser at the anode voltage I was using sufficed merely to slightly reduce the signal strength.

Any reader possessing a set similar to the one I was using, namely, with a D.C. eliminator for the H.T. and with accumulators for the L.T., who contemplates a conversion to all mains, cannot go far wrong if he follows the wiring diagram given on p. 194. The following hints may also be useful. A fixed condenser should be included in the aerial lead if there is not one already in the set. This is in addition to the one in series with the earth lead, which is usually included in the mains unit. No direct connection must exist between the earth and any part of the set. A 1-megohm or ½-megohm will be found the most suitable value for the detector grid-leak. Do not use rubbishy valve holders. Remember they have to stand up to the full voltage of the mains and that the grid of the detector valve particularly must be well insulated.

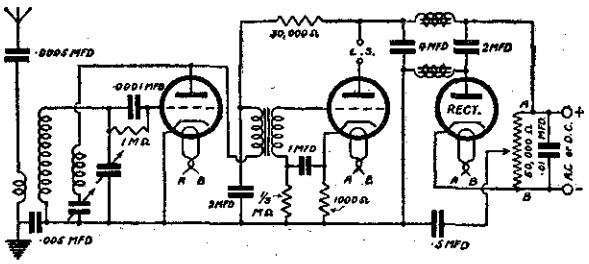


Fig. 4.—Circuit diagram of the Ostar Universal two-valve receiver.

List of Components Used in the Two-Valver Illustrated on p. 194.

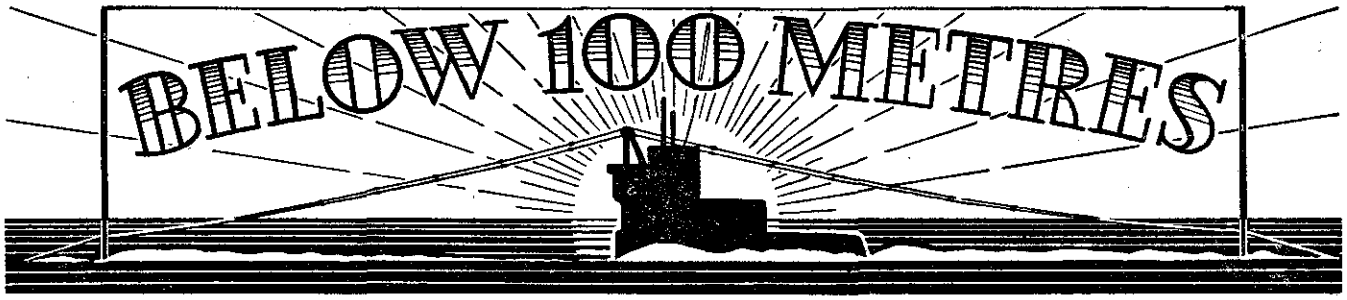
1—.0005mfd. tuning condenser, Stones.
1—.0003mfd. reaction condenser, Lotus.
1—Telsen dual-range tuning coil.
1—L.F. transformer, ratio 3 : 1, Lissen.
1—.0003mfd. fixed condenser, T.C.C.
1—1mfd. fixed condenser, T.C.C.
1—½ megohm grid leak, Lissen.
1—¼ megohm grid leak, Lissen.
1—Spaghetti resistance, 600 ohms, Lewcos.
Pair Lissen panel brackets.
4—Terminals, marked "Aerial, Earth, L.S.+ and L.S.—," Clix.
Aluminium or zinc sheeting for screens.
2—Baseboard mounting 5-pin valve holders, Clix.
1—3-point shorting switch, Ready-Radio.
1—Lissen D.C. eliminator, popular model, type A.
Ebonite panel, 14in. by 7in. Baseboard, 14in. by 7in.
Connecting wire, screws, 2 terminal mounts.
Suitable valves are: W310 or A520 as detector and U920 as amplifier.

Metallised heater wire is preferable to twisted flex for the filament connections. It tends to reduce any mains hum. A zinc or aluminium screen is advisable round the eliminator as shown. Like the metal plate under the baseboard it should be connected to H.T.—

Where it is desired to instal a receiver of this type as the "household" broadcast receiver, it may be thought worth while to take all precautions possible against shocks. Although it may be impossible to actually receive a shock from the apparatus, there is always someone in the family who has a little apprehension on knowing that the set is connected to the mains. It is also possible that some alteration may be desired some day, and it is obviously essential that the high voltages should not be present during such alteration. The following suggestions are therefore offered to enable the constructor to make the set "safe." The lid of the cabinet should be fitted with a switch which will operate in such a way that current is only switched on when the lid is closed. This will ensure that the set is "dead" when it is exposed to view. Control knobs should have the grub screw sunk well into the knob in case the operator touches a high potential point with one hand whilst tuning-in.

Finally, I do not wish to give the impression that the set described here is the last word in D.C. all-mains two-valvers. It is simply an adaptation of an existing battery receiver to all-mains operation and is intended to show how such a conversion may be carried out with a minimum of expense and trouble. Of course, if you wish to make up a set exactly as shown here, there is no reason why you should not, and in using the Lissen Eliminator you will save the trouble of constructing this part of the receiver. Shortly I hope to give particulars in these pages of how to make an all mains three-valver for operation from either A.C. or D.C. at will.

The reader may like to know that the manufacturers of the Ostar valves will be pleased to advise all readers of PRACTICAL WIRELESS regarding the installation of these valves, and their address can be obtained on application. Mark letters "Mains Valves" in the top left-hand corner, and address to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. The query coupon should be attached to every enquiry. Lists giving the full range of valves are available to readers under the conditions given under our weekly "Catalogues Received" feature.



SHORT-WAVE RECEPTION

By R. F. Roberts

MOST owners of radio receivers have heard of the great advances that have been made in the development of short-wave broadcasting in recent years. Numerous broadcast programmes can now be heard at almost any hour of the day or night, whereas up to a few years ago, the number of available stations with a definite programme value could be counted on the fingers of one hand; the amount of entertainment that one could obtain from a short-wave receiver was so small that only the more serious minded experimenters became interested in the subject. To some extent, the idea that "short waves" are a sort of "no-man's-land," only available to the more experienced experimenter, persists to-day, but this is no longer true and anyone who has handled an ordinary receiver can, at very little cost, enjoy reception of stations situated thousands of miles away. It is a characteristic of short wavelengths that it is very often easy to receive, say, a station in Australia on the loud-speaker, whilst another station fifty miles away is barely audible; this is due to certain facts connected with transmission that are worth considering for a moment.

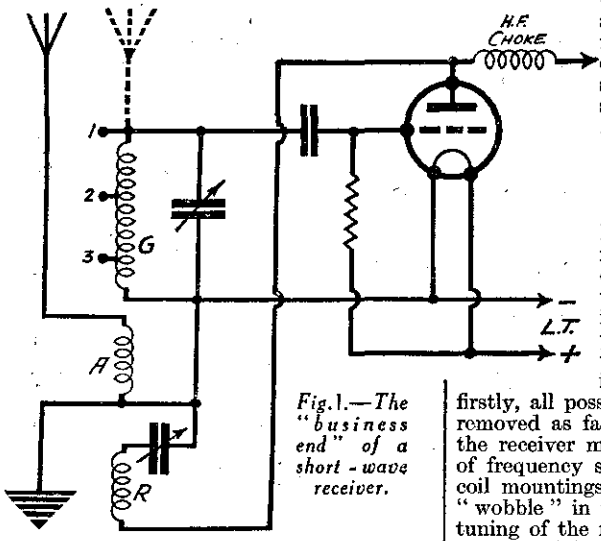


Fig. 1.—The "business end" of a short-wave receiver.

"Ground" and "Reflected" Waves

When a station is transmitting, two types of radiation are really being emitted; one leaves the aerial and follows the curvature of the earth, becoming gradually weaker and weaker in the process due to absorption of energy by earthed objects such as buildings, trees, etc; this is usually referred to as the "ground wave"; the other goes off at an angle up into space until it meets an atmospheric belt known as the Heaviside layer. This layer reflects the radiation back to earth in a similar manner to which a beam of light is reflected off a mirror; this wave is therefore termed the "reflected wave." A station transmitting on, say, 2,000 metres, radiates practically the whole of its energy in the ground wave—the amount of reflected radiation being negligible; another station on 200 metres may divide its energy between the two radiations—the reflected wave being very much in evidence. A transmitter on 20 metres, however, radiates almost the whole of its energy in the reflected wave, the ground wave being very weak by comparison. This explanation, although very general and subject to many modifications, will serve to explain how the use of a short wave enables us to hear stations as remote as the Antipodes.

Essential Considerations of Receiver Design

Now as to the receiver. In what way is a short-wave receiver different from one of the ordinary kind that we use? Fundamentally, there is no difference, the circuit principles being the same; there are, however, two important qualifications: firstly, all possible sources of loss must be removed as far as possible, and secondly, the receiver must maintain a high degree of frequency stability, that is, all wiring, coil mountings, etc., must be rigid. Any "wobble" in the wiring will result in the tuning of the receiver varying with consequent inability to hold a station once it is tuned in. These two qualifications will be better appreciated if we consider the frequency instead of the wavelength. A 300-metre wave has a frequency of 1 million cycles per second; a 30-metre wave corresponds to a frequency of 10 million cycles, but a 3-metre wave means that the frequency is 100 million cycles. Losses due to self-capacity, resistance, and the use of poor dielectrics in our condensers, become, at 30 metres, ten times as important as on 300 metres; at 3 metres these losses are the all-important factor in circuit design.

Now let us consider the circuit of Fig. 1, which is the "business end" of a typical short-wave receiver. The batteries and L.F. end of the set have been omitted, the L.F. side following conventional practice as for ordinary broadcast receivers. The three coils, A, G, and R, may be three separate coils as shown or may all be wound on one former, the latter being the more usual commercial method. The coil G is the most important, being the grid coil forming the tuning circuit with the condenser shown connected across it. The resistance losses are reduced to a minimum by winding this coil with a heavy gauge of wire; the dielectric losses are reduced by making the coil as near self-supporting in the air as is possible, yet retaining enough mechanical rigidity to prevent any possibility of vibration. The question of losses in the reaction coil R does not arise, because it is fed from the amplified high-frequency energy in the plate circuit; we can thus wind this coil with any gauge of wire we like, in a single layer with turns touching or piled into a slot in the former.

Tuning Coil Connections

Before we consider the aerial coil, let us consider connecting the aerial to a point marked 1 on the grid coil. The effect is two-fold; firstly, the damping imposed on the coil by the aerial will undo all the good work we have achieved by reducing

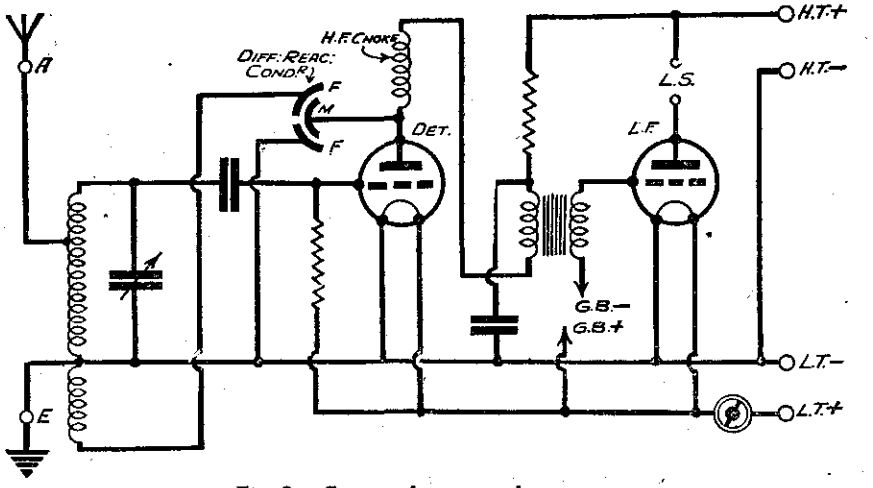


Fig. 2.—Circuit of a two-valve receiver.

the coil's losses, and secondly, any variation in the aerial's capacity (such as might be produced when the aerial lead-in swings in the wind) will be evident as variations in tuning. These effects can be reduced by tapping the aerial on to points down the coil, such as 2 and 3 in the diagram, but we reach a point where the transfer of energy from the aerial to the grid coil begins to fall away. It is more effective to connect the aerial to a separate coil, as shown in the diagram, selecting the number of turns and the position to effect a suitable compromise between energy transfer and damping.

Another important component is the H.F. choke in the anode circuit. This should have a low self-capacity and no pronounced resonances over a wide range of wavelengths; if resonances are present they will have peculiar effects on the reaction—this being controlled by means of the condenser in the reaction coil circuit. There are several very excellent H.F. chokes available for short-wave work—some of the standard H.F. chokes maintain their efficiency down to 10 or 15 metres, so no trouble should be experienced with this component, providing we use a well-tried make.

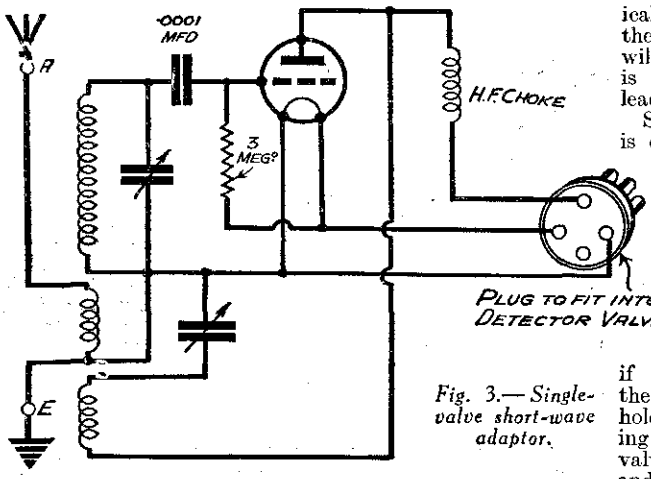


Fig. 3.—Single-valve short-wave adaptor.

Practical Aspects

Now that we have considered some of the more important features of the circuit, let us consider the practical aspects. There are two possibilities for the short-wave enthusiast; he can either build a complete receiver consisting of, say, the circuit of Fig 1, plus two L.F. valves to bring signals up to loud-speaker strength, or he could build this circuit into a unit and arrange for it to plug into the detector valve-holder of his standard receiver, thus using the L.F. end of this receiver to amplify the short-wave signals received by the unit. This system is shown in Fig. 2. A simple two-valve receiver is shown diagrammatically, together with a short-wave unit and the necessary plug for connection. It will be noticed that the grid connection is ignored, only the filament and plate leads being used.

Such a system of short-wave reception is cheap, simple, and efficient. It is an easy matter to construct the unit shown in Fig. 1, when, by withdrawing the detector-valve from your standard receiver, plugging-in the unit and inserting the detector-valve into the unit's valve socket, the standard receiver is instantly converted into an efficient short-wave receiver. Such a unit can be used with almost any receiver—even if it has H.F. stages; we do not use the grid connection to the detector valve-holder, therefore the entire circuit preceding this valve—the tuning circuit, H.F. valves and the rest, is effectively isolated and only the L.F. portion of the set is used to follow the unit.

Constructional details of a suitable unit will appear shortly, but the experimentally-inclined reader may care to try the system in the meantime. An effective coil combination could be made up with three plug-in coils, the aerial being three turns, the grid coil being five turns and the reaction four turns. The tuning condenser may be 0.0003 mfds., and the reaction condenser, 0.00015 or 0.0002 mfds. The tuning condenser must be fitted with a good slow-motion dial, because tuning will appear to be extremely critical—and stations are easily missed if the tuning condenser is rotated too rapidly.

SOME PRACTICAL POINTS

Connecting a Gramophone Pick-Up

Whilst most modern receivers have provision for connecting a pick-up there are many older sets not so equipped. Almost every set having one or more low-frequency stages can be successfully used as a gramophone amplifier.

A single-pole change-over switch—now frequently sold as a "Radio Gram" switch—is required. The wire from the grid terminal of the detector valve holder to the grid condenser and leak is removed from the latter point and joined to the centre terminal of the switch. One of the other switch terminals is connected to the condenser and leak, whilst the third terminal is connected to the slider of a suitable volume control potentiometer. One of the other two terminals is fitted with a flexible lead and a "G.B." wander plug, the pick-up being connected to the latter terminal and to the third one.

If a post-detector volume control is fitted in some other part of the set the potentiometer just referred to might not be required. In that case one pick-up lead will be connected directly to the grid-bias battery and the other to that switch terminal marked "G." When a potentiometer is to be used its correct resistance will depend upon the make of pick-up employed, so the value specified by the makers should be chosen. In receivers having two L.F. stages it is often found that the amplification given is too much when the pick-up is connected to the detector valve (which acts as another amplifier in this case).

Minor Refinements

In addition to the more or less "major" modifications dealt with in a recent issue, there are a number of smaller ones which add a certain amount of refinement. Perhaps the most interesting of these is the fitting of a dial light. Such lights are found on nearly all mains receivers but are comparatively rare on battery ones. Besides illuminating the tuning dial the light acts as a reminder that the set is switched on. Most of the types on the market can be attached to the panel or condenser drive, and the only connections required are two wires, preferably twin flex, to the filament terminals of a convenient valve holder.

Another useful fitting is a station log, a small metal-framed chart, upon which can be written the condenser settings for various stations. The logs are available in various sizes and can conveniently be screwed on the panel or inside the lid of the cabinet. With many of the older sets a substantial improvement can be effected by replacing the ordinary condenser dials by slow-motion ones. In this case it is preferable to choose dials which are fitted with a metal screen to reduce hand-capacity effects; the screen must, of course, be connected to earth to enable it to fulfil its proper purpose.

Users of portable sets often wish to increase the range of reception by connecting external aerial and earth wires but find this impossible because appropriate terminals are not provided. This difficulty can be overcome by winding two or three turns of 24's gauge d.c.c. wire round the main frame, winding and bringing the ends out to convenient terminals. The best position of the turns can best be found by trial, as it depends entirely on the characteristics of individual sets. Often results can still further be improved by connecting the "earth" end of the extra winding to H.T.—. Most readers will have noticed that certain firms now supply their valves with either plain glass or metallised bulbs. When replacing worn-out valves it is often advisable to specify metallised valves. Even if they *do not* give any improvement they will certainly be no less efficient than those of the plain type.

Wavelength and Frequency

A NUMBER of people do not seem to understand the relationship which exists between the wavelength and frequency of a transmission. In most lists of transmissions and broadcasting programmes, transmitters are stated to be operating on a certain wavelength or such and such a frequency. For example, the wavelength of the London Regional is 356.3 metres, and the frequency 842 kilocycles, or 842,000 cycles. To be technically accurate the latter figures should be given in kilocycles, or cycles "*per second.*" Now, wireless waves, like light waves, travel at 300,000,000 metres per second; if, therefore, one wave is, say, 300 metres long 1,000,000 such waves will be created per second. It is the number of waves per second which is referred to as the frequency, one complete wave being called a "cycle," and, of course, 1,000 cycles are equivalent to one kilocycle. It is well to bear this relationship in mind because it is often useful in experimental work and especially in super-heterodyne practice.

If you Have a Point of View——— why not express it in the correspondence pages? See page 208.

CHOOSING RESISTANCES

By G. V. COLLE

IN the light of modern set design, it is both interesting and amusing to view the practice indulged in not so very long ago of choosing resistances for their values, regardless of the current-carrying capabilities and self-capacities. Indeed, many ardent constructors of the "early days" can remember when the acquisition of a resistance of a certain value was deemed a "find," and it was no uncommon thing to be forced to make one from questionable material, such as indian ink, blotting-paper, etc.

Nowadays the position seems to be entirely the reverse. There are literally dozens of makes available, and each in three or four different types, each of which again is available in about four or five dozen resistance values. Add to this multitude the question of a wattage rating, or in other words, a current-carrying capacity, and it will be realized what a difficult task it is for the average constructor to arrive at a suitable selection for his proposed set. Of course, such difficulties do not arise when a published set design is followed, since the designer is invariably careful to name makes, types and ratings, while the resistances chosen are usually capable of withstanding 50 to 75 per cent. overloads.

There is another type of constructor, however, who has just sufficient technical knowledge to design his own receiver. He is the man who sometimes takes a fancy to the H.F. side of one receiver and the L.F. stages of another, and attempts a combination of the two. Often his practical knowledge is sufficient to allow him to make a success of the arrangement, but in rearranging the voltage-dropping resistances or H.T. battery eliminator he comes "unstuck."

Resistance Calculations

In such circumstances the constructor, owing to his unfamiliarity with Ohm's Law, resorts to "hit and miss" methods, often with disastrous results to valves, resistances and mains transformer and rectifying valve. The writer, therefore, makes no apologies for reviving the formula which is as follows:—

Voltage = current × resistance
or ($E = I \times R$).

$$\text{Resistance} = \frac{\text{voltage}}{\text{Current}}$$

or $\left(R = \frac{E}{I}\right)$

$$\text{Current} = \frac{\text{voltage}}{\text{resistance}}$$

or $\left(I = \frac{E}{R}\right)$

Wattage = voltage × current
or ($W = E \times I$).

Where
E = voltage; I = current; R = resistance; W = wattage.

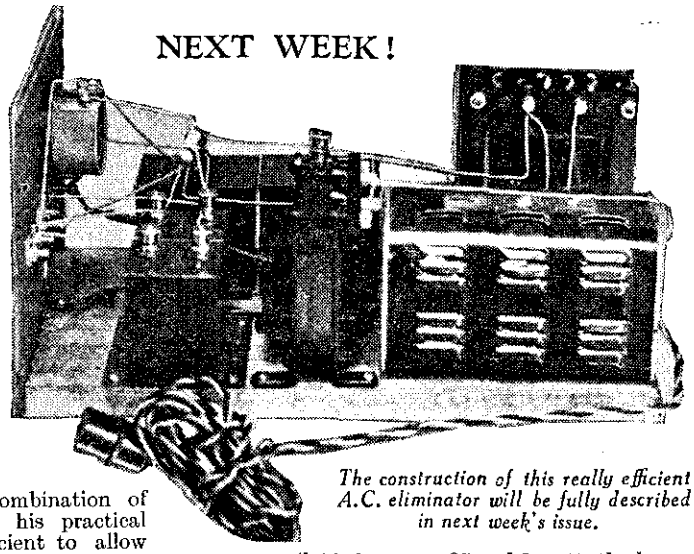
As an interesting example, let us assume an output valve requires a 100-ohm non-inductive resistance in its anode circuit. We require to compute the wattage of a resistance, and we know the maximum anode current of the valve is 63 m/a from the data slip supplied by the makers. Since it is not possible to apply the formula $W=E\times I$ until the voltage drop across the 100 ohm resistance has been decided, we utilize $E=I\times R$, which in this instance will be $E=.063\times 100=6.3$ volts (.063 is 63 m/a expressed as a fraction of one ampere).

Thus, $W=6.3\times .063=.3969$ watt. From a commercial aspect, a .5-watt (half-watt) resistance would be chosen, though as surges of current sometimes take place, or as resistances of 100 ohms are rarely available between .25 and 1 watt, the latter would be the wisest choice.

A further example is a power grid detector, with a positive bias of 1.5 volts on the grid. This valve has an applied H.T. potential of 450 volts, which on test shows an anode current of approximately 8 m/a when a 20,000 ohm anode resistance and 15,000 decoupling resistance are employed. We require to know the wattage rating of the resistances, also the voltage on the anode.

By Ohm's Law $E=I\times R$ or, in one case, $E=20{,}000\times .008=160$ volts, and in the other $E=15{,}000\times .008=120$ volts. Ignoring the resistance of the H.F. choke, which is negligible, the voltage drop is $160+120=280$ volts. Subtracting 280 from 450, the actual voltage applied is therefore 170 volts. Reverting to $W=E\times I$, in the first case, $W=160\times .008=1.28$ watts; in the case of the decoupling resistance $W=120\times .008=.96$ watt. Strictly suitable resistances would be one 20,000 ohms, 2 watts, and one 15,000, 1.5 watts. However, two 2-watt resistances would suit.

NEXT WEEK!



The construction of this really efficient A.C. eliminator will be fully described in next week's issue.

Non-Inductive Resistances

From technical considerations it is always advisable to employ an *anode* resistance, of a non-inductive nature, as a wire resistance, wound in the form of a solenoid on a heat-resisting former, invariably possesses inductance and, consequently, a definite self-capacity. However, from past experience, the writer cannot stress the point, as the internal electrode capacity of the valve, plus the valveholder capacity, are often of a greater dimension than the anode resistance alone. Consequently, unless one has taken extreme precautions to avoid high-note loss in a resistance-coupled L.F. stage, by using a low-loss valveholder, de-capping the valve, etc., the choice need not be a narrow one. The choice nowadays inevitably depends on the price, and it is a matter for congratulation that some of the most cheap and reliable of resistances are also non-inductive.

De-Coupling Resistances

De-coupling resistances can be of any convenient form, so long as they are of suitable wattage. Wire-wound resistances, with adequate ventilation to avoid overheating, are undoubtedly the best, as they are always silent in operation, and rarely change their values under different loads, so long as the maximum ratings are not exceeded.

On the other hand, the manufacturing costs of a modern set do not allow for wire-wound resistances, and synthetic carbon resistances have been commissioned in great quantities. Chemistry has played a very large part in the perfection of graphite compounds, and considerable ingenuity has been shown in some of the designs at present on the market.

Metallized Resistances

The Dubilier metallized resistances, which have achieved a high degree of success, are examples of evaporated water colloidal carbon deposits hermetically sealed in practically non-porous porcelain tubes. It is possible to run these resistances at considerable overloads (not that it is advisable or desirable) before any signs of disintegration occur. Another resistance of a highly-successful nature is the Loewe, which is a carbon deposit on a glass rod suspended in an exhausted glass tube. The resistance operates on the lines of a carbon lamp, except that it runs at "black" heat. Carborundum compounds, compressed at great pressure, are features of certain other makes, which dissipate heat over their entire surfaces, and which are rated according to their cubic area.

It must be borne in mind that all synthetic compounds, if overloaded, not only disintegrate, but cause "frying" noises in the process. By allowing a generous margin for overload, therefore, no trouble should be experienced; the resistances behave to all intents and purposes as if they were wire wound. The strict difference lies in their physical properties, wire windings increasing in resistance with increase of temperature, and carbon resistances decreasing slightly in value with similar increases.

Finally, a few words about grid-leaks. For H.F. and detector circuits, ordinary grid-leaks of reputable make can be relied upon not to break down, but for L.F. circuits, particularly in mains sets and in power-valve grid circuits, the .5-watt type are to be preferred, since occasionally grid current may flow, and the higher rating of the latter type will satisfactorily deal with the momentary loads imposed.

De-coupling grid resistances of .1 to .25 meg. should always be of the .5 watt (or larger) type. Automatic grid-bias resistances, as a matter of good practice, should normally be wire wound.

BREVITIES

JACKSON BROS. SHORT-WAVE CONDENSER

We are asked by Messrs. Jackson Bros. to point out that the price of the short-wave condenser referred to in No. 3 is 5s. 9d. and not 3s. 9d., as it appeared on page 164 owing to a printer's error.

CHROMOGRAM ADVERTISEMENT

An error occurred in Chromogram advertisement on page 157 of the October 8th issue.

The price for the "Unit A" should be £7 7s. 6d. and not £7 17s. 6d.

THE "DOLPHIN" STRAIGHT THREE

We regret that owing to a draughtsman's error six cords were shown for battery connections at the rear of the Dolphin illustration on page 17 of the first issue of PRACTICAL WIRELESS. As described in the text, and list of components, only a five-way cord was required. Also, in the specification for the Long-Range Express, we omitted to include the four Belling-Lee terminals L.S.+L.S.—, Aerial, and Earth.

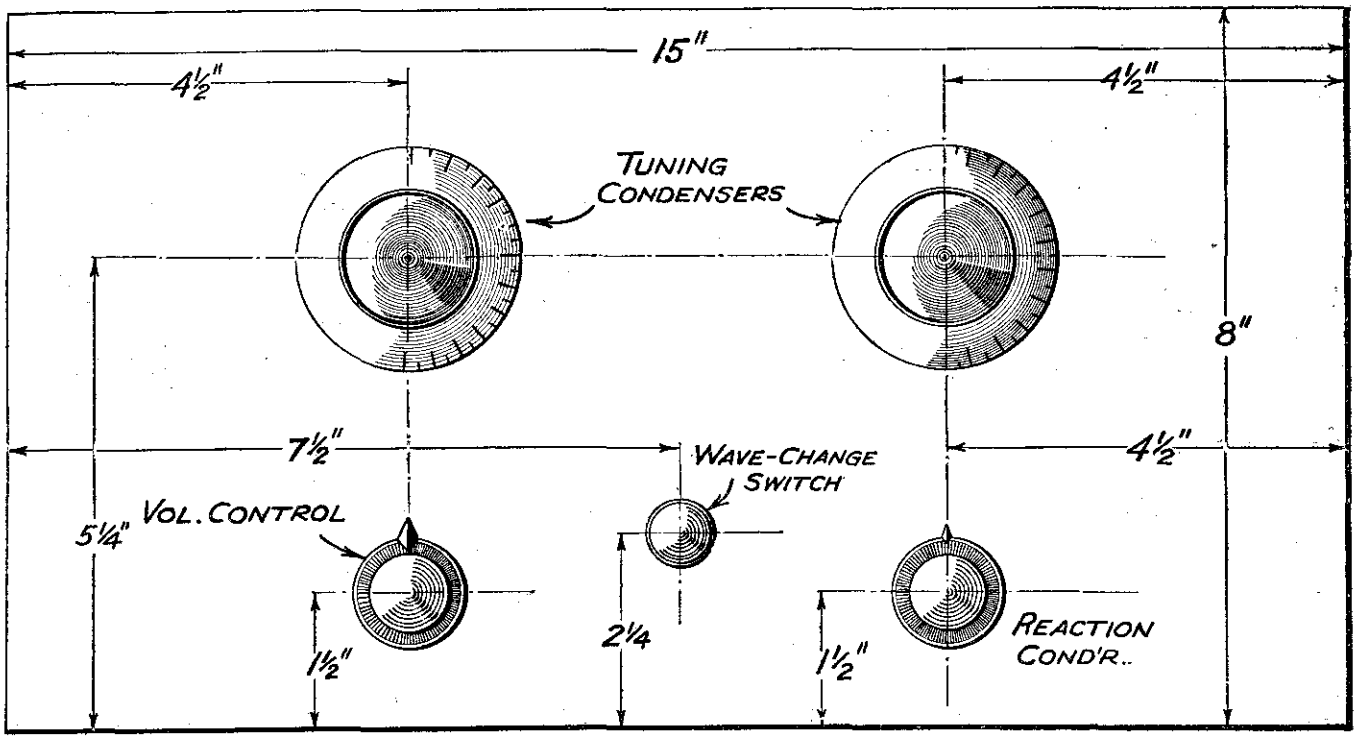
CONDENSER GANGING DEVICE

A number of experimenters are desirous of trying out band-pass circuits and other arrangements which require ganged condensers, but are loth to make the necessary outlay for a ganged condenser assembly. The British General Manufacturing Co., Ltd., have now produced an interesting component known as the Condenser Ganging Device, which consists of two ebonite brackets and an ingenious coupling device. By means of this component two ordinary variable condensers may be mounted on a baseboard in line, and the spindles locked together to enable single-knob control to be fitted. One important point of this arrangement which the makers claim is that two entirely different makes of variable condenser may be employed, thus saving the constructor quite an appreciable amount. The component costs only 2s. 6d.

THE VARLEY D.C. RECEIVER

The price of the Varley D.C. Receiver is 15 guineas, and not 24 guineas, as stated. The illustration at the top of page 98 of October 1st issue shows the new Varley "Square Peak" A.C. mains model at 17 guineas. This latter model is a splendid receiver which we hope to report on in an early issue.

DIMENSIONED PANEL LAYOUT FOR THE MAINS EXPRESS THREE



For full constructional details of this splendid receiver, see pages 140 to 144 of our issue dated October 8th.

DIRECTIONAL RECEPTION

A Short Explanation of the Reason for the Directional Property of a Frame Aerial

By W. O. FORD

NOW that transportable sets have become so extremely popular, many enthusiasts are confronted with the question as to the functioning of the frame aerial usually incorporated inside these receivers, and why the set is rotated—or in other words—why it has directional properties. It would be as well first of all, before describing this, for the reader to get some idea of the electro-magnetic wave. Space unfortunately will not permit of a detailed account of the latter, but perhaps if it is borne in mind how a violin or piano string when struck sets up mechanical oscillation, putting the surrounding medium in a state of alternate bands of compression and rarefaction in all directions, which we term sound waves, it should help considerably in grasping how an electrical wave motion of a much higher frequency—called wireless waves—can be transmitted under suitable conditions.

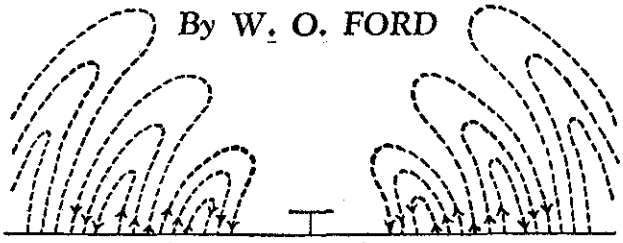


Fig. 1.—How the lines of stress radiate.

The Electro-Magnetic Wave

Let us assume that a station is broadcasting a speech, its transmitting aerial being charged alternatively positive and negative, emitting a high-frequency-carrier wave, modulated at audible frequency. To simplify what takes place, let us choose, for example, the first complete cycle of electro-motive-force (E.M.F.) which charges the aerial. When the latter has reached its maximum voltage, and the current is at zero value, we can imagine lines of electric strain existing between aerial and earth. Directly the voltage falls and current flows down the aerial, this electric field, with its imparted energy, separates itself from the aerial charge and radiates outwards in the form of annular loops. The current then flowing in the reverse direction produces a reverse effect. The illustration (Fig. 1) will perhaps serve to make more clear how these lines of electric stress combine to travel outwards with extending height, but of constant width, at the tremendous velocity of 186,000 miles per second. This alternating moving system of electric force, varying in intensity, has associated with it a magnetic property, which always attends electrons in motion, and is at right angles to these lines of electric strain in the form of horizontal bands as in Fig. 2.

The strength of the magnetic flux density will, of course, vary as the strength of the electric field after the first quarter cycle has passed, when they come into step and rise and fall in phase, gradually dissipating energy as various conductors are encountered. Maybe you have realized that one needs an unlimited stretch of imagination, since this wave happens to be invisible, intangible and inaudible! However, let us perceive what effect these two forces will have upon our frame aerial when they are flashed into space. Perhaps we had better deal with these two components separately, although their effect on the aerial is somewhat similar.

Action of Electric Component

By glancing at the accompanying sketch (Fig. 3) you will notice that the frame aerial is inductively coupled to the high frequency or detecting stage of the receiver by the mutual coupling coil, while Fig. 4 is a plan form of our aerial, with rings indicating the approaching wave from broadcasting stations at different points. First, we will consider the electric component of waves F and J as either pass our aerial, which is at right angles to the direction of the waves as shown in Fig. 4. We find that this force has induced simultaneously an electro-motive force (potential difference, or difference in electrical pressure as we may call it) in the order of milli or microvolts in our vertical conductors—so that A is at a higher voltage with respect to B—as is also C to D—but the induced E.M.F.'s, which are exactly the same in value, are acting in opposition to each other; and as the resultant current round the aerial circuit depends upon the difference between these two opposing forces (which in this case is zero) by neutralizing each other, no current results, consequently the coupling coil is not influenced. Reasoning in the same way, the waves from L or H do not strike both sides of the aerial simultaneously as before—one conductor being reached in advance of the other—so that the total effective E.M.F. driving the current round the circuit will be the difference between the induced E.M.F. in both conductors.

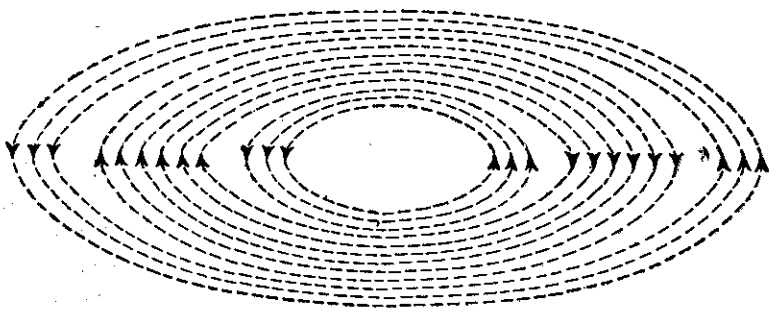


Fig. 2.—A diagram of the lines which accompany the above radiation.

The Magnetic Effect

A similar state of affairs takes place by magnetic induction. According to Lenz' Law, an alternating magnetic field will induce an E.M.F. in any vertical conductor when it is cut *across* by the flux. Referring to the oncoming waves in the same sequence as before, we have a potential difference set up in both sides of the frame aerial, the magnitude of which will depend upon the linkage of the magnetic lines of force with the aerial. From whichever part of the compass we desire to receive signals, we have to rotate our set, thereby placing either side of its aerial in the direction of the incoming wave in order to receive maximum current through the aerial circuit, assuming of course, that this circuit is already in resonance with the desired wave frequency.

It is, of course, obvious that if two high-powered stations are situated in the same direction, it will not be possible to obtain any advantage from the aerial's directional property as a selectivity aid. In this case, all that can be done is to rotate the frame to a position slightly out of the correct line, and use the reaction control to make up for the loss of signal strength caused by this "off-setting." By a judicious use of the reaction and this method of using the frame, it is possible to eliminate an interfering station. In constructing a frame aerial to cover both short and long waves, it is preferable to arrange the two sections at right-angles to one another. This avoids losses due to the unused section.

It is, of course, obvious that the presence of any metallic body, especially of large dimensions, will effect the directional property of the frame. Therefore this fact should be borne in mind.

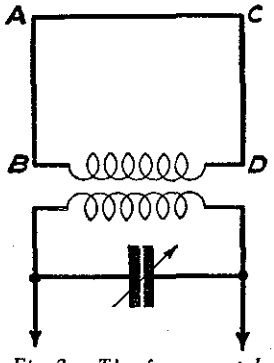


Fig. 3.—The frame aerial with its small coil coupled to the main tuning circuit.

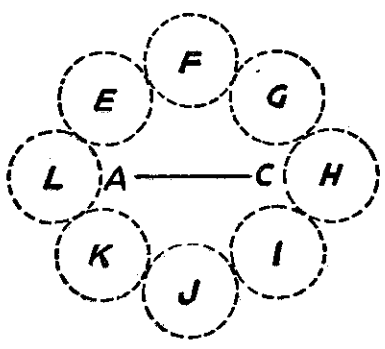


Fig. 4.—The wave-forms of different stations approaching the frame aerial A—C.

A CHAT ON METERS

Use Testing Instruments and Make Certain that Your Set Functions at its Best

A VOLTMETER is looked upon by many listeners as either a luxury or an instrument which is used by "experts," and with the ordinary simple type of battery-driven set a "tester," consisting of an ordinary flashlamp bulb, is used to see if the H.T. battery is running down, and the accumulator charging depot is relied upon to see that the L.T. is all right. Of course, this will serve for a lot of people, but how much better if you can test these articles for yourself in an efficient and reliable manner, and at the same time have something which can be used in your receiver to trace distortion; see if the valves are running at their best; trace breaks in circuits, and so on. The flash-lamp tester above mentioned is very bad in most cases, as the current consumed by the ordinary cheap bulb is on the high side. Now, a new H.T. battery will deliver quite a good current—*for a short period of time*—but where the testing lamp is left connected for some seconds, or maybe minutes, a good many hours of wireless use have been wasted. Suppose your total consumption of H.T. only runs into 5 or 6 milliamps, and the lamp you are using for testing consumes .3 of an amp. This is 300 milliamps, or fifty or sixty times as much as your set takes. Undoubtedly, this is not economy.

Resistances of Voltmeters

A good voltmeter will have a resistance of round about 1,000 ohms per volt, and will cost 25s. or 30s. Such an instrument will only require about one milliamp to read the maximum voltage of the particular range. A cheap instrument, however, will have a resistance of about 200 ohms per volt, and will therefore take a little more current, but if you can afford only this cheap type, then do not leave it joined across the battery for too long a time.

Double-Reading Voltmeters

The cheap instruments usually have what is known as a "double reading scale." This means that the same scale is employed on the face of the instrument, but a resistance is incorporated in the instrument, and two terminals are provided on the positive side. One of the terminals is joined direct to the windings, but the other terminal is joined to the resistance. The effect of this is to make some of the current pass through both resistance and winding with a corresponding smaller movement of the pointer. In this way the instrument which normally reads, say, 6 volts, can be made to register for the same movement of the pointer, say, 200 volts. Bear this idea in mind, as we shall speak of it again later on. Now, as the instrument works by virtue of the current flowing through the winding, it is possible, by joining it in series instead of in parallel as it is intended to be used, to register the amount of current flowing, and therefore it is possible to use an ordinary voltmeter as a milliamp meter. Some instruments are also sold on the scale of which are three readings: low voltage, high voltage, and current. Again, the cheap instrument will require a lot of current, and therefore will not be so efficient as an expensive one.

Triple-Purpose Instruments

A treble-reading instrument of the kind just described will do the following things, then: Test the accumulator; the H.T. battery; record the total current consumption of the set, and so enable you to decide whether or not you are using the right kind of H.T. battery; test for overloading, and enable you to ascertain the correct grid bias for the L.F. valves.

To test the accumulator, simply connect the two low-voltage leads of the instrument across the two terminals of the cell *whilst the valves are alight*. This last point is important, as the valves in the set may be taking a total of 1 amp or so, and the voltmeter will only take a matter of milliamps, so that a wrong reading is recorded unless the full load is imposed on the battery. To test the H.T. battery, the high-voltage leads are joined across the two end sockets of the battery. Remember not to leave it on too long if it is a cheap instrument. In this case, owing to the *higher* current taken by the instrument, you may get a slightly lower reading than is actually applied to the set. The same method is used for testing the grid battery, only no compensation is necessary here.

Measuring Current Consumption

If the instrument is joined in the negative H.T. lead (in series) you will be able to read the total current consumption of the set. Most good makes of H.T. battery have on them the normal rate of discharge, and you should make certain that the battery you are using will deliver at least the same current as the set is taking. If you use a battery with a much higher rating, it will last correspondingly longer. If the instrument is joined in series with the loud-speaker (unless this is filter-fed) it will show the current of the last valve, and you should see if this is the same as that stated by the valve makers. If not, then see to your grid bias. If the needle does not remain quite steady whilst signals are being received distortion is indicated. If the needle kicks in an upward direction, too much grid bias is being employed. If it kicks downward, then not enough grid bias is applied. If it kicks violently above and below the normal reading, then you are overloading, and must either increase the H.T. or fit a valve which will handle greater power, unless you are content to reduce signals to the strength which can be handled by the valve in use.

From the foregoing it will be seen that a meter is really essential to the correct running of your receiver, and in our next article we shall describe how to construct an instrument to enable you to read volts (high and low), current, and, in addition, ohms, so that you can test for yourself the resistance of grid leaks, anode resistances, and any other resistance used in a set, including those of the spaghetti type.

Radio Ramblings

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

I HAVE seen the criticism levelled at British manufacturers that in designing this season's sets they nearly all forgot that perhaps the prospective customer already has a good loud-speaker. There is, no doubt, some justification for this, for, attend what Radio show you will, apart from kit sets, you would have difficulty in finding a commercial set of note that did not include a built-in speaker. On second thoughts, however, I am inclined to think that this policy is all for the better, because it allows the maker to match his set with the speaker he supplies in such a way as to obtain the very best possible results. On the results of his sets the manufacturer's reputation is built up, and the non-technical listener is apt to give the best of sets a bad name if heard working through a speaker of ancient vintage. I think, therefore, that in the interest of quality it is to the good that radio receivers should be sold complete, especially as prices have fallen to a level where one can get a complete outfit including speaker for the figure which had to be paid for a good speaker a few years back. If you have a speaker to spare, do not worry, for on the end of a trailing lead it will come in very handy when reception is required in other rooms beside the one in which the set is installed.

A Question of Matching

THIS tendency to produce sets "all in," as it were, has a certain disadvantage for the experimenter, however, for in the old days of general-purpose valves and general-purpose speakers and headphones any old set could be tried out on any old speaker without any doubt that signals of some sort would be obtained if everything was O.K. Now, of course, one has to be very careful, and make sure that the speaker is matched within fairly close limits to the characteristics of the output valve. This makes for better quality, but it cuts down the versatility of our equipment even though most modern speakers include a multi-ratio transformer, even on the very cheap makes. While on this topic I feel compelled to warn the man whose set doesn't work, and who has traced the trouble to the valves, to be careful to replace the defective valves with others of same make and type. Do not be led astray by advertisements of cheap and nasty valves alleged to be "just as good," and do not invest in a British valve of a new type until you have asked the opinion of the makers of the set. The latter want you to get the best from their set, and none of our valve manufacturers really want you to buy a valve that will not give you the very best results; they envy their reputation too much! This matching of valves with the reproduction equipment is becoming a problem, and I may mention that I have been engaged in carrying out exhaustive tests with several makes of speakers on different sets and under varying conditions. I have held one goal in mind—QUALITY, and with the Editor's permission I hope to tell you all about it later on.

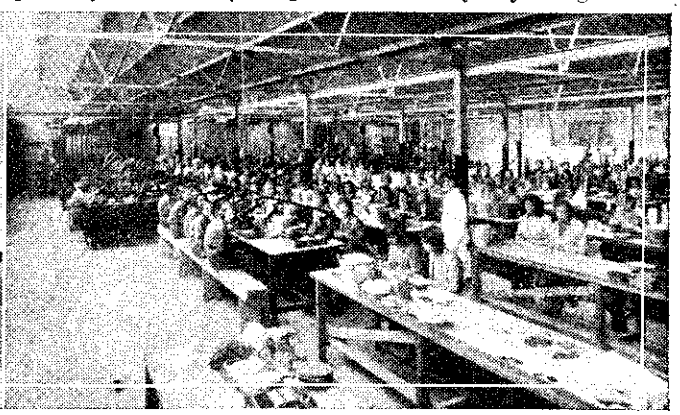
Bristol Radio Exhibition

I WAS down in the West Country recently, and took the opportunity of visiting the Bristol Radio Exhibition during that city's radio week. There was the usual range of sets and components as seen at Radiolympia, and the B.B.C. had a working studio giving out a programme the whole of the time. Some of it was broadcast from the West Regional station. Two features of great interest attracted me. These were organised by the two rival evening papers published there, and consisted of a set builders' competition and a wireless museum respectively. The set-builders were in great stride. There were little sets in big cabinets and big sets in tiny boxes. We did not hear them working, but it was evident that some of the exhibitors had put a lot of time in on them. There were some very fine examples of good wiring, but, on the other hand, some of the sets were just the reverse. In the museum there were a fine lot of old-time and amusing (to us in 1932) apparatus. There was a collection of loud-speakers, and spectators were invited to switch on any of them and receive the programme the B.B.C. were transmitting. Nobody kept the switches down long! Mr. W. S. Weber, Bristol's patron saint of amateur broadcasting, whose station 6 QW comes in particularly well on Sunday mornings, had loaned his first transmitter. We know it worked—but—well, well!

"Rubber-tyred" Electricity

WHAT strange things are found by accident! Following on complaints received from the toll collectors on Sydney Harbour Bridge, investigations were made by the Physics Department of the Sydney University into the matter of the electric shocks the collectors said they often received from the bridge. After a lot of experimental work it was found to be due to the friction of the rubber-tyred vehicles on the asphalt, and similar experiments in London and Chicago have proved that quite a considerable amount of electricity is generated in this way In fairly dry weather, and with a temperature of 70° F., voltages as high as 6,000 have been recorded from vehicles travelling at 35 miles per hour. I wonder if these stray chunks of electricity wandering around cause interference in our radio systems. If so, the finding of a cure will be a problem, even though on the new Sydney Bridge it was

An interesting view of the new Belling-Lee factory on the Cambridge Arterial Road at Enfield. The present structure having a floor space of 22,000 ft. covers one-third of the site, which has a total frontage of 500 ft. It is entirely devoted to the manufacture of Belling-Lee Radio Specialities. The situation is ideal in that it faces the municipal playing-fields and the new open-air swimming baths.



Showing part of the main shop in the new modern factory of Belling and Lee, Ltd. In the foreground can be seen clamping and eyeletting presses, and on the left a power bench. In the background, just right of the centre, is a large battery of capstans. The whole resources of this factory are devoted to the manufacture of Belling-Lee specialities, 90 per cent. of which are absorbed by the radio industry.

simplicity itself. You see, every vehicle has to stop to pay the toll, and at the stopping place metal spirals are placed on the asphalt. These come in contact with the chassis of the vehicles and the current present is discharged through a flexible connection to earth.

Travelling Radio Shows

DID you see the convoy of decorated vans and cars anywhere on their route from London to Manchester in connection with the Northern Radio Exhibition held in that town? The convoy served the double purpose of a travelling radio show and a means of transport of exhibits, and made good publicity out of the carrying of the radio exhibits to the Show. The Monday night was spent at Leicester, where a ball and exhibition was staged in double-quick time, and the convoy arrived in Manchester on Tuesday, September 27th, in readiness for the opening on the 28th. A carefully selected route of 200 miles in length was taken, and aeroplanes escorted the vehicles in places. The next thing for you to look out for in your district will be the demonstration sound-amplifying van fitted up by the B.T.H. people. This van is touring the country, and all of you who pride yourself on the quality of your output should turn up and mentally compare the results. You will either think your reproduction better or worse than that of the B.T.H., but it will do you good to hear it all the same. The equipment includes two 20-watt undistorted output amplifiers and 12 R.K. moving-coil speakers. Gramophone records and radio will be sent out, the radio being supplied from a set operated from a concealed aerial in the roof of the van. British and foreign programmes will be broadcast, and I understand the reproduction is as near perfection as it is yet possible to get. Now, don't forget to look out for this van. It'll be an education! Meanwhile, I see the B.T.H. are busy fitting up the whole of the cafés, lounges, ballrooms, circuses, and other places that come under the management of the Blackpool Tower Co., with a band relay public address system. Those of you who know the Tower premises will have already appreciated the whole day's entertainment available for a shilling or so inclusive admittance charge to all these places, but soon it will be worth the money just to see and hear the B.T.H. equipment. A total of 280 watts undistorted output will be regularly delivered through forty-four moving-coil speakers!

Automobile Association's Broadcast

I SUPPOSE you know that a daily broadcast is made by the Automobile Association on 833 metres to aircraft, giving weather reports and other matter of interest to pilots. It is sent out from Heston, I believe, and any decent set will get it so long as your coils will tune to the wave-band. Try for it one day, but don't try in future on the second Tuesday in each month at 11.30 in the morning, for at that time the National Physical Laboratory sends out a calibration signal on the same wave-length. As a result of interference the A.A. station will shut down at this time and leave the ether clear for the N.P.L.

Early Days of Broadcasting

ON the occasion of our own or anybody else's birthday we are rather prone to look back over the years and bring forth memories gay and otherwise. As the tenth birthday of the B.B.C. draws near I have been thinking a lot of the first days of broadcasting. We went to no end of trouble to obtain absolutely mediocre results, and the switching on and tuning in of a set was a man's job, to be performed before an admiring crowd of relatives and friends. Wireless was blamed for any and every complaint, and hosts of wives sighed and silenced the family when father took down the crystal set to get the news. Of the foreigners, there were three stations that we could rely on in those days: they were Toulouse, Petit Parisien, and Madrid. Toulouse is still going strong, and has always been fairly reliable, even if he does fade badly; but what has become of Madrid? He is still on the air, but he takes a bit of getting, whereas in the old days you could usually get him somehow, and his strength used to improve progressively throughout the evening until well after midnight. That was allowing, too, for the gradual fading out of the H.T. battery, which too often used to take place nightly at that time. The H.T. battery used to recuperate to some extent by the next night, but it was a good battery that stood up to a whole night's listening without some signs of distress. Talking of fading stations reminds me that we must all take particular note of the reception of the new Breslau station at Rothsürben. An unusual aerial is being used which creates a greater field intensity and by means of which the nearest zone of fading occurs at a greater distance than hitherto. This means that a larger area is served by the surface wave and a correspondingly larger area is free from fading. That is, of course, if everything works according to plan!

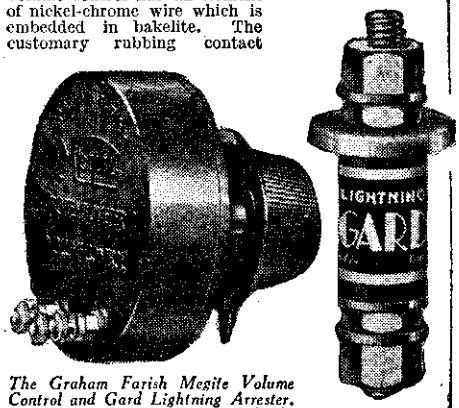
A New System of Tuning-coil Construction

ALTHOUGH fashions have changed many times the actual principles of tuning-coil design are the same to-day as they were twenty years ago. All coils consist of a number of turns of wire wound on a circular or polygonal track and having an air "core." We know that the inductance of coils can be increased by replacing the air core by one of ferrous metal, but we have found that this reduces the efficiency and is the source of serious losses. The losses are of no great consequence when the coil carries low-frequency currents as does an L.F., or smoothing choke, but they mount up to tremendous proportions where high-frequency currents are concerned, such as in a tuning coil operating at radio frequencies. It is therefore very interesting to learn that a German scientist has produced a solid material which, when used as a core for a tuning coil, increases the inductance without introducing any more loss than air does. He has named the substance "Ferrocart," and it consists of minute particles of a magnetic material separated by a special form of insulating material. The result is that coils of high inductance can be wound with only a comparatively few turns of wire on a core of this material. The coils are thus of very small dimensions and—due to the fewer turns of wire—have a much lower resistance than normal coils of equal inductance. Another important feature is that screening covers can be placed much closer to the windings without affecting the characteristics. The size of a completely screened dual-range coil made in the new way is only about 2 inches in diameter by 3 inches high. It is understood that "Ferrocart" coils will shortly be available in this country.

A CHAT ABOUT THE LATEST COMPONENTS

MEGITE VOLUME CONTROL GARD LIGHTNING ARRESTER

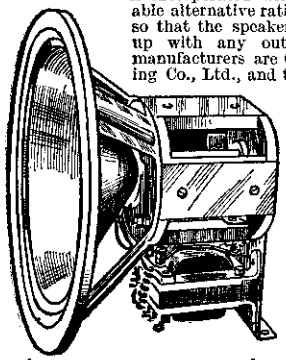
THESE two products, from the well-known firm of Graham Farish, are both interesting items. The volume control has an element of nickel-chrome wire which is embedded in bakelite. The customary rubbing contact has been dispensed with, and a slipper plate arrangement fitted, which permits of silent, frictionless variation, and so makes broken contacts impossible. Protection against lightning and static is afforded by the Gard protector, which is installed between the aerial and earth leads. The makers claim that it definitely does not affect reception, and that its protection is permanent. The price of the volume control is 3s. 6d. for values up to 20,000 ohms, and 4s. 6d. over 20,000 ohms. The Gard arrester sells at 1s.



The Graham Farish Megite Volume Control and Gard Lightning Arrester. This latter component may easily be fitted to any existing lead-in, and gives permanent protection against static and lightning without affecting signal strength.

A PERMANENT MAGNET MOVING COIL

THE illustration below shows an interesting moving-coil loud-speaker having a very massive permanent magnet of unique design. This is not one o the "midget" types of speaker, but is a very substantially-built instrument, which has obviously been designed for real power work. An ingenious centralizing device is fitted, and the method of suspension, design of speech coil, and the cone are all arranged to give a truly parallel action, with the ability of handling heavy inputs without distress. A speech transformer is incorporated with terminals to enable alternative ratios to be obtained, so that the speaker may be matched up with any output valve. The manufacturers are Ormond Engineering Co., Ltd., and the price 65s.



A permanent magnet moving-coil loud-speaker with transformer incorporated.

GANGED COIL UNITS

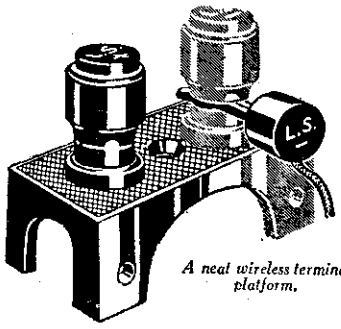
THE famous shielded coils produced by Messrs. Lissen have now made their appearance in a new form, the coils being mounted on a base plate in two or three gang units. Wiring is greatly facilitated by this method of construction, and the coils are designed to suit the particular requirements of the various circuits in which they are to be used. The coils are lettered "A," "B," or "C." Coil "A" is for aerial circuits, coil "B" as the second coil of a band pass pair. Coil "C" is a similar coil with the addition of a reaction winding. Wave-change switches in the base of the coils are cam operated, the rod for which is extended to operate a filament switch at the end of the coil base. One control, therefore, provides wave-change switching and, at the same time, an "on-off" switch. The two-gang coil costs 17s. 6d., and the three-gang 26s.

A SUPER FRAME AERIAL

FRAME aerials are again coming into favour, principally on account of the increased number of sup-hets. being produced. It is not only with this type of circuit, however, that a frame aerial is useful, as there are many circumstances which will always call for such a device. Flat dwellers and especially listeners situated close to a high-powered transmitting station are among those who will obtain the greatest benefit from the use of a good frame aerial. The super frame aerial manufactured by Messrs. Wright and Weaire is in every respect a super, having separate windings for long and short waves, arranged at right angles to each other, a switch for changing from one band to another, a centre tap for reaction purposes, and Litz wire for the windings. The price is 42s., in polished oak or mahogany.

TERMINAL BLOCKS

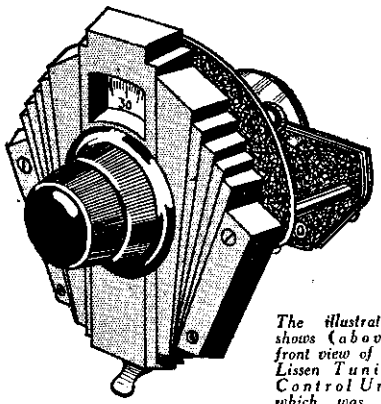
THE small terminal blocks manufactured by Messrs. Belling-Lee (illustrated below) are of great value to the home constructor. Each block accommodates two terminals, and the holes are recessed so that the large type of Belling-Lee terminal may easily be fitted. The blocks may be mounted in a vertical or horizontal position, and for the experimenter they will be found of great use. The price is 8d. each.



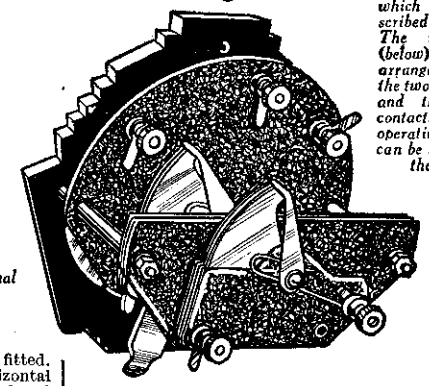
A neat wireless terminal platform.

NEW SPEAKER BAFFLE

It is very difficult to remove box resonance from the small types of cabinet loud-speaker, and various methods have been adopted from time to time to overcome this difficulty. The Broadcasting House Speaker Baffle is the most efficient scheme yet devised, and, as its name implies, it is employed at the new B.B.C headquarters. A small box is used to contain the speaker, and this is packed with a material known as Slagbestos. This is packed in a definite shape, the finished form resembling the mouth of a trumpet, with the speaker at the apex. The effect is to improve the reproduction of frequencies of the order of 250 to 500 cycles, and it is claimed that the quality of the reproduction is better than that obtained with a good moving coil fitted to an efficient flat baffle. The baffle is supplied in kit form with three different types of cabinet, the size in each case being 18in. by 18in. by 12in. The kits are marketed by Weedon Power Link Radio Co., of 185, Earlham Grove, London, E.7, at 20s., 30s., and 35s.

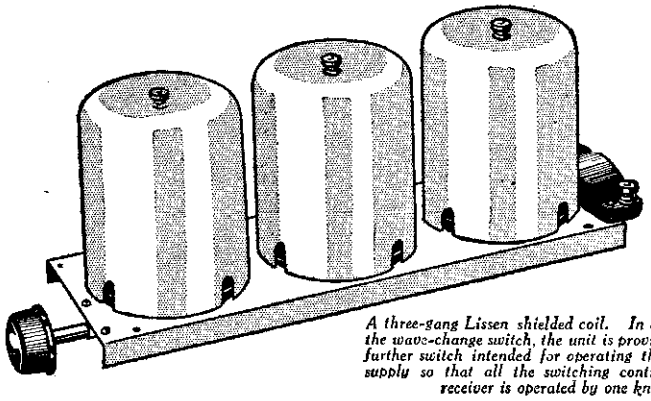


The illustration shows (above) front view of the Lissen Tuning Control Unit which was described last week. The rear view (below) shows the arrangement of the two condensers and the switch contacts. The operating lever can be seen below the dial.



TINSIT

Soldering is made still simpler by the latest flux to be produced, and which bears the above name. This is a non-acid preparation which is soluble in water, and is, therefore, very economical to use, as a little of the flux (which is in paste form) is dissolved in a quantity of water before use. Furthermore, when the tube is apparently empty, the lead is simply cut open, and the tube rinsed in water, so that there is absolutely no waste. The makers are Tinsit, 22, Woburn Square, London, W.C.1.



A three-gang Lissen shielded coil. In addition to the wave-change switch, the unit is provided with a further switch intended for operating the filament supply so that all the switching control of the receiver is operated by one knob.

WHEN ARE WE GOING TO HAVE REAL PORTABLES?

In This Article W. B. Richardson Offers Some Criticisms of Modern Portable Receivers and Makes Suggestions as to the Line of Future Development

IN spite of the enormous advances made recently in the design of ordinary receivers and radiograms, it seems that inventors and manufacturers are still a long way from producing a real portable set. Most examples of "portables" shown at Olympia were both bulky and enormously heavy. There was, I must admit, one notable exception. This was a little four-valver not much larger than a reflex camera. Unfortunately, I did not hear it working. However, the usual run of sets of this class seem to be built round the inevitable 99 to 120 volt. H.T. battery. This, together with a lead plate accumulator, weighs at least 12lbs. to start with. (A 99-volt. H.T. battery weighs 8lbs., plus 4lbs. for a small accumulator.) Thus it will be seen that, however small is the weight of the case and the set itself, there is still this initial 12lbs. to be included.

Total Weight of the Set Dependent on the Batteries

Now I suggest that no one would object to carrying a set the size of an attache case if it weighed only about 12 lbs., but the average portable turns the scale at something like 2 stone. Personally, I don't see why the case and "works" should not be reduced to a very small figure. By the free use of aluminium for case, chassis, condensers, etc., the only "heavy" parts would be the loud-speaker unit and the L. F. transformers. Lightweight units of the moving-iron type we already have, and, as regards the transformers, the use of parallel feed would solve that problem, since with this form of coupling the transformers can be made absurdly light and small. This brings us back to where we started—namely, that the ultimate weight of the complete set is dependent on the weight of the batteries. This being so, it seems to me that designers should direct their efforts either to the production of lightweight batteries or to the invention of valves which will work efficiently from a much lower H.T. voltage than valves do at present. It may be a combination of both will be necessary.

Use of "Soft" Valves?

I do not profess to be a valve expert, and it may be that I am setting them an impossible task. However, I still have recollections of the "soft" valves we used to use ten or twelve years ago. One of these I remember used to work quite well as a detector using five pocket-lamp batteries (about 22 volts) as the H.T. supply! Since then "hard" valves have gradually ousted the soft types. This, I believe, is partly because the former can be produced with more consistent characteristics and have a longer life. But the fact remains that, whereas one of these old valves could be run successfully from a small H.T. battery, the tendency nowadays seems rather towards higher and higher plate voltages. Would it be possible to produce both detector and amplifier valves with a predetermined amount of softness which would function with a low anode voltage? I know, of course, that in this world one cannot get something for nothing, and that if such valves could be made they would no doubt take a correspondingly large anode current. This is where the battery designer comes in. It seems to me the need is not so much for a long-life battery as for one that will give a large output for the whole of its life. This rather points to an unspillable accumulator composed of a number of tiny cells. Here again we are up against the weight problem, but I do not think a *very* small accumulator of, say, twenty or twenty-five cells need weigh more than an equivalent dry battery, and would be capable of a much higher discharge rate.

Nickel-iron Accumulators

Now let us consider the low tension and grid bias side of the problem. Barring the advent of even lower consumption filaments than at present, we shall still have to employ a fairly heavy accumulator for reasonable periods of use between each re-charge, unless a solution can be found in the nickel-iron type of accumulator. In the larger sizes these batteries have a much better capacity-to-weight ratio than the lead type, and will stand more knocking about. I do not see why a small nickel-iron battery could not be produced suitable for portables, with a consequent saving in weight.

The case of the grid-bias battery is rather different. If valves can be made requiring only a small plate voltage, no doubt the grid bias requirements would be correspondingly small. Even as it is I fail to see why we should not have special G.B. batteries for portables with infinitely smaller cells than standard, since there is no heavy discharge from them as with the H.T. cells.

Wanted—a Shock-proof Portable

I rather think that the design of portable sets should be undertaken as a distinct and separate branch of the science. It has problems of its own quite apart from those of ordinary set design, and should therefore merit special attention from designers and research workers. At the present both constructors and manufacturers try to build portable sets with components which are intended for use under normal rather than special conditions. Naturally, special conditions require special components. Where, for instance, can one get a sprung radio chassis? Nowhere! Simply because such a chassis is not required for the ordinary set. Yet that is probably the very thing necessary as the foundation for a shock-proof portable!

I see that I have indirectly brought up the question of the frailty of portables. This I feel sure must be a thorn in the side of manufacturers, for everyone knows that few sets will stand many miles bumping in a car without showing signs of disintegration. Were I a manufacturer, one of my first stunts for the next radio exhibition would be to produce an unbreakable portable. This I should insulate so thoroughly with sponge rubber that the set could be knocked off the table and would still continue to play while lying on the floor!

Radio and the Car

An idea that rather appeals to me is that of a lightweight portable for use when motoring. This would contain no batteries, but would derive its power from the car battery, a flexible lead and plugs being provided for connection to the switchboard of the car. Of course, a booster of some sort would have to be run from the car battery in order to provide the necessary high tension supply. This would be included as part of the car's electrical equipment rather than as a part of the set. Of course, the snag here lies in the necessity for the booster. Perhaps it is too much to expect that a valve will ever be invented which will work with 12 volts on the plate so that both filament and anode current could be supplied by the car battery without conversion!

Manufacturers in America are obviously alive to this situation, as in that country not only are 7 and 8-valve super-heterodyne receivers built to fit into the dashboard, but ingenious schemes to supply the necessary potential have been devised. Obviously the metal chassis of the car may be used for the earth connection, and the aerial difficulty has been met in many ways. Wires built into the framework of the body—chiefly in the roof—have proved most effective, and in this form, of course, all the unsightliness is avoided.

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 Suggestion

SIR,—Hearty congratulations to you and your staff for the very fine effort in Vol. I, No. 1 of PRACTICAL WIRELESS.

Now you have asked for suggestions and criticisms; well, here's a suggestion which I think would interest quite a lot of fellows like myself who are unable to work these things out for themselves, also an idea which I have not yet seen in any wireless paper or described by any set designer.

Here goes. When you publish a new set, why not give such useful data as the actual consumption in milliamps or total consumption in watts or units, if run from an eliminator, so that a fellow can see at a glance what it will cost, what type of eliminator to use and a lot of interesting facts besides.

I sincerely hope you are not going to make the mistake that is being made by some designers, of which the names need not be mentioned; the mistake I refer to is publishing designs for expensive sets.

Make absolutely sure that it is cheap before publishing it; when the set is described quite a number of fellows like myself get together, and there is sure to be one of the crowd who has built it, so we can all go along and have a real look at the hook-up and if the results are there, we crowd are bound to find them, even if we don't all build the set.

I must ring off now, as I suppose reading this, even if you have got so far, has taken up quite a lot of your valuable time, so best of luck in your new venture. I shall be writing to you from time to time, so I might have something of interest to describe later on.

The best of luck to you and your staff.—B. DYER (Chatham).

Wanted—An Aid to Hearing

SIR,—Hearty congratulations on your new paper.

I have a suggestion. Could you design a Hearing Aid like those given this year in Radio News of America? There is a big field for such, seeing defective hearing is about as common as defective eyesight, and wireless has not yet entered the field as it ought to have done. A small, light one-valver with a peanut valve would be far better than anything on the market. Every fan could help his friends.

I have heard of, but never seen, a small one made in Germany. Could you by any means let me know the name and address of makers?

The ordinary telephone type of earphone is useless. It distorts, and very few people can use them. Valves are the solution.—E. WOOD (Ulverston).

Gramophone Critique Required

SIR,—Congratulations on No. 1 of PRACTICAL WIRELESS. I feel very enthusiastic about it, and have already placed a standing order with my newsagent for a copy to be delivered to me every week. If succeeding numbers are up to the standard of the first number, then PRACTICAL WIRELESS will quickly become the leading weekly radio journal.

May I be permitted to offer a couple of suggestions? Firstly, as you are aware, the gramophone companies issue new records monthly, and mid-monthly. As a keen radio-gram man I realise that a number of these records are excellent when played on an ordinary acoustic gramophone, but it is a different story when an electrical pick-up is used. Would it be possible, please, to introduce a weekly feature, giving a list of records especially suitable for pick-up reproduction? I am sure that such a feature would be a very popular one among all your readers.

PRACTICAL WIRELESS is written and illustrated so simply that a child going to school could almost follow it, and if the foreign programme feature perhaps could be added, it would indeed become the wireless weekly journal *de luxe*. There would, I feel sure, be no grumbling from the public, nor would, in my opinion, the circulation suffer, if, with this added attraction, the price of your journal was increased, say, to fourpence a week.

Again congratulating you on a wonderful threepennyworth. — FRANCIS S. COLEY (Tonbridge).

Gas Bracket as an Earth

SIR,—I am writing to you with reference to an article on page 84, Fig. 2, "Using the Gas Bracket as an Earth Connection." The main rule for electrical engineers is to keep all cables and switches away from gas, as one in the course of life might have a short circuit and cause an explosion. How would general insurance come under this matter? Yours is a practical book, on all wireless matters. I have had sixteen years general and scientific wireless engineering, and am a keen reader of your journal.—H. SMITH (Torquay).

A Bouquet

SIR,—As a wireless amateur since broadcasting commenced, I should like to congratulate you upon the excellence of your first number. If, as I venture to hope, your policy will be to cater occasionally for the more experienced hand who wishes to make a set he can be justly proud of, that modern practice as followed by the leading manufacturers incorporating mains drive, metal chassis, screened coils, S.G. and pentode valves, etc., will be available to your readers, then I think you will have a large following who have waited a long time for your appearance.

I notice that three excellent circuits of this type appear in the article dealing with the favourite circuits of your technical staff, and I look forward to seeing them form the subject of a constructional article in the near future. Wishing you every success.—WALLACE F. GENTRY (Norbury).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—That wireless waves travel as fast as light—186,000 miles per second.

—That a counterpoise will often prove more efficient than an inferior earth connection.

—That a three-electrode valve arranged as a "diode" is capable of giving first-class quality.

—That there is no need to fit a switch when fitting a pick-up, provided the receiver is tuned to avoid radio breaking through.

—That an output tone control can be easily made up from a 10,000 ohm resistance and a .01 condenser.

—That if you think in kilocycles instead of wavelengths you will more easily understand the "short-wave" problem.

—That the material of which a cone diaphragm is made has an important bearing on the reproduction.

—That a D.C. mains-operated set must be provided with a large condenser in the earth lead and, in many cases, also in the aerial lead.

Wanted—A Weekly Index

SIR,—PRACTICAL WIRELESS, Vol. 1, No. 1, seems, if it maintains its promise, the very thing most people want.

What the general public wants, I believe, is to be kept fully up to date, with clear explanations of the latest scientific discoveries and developments, and assistance in understanding accepted theory and practice, and also articles on improving reception on existing sets, such as your first number richly contains. Here is a suggestion.

Most people cut out of a wireless paper those articles and advertisements which appeal, and destroy the rest; but it would be very much better to keep and file each number. But searching through back numbers for any particular item is a very tedious job, whilst one does not want to be making one's own index. Why should you not include with each number as a flyleaf, on paper which will take pen and ink, a concise index of the contents with the page number, and space below for the reader to add details of any advertisement he fancied? He could then make a red pencil mark against the article he might want to study later; and also find any advertisement he might want. This flyleaf might be on fairly thick paper about half the size of the present letter sheet, and the bundle kept separately for ready reference. Naturally, as you are so near your first issue, you should make these indices complete from the first—a separate one for each issue. A. BENHAM (Lewes).

Point-to-Point Wiring

SIR,—Congratulations to PRACTICAL WIRELESS on the "Long Range Express Three"! At last we have variable-mu H.F. and choke output, tone compensated, pentode—ideal for battery users. Too long have designers thrust medium-power valves upon us with an output of 150/200 m/W, whereas for exactly the same m/A consumption the pentode gives double.

I certainly think, however, you have made a mistake in not numbering the wiring on the blue print, as tens of thousands of new constructors have joined the ranks in the last year or so, and it's not so simple to them. Also a clear photograph of the sub-base wiring should be shown so the

builders can see the *shape* the wiring takes from point to point; besides, it's invaluable for checking. As selectivity is of vital importance to-day, Mr. Ray should stress this point in his notes.

One other point. There must be literally countless thousands of people wanting to sell sets. To my mind, there is a big field for small ads. at a reasonable rate.

W. E. WILLIAMS
(East Grinstead).

Sale and Exchange

SIR,—In response to your invitation for readers' suggestions in PRACTICAL WIRELESS, I beg to suggest that sale and exchange pages, at reasonable charges, for receivers, component parts, etc., would be a welcome feature, especially as there are so few channels at present available for selling or buying.

A. T. PYM
(Purley).

Short Waves

SIR,—I have read with considerable interest your first publication of PRACTICAL WIRELESS and, whilst I must admit that this is the type of periodical which the public have been waiting for, I was rather surprised to find that there was no article given solely to short-wave work.

Recently the Coventry Short Wave Radio Club has been formed, comprising fifty members, of which I am treasurer. There are also other clubs being formed, which I think proves the growing popularity of this section of wireless.

H. CHATER (G2BJI) (Coventry).

[*It will be noted that we have made arrangements to publish a regular short-wave feature.*—ED.]

Do You Understand Your Speaker?

SIR,—May I congratulate you on your first number?

There are one or two points I should like to discuss and a few suggestions I should like to make.

I have been using a Lamplugh Inductor Dynamic Speaker for some time and, after reading your article, "Do You Understand Your Speaker?" I found that I was not using it correctly. Since reading this article I feel that the majority of listeners would be more satisfied if they had a concrete proof of the limits of their speakers, and I suggest that you should prevail on the B.B.C. or the manufacturers to broadcast a series of high and low notes giving the frequencies as they did so, so that listeners would know the cut-off points in their speakers.

In the article for "The Gramo-Fan" a most important point was missed, *i.e.*, the height of the playing surface above the baseboard. The standard height is one inch.

H. DAVIDSON (Milngavie).

Some Suggestions

SIR,—I would like to congratulate you on the appearance of the first number of your new paper, PRACTICAL WIRELESS, and I hope that your venture will meet with every success.

It would, I am sure, assist country readers if the prices of the various components were given. Constructors have very often to pay last season's prices in remote parts, as the dealers have no idea of any changes which take place, and they usually rely on out-of-date catalogues for their quotations.

I find that most makers of this type specify expensive coils, of different make or type, for almost every circuit dealt with, and no attempt is made to assist the amateur who may wish to make an attempt to make his own coils.

Many readers still use battery sets, probably 50 per cent. In most parts of the country they have no choice.

Let every set described be complete. It is very annoying to be shown next week how to add some component, *e.g.*, gramophone pick-up. This means practically spoiling all the good work previously done.

I have had little time to read your second number thoroughly, but I find it suggested, on page 84, that the gas bracket may be taken as an earth for the set.

ERNEST O. W. (Aberystwith).

[*The risk attending the use of a gas-bracket earth is grossly exaggerated.*—ED.]

The Long-Range Express

SIR,—May I, as an ordinary home constructor of wireless sets, be allowed to congratulate you on the excellence of the first number of PRACTICAL WIRELESS. It is essentially a practical journal, and one that has long been wanted. I should like to congratulate you on the general excellence of the "Long-Range Express Three" receiver. It is a circuit that I have longed for ever since the "variable-mu valve" was introduced. There have been plenty of S.G. det. and power valve sets, but none like the "Long-Range Express." It is obviously a fine set, and designed expressly for the "constructor" who has to rely on batteries to run his set, but at the same time wants the best. I am disappointed that I am not able to make this set up at present, but I shall keep it by me until such time as I can afford it. When I have made it up, I shall let you have a report as to its performance in this district, which will be a severe test of its capabilities and selectivity, seeing that we are under 10 miles from Daventry, and the Post-Office Wireless Station is just across the fields. I wish PRACTICAL WIRELESS every success.

A WIRELESS BEGINNER (Rugby).

Thick or Thin Wire?

SIR,—I think your first number of PRACTICAL WIRELESS is very instructive and interesting, and is a better threepennyworth than one usually gets. I wish it well.

Might I be critical enough to point out what I consider is not quite in order for a new journal such as P. W., that is, that, on Page 21, W. B. C. Richardson says that for wiring an ordinary set it is just a fad to use thick wire, etc., and yet on page 45 one is told to use wire as thick as is conveniently possible. Surely this is a contradiction, or is it that I have not quite grasped the two sentences?

F. E. GAGE (London, E.C.4).

[*Both statements are correct. One refers to the H.F. side and the other to the L.F. side of the circuit.*—ED.]

From a Beginner

SIR,—I should first like to congratulate you and your compeers on the excellence of your first issue, which I feel sure will find its place among the multitudinous books on this subject. I have only recently joined the brigade of wireless enthusiasts, and you will be pleased to know your first issue enabled me to see several valuable points in a way that had not occurred to me before.

G. W. J. ALLEN (Norwich).

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

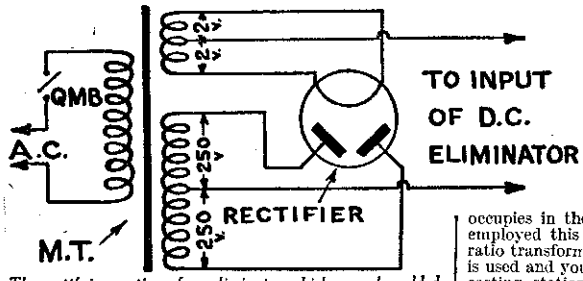
REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

The coupon below 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.

CONVERTING D.C. ELIMINATOR FOR A.C. CURRENT

"I have lately removed from a house having D.C. mains to one with A.C. and am wondering what to do with my D.C. eliminator which is now useless. Must I scrap it and buy a new A.C. model or can I dismantle it and make use of the parts in building a unit suitable for A.C.?"



The rectifying section of an eliminator which may be added to an existing D.C. mains unit to convert for A.C. operation.

Fortunately there is no need to do either of the things you mention, for by making a rectifier unit your D.C. eliminator can be used just as it is. The circuit given herewith (see above) gives details of the rectifier. A mains transformer feeds into a full-wave rectifying valve, the output from which is connected to the D.C. eliminator input terminals. The output of the rectifier corresponds, of course, to the D.C. mains supply. Details of the components required are as follows:—

Switch: Single Pole Quick-Make-Break, Mains type.

Mains Transformer (M.T.): Such as Ferranti type S.V.8 or Savage type A.3, having Primary to suit A.C. mains voltage; H.T. Secondary giving 250 volts on each side of a centre tapping; L.T. Secondary giving 2 volts 1 amp. on each side of centre tapping. Both transformers mentioned include also a 4-volt A.C. winding for heating the cathodes of A.C. valves; this will not be required at the moment, but might be useful later if "all-mains" working is desired.

Rectifying Valve: A type A Full-Wave Valve, such as Cossor 506 B.V. or Mullard D.W.3.

The components can be mounted on a small baseboard and enclosed in a suitable box to avoid touching any "live" terminals. Voltage outputs from the various D.C. eliminator tappings will be practically the same as when the eliminator was fed from D.C. mains.

PORTABLE AERIAL

"I have a 4-valve portable set, of well-known make, but can only hear London when the set stands in a certain position. Is anything wrong with the set?"—(A. H., Preston).

You have apparently overlooked the directional property of the frame aerial which the portable utilises. This type of aerial has to be arranged so that it is pointing in the direction of the station being received. If, therefore, you turn your receiver about you will find that there is a position where each station comes in at maximum volume, and when at right angles to that direction you will not hear the station at all.

SQUARE LAW CONDENSERS

"I have got a condenser of the 'square law' type, and as I have noticed that condensers are of various kinds—S.L.F., Log Law, etc., I should be glad to know what 'square law' means."—(F. M., Dulwich).

The term square law as applied to a wireless condenser signifies that its capacity increases as the square of the movement of the plates. Such a condenser enables the various wavelengths to be more evenly distributed, and not crowded together into a comparatively short movement.

ELECTROLYTIC CONDENSER

"I have noticed recently in the adverts of a well-known condenser firm, references to an electrolytic condenser. I should be glad if you would inform me what this article is."—(J. B., Harrow).

Electrolytic condensers are made up from two plates of metals having dissimilar characteristics. For the dielectric a special chemical solution is employed which, upon the application of a potential, acts upon one of the plates and forms an insulating coating. Actually, therefore, it is not a condenser until it has a voltage applied to it. These condensers are employed principally in mains-driven apparatus.

FINDING THE RATIO OF A TRANSFORMER

"I am making up a wireless set of my own design, and am doubtful as to the ratio of the transformer to use. Is there any easy way of working this out."—(J. L., Bristol).

The ratio of the transformer should be chosen according to the position it occupies in the receiver. If only one stage of L.F. is employed this may conveniently be one of the high ratio transformers, say 7 to 1. If, however, a pentode is used and you are situated near to a powerful broadcasting station, this will result in overloading the pentode, so in this case do not use a higher ratio than 3 to 1.

DATA SHEET No. 4
Letter Drill Sizes

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

No.	Size (inch).	No.	Size (inch).
A	.234	N	.302
B	.238	O	.316
C	.242	P	.323
D	.246	Q	.332
E	.250	R	.339
F	.257	S	.348
G	.261	T	.358
H	.266	U	.368
I	.272	V	.377
J	.277	W	.386
K	.281	X	.397
L	.290	Y	.404
M	.295	Z	.413

If more than one L.F. stage is used, the first transformer should be of medium ratio, say 3 to 1, and the second of 4 or 5 to 1. If you place the transformers the other way round, there is a danger of overloading the first L.F. valve.

ACCUMULATOR TROUBLE

"My accumulator, which I have only had nine months, has a lot of sediment at the bottom. I always understood that a sediment should not form until it has been in use for years. Is anything wrong with the battery?"—(P. F., Richmond).

In view of the short time you have had the cell, a thick deposit certainly shows misuse. This can arise from two causes, over-charging or over-discharging. If you can be sure that the charging is carried out correctly, you are running the accumulator too low. Endeavour to test the condition of the battery with volt-meter and hydrometer, and do not discharge below the values stated on the label by the manufacturers.

H.T. CAPACITY

"My H.T. battery has just run out, and I wish to buy a new one. I notice, however, that the batteries are of different sizes though the voltage is the same. Why is this?"—(S. A., Reading).

The choice of the high tension battery does not depend alone on the voltage of the H.T. required by the valves in the receiver. The capacity is much more important. Suppose, for instance, that the output valve of your receiver takes a current of 10 milliamps. If an H.T. battery of the necessary voltage, but only designed to give an emission of 5 milliamps, is employed, it will last a very short time.

H.T. batteries are made in various capacities, some firms denoting this difference by coloured cases, or by some fancy name, such as treble capacity, double capacity, red label, etc. Whatever type of nomenclature is employed, ascertain from the valve maker's curves just what current your receiver is taking. Then obtain a H.T. battery which is made to give a *larger* emission than this.

VARIABLE CONDENSERS

"Is there any special value for the variable condensers in a receiver."—(F. L., Glasgow).

The value of the tuning condenser in a normal broadcast receiver is usually .0005 mfd. Most commercial coils are designed to cover a given wave-band with this value of condenser. If a smaller condenser is employed, the various stations will be separated by a greater distance, which will make it easier to tune in distant stations. The coil will not cover the same range, however, and this is the only drawback.

For short-wave receivers a much smaller capacity is essential, or it will be impossible to accurately tune in short-wave stations. A value of .00025 mfd. is fairly convenient, but where it is possible to change the coils for different wave-bands a value of .0001 will be found ideal. It will necessitate a number of different coils, however, but this disadvantage will be offset by the ease of tuning. The reaction condenser is usually of .0003 mfd., and most commercial coils have the reaction winding adjusted to give good smooth control with this value of condenser. Where a larger value is employed, reaction will be very difficult to control, the receiver bursting into oscillation before the weak stations are brought up to maximum value.

Conversely, a smaller value of condenser will prevent the maximum reaction being applied.

LENGTH OF AERIAL

"I have just moved into a new house from a flat, and now wish to erect an outdoor aerial. What size, material, etc. would be best?"—(F. B., Ealing).

The aerial should be of as large a conducting surface as possible, and as it would be impracticable to use a very thick wire, the usual practice is to employ stranded wire. The most common size of the aerial is known as 7/22's, which means seven strands of gauge 22 wire. The best is that in which each separate strand is enamelled.

The height of the wire is important, and therefore expense should not be spared in purchasing a good pole. For the best results the end of the aerial farthest from the receiver should be the higher. That is to say, the wire should run down towards the receiving set, the lead-in being a direct continuance of the wire. For general domestic purposes a height of 30 feet will be found most suitable and convenient. Where it is not possible to obtain a long straight run, there is no objection to using two or more wires running parallel. However, a space of at least 3 feet should separate these wires, and they should be joined at one end only—the joining wire being continued as the lead-in. The total length should not exceed 60ft.

WHY USE A TRANSFORMER?

"Why is a mains transformer always used between the supply leads and rectifier, even though the secondary winding gives the same voltage as do the mains? I cannot see any reason why the rectifier should not be connected straight to the mains in the case of, say, an eliminator required for high tension only."

The transformer is used principally as a "safety-first" device in an instance such as that you quote. It serves to isolate the mains from the receiver, and so minimises the possibility of receiving a shock whilst adjusting the receiver. It is a regulation of the I.E.E. that no instrument which is earth connected should be in direct connection with any A.C. mains supply. A rectifier can, however, be connected directly to the mains when the output is required for the field windings of a M/C speaker.

FREE ADVICE BUREAU
COUPON

This coupon is available until Oct. 22nd, 1932, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 15/10/32.

Curing Common Receiver Faults

(*Continued from page 170*)

remedy is to connect a .002 mfd. fixed condenser across the loud-speaker terminals or to employ metal shielded wire for the speaker leads. In the latter case the metal screening should be connected to earth or high-tension negative. Yet another way of preventing the howling is to connect the first L.F. transformer to the grid of the L.F. valve through a non-inductive resistance of about 100,000 ohms. See Fig. 3b. A similar kind of trouble to that just dealt with is frequently caused by a "microphonic" detector valve. The detector valve is sensitive to vibration and when it receives a slight jar a "ring" or "hum" is heard in the speaker. If the speaker is near the valve the vibration set up by the diaphragm causes the valve to vibrate still more. This process goes on indefinitely, the sound increasing meanwhile. The cure in this case is to use an anti-microphonic valve-holder and to wrap the valve in thick felt. Instead of felt, a good result is often obtained by sticking a lump of plasticine on top of the glass bulb.

Mains Hum

The most frequent source of trouble with the older types of mains receivers is hum. There are numerous causes, some of which are too involved to receive treatment in the present article, but most of them can be cured by fairly simple means. Fig. 4 shows a method which is generally beneficial. Two .01 mfd. fixed condensers are put in series across the primary of the mains transformer and the junction is connected to H.T.—or earth. Hum caused by an electric gramophone motor housed in the same cabinet as the set can often be cured by a similar connection of condensers across its terminals. An insufficient earth lead can be the cause of the most troublesome mains hum, so this point should receive special attention when using an all-mains set. Instability of the kind dealt with as low-frequency reaction often appears as a troublesome hum in mains sets and the tests are the same as those explained above. Just one word of warning. Unless you are thoroughly conversant with electrical engineering, do not tamper with any all-mains set without first disconnecting it from the power supply.

The Heart of Your Set

(*Continued from page 182*)

ohms. The former type should be selected if the coupling transformer is of somewhat old type, while for the modern high and medium impedance transformers, "H.L." valves can be utilized to good effect.

Amplification Factor and Impedance

The next point to be considered is the signal which the valve will be called upon to handle, and the recommended grid bias furnishes a good guide on this point. For early-stage valves, types requiring a small bias—that is, 1.5 to 3.0 volts—are usually quite suitable, while for later stages the valve should have a longer grid base, indicated by a higher recommended bias. Of two or more valves which, judged on the above points, seem to be of equal merit, that having the highest amplification factor is the more efficient, and this point is of particular importance in resistance-coupled stages where all the effective amplification is provided by the valve, there being no transformer to give an additional step up.

For radio-frequency amplification there is not quite such a wide range of choice. In portable receivers having three electrode high-frequency amplifiers with untuned couplings, a high-impedance, high-magnification valve of either the "H" or "H.L." type should be chosen, while in screened-grid stages the valve having the highest "mutual conductance" is, generally speaking, the better valve. The mutual conductance is a quantity the value of which depends upon both the amplification factor and the impedance of the valve, and by comparing the mutual conductances of different valves of similar class a good idea of their relative "goodness" can be obtained.

CATALOGUES RECEIVED

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state 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 must be enclosed.

R.I. Components

THE latest list issued by Radio Instruments, Ltd., contains a wide range of high-class components, including their well-known L.F. intervalve transformers, output transformers, eliminators, chokes and dual-range coils. Technical data for each component is given which makes the list particularly useful to constructors who wish to have components of the correct values in their sets. There are also several diagrams showing clearly how some of the components are connected in various circuits. The address is Purley Way, Croydon.

Loewe Radio Specialities

WE have received from The Loewe Radio Company, Ltd., their latest price list and several leaflets giving full particulars of their new all-mains receivers, speakers, paper condensers, pick-up and volume control, and high vacuum resistances. One of the all-mains receivers, the "Super-Power" three-stage model, is equipped with a built-in four-pole loud-speaker, and embodies the latest improvements. It can be supplied for operating on either D.C. or A.C. Another model is made for A.C. only, and is for use with a separate speaker. Both receivers are housed in handsome cabinets. Something new in loud-speakers, the "Varitone," is also listed. This instrument is fitted with a special three-way switch for adjusting the tone and for matching the output of the power valve. The unit is fitted with a centre-balanced armature and covers the whole range of frequencies. The speaker, which is fitted in an attractive cabinet, is priced at the very moderate figure of 39s. 6d.

Osborn Cabinets

TO the ever-increasing world of radio enthusiasts the names Osborn and cabinets are synonymous. No matter whether you require a table cabinet on simple lines or a more pretentious floor cabinet of Queen Anne style, you will find a design to suit your purpose in the new list issued by the firm of Chas. A. Osborn. In addition to completely-finished cabinets, machined parts of most of those listed can be had ready for assembling, or assembled ready for polishing. Futuristic, Jacobean, Adam and Gothic designs, neatly executed in either figured oak, mahogany or walnut, all find a place in this well-illustrated list, which should be in the hands of every constructor on the look-out for a smart and well-made cabinet in which to house his set.

Epoch Loud-speakers

THE Epoch Radio Manufacturing Co. have specialised in loud-speaker construction for the past five years, and the latest catalogue issued by this firm shows some very interesting models. The speakers of this firm are supplied with different types of diaphragm and the catalogue gives a chart to enable any valve to be accurately matched by a diaphragm number. The speakers vary in price from £1 7s. 6d. to £14 10s. The address is Exmouth House, Exmouth Street, E.C.1.

MOTORBOARD MUSINGS

(*Continued from page* 187)

swing. This results in overloading of this valve, and, consequently, a volume control in the remainder of the circuit will have no effect on the purity of the output. It is, therefore, advisable in the majority of cases to fit a volume control across the pick-up—the most convenient position being on the gramophone motor-board—so that the signal voltage applied to the grid of the input valve may be kept within the limits which that valve will comfortably handle.

The value of the control should be carefully chosen in order not to interfere with the characteristics of the pick-up, and, therefore, the makers' instructions should be carefully adhered to.

Broadcast Query Corner

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

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

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

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

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

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

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

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

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

Although the service is mainly applicable to broadcasting stations, wherever possible replies will be given in regard to morse transmitters (commercial stations, fog beacons, etc.) and short-wave broadcasts. For the 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 if 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

EVERSEARCH (Camberwell): A test by station engineers; possibly Radio Normandie (Fécamp). SEYON (Battersea): Your wavelength must be wrong as transatlantic telephony is not yet carried out on such short waves. If between 16 and 20 metres, possibly WND, Ocean Township (N.J.), on 16.36 m., working with London *via* GBS, Rugby. ARMOURER (Luton): LR3, Radio Naçional, Buenos Aires (316 m.). METEORITE (Aberystwith): Warsaw. The call was *Hallo! Hallo! Radjo Polskie Warszawa.* F. G. N. (Glasgow): Langenberg relaying Cologne. PORTLAND BILL (Southsea): Neither Spain nor Portugal adopted Summer Time this year. G.M.T. is used. Madrid (EAJ7) is now back again on 424.3 m. RUMBA (Cork): W2XAF (31.48 m.) relaying WGY, Schenectady (N.J.); National Broadcasting Company programme from New York. THREE VALVER (Seven Kings): Yes, Hilversum. From 8.0 p.m. the 20 kW. transmitter is brought into operation. WONDERLAND (St. Briac): GBC, Rugby works with liners on 60.30 m. K. G. (Galashiels): Radio Nations (Prangins, Switzerland), on 31.31 m., testing with New York. Gramophone records relayed from Geneva studio. OVI (Enfield): CT1AA, Lisbon (31.25 m.). Call: *Radio Colonial, Lisbon*; announces in five different European languages. Interval signal: Cuckoo call.

ADVERTISEMENT INDEX

P.W. Gift Stamp No. 3

Printed by NEWNES & PEARSON PRINTING CO., LTD., Exmoor Street, Ladbroke Grove, W.10, and published by GEORGE NEWNES, LTD., 8-11, Southampton Street, Strand, W.C.2. Sole Agents for Australia and New Zealand : GORDON & GOTCH, LTD. South Africa : CENTRAL NEWS AGENCY, LTD. *Practical Wireless* can be sent to any part of the world, post free, for 17/4 per annum ; six months, 8/8. Registered at the General Post Office for Transmission by Canadian Magazine Post.

Practical Wireless, October 22nd, 1932

INSIDE! MAKING AN A.C. ELIMINATOR!

Practical Wireless

3D.

Published every Wednesday by
GEORGE NEWNES LTD.

Vol. 1——————No. 5
OCTOBER 22nd, 1932
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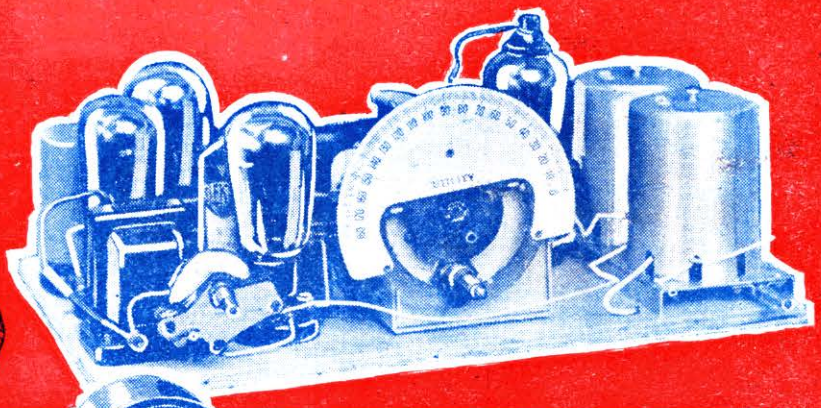


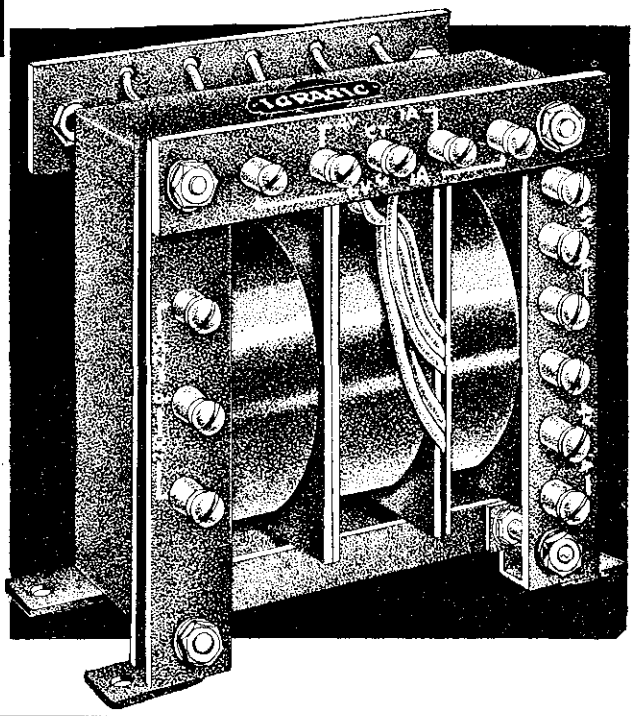
Tuning and Adjusting the "SONOTONE"

how to bring in more stations

fit COSSOR S.G. VALVES

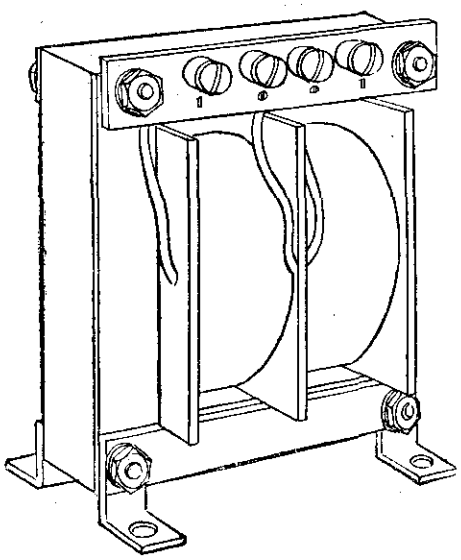
IGRANIC MAINS COMPONENTS

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.



TYPE C.H.2. CHOKE

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**

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		s.	d.
1	Panel 14 x 7 ins., ready drilled ...	4	0
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1	UTILITY .0005 mfd. variable condenser, two-gang, type 312/Air ...	19	6
1	READY RADIO .0005 mfd. reaction condenser	2	6
1	SOVEREIGN .0005 mfd. pre-set condenser	1	3
1	T.C.C. type S.P. .0002 mfd. fixed condenser	2	4
1	T.C.C. type "S" .0001 mfd. fixed condenser	1	3
3	T.C.C. type No. 50 2 mfd. fixed condensers	11	6
1	SLEKTUN standard H.F. Choke ...	4	0
1	BULGIN Standard Screened H.F. Choke	3	6
1	READY RADIO ratio 3—1 L.F. Transformer	8	6
1	BENJAMIN Transfeeda	11	6
4	LOTUS 4-pin Valve holders	2	0
1	R.I. output choke type DY. 25	12	6
1	LEWCOS 600 ohms Spaghetti fixed resistance		9
1	LEWCOS 10,000 ohms Spaghetti fixed resistance	1	6
1	COLVERN 25 ohms filament variable resistance Type FR.	3	6
1	SOVEREIGN 500,000 ohms volume control	4	6
1	100 m/a Microfuse	1	0
3	BELLING & LEE Terminal Blocks	2	0
6	BELLING & LEE marked Terminals	1	3
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ANY PARTS SUPPLIED SEPARATELY.
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4	*Valves as specified*	*£1*	*7*	*0*
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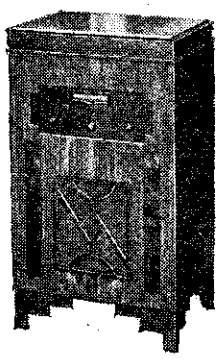
1933 ADAPTAGRAM

Trade Mark

Constructed in Walnut with Inlaid Walnut Veneers,



Dimensions: Height, 38½in.; width, 21½in.; depth, 15½in.; panel size: 13 x 18in.; baseboard depth, 14in.; Speaker Compartment, 17 x 19½ in.; Clearance Between motor board and underside of lid 4in. Ready fitted with back Baffle Board, 2/6 extra if required.

MODEL A Convert your existing set to a Radio-gram. Comes to you with vignetted front as illustrated and motor board, ready to take your own Set, Gramophone Motor and Pickup. No skill or expensive tools are required to transform your Radio into a combination instrument, presenting the professionally-finished appearance of the most luxurious Radio Gramophone money can buy. 12 monthly payments of 5/9. **63/-**
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MODEL C with Collaro Induction Electric Motor with Tone-Arm, Pick-up and Volume Control in one Unit. 12in. Turntable. Automatic Stop. Automatic Needle Cup. (For A.C. Mains). Cash or C.O.D. or 12 monthly payments of 13/9. **7 GNS**

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WE have received many letters from readers (with cash enclosed) asking to be supplied with copies of the WIRELESS CONSTRUCTORS' ENCYCLOPÆDIA. In spite of the fact that our first print ran into many thousands, every copy was reserved within a few days of publication of Number 1 of PRACTICAL WIRELESS. Two reprints have since been similarly reserved by readers, and no copies of the work will, therefore, be on sale until all regular readers have been supplied. When copies are available for sale through the ordinary channels, an announcement will be made in these pages.

A New Public

THERE can now be "no possible probable shadow of doubt" (to drag Gilbert and Sullivan into it) that PRACTICAL WIRELESS is an established success. The thousands of letters of congratulation which continue to pour into these offices provide weighty evidence of our success; and the reprints of our earlier editions, and the thousands of repeat orders from the trade, coupled with the fact that the print of Nos. 4 and 5 is progressively many thousands greater even than the three preceding issues provides even weightier evidence that a vast public was waiting for a paper run on *practical* lines. We shall unceasingly continue our efforts to provide the type of matter which has quite evidently met with such universal approval.

Queries

QUERIES by the thousand have poured into our offices, and a greatly augmented staff is hard at work answering them. If *you* have a question to ask, send it along; you may rely upon a careful analysis of your difficulty.

Proposed New French Station

SOME eighteen months ago work was started at Camphin (France) on a new 20 kilowatt transmitter, destined to replace the station now operating at Lille. Lack of funds, however, put a stop to its construction, with a result that listeners appealed to the Paris authorities for further assistance. It is now reported that negotiations are proceeding with the French administration of Posts and Telegraphs, and that Lille may be endowed in 1933, not with a 20 kilowatt, but with a transmitter of much higher power.

Loud-speakers on Tramway Cars

IN Stockholm (Sweden) many electric tramway cars are equipped with a microphone, amplifier and loud-speaker. The apparatus is operated by the conductor, who announces by this means the various stops during the journey.

Italian Operatic Broadcasts

LISTENERS to Italian transmissions in the past will have heard relays from the famous Scala Opera House at Milan. As this theatre was threatened this year with a serious deficit, there was a strong possibility that it might have to close down. In order to assist, the E.I.A.R., the association responsible for broadcasting

in Italy, has agreed to grant a substantial annual subsidy on the understanding that relays are to be carried out at regular intervals of performances given during the coming winter season. These broadcasts will be taken by the North Italian group of stations, including Genoa, Milan, Trieste, Turin, Florence and Bolzano, and also on many occasions by Rome and Naples.

Wireless Picture Postcards

A NEW wireless picture-postcard service has been inaugurated by the German Posts and Telegraphs, by which passengers on liners, taking part in pleasure cruises to Scandinavian and other countries, may now transmit messages at reduced rates to their friends on shore. The radiogram is wirelessed from the steamer to the Norddeich coastal station, where a number of suitably illustrated postcards are kept for this purpose. The traveller gives the ship operator the text of a message limited to some ten words, and also stipulates the type of postcard to be used. On reception at Norddeich, a similar type of card is duly filled up and sent to the addressee by post. For such wireless greetings the charge made is roughly 2s. 6d.

French Stations and Sponsored Concerts

UP to the present the French wireless fan has never been asked to pay a listener's tax, but the law compels him to declare his receiver at the nearest post office, and to secure a registration certificate, for which the modest sum of one French franc is charged. Although the new budget does not foresee any special tax on radio receivers, it is expected that a broadcasting bill may be brought in at a later date. With the exception of the State-owned stations, to which an official subsidy is granted, the French broadcasters must defray their expenses by revenue derived from voluntary subscriptions, or subsist on an income secured from publicity transmissions and sponsored concerts.

Beginners' Turns in Spanish Programmes

IN Spain no artist engaged by the studio is allowed to broadcast unless he can show documentary proof to the effect that he owns a wireless receiver. In place of the usual private audition of singers and instrumentalists, the Barcelona (EAJ1) station incorporates a number of "beginners'" turns in its programmes. Would-be broadcasters are invited to face the microphone, and judgment of their talent is left to the unseen audience. In consequence, the studio postbag during the past few weeks has assumed unwieldly proportions.

Short-wave Broadcasts from Prangins

RADIO Nations, the 20-kilowatt station at Prangins (Switzerland), may be heard every Sunday between 10.0 and 10.45, G.M.T., on 40.3 m. and 20.64 m. For the first fifteen minutes a talk is broadcast in French, for the second in English, and the last quarter of an hour is devoted to the Spanish language. These transmissions are destined to give listeners all over the world an opportunity of hearing an account of the League's activities. In future broadcasts, a portion of the time may be devoted to the answering of questions sent in by listeners or representative journalists. At a later date a special programme for Europe will also be transmitted on Sundays, but for this broadcast another, and perhaps more suitable, wavelength may be chosen.

Round the World of Wireless (continued)

Russia and European International Concerts

IN view of the fact that Soviet representatives were invited to attend at the Madrid International Conference, it is reported from Moscow that the Russian broadcasting stations will suspend the transmission of special propaganda talks destined for foreign countries and, in future, that such talks will be limited to a mere description for living conditions under Soviet rule. Further, a network of pupinized cables is being laid down in order to link up Moscow and Leningrad with the Polish and Lithuanian frontiers, in the hope that Russia may take part in the European International concerts.

Paris Fashion Broadcast to New York

ON November 6th, when a fashion show takes place at the American Women's Club at Paris, a running commentary on the gowns displayed will be transmitted by wireless to New York. Photographs of the new creations will then follow by the first mail.

Belgian Privately-owned Transmitters

OVER and above the two high-power stations at Velthem-Louvain, which broadcast the Brussels, Flemish and French programmes, and the smaller Radio-Schaerbeek and Radio-Conference transmitters in the capital, Belgium possesses a number of miniature, privately-owned transmitters working in the provinces. Of these, five are situated in and around Liége, namely, Radio-Franchimont (207.3 m.); Seraing (203.6 m.); Liége Regional (215 m.); Liége Expérimental (241.3 m.); and Radio-Cointe in the same city, working on 271 m. Small stations also exist at Binche (231.1 m.), Antwerp (211.3 m.), and at Fontaine l'Evêque (231.3 m.). Authority has been granted to these stations to broadcast, but only on the condition that common wavelengths between 200 and 207 metres are used. A further stipulation is made to the effect that they must not resort to microphone publicity. In these circumstances it is expected that many of them will be compelled to close down.

Strasnice Again

IN order to establish a service of alternative programmes, the old Strasnice transmitter, which previously broadcast the Prague wireless entertainments, has again been resurrected on 249 m.; its power is 5 kilowatts.

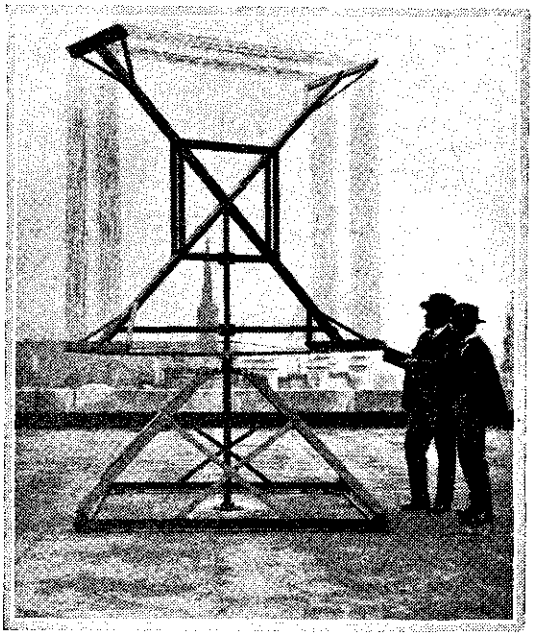
Wavelength of New Belfast Station

IT has been decided that the Belfast 50-kilowatt Regional transmitter will be built at some few miles from the city, on the summit of Divis Hill. As 242 metres would not be a suitable wavelength, something nearer to the frequency used by London Regional may be used. Work on the station is to be started without delay.

New Latvian High-power Station

AS the geographical position of Riga (Latvia) has been found unfavourable for the broadcast of wireless entertainments over the entire country, a new high-power transmitter is being erected at Aiviekste, near Madonna. Although, at the outset, it will work with a power of only 15 kilowatts, provision is being made for an increase to 50 kilowatts, if necessary. It is not expected that the wavelength of 525 metres will be retained, and it is reported that a channel in the neighbourhood of 342.8 kilocycles (875 metres) may be adopted.

INTERESTING & TOPICAL PARAGRAPHS



What is said to be one of the largest wireless frame aerials in Europe is situated on the roof of the Bush House, Aldwych, W.C. It was erected by the United States Shipping Board to conduct the business between London and the United States. It is 8ft. by 6ft., and is wound with forty-eight turns of aerial wire. Mounted on ball bearings, it can be made directional from the interior of Bush House by a wheel similar to the steering-wheel of a motor-car. Messages can be received from places 8,000 miles distant.

SOLVE THIS!

Problem No. 5.

Tompkins made up a three-valve set, using an aluminium chassis, and followed the lines of our Long Range Express Three. When completed and ready for test, he switched on, but no signals came through. All wiring was checked, and on testing with a voltmeter no voltage reading could be obtained across the filament terminals of the valve-holders. Wiring to the on-off switch was from L.T.+, but this wire was intact and making good connection, whilst the negative filament circuit was completed from the chassis, which also should be O.K. Where had he gone wrong?

Three books will be awarded for the first three correct solutions opened. Mark envelopes Problem No. 5 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 October 24th.

SOLUTION TO PROBLEM No. 4.

The L.F. valve was oscillating.

The following readers received books in connection with Problem No. 3:

Mr. F. Ball, 55, Common Lane, Washwood Heath, Birmingham; Mr. S. Brown, 106, Nicolas Road, Chorlton-cum-Hardy, Manchester; Mr. S. Frost, 67, Hawkins Lane, Burton-on-Trent.

The Cuckoo Club's Broadcast

SHORT-WAVE "fans" who tune in to W2XAD, W2XAF, Schenectady, or to the Boundbrook (N.J.) relays in the early hours of Sunday morning may have been mystified by a "KUKU" call. This is the name of a mythical station adopted in a burlesque skit broadcast by an association calling itself the Cuckoo Club. It is usually heard from the New York studio on the National Broadcasting Company of America chain of stations between 3.0 and 3.30 a.m., G.M.T.

Leipzig's Interval Signal

TO commemorate the work of its great composer, Leipzig, as an interval signal, uses four notes, B A C H, the last note in German musical terms being equivalent to our note B. The signal usually follows the ticking of a metronome. Dresden, as the relay station, proposes to use a melody associated with its own city, and may adapt a tune by Carl Maria von Weber, who for many years directed the State Opera House. By this means it hopes to identify itself to all listeners.

Weather Reports from Heston

THE Heston Airport broadcasts of the Air Ministry weather reports on behalf of the Automobile Association, on 833 m., may be heard daily every hour from 9.30 a.m. until 1.30 p.m., and again at 3.30, 5.30 and 6.30 p.m., G.M.T. On the second Tuesday of every month the 11.30 a.m. transmission is not given in view of the interference caused by the National Physical Laboratory calibration signal, on 830 m., sent out at that time.

B.B.C. and Physical Exercises Broadcast

IT is reported that the B.B.C. may broadcast early-morning physical exercises in the near future, in a similar manner to those transmitted daily from a number of Continental stations. The early broadcast would be followed, possibly, by a "spot of music" provided by gramophone records, and would be carried on, with but a short interval, until the daily service (10.15 a.m.) is put on the air.

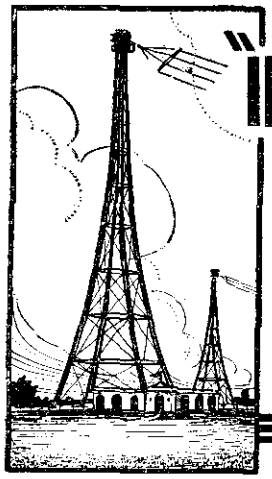
French Operatic Broadcast

A RELAY of a performance of the opera *Der Rosenkavalier* (Strauss) will be broadcast from the Paris Grand Opera House on October 30th; it will be re-transmitted throughout France by all PTT stations, including Eiffel Tower.

Wireless Retailers' Association

WHEN your new set is held up for a grid leak, a special type of coil, or some other gadget that you have on order, your local wireless dealer is apt to come in for a lot of unkind criticism. Those seventy dealers situated in the Manchester area, therefore, deserve a special pat on the back for their enterprise in each donating £3 to a £200 fund to advertise the Manchester branch of the Wireless Retailers' Association during the run of the Northern Radio Exhibition. By fostering such associations their customers—that's you and me—are protected just as much as the retailers themselves, for the association has an effective way of dealing with traders who give customers anything but a fair deal.

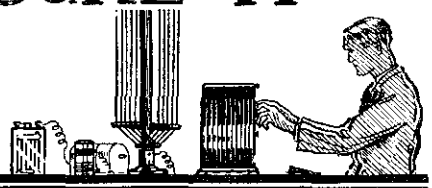
(Continued at foot of page 234)



"BREAK-THROUGH" AND HOW TO CURE IT

BY W. B. KINGSTON

In this instructive article the author explains lucidly the cause of this common form of interference, and shows how it may be overcome.



THERE is a very troublesome form of interference sometimes met with in dual-range coils known as "break-through." It is the breaking through of one or more powerful medium-wave local stations on to the long waves. In extreme cases the station or stations on the medium waves which are causing the trouble can be heard all over the dial when the set is switched on to the long waves. Usually, however, it is not quite so bad as this, the interference being most noticeable at the lower end of the tuning dial and very gradually decreasing towards the upper end.

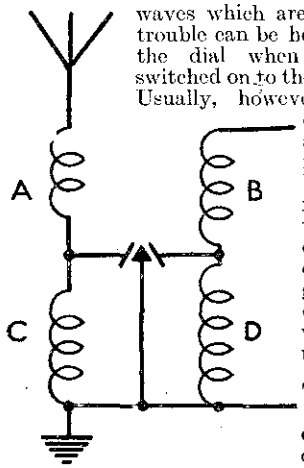


Fig. 1.—Circuit of a dual-range coil with which break-through may occur.

The Cause

Curiously enough, the cause of the trouble is usually due to an attempt on the part of the designer of the coil to obtain selectivity on the long-wave band. In order to do this it is usual to employ either a separate aerial coil of comparatively few turns coupled to the long-wave grid coil, or to tap the long-wave coil near the earthed end. This, of course, gives the desired selectivity as regards the long-wave stations themselves, but introduces break-through with it from the medium waves.

What Happens?

Now look at Fig. 1, which shows a typical dual-range circuit. In this case when the switch is in the "in" position the medium-wave circuit consists of an aerial, or primary coil A of from five to fifteen turns, and a grid, or secondary, coil B coupled to it of about sixty turns. When the switch is "out" the windings C and D are included in series with A and B respectively so as to bring the total inductance up to that required for tuning in the long-wave stations. Now C may consist of twenty or thirty turns, and this, together with A, gives an aerial coil of about forty turns. This winding is not of itself very selective, and being of about the right wavelength, brings in the powerful medium-wave local sufficiently strong to impose the signal on to the grid coil BD. In other words the medium-wave station "breaks through." In the case of the circuit shown in Fig. 2, which is another popular arrangement for a dual range coil, the effect is similar. Here the long-wave primary circuit consist of windings A and C, but C this time is not a separate coil, but a tapped portion of D. The practical difference is that the circuit of Fig. 2 is more tightly coupled on the long waves than that of Fig. 1.

How to Cure It

Any attempts at a cure must be in the direction of keeping the natural wavelength of the primary coil AC well away from the medium-wave band. Fig. 3 shows a very popular circuit much used in commercial coils where only the medium-wave winding is tapped, but here, of course, there is no attempt at selectivity on the long waves. With the circuits given in Figs. 1 and 2 there are two courses open. One is to raise the natural wavelength of A.C. *above* the medium-wave and the other is to take it well *below* it. The usual practice is to raise it. Fig. 4 shows one method. This consists of introducing a separate coil E in series with A and C. This raises the wavelength of the primary circuit sufficiently high to clear the medium band and at the same time does not decrease the selectivity. The coil E should consist of about fifty or sixty turns, and should be placed a little way from the tuning coil or with its axis at right angles to that of the tuning coil so as to prevent interaction. Screening is hardly necessary unless space is very limited. The design of the coil is not critical, and pile winding is quite suitable, especially as this method tends to limit the external field. Fig. 5 shows a very simple and effective method which can be applied to the circuit of Fig. 1. A fixed condenser of .0003 mfd. or .0005 mfd. is placed across C. This again increases the wavelength of the aerial coil without increasing the coupling. In this way the selectivity on the long waves still remains good.

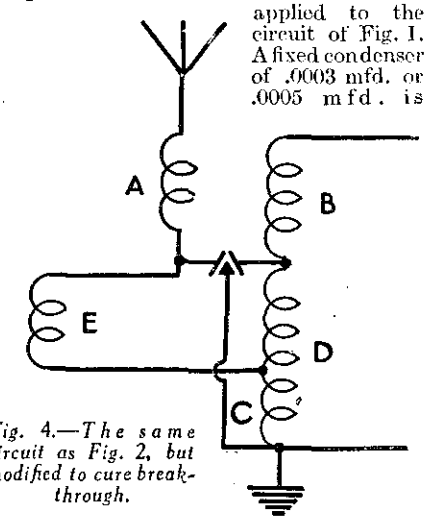


Fig. 4.—The same circuit as Fig. 2, but modified to cure break-through.

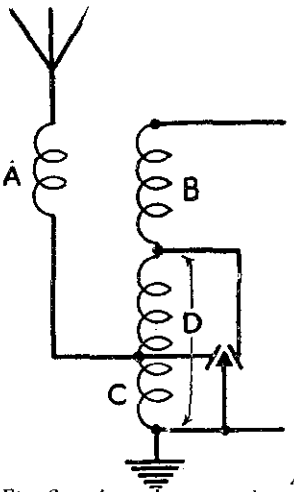


Fig. 2.—Another typical dual-range circuit.

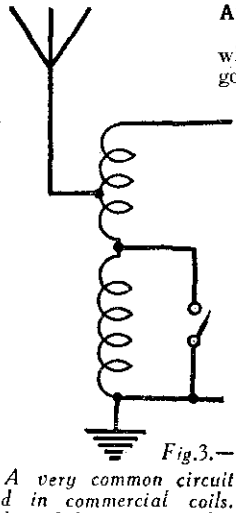


Fig. 3.—A very common circuit employed in commercial coils. Break-through does not occur, but it is unselective on the long waves.

Another Method

Taking the wavelength of the aerial winding *below* the medium band is not generally considered good practice, since it can only be done by making both A and C very small, and this naturally increases the selectivity on both the medium and the long waves to a degree which is not always desirable. However, the writer has found that where great selectivity *is* necessary this method is admirable. The circuit is precisely the same as in Fig. 2, but A consists of about five turns tightly coupled to B, that is wound on top of B, and C is a tapping of about fifteen turns.

"Selectivity" Condenser and Break-through

There is one advantage in this method, and that is there is no fear of trouble arising through the use of a condenser in series with the aerial as a selectivity control. It sometimes

(Continued on page 263)

AN ALL-POWER

A Fine Home Constructor's Set for A.C. Operation

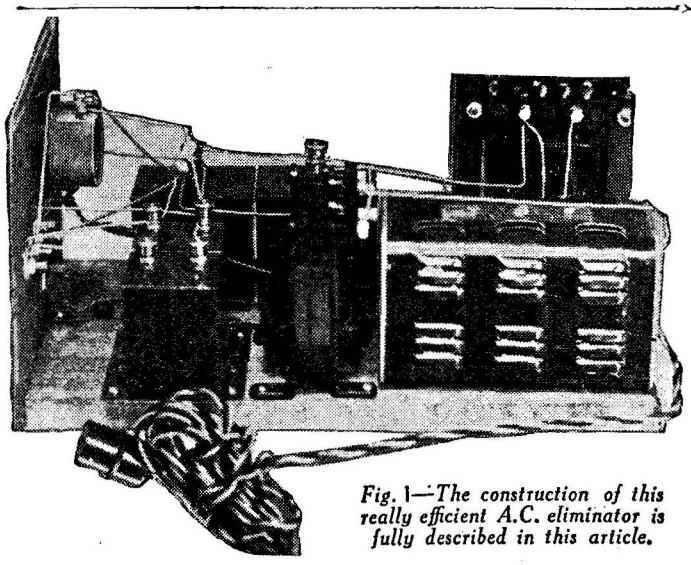


Fig. 1—The construction of this really efficient A.C. eliminator is fully described in this article.

IN designing the eliminator illustrated in Figs. 1, 4 and 6, it was decided that it should comply as nearly as possible with the following conditions.

It must:—

1. Be suitable for any average receiver having from one to four valves (battery or A.C. types).
2. Supply H.T. and L.T. current whilst having sufficient reserve voltage to allow for "automatic" grid bias when required.
3. Be absolutely safe, reliable, and foolproof; and
4. Its cost should not greatly exceed £4.

These considerations have all been met and the exact methods employed can best be explained by making reference to the circuit (Fig. 3). Starting with the mains transformer, this has a tapped primary winding so that it can be used on any mains voltage from 200 to 240 and having a frequency of 40 cycles per second or more. One secondary winding gives 4 volts, 4 amps. A.C. current and is thus capable of heating the cathodes of up to four indirectly-heated valves. The high-tension winding supplies 200 volts at 30 milliamps, and this is passed on, through a safety fuse, to a metal rectifier which is connected on the half-wave principle. During rectification the voltage is reduced to approximately 160, the maximum available current being 28 milliamps. The current is smoothed by passing it through a 40 henry choke and by connecting two 4 mfd. condensers between the positive and negative leads. After smoothing, the maximum output is fed to sockets H.T.1 and H.T.—; the H.T. supply from these points is intended for feeding the anodes of the S.G. and L.F. valves. A 60,000 ohm voltage dropping resistance is connected between H.T.1 and H.T.2, so that the voltage at the latter point is between 60 and 100 (depending upon the current consumption). It is, therefore, suitable for connection to the anode of the detector valve. A 2 mfd. condenser is connected between H.T.2 and H.T.— to complete the decoupling arrangement and to further assist in smoothing. Screening-grid supply for S.G. valves is taken from socket H.T.3, which is connected to the slider of a potentiometer wired across the main supply.

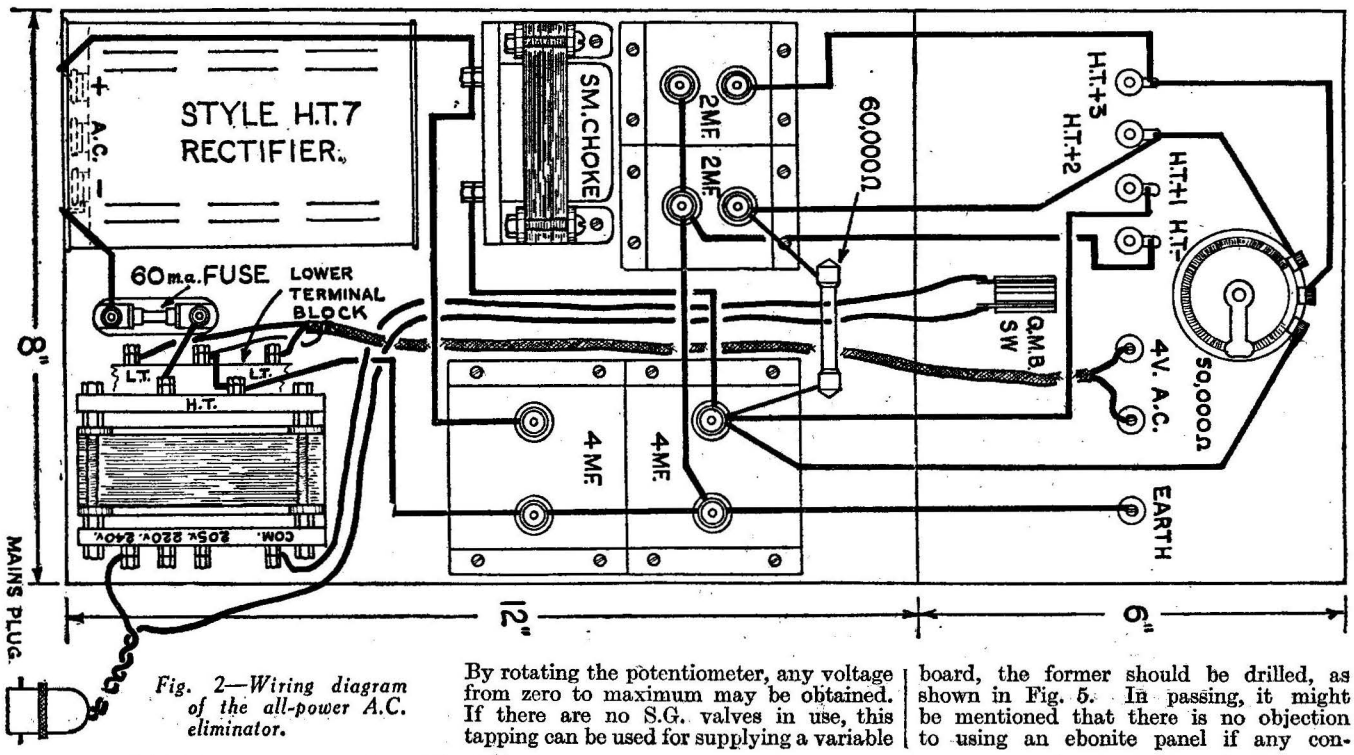


Fig. 2—Wiring diagram of the all-power A.C. eliminator.

By rotating the potentiometer, any voltage from zero to maximum may be obtained. If there are no S.G. valves in use, this tapping can be used for supplying a variable voltage to the detector. An earth connection is made direct to H.T.— as an additional safety measure, and to minimize the possibility of receiving shocks when using the eliminator.

Choice of Components

In making any apparatus to work from the A.C. mains it is essential to allow an ample factor of safety in every component part. This explains why all the smoothing condensers are specified as being for 400 volts D.C. working; they will thus withstand a voltage of twice that supplied by the transformer secondary. Experience shows that such a safety factor is not too great because, when the eliminator is first switched on, the voltage momentarily rises to at least twice its normal value. This is due to the fact that there is no load on the high-tension supply until the valve cathodes warm up, which takes upwards of ten seconds. The terminals and H.T. sockets are covered with material of high insulating properties, and are insulated from the panel by means of suitable paxolin washers. These latter are supplied with the sockets, but must be bought separately for the terminals. A 60-milliamp safety fuse is included in the lead from the transformer secondary to the metal rectifier to guard against short circuits. If the fuse were not employed here a short circuit might easily ruin both rectifier and transformer. The particular kind of mains plug required will depend upon the type of wall socket or lamp holder from which the A.C. supply is to be taken.

Making the Eliminator

After cutting out the panel and baseboard, the former should be drilled, as shown in Fig. 5. In passing, it might be mentioned that there is no objection to using an ebonite panel if any con-

A.C. ELIMINATOR

Unit for Converting Any

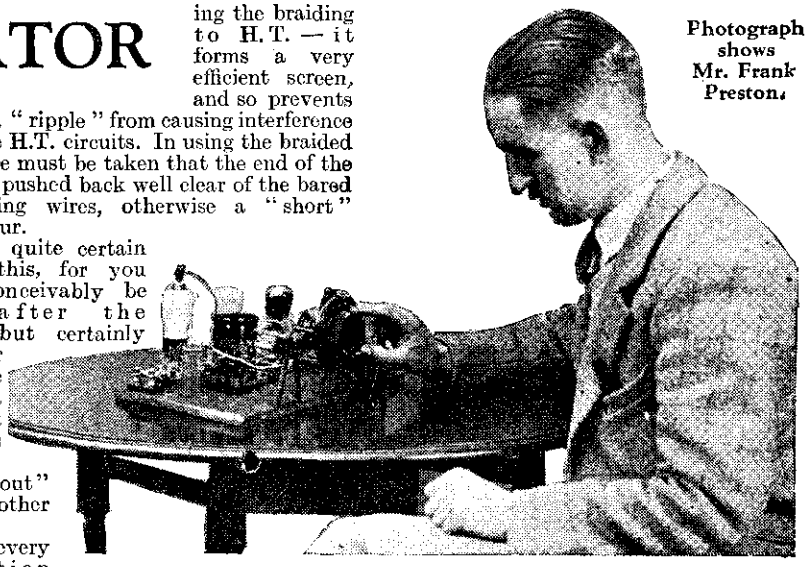
By FRANK PRESTON, F.R.A.

structor prefers to do so. Mount all components in the positions indicated in Fig. 2 and commence the wiring. When making receivers it is usually quite optional to use bare or insulated wire, but in this case it is very essential to employ well-insulated material to prevent short circuits to the metal portions of components.

Connections to the high-tension sockets are made by soldering the appropriate wires to tags provided, but the terminals are made with a slit down the shank so that the end of the wire can be put in and securely attached by screwing down the nut. The connection from the "4-volt A.C." terminals of the transformer to the panel terminals is made in Lewcos twin braided wire. This material consists of two strands of rubber-covered wire passing through a tubing made of braided metal. By connecting the braiding to H.T. — it forms a very efficient screen, and so prevents the A.C. "ripple" from causing interference with the H.T. circuits. In using the braided wire care must be taken that the end of the braid is pushed back well clear of the bared connecting wires, otherwise a "short" will occur.

Make quite certain about this, for you may conceivably be wiser after the event, but certainly poorer by the cost of a new set of valves or a "burn-out" of some other parts.

Take every precaution when experimenting with mains sets, and short circuits cannot occur.



Photograph shows Mr. Frank Preston.

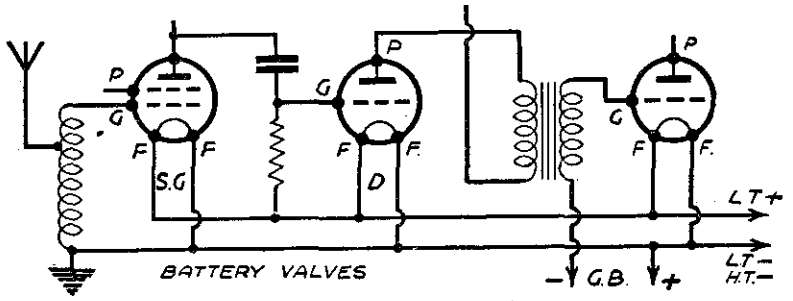
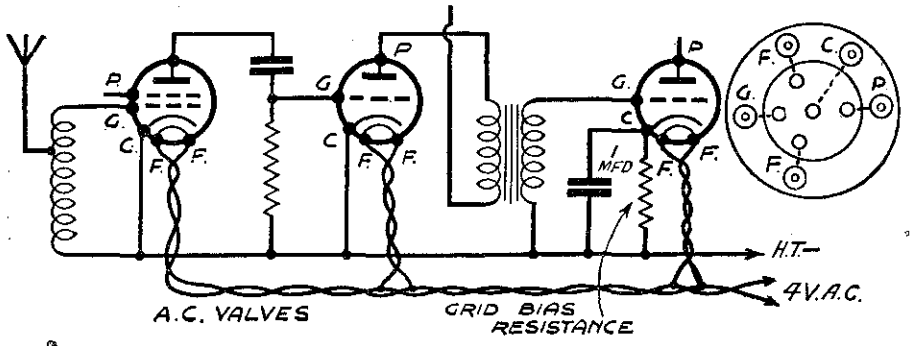


Fig. 3—Diagrams showing alterations required to a battery set when converting it for all A.C. operation.



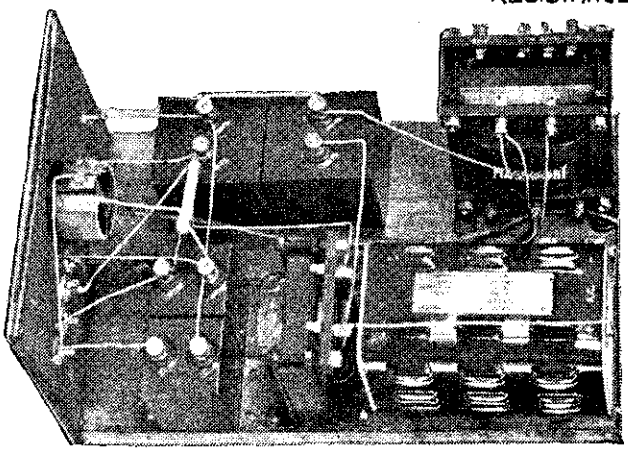


Fig. 4—A plan view of the A.C. eliminator, showing the layout of the components and the wiring.

Methods of Connection

As stated previously, the eliminator can be used with almost any type of receiver. If the latter employs battery valves, and it is desired to retain the same valves and accumulator, the high-tension portion only will be required, the connections being as mentioned before. Just one word of warning: when using the eliminator to supply high tension only, be sure to switch on the filament current to the valves *before* switching on the eliminator, and to switch it off *after* the eliminator. This prevents the liability of damaging the receiver due to the H.T. voltage rising to a high value when there is no "load" on it.

On the other hand, if one prefers to make the set entirely mains operated, new A.C. valves will be required and a few simple alterations must be made to the wiring of the set. Also, if four-pin valve holders are in use, they must be replaced by those of the five-pin type. Fig. 3 (left) is given to illustrate the few changes required in the wiring, a three-valve (S.G.—D.—L.F.) receiver being chosen as an example. With other types of set the alterations will correspond. It will be seen that the earth connection is not shown in Fig. 3; this is because it has been transferred to the earth terminal on the eliminator. Fig. 3 also shows how automatic grid bias can be

(Continued overleaf.)

AN ALL-POWER A.C. ELIMINATOR: COMPONENTS REQUIRED

- 1 Plywood Panel, 8in. by 6in.
- 1 Baseboard, 8in. by 12in. by 5/8in.
- 1 Mains Transformer supplying 200 volts at 30 milliamps and 4 volts at 4 amps (Savage).
- 1 40 Henry Smoothing Choke (Savage type C.C.38).
- 2 4 mfd. Condensers, for 400 volt working (T.C.C.).
- 2 2mfd. Condensers, for 400 volt working (T.C.C.).
- 1 Baseboard Fuse Holder with 60 m.A. Fuse (Belling-Lee).
- 1 60,000 ohm Metallized Resistance (T.C.C. 1 watt).
- 1 50,000 ohm Potentiometer (Colvern type S.T.10).
- 1 Q.M.B. Mains Switch (Bulgin).
- 3 Terminals: 2 marked "L.T.A.C." and 1 "Earth" (Belling-Lee type R).
- 3 Terminal Insulating Washers (Belling-Lee).
- 4 Plugs and Sockets, marked H.T.—H.T.1, H.T.2 and H.T.3 (Belling-Lee).
- 1 Mains Plug to suit convenient socket. (Belling-Lee)
- 1 Coil Glazite, short length Lewcos twin braided wire, length flex, screws, etc.

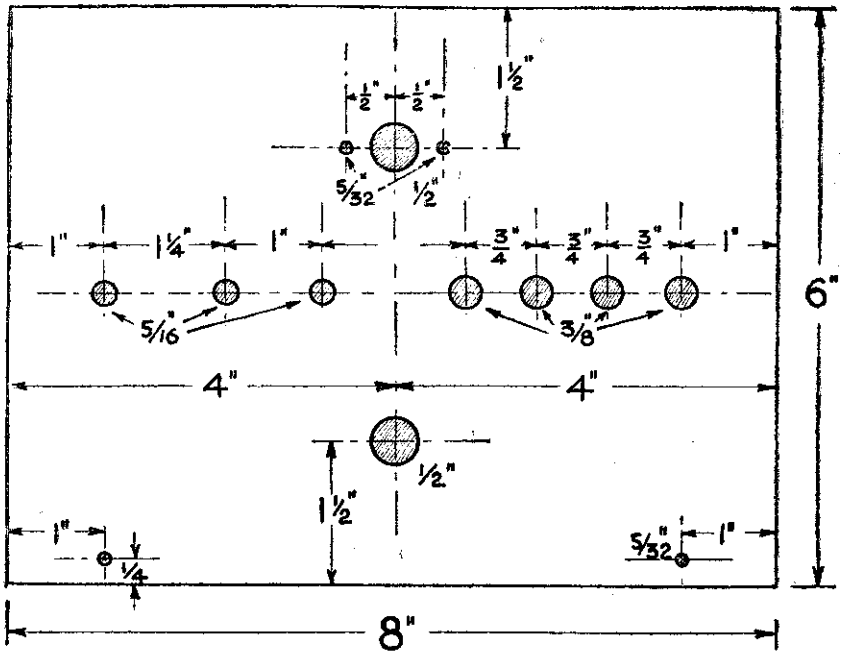


Fig. 5—Panel layout.

obtained for the power valve by inserting a suitable resistance (shunted by a 1 mfd. condenser) in the lead from the cathode to H.T.—. The actual value of the resistance will depend on the type of valve employed, but with such power valves as the Cossor 41 MP., 300 ohms will be correct. For the benefit of those of my readers who are not quite "au fait" with A.C. mains receivers, a drawing is given to show how the terminals of a five-pin valve holder are arranged. The markings of the terminals correspond to those in the circuit diagram, Fig. 3.

H.T. Voltage Available

Before this article was written, the eliminator was tested on a number of receivers, and in every case results were very satisfactory. In the case of those sets primarily intended for battery operation the volume was considerably greater even when the H.T. portion alone was in use. When the sets were converted for full mains working, results were still further improved, both range and volume being increased. In all cases mains hum was almost entirely absent. It was just audible during the silent periods of a programme, but disappeared entirely as soon as the programme was continued. The H.T. voltage available from the eliminator is the maximum for most battery valves, but is rather less than the maximum (of 200) for A.C. valves. This did not appear to be any disadvantage in the receivers available for test, because the difference in volume level at 160 and 200 volts was imperceptible. Of course, the lower voltage does slightly restrict the power handling capacity of the output valve, but this is of very little consequence in practice.

It is hoped that the brief description of the method of converting a battery set for mains working with this instrument will be sufficiently explicit, but if readers experience any difficulty, the writer will be pleased to advise for any particular circumstances.

Test Results

When tested recently on an average type of 60ft. single wire aerial situated twenty miles from a Regional transmitter, this set gave a remarkably good account of itself. It did, in fact, prove to be far superior to any receiver of similar type—and at any price—that the writer has ever had the privilege to experiment with. Using the valves specified, it was found that the reaction condenser could be set to its optimum position for either wavelength range and then left entirely alone whilst numerous stations were easily tuned in. Some twenty-odd stations on the medium waveband and eight on the long were received at good loud-speaker strength, and in each and every case the "quality" was of the kind usually obtained only on an expensive instrument. There was no interference on any stations except those very near in wavelength to the "local," the tuning of which was found to spread over about 12 degrees. The latter station could also be heard towards the bottom of the tuning range with the switch in the long-wave position, but it was easily eliminated by tightening up reaction. A number of pick-ups were tried, and in most instances reproduction was very good and of ample volume. Some pick-ups, however, require a volume control in shunt with them to reduce high-note response and are consequently unsuitable for connecting directly to the set. Types not requiring a volume control are the high-resistance ones. If a low-resistance pick-up is to be employed, it should be used in conjunction with an appropriate shunt resistance as advised by the makers.

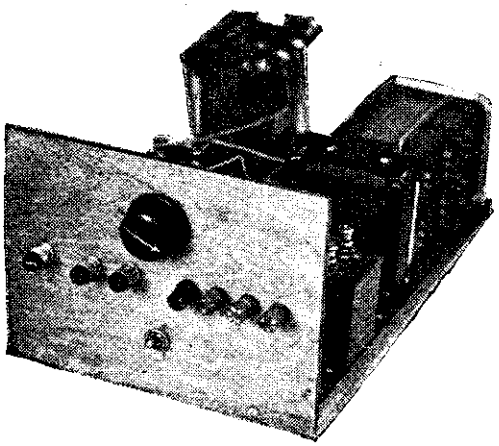


Fig. 6—Front view of the finished eliminator.

Voltage Tappings on Mains Transformers

Mains transformers are almost invariably fitted with three or four primary terminals, each of which is suitable for a particular mains voltage, but sometimes none of these is exactly the same as that of your mains. In such a case it is quite permissible to use the terminal nearest to the mains voltage. If it is known that the mains voltage frequently rises above its nominal value, or if it is suspected that the set is receiving too high a voltage, the mains lead should be connected to a higher tapping. This will reduce the output voltage from the transformer and might improve the working of the set. On the contrary, the output voltage can be increased by connecting the mains lead to a lower voltage terminal. If this is tried one should make sure that the transformer is not being unduly overloaded as would be indicated by excessive heating.

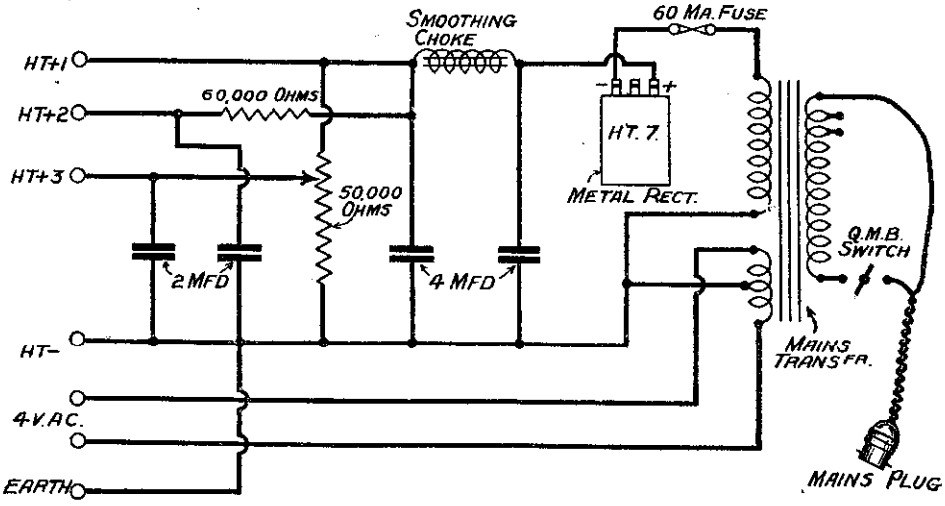


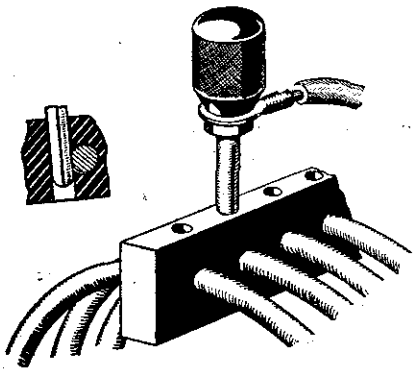
Fig. 7—The circuit diagram.

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

Tapping Short-wave Coils

AN unusual method of tapping short-wave coils of thick gauge bare wire, supported by ebonite spacing strips, is illustrated by the accompanying sketch. One of the spacing strips has holes of a

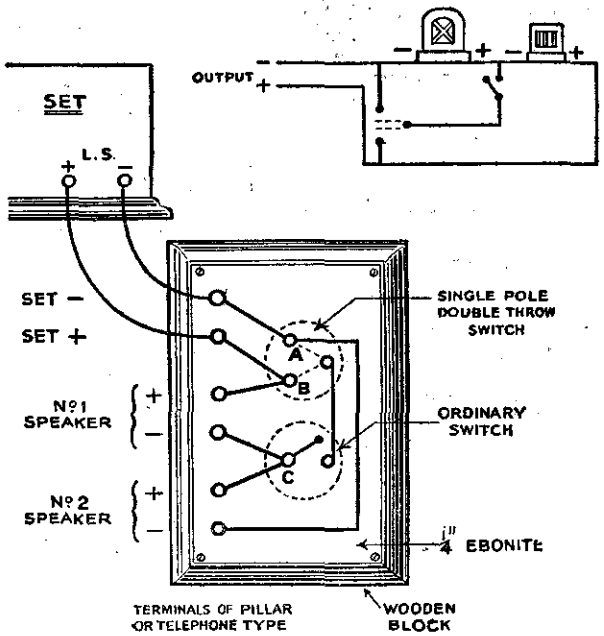


Simple method of tapping short-wave coils.

diameter in which an ordinary wander plug fits fairly tightly, drilled at right angles to the spacing holes and slightly offset, as shown in the sectional view. This allows the wire, when threaded on the strip, to partially project into the second set of holes so that the wander plug, when inserted, will make a reliable, firm contact.—B. G. R. HOLLOWAY (Woking).

Using Two Loud-speakers

MANY radio enthusiasts nowadays utilize two loud-speakers, and it is invariably discovered that the best result is obtained if they are connected in series rather than in parallel. The accompanying switch system will probably interest readers, and it will be seen that it enables either, or both, of the speakers to be used by the simple turning of a switch. The method of construction is clearly indicated in the diagram, and it will be observed that the top switch is of the single-pole double-throw type, whilst the other is of the ordinary make-and-break variety. Spare electric lighting switches of this description can, of course, be utilized, if on hand. The six terminals can be of the ordinary pillar variety, or telephone terminals can be used if desired, and should be mounted on a piece of ebonite approximately 4in. wide by 6in. deep. This can be mounted on a wooden block which can be fixed outside the set in any convenient position. To obviate indifferent connections, it is advisable to loop-in the wire at the three switch points. The wiring can be done in Glazite or other similarly insulated wire. It will be seen that if the lower switch is left open, both speakers are in circuit, whilst the closing of this switch places either of the speakers in operation by the position in which the top switch is turned. The arrangement obviates the possibility of short-circuiting the L.S. output, as no matter how the switches are handled, one or the other (or both) of the speakers is in circuit. In other words, it is impossible to cut both speakers out entirely. If the set is provided with choke or transformer output, there will, of course, be no necessity to observe the negative and positive positions for the various leads.—CAMELOT (Scarborough).



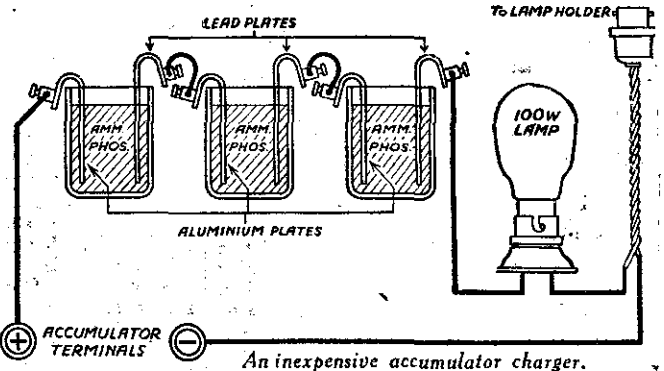
A method of switching loud-speakers. Glazite or similarly insulated wire at back of ebonite. Wiring looped in at points A, B and C.

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. A further 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*.

An A.C. Accumulator Charger

A VERY inexpensive accumulator charger, suitable for A.C. mains, may be made from a one pound jam jar, some sheet lead, some aluminium sheet and half a pound of ammonium phosphate. Two plates, one of aluminium and the other of lead, are cut from the sheets, so as to easily fit the jar. A terminal is fitted at one end of each plate, and the constructional part of the rectifier is finished. The plates should now be bent as shown in the accompanying sketch and inserted in the jar. About two level tablespoons of ammonium phosphate are placed in the jar, which is then filled with water. If the supply mains are in the two hundred volt range it will be necessary to connect three of the rectifiers in series. Sufficient ammonium phosphate may be obtained at any chemist's shop for a few pence.—J. HICKMOTT (West Kensington).



An inexpensive accumulator charger.

A Useful Wiring Hint

IN the instructions given for the wiring-up of "The Long Range Express Three," it is stated that "the valve-holder legs will only comfortably take one piece of Glazite." On terminals with very little space under the holding-down nut for the wire I have found the following method very useful: Ring the wire at the end—with round-nose pliers preferably—to slightly over the required size; then place the ring on a flat metal surface and give it a few sharp taps with a hammer. The copper wire flattens out very easily in its cold state and it can be made, in a second or two, so thin that three or four connections can be made on a terminal where only one would fit before. A further advantage is that the flat surface of the wire makes better connection with, and fits more snugly against, the shoulders of the terminal and the holding-down nut. I make all my connections in this manner on account of these advantages.—A. BAXTER (Burnley).

NEXT WEEK!
SPECIAL BEGINNERS' SUPPLEMENT!

CHOOSING A MODERN VALVE

PERCY RAY Gives Some Very Interesting and Informative Notes Concerning the Valves of To-day

THE selection of a modern valve for any particular purpose has become increasingly difficult during the last two years, and to-day the multiplicity of types available has bewildered even the experienced constructor. One manufacturer lists three valves, all of which have the same impedance—namely, 4,000 ohms; quite obviously these are all small power valves, but the very fact that they are all listed clearly indicates that they are

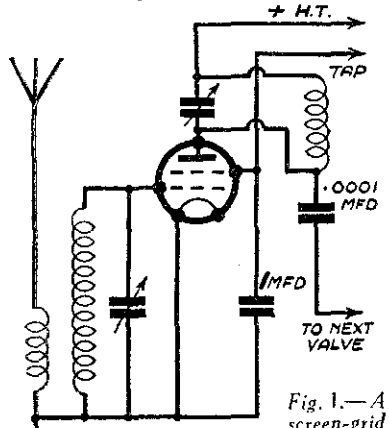


Fig. 1.—A screen-grid valve with tuned anode coupling.

different. How, then, is the would-be user to decide which valve is the one for his particular set? The answer is that to-day the choice of a valve by the old method of impedance is not enough; at least two characteristics, and in exceptional cases four, have to be taken into consideration. This review has been specially written so that the amateur may fully understand the functions of the various types and be enabled, with the knowledge of his own set, to select the valve that will at least give the same results as the one previously used. Probably the greatest mistake that listeners make is to find the nearest equivalent of impedance. This is dangerous with battery valves and fatal with mains types.

Indirectly-heated Mains and Battery Valves

For general consideration it is not necessary to consider separately indirectly-heated mains valves and battery valves, as they are much more closely allied than is popularly supposed. A battery valve filament is a core which is surfaced with some special substance, generally a mineral oxide, that has the property of emitting copious quantities of electrons at a low temperature. At the temperature to which the filament is heated by the low-tension accumulator the actual metal core will not give off any appreciable quantity of electrons; on the other hand, the coating is of considerable resistance and will not pass any appreciable current: thus the core heats the coating or surface, which in turn gives off electrons.

In an indirectly-heated mains valve the mechanical construction is different, as it is necessary to insulate the "core" from the "coating," and consequently they are made separately and are called respectively heater and cathode. The heater is a thick wire which heats the cathode in exactly the same way that a radiator is used to warm a room, and is covered with an insulating material to prevent it from coming into direct contact with the cathode. The cathode is the equivalent of the emissive surface and consists of a metal tube covered with the same substance that is used to cover some makes of battery valve filaments; the metal tube serves no other purpose than something to put the coating on to, as the latter does not possess the mechanical properties to stand alone.

The foregoing description of a filament heater and cathode shows how clearly a battery and a mains valve are allied; both arrangements are provided to throw off the necessary electrons, and it will be interesting to mention in passing that a two-volt super-power valve will give off in one thousand hours' normal use electrons totalling about one hundred and fifty times the weight of its own filament.

The Anode of a Valve

This is fundamentally a piece of metal situated at a reasonable distance from the filament, so that when made very positive by connecting it to an H.T. battery it will attract the electrons towards it at an incredible pace and in incomprehensible hordes. The key to the valve is the grid, which controls the number of electrons that can pass from filament to plate by reason of the voltage on it; for instance, the electrons in the first valve of a receiver will be controlled by the signals varying the potential (or voltage) of the grid. The requirements of, say, the first and last valve in a set are totally different: the first will be called upon to handle very, very small signals and the last relatively big ones. It is desirable that each stage should give as much amplification as possible, but unfortunately a valve that will give big amplification will handle only small inputs, and vice versa. Thus the first valve can conveniently be a valve with big amplification and small handling capacity, while the last will require a big handling capacity and will unavoidably have a small amplification factor.

High and Low Impedance

The extent of a valve to accommodate the signal passed to it from the preceding valve is called the grid swing, while the output that it will handle before distortion becomes evident is called undistorted output. A valve that will handle a heavy output has low impedance, and one that will handle only small inputs has high impedance; the former will have a low amplification factor, the latter a high amplification factor. This term denotes the number of times that the valve will multiply a signal. For example, if a signal of one volt is applied to the grid and filament, with the result that a voltage change of eleven volts is created to pass on to the next stage, the amplification factor must be eleven. In actual practice the full amplification factor is not often realised, but the foregoing explanation serves to make the meaning of this term clear. It will be as well to mention that amplification factor, magnification factor and mu all mean the same thing. (The latter is the phonetic of the Greek letter μ which is used to denote this characteristic.)

Slope is the term that combines impedance and amplification factor in such a way that the degree of efficiency of the valve can be readily seen: a high slope denotes that the amplification is high for the particular impedance, and vice versa. For example, if two valves had an impedance of 8,000 ohms and one an amplification factor of 12 and the other 16, the slope of the former would be 1.5 and the latter 2.

The Screen-grid Valve

Following the brief survey of the main characteristics, the various groups of valves call for separate attention, and the logical beginning is the screen-grid. Ten years ago plug-in coils and ordinary valves were used for high-frequency amplification, with no special precautions for stability. This was possible owing to the horribly inefficient coils and poor valves (the old R type seldom reached a slope of .2). With the appearance of the Cossor P1 and Ediswan A.R.D.E. something had to be done to hold the set down and prevent it from bursting into a violent howl, and a potentiometer was usually pressed into service to adjust the potential on the grid and make it slightly positive; this resulted in a loss of selectivity that would make the set useless to-day. The base of the trouble

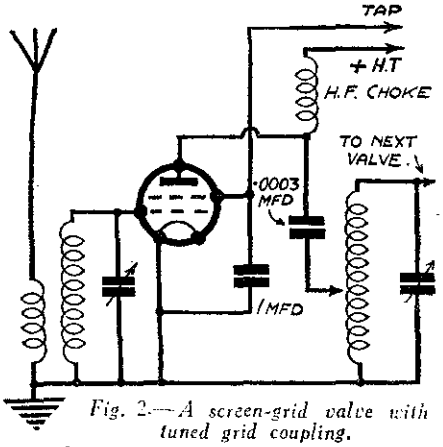


Fig. 2.—A screen-grid valve with tuned grid coupling.

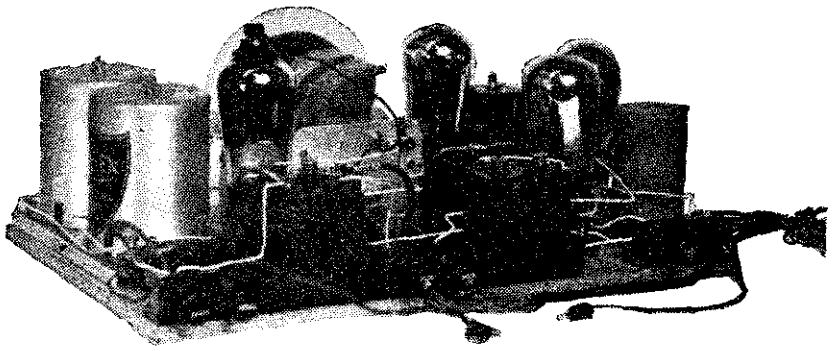
was that the grid and anode formed the plates of a condenser and coupled the anode coil and the aerial coil together. The next step was the neutrodyne, which was an arrangement wherein the coupling fed through the capacity of the grid and anode of the valve could be balanced out by reversed coupling. This system was most efficient, and the screen-grid valve in the state that was originally presented to the public was, in the writer's opinion, a definitely retrograde step; in fact, it was not until about eighteen months ago, when decent screen-grid valves were available, that it was possible to beat a neutrodyne, as the screen-grid valve is inherently unselective compared to an ordinary type, although the former has a far higher amplification factor.

(To be continued)

TUNING AND ADJUSTING THE SONOTONE

By W. J. DELANEY

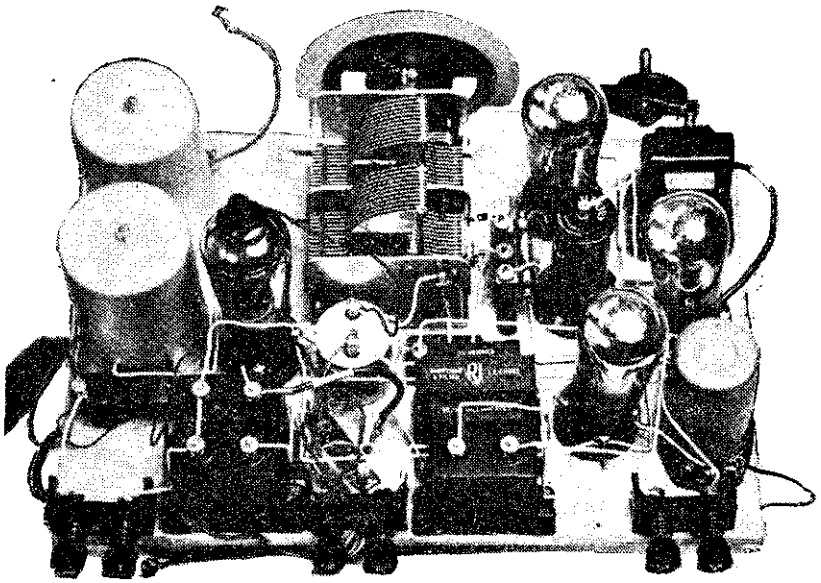
Some Notes on the Correct Adjustment of the Trimmers and Volume Controls.



This illustration shows the complete baseboard lay-out viewed from the back.

IN order to get the best out of the Sonotone it is necessary to adjust the trimming condenser, the series aerial condenser, and the volume controls in the correct manner, and if you have built the receiver as described in these pages last week, you will have found probably that the receiver when first completed at once lives up to its claims. It must be understood that the aerials used by each listener will vary, not only in length, but in height and insulation efficiency, etc., whilst in connecting up, the small trimmer on the front section of the condenser will also be moved. These factors, in view of the fact that ganged tuning circuits are employed, will have to be adjusted, and it is for that reason that these notes have been written.

We will assume that the receiver is completed, and batteries are connected up—in other words we are ready to listen-in. Before switching on set the various knobs as follows: the right-hand knob with the arm about half-way round; the top left-hand knob also about half-way round, and the lower left-hand knob with the vanes of the condenser all out, that is, with the knob turned as far as it will go to the right. Now turn the small knob at the right-hand corner of the cabinet to the left. The receiver is now in a position to tune over a wave-band from 200 to 530 metres, and there will no doubt be a fairly powerful local station in this band within a few miles of you which you can use for the preliminary adjustments. For the sake of this article we will assume that this local is the London Regional, although listeners in other parts of the country can proceed exactly in the same manner by substituting their local for the London station. Rotate the tuning-dial to the 80-degree mark and slowly rotate it over three or four degrees each side of this spot. The London station will be heard somewhere just here, and if you are lucky in the setting of the trimmers and the other factors mentioned at the beginning, this station will come in with a roar. We will, however, for the benefit of those who are some distance from a station, assume that everything is against us, and all the adjustments are right out. Well, then, the London station will, in these circumstances, be very faint indeed, perhaps barely audible. Turn the dial slowly, and find the exact position of the station, which will be somewhere about 80 degrees.



A plan of the set, showing the very neat and compact arrangement of the components.

Adjusting the Trimmer

Now, on the front section of the variable condenser (that is the section farthest from the panel) will be found a small trimming condenser. This is a small piece of springy brass over a strip of mica, with a nut at the lower end. Give this nut half a turn in each direction, trying the tuning after each adjustment to see if any improvement in signal strength is obtainable. If an improvement is noticed when it is turned in one direction, give it a further half-turn in the same direction and again try the tuning. Do this until you find a position where signal strength falls off on turning it either one way or the other. This will then indicate that the two sections of the condenser are ganged at that particular tuning position. Now turn the dial to a low reading station, such as the London National, and on tuning to the loudest position, rotate the small knob which is concentric with the tuning knob, and see if this has any effect on the tuning. If you examine the condenser you will find that this smaller knob controls a small air-dielectric trimming condenser on the rear section of the assembly, and if the wiring has been well carried out there should be no need to employ this small knob at any part of the tuning range. It is always as well however, when a station has been tuned in by means of the main tuning knob to rotate the small knob in each direction, that is, swing it about a central point, to make quite certain that the two circuits are in tune. We shall have more to say about this trimming control later on when dealing with the reaction control.

The Pre-detector Volume Control

We have balanced our tuning condensers, and tuned-in our local station, and the result is, perhaps, anything but pleasing. This is due to the tremendous amplification

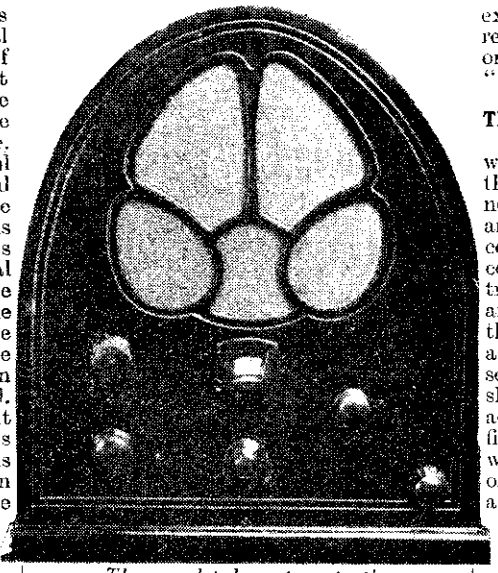
The 46 Stations received on the Sonotone.

SHORT WAVES	Madrid
Fécamp (Radio Normandie)	Belgrade
Cork	Stockholm
Bordeaux	Rome
Nürnberg	Paris (PTT)
Belfast	Beromünster
Trieste	Lyons
Gleiwitz	Langenberg
London National	North Regional
Turin	Prague
Heilsberg	Florence
North National	Milan
Bordeaux	Brussels (No. 1)
Genoa	Vienna
Göteborg	Sundsvall
Breslau	**LONG WAVES**
Brussels (No. 2)	Kalundborg
London Regional	Motala
Toulouse	Warsaw
Midland Regional	Eiffel Tower
Sottens	Daventry
Katowice	Königs Wusterhausen
Dublin	Radio-Páris
Berlin (Witzleben)	Huizen

given by the set, and the volume controls have now to be adjusted. The central knob on the right controls the filament of the H.F. valve, and by turning this so that the voltage on the filament is reduced, the strength of the signal passed on to the detector valve is also reduced. Therefore, if you are situated fairly close to a powerful station this control will have to be employed on the local to avoid overloading the detector. The upper left-hand control is the post-detector volume control, and this is used to reduce the volume of the signal passed on by the first L.F. valve so that the output valve is not overloaded. When the local is tuned-in with neither of these controls adjusted, the result will be terrible distortion, and the first thing to do is turn down the post-detector volume control. You will find, if the local is very near, that no matter how much the signal strength is reduced by means of this control, signals are still distorted. This is the indication of detector overload, and therefore the pre-detector volume control must be reduced. As soon as signals become clear you can increase the post-detector control, and you will no doubt find that louder signals are possible from the loud-speaker without distortion. These two controls have, therefore, to be balanced, and although the above description may seem to suggest rather complicated operations it will become quite a simple matter to decide when output valve or detector valve is overloaded, as you will get used to the maximum volume the output valve will deliver without distortion, and then it will be a simple matter to bring all signals to that level.

The Reaction Control

When a distant station is required, the dial should be turned to the approximate



The completed receiver in the Ambassador Cabinet.

reading, and then if the signal is not loud enough, the reaction control should be used to bring up the volume. This control is the lower left-hand one, and it should only be needed when a very distant station is required. When use is made of this control it will be necessary to make slight compensation in the balancing of the two tuning circuits, and for this reason the small trimming knob on the front of the panel has to be used. Remember, therefore, that the reaction knob and trimming knob must be used together. Bear in mind always, that excessive use of the reaction control will result in distortion, and it should, therefore, only be used in what might be termed "an emergency."

The Aerial Condenser

So far we have not told you what to do with the aerial condenser, and we must therefore explain the use of this control next. As an experiment, tune in the local, and notice how many degrees this station covers. Now adjust the screw on this small condenser and, after adjusting the front trimming knob notice the difference in the amount of "spread." You will find that there is a position for this screw that gives a compromise between signal strength and selectivity, and once this has been set there should be no need to touch it again. It is advisable, however, before the receiver is finally installed in the home, to experiment with this control and make quite certain of the best position. Do not forget, any adjustment of this condenser will upset the trimming, so that use will have to be made of the trimming control, as it is adjusted, to keep the circuits in tune.

The list accompanying this article gives the principal European stations which have been received on this set, and they are in strict order of wavelength. It is only necessary, therefore, to tune in the principal stations, and enter these on a piece of ruled paper, and then the remaining stations will be found in between those tuning points.

The list on page 225 gives the stations you can expect to hear, although it must be understood that a few of these are badly heterodyned during some part of the evening, and you cannot, therefore, rely upon them for a programme of entertainment value.

A SIMPLE COIL WINDER

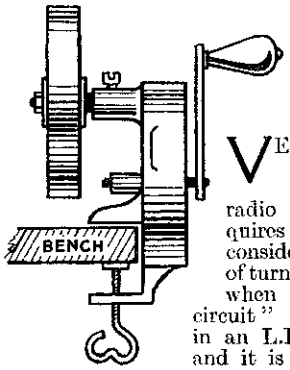


Fig. 1.—The grindstone before conversion to a coil winder.

VERY often in repair work the practical radio enthusiast requires to unwind a considerable number of turns; for instance, when an "open-circuit" has occurred in an L.F. choke, etc., and it is a tedious job unless some form of machine is available. The following description of an inexpensive coil-winder, which I have found extremely handy in my own workshop, may perhaps be useful to other readers of PRACTICAL WIRELESS.

Fig. 3 of the accompanying diagrams shows the finished winder. It consists of a small hand-grinding machine (obtainable for about one shilling); an empty tin about 2in. diameter by 4in. long; a wood screw telephone terminal; a 1in. round nail; a small block of wood approximately 4in. by 1¾in. by 1in., and sundry screws. Fig. 1 illustrates the grinder with the tool-rest removed, but before doing this take the one-inch nail, grind a concentric point at the end and lay aside for future use as the "centre." Then remove the tool-rest, grinding wheel and the two clamping washers, leaving the spindle, which is held in position by the grub-screw A, Fig. 3.

Details of Construction

The next step is to take the tin, which must have a tight-fitting lid, and pierce the bottom exactly in the centre with an old pair of compasses to allow just the point of the sharpened nail to enter. This should be done carefully, as once the tin is pierced it is easily made too large. A half-pound size carbide tin, with a tight-fitting lid answers the purpose admirably.

Next, take the lid, lay it on a piece of wood and drill it to make a sliding fit on the spindle. It will be noticed that the spindle has a shoulder on it (see B, Fig. 3) against which the grinding wheel was clamped, and it is advisable to put on a small sleeve to keep the tin clear of the driving-wheel spindle (see C, Fig. 3). Now put the lid on the spindle, with a washer on either side, tighten up the nut, and force the tin on, taking care not to bend the lid. Screw the telephone terminal on the block of wood, insert the nail through the hole and bring it up to the centre of the bottom of the tin. It is now a simple matter to adjust the height of the "centre" to level up the tin. Put a drop of oil on the "centre" point and the machine is ready for use, after screwing down the block.

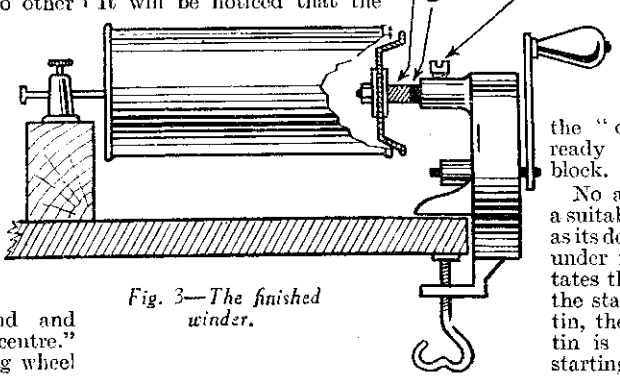


Fig. 3—The finished winder.

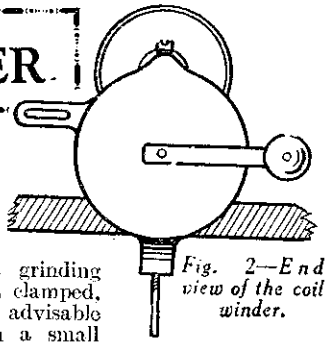


Fig. 2—End view of the coil winder.

No attempt has been made to describe a suitable holder for the coil being unwound, as its design will depend upon the component under repair. A useful hint which facilitates the testing for continuity is to solder the start of the winding to the rim of the tin, then a touch of the test leads on the tin is much easier than looking for the starting end each time.

NOISES: THEIR CAUSE AND CURE (Part 2)

By W. B. RICHARDSON

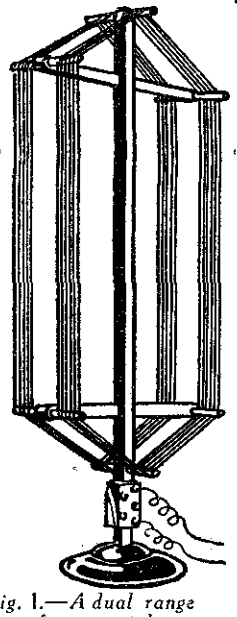


Fig. 1.—A dual range frame aerial

NOISES which occur from causes outside the set are usually far more difficult to eliminate than those which are caused through some defect in the receiver itself, since it is very rarely that they can be tackled at their source. That the source may be well known to you is not usually of much help for that reason.

The usual noises experienced are crackling and similar noises due to electrical machinery, mains hum, atmospherics, and heterodyne whistles.

Interference Due to Electrical Machinery

The problem of disturbances due to electrical machinery in the neighbourhood of the receiver is one of the hardest to solve. Amongst the more usual sources are trams, trains, electric signs, automatic traffic signals, charging plants, generators, etc. The radiations are apparently caused by sparking at commutators and switches, etc. These act in much the same way as a spark station, the transmitting aerial being represented by the supply mains which feed the machinery. In the case of trams, the overhead trolley which collects current from the conductor is often a prolific source of crackles and crashes, and even the ordinary tumbler switches of the house lighting system cause a click in the loud-speaker every time they are operated.

In some of the worst cases a complete cure is often impossible unless the cause is removed. The B.B.C. are, of course, doing much good work in this connection, but you can often supplement their efforts by yourself approaching owners of noisy plant, such as electric charging systems, sausage machines, etc. Often the fitting of such an inexpensive addition as a good earth connection or a pair of 4 mfd. condensers across the brushes, with the centre point earthed, will make all the difference.

Frame Aerial as a Cure

As regards the receiver itself, there are various dodges which may be tried, but probably the most successful of all is the centre-tapped frame aerial. An ordinary frame will generally effect some improvement, but not to the extent that a properly balanced frame will. The merit of the frame is not due to the fact that it is less efficient than an outdoor aerial, and that therefore it picks up less of the disturbance. If that were so, there would be no advantage

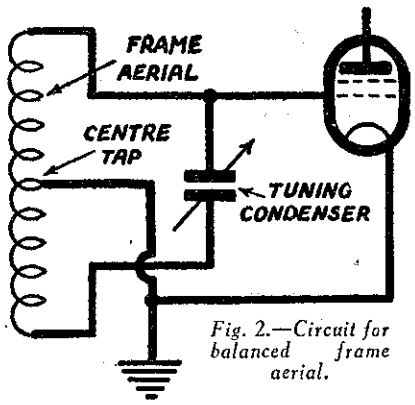


Fig. 2.—Circuit for balanced frame aerial.

since signals would also be reduced in proportion, and any attempt to increase the signal strength would increase the disturbance again. Actually, however, the frame appears to be much more sensitive, at any rate, to the distant broadcast than to the local disturbance.

The circuit for the balanced frame is shown in Fig. 2. It is similar to that of an ordinary frame, except that the centre point of the winding is earthed. One end of the frame goes to the grid of the first valve in the usual way. The centre tap goes to earth, while the other end is joined to one side of the tuning condenser only. Points to remember in the fitting up of such a frame are: that each half of the frame should be as nearly identical as possible, electrically as well as mechanically. Both the outside leads should be the same length and equi-distant from the centre or earthed lead. Naturally, you will need a sensitive receiver with a frame aerial if you wish to get foreign stations with any degree of volume. A super-het. is ideal, but a straight four-valver, with a screen-grid stage, will usually meet all average needs. The placing of the receiver in a metal box or in some way screening it, will be an advantage when used in conjunction with the frame, although it is unlikely to be of much help with an ordinary aerial.

Try a Counterpoise

The use of band-pass tuning and variable-mu valves is sometimes very helpful in reducing electrical disturbances, as both tend to give a silent background. Another scheme is the use of a counterpoise earth. This has somewhat the same action as the frame aerial, although it is not so effective. In its simplest form it consists of an insulated wire similar to the aerial and placed directly underneath it. Naturally this is not always a practical arrangement, but for those who wish to try it, it is illustrated in Fig. 3. The earth terminal of the set is joined to the counterpoise instead of to earth.

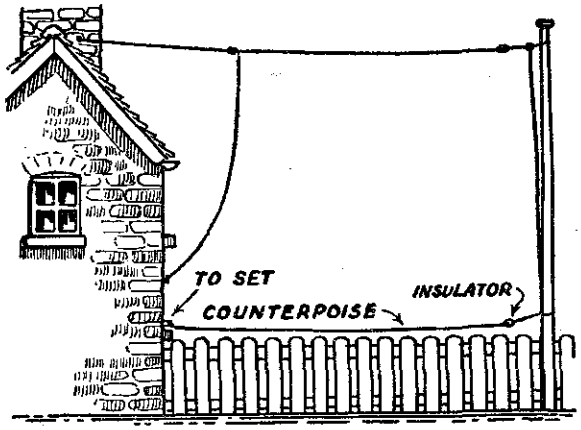


Fig. 3.—A counterpoise earth.

H.F. Interference *via* the Mains

It sometimes happens that most of the noise arrives *via* the mains, and not down the aerial. This can be tested by disconnecting the aerial. If the noise continues then, you can be fairly certain that the mains are picking up most of the unwanted impulses. Try a good H.F. choke in each lead with a fixed condenser across them, as in Fig. 4. An .01 mfd. condenser (or larger in the case of D.C. mains) will be suitable.

Mains Hum

This most troublesome form of noise can usually be dealt with quite successfully in the set itself. I might for that reason have included it under the heading of noises due to defects in the receiver, but although careful design of the receiver will eliminate it, it cannot, strictly speaking, be said to emanate from the set. In the ordinary way the average set does not give

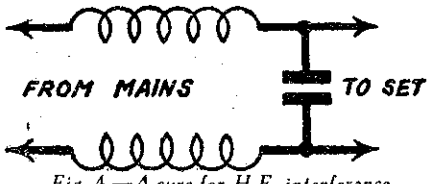


Fig. 4.—A cure for H.F. interference via the mains.

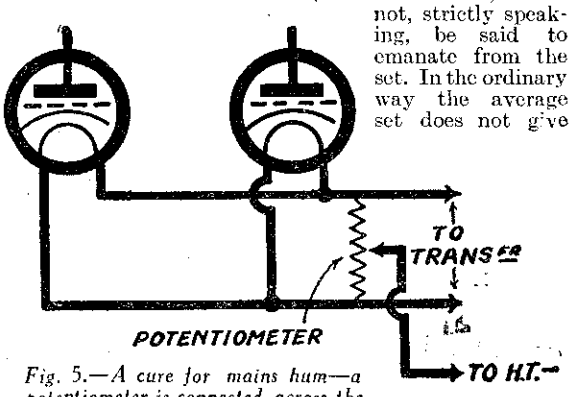


Fig. 5.—A cure for mains hum—a potentiometer is connected across the heater supply wiring.

trouble. It is when the mains are exceptionally noisy that they show up little defects in the wiring of heaters, transformers, etc., and a hum is produced in the speaker. Sometimes, for instance, the set will be perfectly silent during most of the day, but at certain times, usually in the evening when the generators are working at full load, it suddenly becomes noisy.

A device that is worth trying is the fitting of a 30 or 40 ohm potentiometer across the heater supply wiring. Of course, the usual practice is to connect the centre tapping of the heater wiring of the mains transformer to H.T. negative. The use of a potentiometer, however, allows the dead-true electrical centre to be obtained. You see the *mechanical* centre of the transformer is not always the same as the *electrical* centre! By moving the knob of the potentiometer one way or the other the hum can be exactly balanced out. In making the change, disconnect the wire going to the centre tap of the heater winding of the transformer and join it, instead, to the slider of the potentiometer as in Fig. 5. The tapping on the transformer is left free. A point to remember is to place the potentiometer as near the valves as possible and not actually across the transformer terminals.

Smoothing the H.T. Supply

A potentiometer may also be included with advantage across the filament of the usual full-wave rectifier valve, the H.T. positive lead being taken from the slider instead of from the centre tap of the transformer. This will balance out any hum that would otherwise enter the filter circuit. The connections are shown in Fig. 6. There are several potentiometers on the market suitable as hum eliminators. The type shown in Fig. 7 is specially made for the purpose. It is the Clarostat "Humdinger."

The shielding of all heater wiring in earthed sleeving and the use of earthed lead-covered wire from the mains to the set are other well-known dodges for eliminating hum. Take care also that your aerial, earth and speaker wires do not run close to or parallel with the supply mains.

Tunable Hum

A hum may sometimes be experienced when tuned into a strong transmission like the local station. This must not be confused with the microphonic noise due to vibrating condenser vanes described in my first article. Tunable hum is usually accentuated, if not caused, by a poor earth connection. Failing a cure when this has been attended to, try the following: connect a .01 mfd. condenser (1,000 volts D.C. list) between one mains terminal of the transformer in your power unit and the earth terminal of your set.

Atmospherics

These do not trouble us much in this country except during the few periods of thundery weather we experience each summer. In fact, what is often put down to atmospherics is nothing more than crackles caused by a worn-out H.T. battery or some faulty or dirty connection in the set. If you have any doubts as to the cause, disconnect the aerial temporarily. If the crackles cease they are due to atmospherics. A cure is practically out of the question at the present time, but those means I have described for the elimination of electrical disturbances may be found helpful in reducing their effects. One thing to remember is that volume control should never be effected by detuning, since by this method the atmospherics, being untunable, remain at full strength, while the signal is reduced. The best way is to tune in the required station accurately and then reduce it to a workable volume with the reaction or the volume control. This will at the same time reduce the atmospherics. It is perhaps not quite correct to say atmospherics are untuned, as they will often be found to be less troublesome on the medium waves than on the long. In this case, if you have a choice of using either band for your local programme, as for instance when Daventry National and London National are giving the same programme, you will naturally tune in to the one which has the least interference.

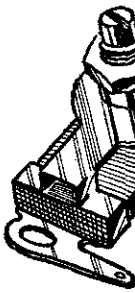


Fig. 7—Suitable potentiometer for eliminating hum.

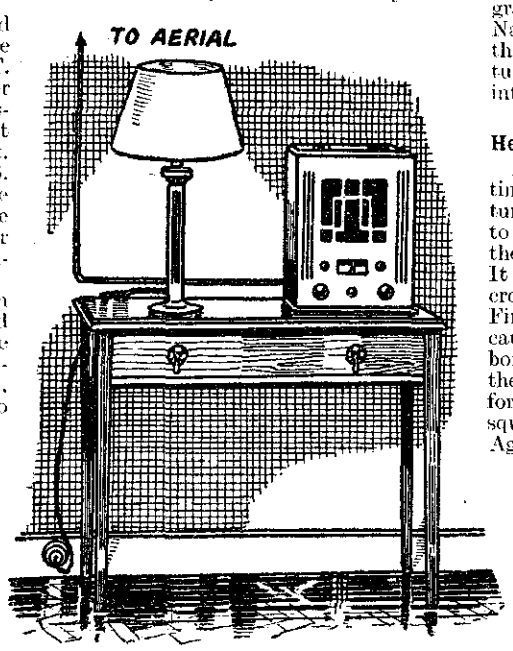


Fig. 8—One cause of hum is the aerial, earth or speaker leads, running parallel to the supply mains.

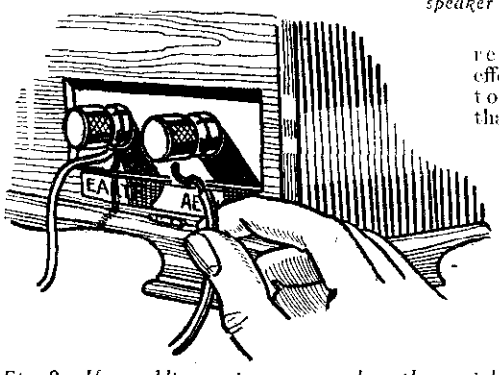


Fig. 9—If crackling noises cease when the aerial is disconnected this is certain proof that they are caused by atmospherics.

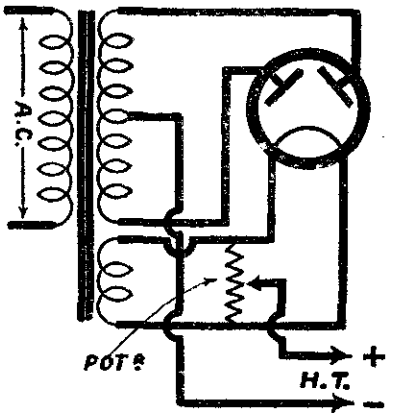


Fig. 6—Another cure for mains hum.

Heterodyne Whistles

A very shrill whistling sound is sometimes heard above the legitimate signal when tuned to a particular station. This is due to jamming by another station working on the same, or nearly the same, wavelength. It is not uncommon in these days of overcrowding on the broadcast wavebands. First of all make quite certain that it is not caused by your own receiver being on the border of oscillation and itself heterodyning the incoming carrier. It is quite possible for this to happen if you are trying to squeeze the last ounce out of your reaction. Again, the trouble may be due to a neighbour's receiver oscillating. Your redress here lies with the Post Office. Assuming, however, that the trouble is due to jamming, and if the station affected is one of your favourites, you may care to fit up a high-note filter. This is shown in Fig. 10, and consists of a .01 mfd. condenser and a 50,000-ohm variable resistance fitted across the speaker terminals. By varying the resistance the degree of cut-off is controlled.

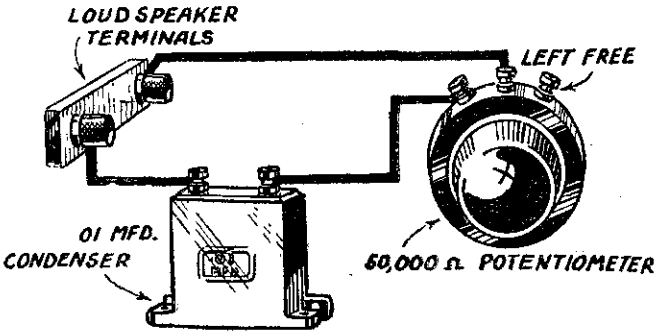


Fig. 10—A high-note filter—a cure for whistle, caused by heterodyning.

MAKING A MAINS TRANSFORMER

This Article Explains How to Make Mains Transformers and Smoothing Chokes at Home

By FRANK PRESTON, F.R.A.

ALL-MAINS receivers and mains eliminators are rapidly increasing in favour and their construction has been simplified to such an extent that amateur set-builders can make them with every confidence. But most amateurs are in the habit of buying all the necessary components ready-made and merely assembling them. This is perhaps the wisest plan in regard to many components, but there are some which could be made at home at a fraction of the cost of the ready-made articles. And, what is more, the work of making them would prove of great interest to all amateur mechanics and electrical enthusiasts. Among these latter, mains transformers and smoothing chokes first come to mind. These are probably the most expensive items whilst being the easiest and safest to construct.

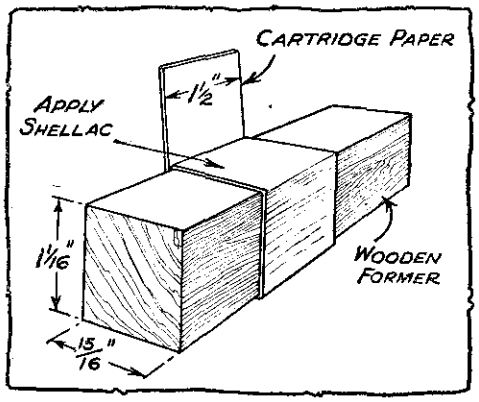


Fig. 1A.—Details of the former

No doubt they would be made at home far more extensively if constructional information were available regarding them. Peculiarly enough, very few technical writers have devoted their attention to this interesting subject and therefore the writer does not consider any apology necessary in presenting the practical data to be given in this article. Although one specific transformer will be described, it is hoped that the information supplied will be sufficient to enable any reader to modify the component, if necessary, to meet his own requirements.

The instrument to be described is suitable for operation from any A.C. mains having a voltage of from 200 to 240 volts and a frequency of 40 to 100 cycles. It supplies both H.T. and L.T., the high tension being at 135 volts 100 milliamps and the low tension 4 volts 4 amps. The higher voltage is correct for feeding a Westinghouse H.T.7 metal rectifier on the "voltage doubler" principle, and the output from the rectifier is approximately 220 volts at 28 milliamps. After smoothing the current, by passing it through the usual choke, the voltage is reduced to just about 200, which is the maximum required by nearly all indirectly-heated valves. The 4-volt winding will heat the cathodes of from one to four A.C. valves. Both core and windings are designed on very generous lines, so that the transformer will safely stand an overload up to 25 per cent. without damage.

Materials Required

The list below assumes that every item is home-made, but mention will later be made of alternative ones that can be bought complete if desired :—

6 doz. pairs No. 4A Stalloy stampings.
1 length ½in. by ½in. mild steel.
4 3 16in. bolts, 1¼in. long, with nuts.
2 strips Paxolin, or Ebonite, 3 9/16in. by ⅝in. by ⅛in.
9 6 B.A. Terminals with soldering tags.
2 pieces ⅛in. Fibre, 2¾in. by 2⅝in.
2 pieces 1/16in. Fibre, 2¾in. by 2⅝in.
1 sheet Cartridge Drawing Paper about 30in. by 1½in.
6½ ounces 36 s.w.g. Enamelled Wire.
2½ ounces 18 s.w.g. d.c.c. Wire.

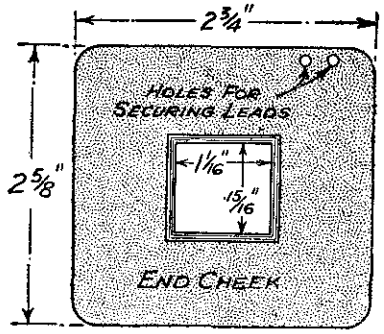


Fig. 1B.—Dimensions of the end cheeks.

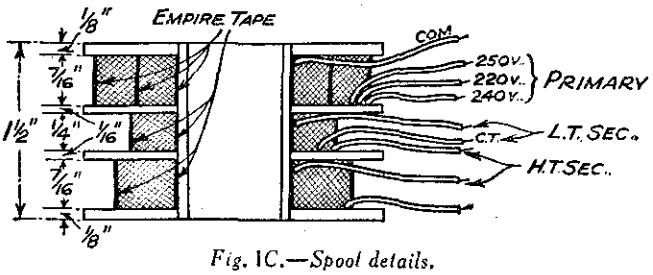


Fig. 1C.—Spool details.

The Winding Spool

This is the first and most important part, and is made as illustrated in Fig. 1A. A wooden former having the same cross section as the core (1 1/16in. by 15/16 in.) is required and a 1½in. wide strip of cartridge paper is tightly wound round it. Thick shellac varnish is applied liberally to the paper as it is being put on, to stick it and to stiffen the tube. When the tube has been built up to a thickness of about 1/16in. it should be removed from the former and thoroughly dried—preferably by baking in a warm oven.

Next make four end cheeks to the dimensions shown; two are ⅛in. thick and two 1/16in. The cheeks are made of fibre, although cardboard, if treated with shellac and then baked well, would act almost equally well. The square holes in the centre should be cut (with a sharp knife or chisel) to make the cheeks fit tightly on the square tube. First put a thick cheek on one end, wrap round a few layers of empire tape, 7/16in. wide, and then put on one of the thinner cheeks. Again, wrap a few layers of empire tape (this time ¼in. wide) round the tube before putting on the third cheek. Finally, apply more 7/16in. tape before putting on the last cheek. The tape is used, of course, to space the cheeks evenly, and it helps to strengthen the spool. If the spool does not appear to be quite rigid by this time it should be given two coats of shellac and allowed to dry thoroughly.

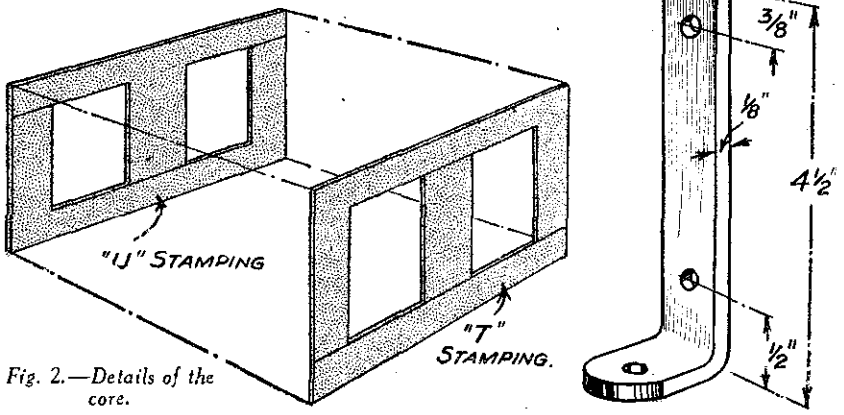


Fig. 2.—Details of the core.

Putting on the Wire

When the spool is ready the windings can be put on. This may be done by replacing the spool on the wooden former and gripping the latter in a lathe or holding it in the hand. The number of turns required for any winding depends upon the voltage, frequency, core cross section and material used for the core. Without entering into the necessary calculations it will be sufficient to state that in the present instance, with a core of approximately one square inch and a mains frequency between 40 and 100 cycles, a suitable number of turns-per-volt is 8.

Thus the H.T. secondary requires 8 by 135, or 1,080 turns; the L.T. secondary 8 by 4, or 32 turns (with a centre tapping); the primary, a total of 8 by 240, or 1,920 turns, with tappings after 1,640 and 1,760 turns. The H.T. secondary should be capable of carrying up to about 100 milliamps and therefore 38 s.w.g. wire would do. As, however, there is sufficient space for 36 gauge enamelled wire which is much easier to handle, the thicker wire is specified. The L.T. secondary must carry over 4 amps. to ensure an ample margin of safety, and we therefore use 18 s.w.g. double cotton covered wire which has a safe current capacity of 7 amps. The primary has to deal with the total of the power in both secondary windings plus a certain loss in the core, etc., which amounts to about 30 watts. This is equivalent to a current in the region of .15 amp. and we therefore employ 36 gauge wire which has a safe current rating of .18 amp.

Before commencing any winding, solder a 12in. length of rubber-covered flex to the finer wire to act as a terminal lead. It is advisable to use resin as a flux so as to obviate subsequent corrosion of the joint. Take the flex once round the spool and continue to wind on the finer wire. If a lathe is used it must be run at a slow speed or else there will be a danger of breaking the wire. Keep a fair and even tension on the wire and run it on as evenly as possible. A layer of insulation (empire tape, oiled silk or thin waxed paper) is used half-way through the primary winding to prevent any turns at widely different potentials coming in contact. No insulation is necessary in the other windings which provide a lower voltage. After putting on the insulation be careful that no later turns are allowed to slip past it or it will have no effect.

Tappings are made by baring the wire for a short distance, twisting the end of a piece of flex round the bared portion and applying a spot of solder. Here, again, it is well to wind the flex once round the spool before bringing out the lead, so as to reduce the tension on the fine wire. It is also a good thing to cover the soldered joint with a small piece of gummed paper to prevent any sharp ends scratching against other wires and so causing a short circuit of some of the turns. At the end of each winding solder another length of flex as at the beginning, and cover the winding with a few layers of empire tape. The flex can most easily be secured by passing it through two holes made in an adjacent cheek, as shown in Fig. 1B.

Assembling the Core Stampings

The core stampings, which are supplied in pairs, consisting of a "T" and a "U" piece, should next be fitted into the spool. The method of fitting these is shown in Fig. 2, where it will be seen that they are inserted from alternate sides. A "T" piece and then a "U" piece are put in from one side, a "T" and "U" from the opposite side, and so on until the spool is quite full; the stampings should be packed as tightly as possible without applying undue force. It will be noticed that one side of each stamping is white, being covered with insulating material; the insulated sides of all stampings must face in the same direction, so that every stamping is insulated from the next.

Final Operations

Theoretically, the transformer is now complete, but for practical reasons the core stampings should be tightly clamped together to prevent vibration and suitable terminal strips should be fitted. A pair of core clamps can be made from two strips of mild steel hoop as shown in Fig. 2, or alternatively they may be bought ready-made in the form of strong castings from the firms mentioned below. The drawing will need no explanation, whilst the method of fitting the clamps is clearly shown in Fig. 3. This latter drawing also shows the paxolin (or ebonite) terminal strips. These are fitted under the heads of the clamp bolts, and the leads from the spool are brought up to, and soldered to, the terminals.

Connections

Figure 3 shows the finished transformer and gives diagrammatic details of the connections to a Westinghouse style H.T.7 metal rectifier. As mentioned previously, the rectifier is connected on the "voltage doubler" principle, two 4 mfd. condensers (of no less than "250 volts working" specification) being employed for voltage doubling. The 220 volt D.C. output will, of course, require to be smoothed in the usual manner before it is applied to the receiver.

A Smoothing Choke

A really good smoothing choke, having an inductance of about 30 henries at 30 milliamps, can be made in a similar manner to the transformer by using six dozen No. 30A Stalloy stampings, with a spool ¾in. long, and having two end cheeks of the same size as those shown in Fig. 1B. No intermediate cheeks are required, and the single winding should consist of four ounces of 38's gauge enamelled wire.

Obtaining the Materials

There are now two or three firms who specialise in the supply of transformer components, and among these might be mentioned Messrs. W. Brian Savage, 292, Bishopsgate, London, E.C.2; Messrs. Sound Sales, Tremlett Grove, Highgate, N.19; Messrs. Lumen Electric Co., 19, Scarisbrick Avenue, Litherland, Seaforth, Lancs. These firms will supply everything required, including cast core clamps, fibre end cheeks and ready-cut terminal strips. The prices in all cases are distinctly moderate, and it is possible in many cases to purchase complete sets of parts of chokes and transformers, which include all the necessary fittings, such as bolts, wire, etc., enabling the complete component to be home-made. Apart from the interest of this home-manufacture, one also obtains valuable information on the design of mains apparatus.

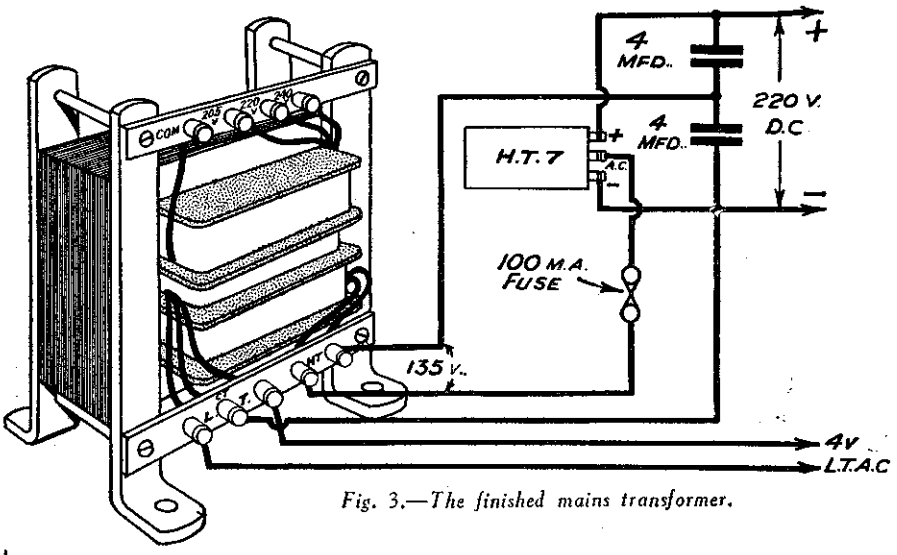


Fig. 3.—The finished mains transformer.

The Trans-Atlantic Telephone

THE recent excitement in the daily press regarding the "eavesdropping" on the trans-Atlantic phone service has been of interest to me and has afforded not a little amusement. I have not tried to receive Rugby or its American counterpart recently, but I remember that soon after the service was inaugurated I often listened to the transmissions from both sides of the Atlantic. So far as I can recollect, the transmissions were on about 4,000 metres and could be brought in at good strength on a three-valve set. There was certainly no secrecy about the transmissions beyond the fact that they were on a longer wavelength than most receivers could be tuned to. I know that some alterations have been made, but I fail to see how the transmissions could be made absolutely private, and it seems to me that people using them should be made to realize this fact, especially when transmitting information of National importance. When conditions are favourable I believe the transmissions consist of a modulated carrier of which some of the sidebands are "chopped off" at the transmitter and added again at the receiving end. Thus, if the transmission were tuned in on an ordinary set speech would be quite unintelligible. But there should be little difficulty in devising a corrector circuit if any one were so anxious to overhear the transmissions. According to a Post Office statement, however, it is sometimes necessary to revert to a more or less normal method of transmission when reception conditions are poor. In that case, it is assumed that communications could be heard with any long-wave receiver.

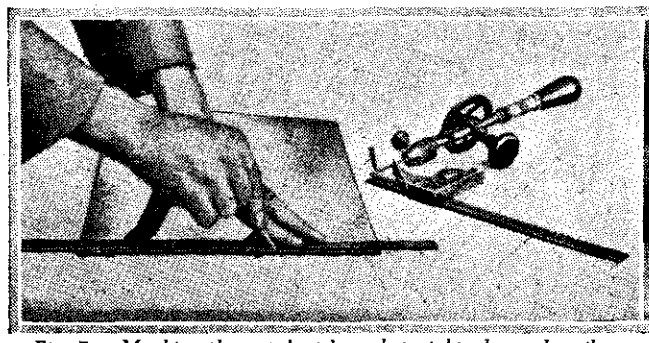


Fig. 7.—Marking the metal with steel straight edge and scriber.

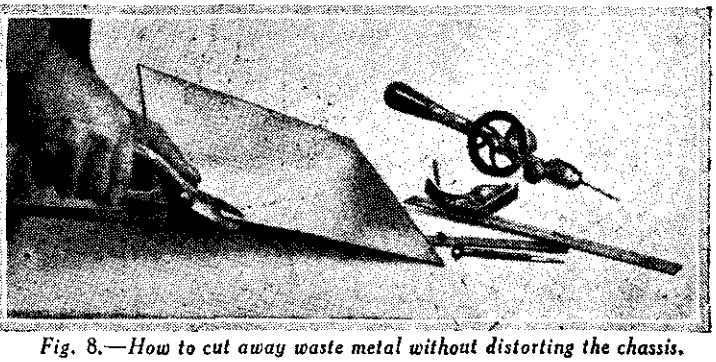


Fig. 8.—How to cut away waste metal without distorting the chassis.

SIMPLE CHASSIS CONSTRUCTION

How to Make Up the All-metal Type of Chassis, Simply Explained by W. H. DELLER

IN its simplest form a chassis is that which is built of wood and covered with metal foil, and is seen in Fig. 1, and while these are all very well in their way, an all-metal chassis makes a wireless set into a real engineering job.

An all-metal chassis can be built up in a variety of ways, and aluminium has the advantage of being easily workable. Fig. 2 shows one method of constructing a chassis. It will be noticed in this arrangement that no sheet metal bending is required. The metal panel is attached to the platform with a convenient length of angle aluminium, and the same material is used for the returned portion or terminal panel. Thus the chassis comprises three flat pieces of sheet aluminium and a couple of lengths of angle. This material, by the way, is obtainable in various gauges and with equal and unequal width of sides. For the present purpose, however, ½in. to ¾in. width by 16 to 18 s.w.g. thickness is most suitable. The sheet aluminium and angles are joined together by drilling holes through both pieces and fixing with small brass screws and nuts. In another adaptation of this arrangement an ebonite terminal strip may easily be incorporated as shown in Fig. 3. One further advantage to be obtained from the adoption of this or a similar form of construction is that, after marking out the positions of holes required to accommodate fixing bolts for the components or for the passage of wires, the chassis members may be taken apart, thus leaving the essential portions in the flat, thereby greatly facilitating drilling, and more especially will this convenience be appreciated where an irregular-shaped hole or two has to be pierced with a fret-saw.

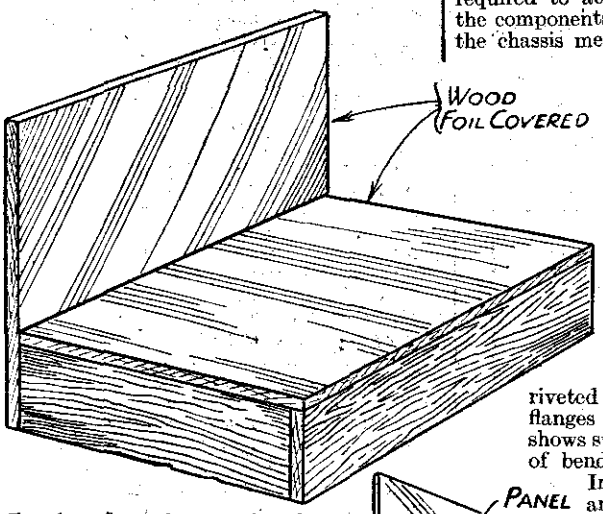


Fig. 1.—A simple way of making a "metal" chassis. A wooden framework covered with metal foil.

Various Formations

The more usual form of chassis now employed is made by bending sheet metal into a fairly wide channel section formation, the panel being either riveted or bolted on to one of the flanges or narrow edges. Fig. 4 shows such a chassis. Another form of bending is illustrated in Fig. 5. In this the panel platform and terminal panel are in one piece, and the remaining portion of the front panel below the platform is completed by the addition of an angle piece running the whole length. The fitting of side pieces in wood or metal as in Fig. 6 would make this unnecessary.

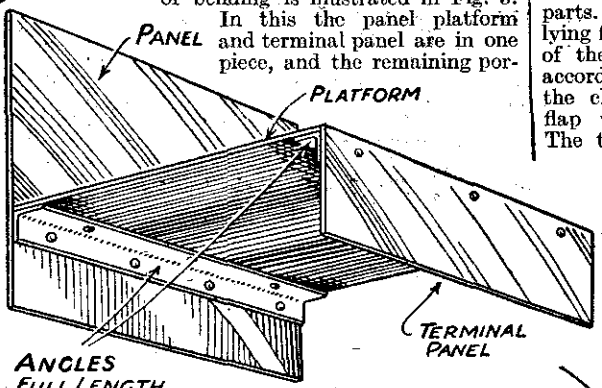


Fig 2.—A metal chassis using angle-irons instead of bending the aluminium.

Now unfortunately these long right-angled or modified forms of bends are not easy to make with the means at the disposal of home constructors generally, and while beating the metal over an object with a square edge with a hammer or mallet might produce a very nice antique effect, the resulting chassis would not please the discriminating wireless enthusiast.

Method of Bending

The only reliable way of making bends of this description is to employ some mechanical means, and the following is a short description of a simple appliance for this purpose. Reference to the photograph, Fig. 9, in which the bender is seen in operation, shows it to be a contrivance which anyone with a very elementary knowledge of woodwork could quickly make. The essential parts are a baseboard with clamping bar fitted to it with a bolt and wing nut at each end. The bending flap is hinged to the baseboard, and is provided with a short handle for extra leverage. Just a word of warning: do not use timber that is too light for the job, it should be 1in. to 1¼in. thick, the latter for preference; use a good pair of steel hinges, either back flap or butt pattern will do, secured with good stout screws. Arrange the position of the hinges so that the unsupported part of the bending flap is divided into three equal parts. The bending face of this flap, when lying flat, should coincide with the top face of the baseboard, so arrange the hinges accordingly. See that the front edge of the clamping bar lays parallel with the flap when it is in a vertical position. The two clamping screws are ¾in. Whit. countersunk-headed ones; tight-fitting holes, afterwards countersunk on the underside, are drilled in the baseboard to receive them, and the matching holes in the bar are drilled to give a slight clearance. Provide two large diameter washers for the wing nuts to butt against.

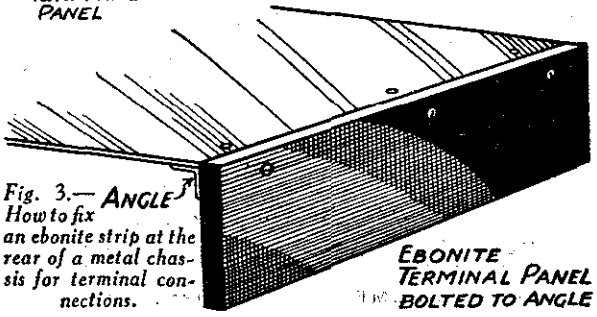


Fig. 3.—How to fix an ebonite strip at the rear of a metal chassis for terminal connections.

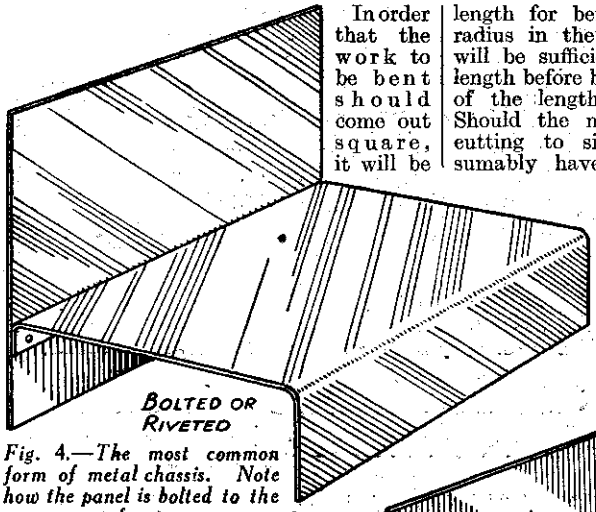


Fig. 4.—The most common form of metal chassis. Note how the panel is bolted to the front.

In order that the work to be bent should come out square, it will be necessary to pull the flap through an angle of a little more than 90 degrees, so make an allowance for this by planing the front edge of the clamping bar one or two degrees out of square, at the same time making sure that there will be room for a thickness of metal of the gauge to be used between the bending faces. A small radius should be worked along the bottom front-edge of the clamping bar; this will leave a similar radius in the corner of the work being bent.

Marking Out and Cutting

Having decided on the sizes of the chassis to be made, the making-up should be proceeded with as follows. If possible, buy the aluminium already cut to required sizes with the edges, of course, clean cut and square with one another. Make allowances in the length for bends, but provided that the radius in the corners is not too small, it will be sufficiently accurate to make the length before bending the total of the lengths of the sides. Should the material require cutting to size, it will presumably have at least one clean-cut edge; if so, this is the one to work from. Make a mark at each end on the opposite side of the metal, and with a steel rule placed against these marks, strike a well-defined line with a sharp-pointed scriber as shown in the photograph. The remaining edges are scribed off square with the ready-finished edge. To make a good job of the chassis the metal must be kept free from buckles, so great care must be taken to maintain the flat surface during cutting operations. So for this reason work outside the wanted portion, bending the scrap part as it is cut to provide an easy path for the snips. Any roughness or irregularity caused by a slight deviation from the line in any place is easily removable by draw-filing with a fine file. The bending may now be commenced. Make a pencil line where each bend is required, keeping these lines, of course, parallel with the respective edges. Undo the wing nuts and slide the metal under the clamping bar until bending line coincides absolutely with the front edge of the bar, afterwards tightening the nuts well down. Raise the lever until it is in a vertical position, when bend may be examined for squareness. Owing to the slight spring-back on the metal a little extra bending may be necessary. Having attained the desired result, the remaining bend or bends may be completed in like manner.

The remaining work consists of drilling and needs no comment, but the photograph shows a method of cutting large circular holes such as are required in screens. A small hole is drilled in the centre of the required hole and the metal is cut through from either side with a pair of dividers. These dividers must be of the type provided with a quadrant and positive locking device, the end of one leg being sharpened to a keen point. Hold the aluminium on a hard surface to prevent the leg in the centre hole from pushing through and enlarging it.

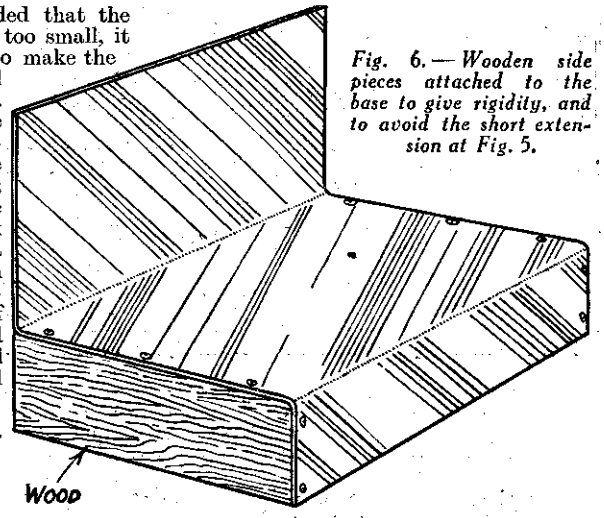


Fig. 6.—Wooden side pieces attached to the base to give rigidity, and to avoid the short extension at Fig. 5.

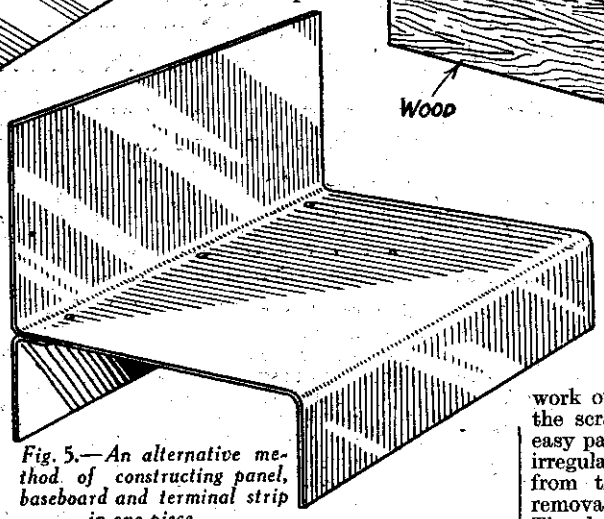


Fig. 5.—An alternative method of constructing panel, baseboard and terminal strip in one piece.

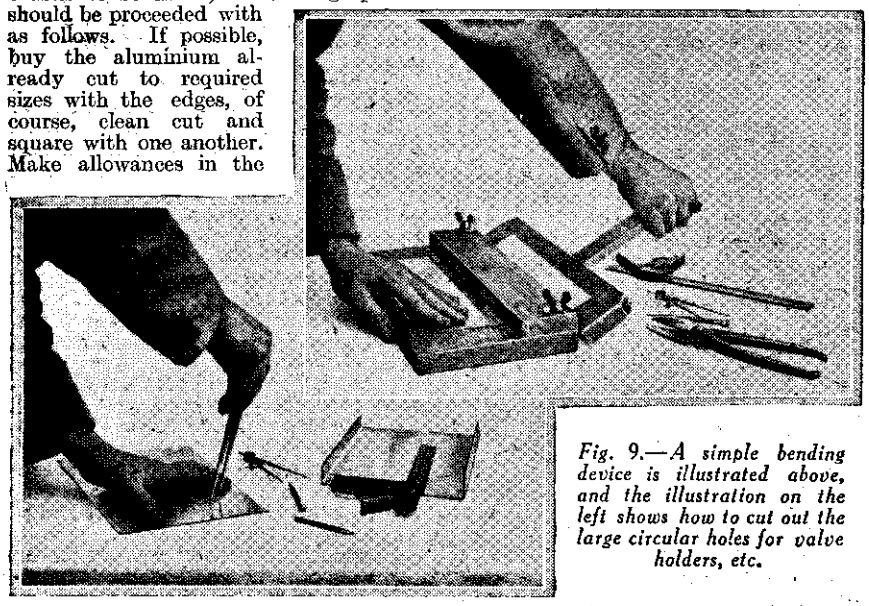


Fig. 9.—A simple bending device is illustrated above, and the illustration on the left shows how to cut out the large circular holes for valve holders, etc.

French Announcers

IN many Paris broadcasting studios announcers are not paid a fixed salary but are remunerated on the piece-work system, namely, according to the hours of duty undertaken by them in the course of a week.

Dutch Mystery Station

A MYSTERY pirate station calling itself "T.730" and broadcasting on 230 metres when the Dutch transmitters have closed down, is arousing considerable interest in Gouda (Holland). Its location has completely baffled the local police authorities. The owner in his announcements usually sends greetings to these officials and much to the delight of the listening public, dedicates various items of his repertoire to the police officials who are endeavouring to discover his whereabouts.

ROUND THE WORLD OF WIRELESS

(Continued from page 218)

Russian Interval Signal

MOST of the Russian studios, including Moscow and Leningrad, as an interval signal, have adopted the striking of a hammer on an anvil. This sound may be heard nightly through Moscow (Trades Unions) on 1,304 metres or through the short-wave station on 50 metres.

THE HEART OF YOUR SET

Part 3.—OUTPUT VALVES

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

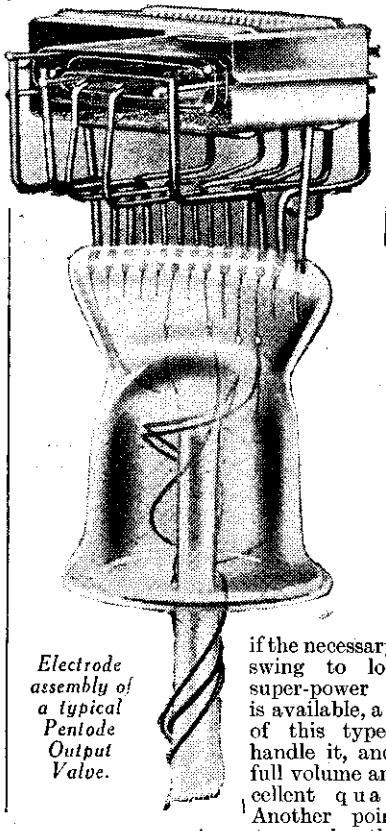
THE earlier stages of a receiver are only required to provide voltage amplification, but to the power or output stage is given the task of providing a substantial amount of energy to operate the loud-speaker. Something over 100 milliwatts of audio-frequency power is required for reasonable volume and quality with the smallest type of speaker, while anything up to 2,000 milliwatts is necessary to operate the larger types of domestic speaker. The output valve, therefore, must be capable of delivering ample power for the speaker to be used. Provided the impedance of the speaker is of suitable value for the valve which will drive it, the output of a power valve depends upon three factors—the signal voltage input to the grid, the impedance of the valve and the amplification factor.

Unfortunately, in the case of three-electrode output valves, these factors are strangely conflicting. For instance, it is not easy to design a triode which will have the high amplification factor required for high sensitivity, and also the low impedance required for big output. This at once limits the output obtainable if only small signal voltages are provided by the earlier stages of a receiver. For big outputs with a three-electrode valve, therefore, a low impedance valve having a comparatively low amplification factor must be employed, and the set must have sufficient earlier amplifying stages to provide a big grid input to the output valve.

Power Valves

A natural process of competition and selection has resulted in the survival of two main classes of three-electrode output valve. The so-called "power" valve has a fairly high amplification factor, of the order of 12, and a medium low impedance of from 3,000 to 4,000 ohms. It will handle without distortion signals up to about 6 or 7 volts amplitude, and is thus suitable for providing moderate output and good quality reproduction in such sets as portables or 2-valve domestic receivers where it is necessary to make the most of comparatively weak inputs. Where previous amplifying stages are employed, the signals will be sufficient to load a "super-power" valve. Valves of this class have very low impedance, of the order of 2,000 ohms or even less, but as already pointed out, this is only achieved by a reduction of the amplification factor, so that greater amplification must be supplied in earlier stages. On the other hand, the super-power valve has a longer "grid base" than the power valve, and thus can handle the stronger signals without distortion.

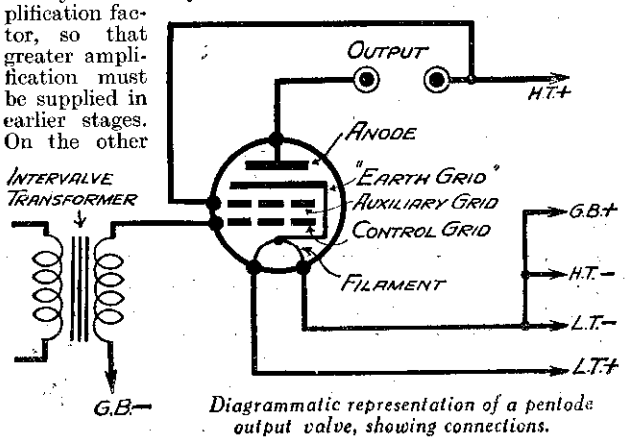
It must be clearly understood that the mere substitution of a power valve by a super-power valve will not produce greater volume—on the contrary, the lower amplification factor of the super-power valve results in a diminution of volume. But if the necessary grid swing to load a super-power valve is available, a valve of this type will handle it, and give full volume and excellent quality.



Electrode assembly of a typical Pentode Output Valve.

Another point of importance is that a super-power valve naturally makes bigger demands upon the high tension battery than a small power valve, and it is hopeless to expect good quality reproduction and reasonable life of the high tension battery when using a super-power valve unless a large capacity battery is fitted.

Were three-electrode valves the only type available for use in the output stage, the owner of a small set would be limited to the moderate volume obtainable from a small power valve. But the development of yet another class of valve, the "pentode," makes possible a combination of high amplification and big output in one valve.



Diagrammatic representation of a pentode output valve, showing connections.

The Pentode

The pentode is so called because it has five electrodes—filament and anode, control grid, and two further grids. The second grid, termed the auxiliary grid, is connected to the high tension supply—usually to the maximum voltage tapping. The third grid, located between the auxiliary grid and anode is connected inside the valve to the filament. The operation of a pentode is somewhat complex, but the effect of the auxiliary grid is to give the valve a very high amplification factor, while the third or "earth" grid avoids the secondary emission of electrons from the anode to the auxiliary grid which would otherwise occur and upset the proportionate amplification produced by the control exercised through the normal control grid.

The average battery-operated pentode requires a grid excitation of the same order as a "power" type triode; while its power output is comparable with that of a super-power valve. There are, in addition, two further classes of pentode. One is an "economy" pentode, requiring a grid swing of only from about 3 to 4½ volts peak value and operating at a very low anode current, and the other comprises pentodes with grid acceptances comparable with those of super-power types, but giving still greater output. Pentodes, therefore, may be considered as a special class of output valve, having a higher sensitivity or higher electrical efficiency than triodes.

(Continued on page 260.)

LITTLE MISTAKE

An Interesting Article Pointing C Construction and How to Av

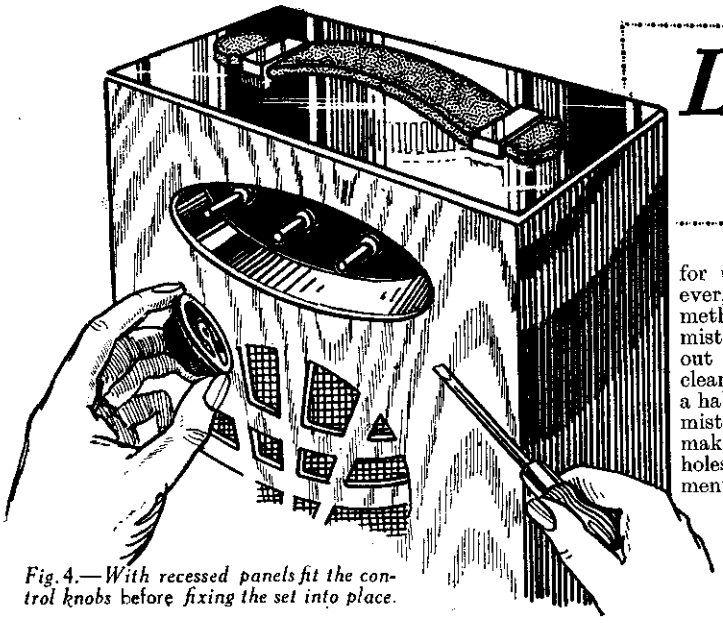


Fig. 4.—With recessed panels fit the control knobs before fixing the set into place.

"HE who never makes mistakes never makes anything." So it has been said, and, of course, in this constructional age it follows that we all make mistakes. Radio folk, whether they be manufacturers, constructors or designers, are no exception to the rule. I would be the last person to claim immunity from an occasional stumble into one of the many pitfalls open to the unwary. In fact, it is just this reason which prompts me to give here some of the errors and "snags" which I have come across from time to time in my own and other people's work, with the idea that a knowledge of them may possibly save *you* from much "gnashing of teeth and vexation of spirit." After all, to be forewarned is to be fore-armed!

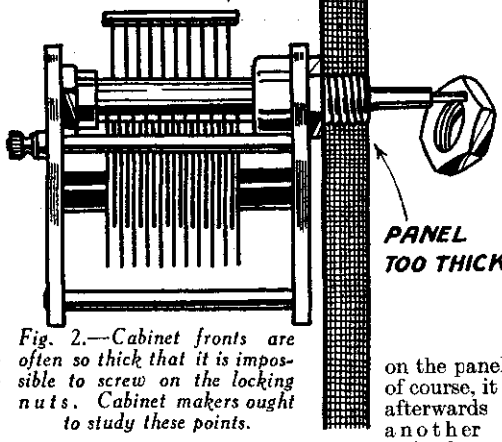


Fig. 2.—Cabinet fronts are often so thick that it is impossible to screw on the locking nuts. Cabinet makers ought to study these points.

Drilling Panels

I shall deal chiefly with errors in the practical work first of building, then of testing a receiver. One of the first little mistakes the amateur constructor must beware is in drilling ebonite or wood panels. Do not drill straight through from one side to the other. If you do the drill will burst through just at the finish and leave a nasty ragged edge to the hole. The proper way is to drill until just the point of the bit comes through and then to reverse the panel and start drilling from the other side. This will give a clean edge to the hole on both sides. Fig. 1 shows the process in detail. Even an aluminium screen may be drilled for the screen-grid valve quite successfully with a sharp centre bit by this method. Make a small hole to start the bit and support the screen on a block of wood. Naturally care should be taken as these centre bits are not really intended for use on metal; however, this is a much better method than making the mistake of trying to chisel out the hole and then cleaning up the edges with a half-round file. Another mistake one is liable to make is to drill the panel holes from the measurements on a blue print, quite forgetting that one intends using some component one happens to have on hand in place of one of those specified. If this happens to be of a different shape or size, it may mean it will foul some other part when in operation, unless we alter its position by drilling the hole for the spindle in a slightly different position on the panel. Sometimes, of course, it can be altered afterwards by drilling another hole by the side of the first one and relying on the dial or knob to cover up the error from the front. But it may be that the new hole has to be only a fraction of an inch to one side, in which case the two holes would run into one another and the panel would have to be scrapped.

Fig. 3.—A cure for the trouble illustrated in Fig. 2.

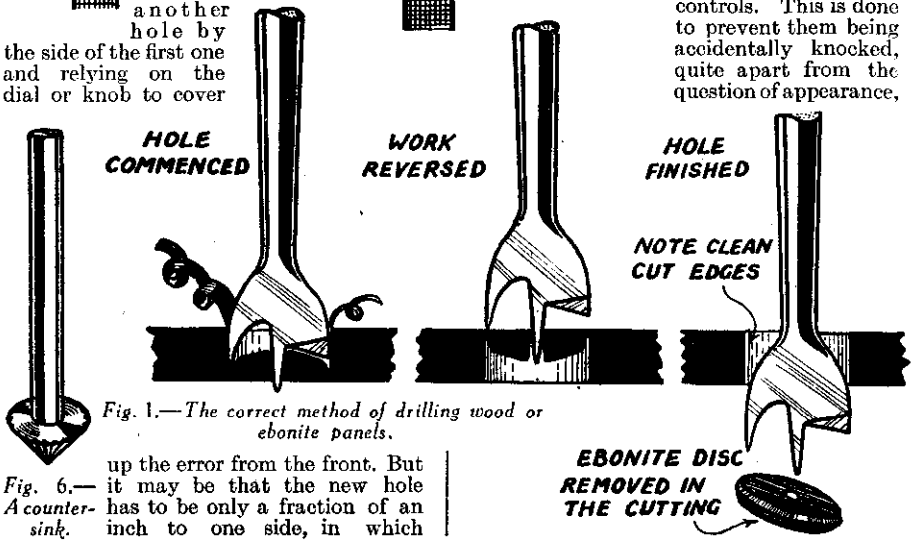


Fig. 1.—The correct method of drilling wood or ebonite panels.

Fig. 6.—A countersink.

Mistakes in Cabinet Design

While on the subject of panel drilling I might mention a mistake which I have come across several times recently in the products of professional cabinet makers. I refer to the thickness of the wooden panels on which the controls are supposed to be mounted. These are often so thick that it is impossible to screw the locking nuts on to the spindles of the various controls (see Figs. 2 and 3). Even if you drill away the wood round the hole so as to countersink the locking nut, then often the dial will not go on, since there is insufficient of the spindle protruding for the set-screw to grip. Clearly these manufacturers have not tried fitting a set into one of their own cabinets! Another point: Why is not the panel made detachable so that it can be used in the construction of the receiver? As it is a separate panel is always necessary in order to build the receiver as a unit. This panel, unless it is of very thin metal, will again add to the total thickness of material through which the spindles have to pass.

Recessed Panels

Here is a little point to remember if you are building a portable in which a sunken panel is used for the controls. This is done to prevent them being accidentally knocked, quite apart from the question of appearance,

ES WE ALL MAKE!

Out Some of the Minor Errors of Radio oid Them—By W. B. RICHARDSON

but don't forget when assembling to fix the knobs in position *before* screwing the set in the case, otherwise you may not be able to get at the grub screws which hold them in place. The edge of the case will prevent you holding the screwdriver at the right angle. (See Fig. 4.)

Fixing of Screws

Next to drilling the panel comes the mounting of the components. Here the use of round-headed screws is usually necessary since the holes in the fixing flanges of most parts are not countersunk. If you use screws with flush fitting heads you are liable to split off the fixing flange, as in Fig. 5. Naturally if you possess a countersinking bit you can countersink the holes first, and this will then make an even neater job than using round-headed screws. Such a bit can be obtained for a few pence. One type is illustrated in Fig. 6.

Some sets mounted on wooden baseboards have a sheet of metal fixed underneath part or whole of the baseboard to act as a screen. Usually a wire is taken from this to some earthed point. In constructing such a set be very careful that the screws used to hold the parts in position are not so long that they go right through the wood and into the metal plate. Obviously no harm will result if all the components have bakelite flanges, but in the case of some strip resistances and similar components, the metal connecting tags also act as holding down lugs, in which case if the fixing screws pass right through and touch the metal plate a direct short circuit will result. Fig. 7 shows what I mean.

Earthing the Screen

Sometimes a set refuses to work when everything is apparently in order simply because some point which should have been earthed to the screen has been left unconnected. It may be just a short wire from a terminal to a holding down bolt passing through the screen which, through its very insignificance, has escaped our attention. The leaving out of the insulating washers under a terminal fixed to a metal chassis is a similar kind of thoughtless mistake. This, however, may lead to more disastrous results. To make an unnecessary connection is always more risky than leaving one out.

A mistake which is quite easy to make if you are getting out your own design is to make a wrong connection to the filament of a metallised valve. As you know, the metal covering is always connected to one particular filament pin. This is usually marked and must of course be joined to the filament wire which is at earth potential. This is usually the negative one. Often when planning out a neat wiring layout one is apt to forget that the negative wire must go to, say, the right-hand filament terminal, when it would be much simpler to take it to the left-hand one.

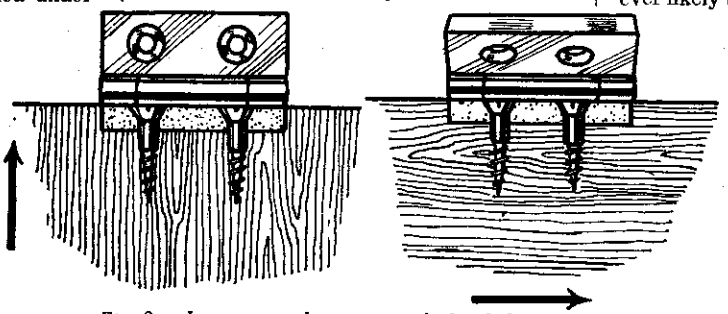


Fig. 8.—Incorrect and correct methods of fixing hinges.

Mistakes of Amateur Designers

While on the subject of home-made designs, here are one or two points which come to mind.

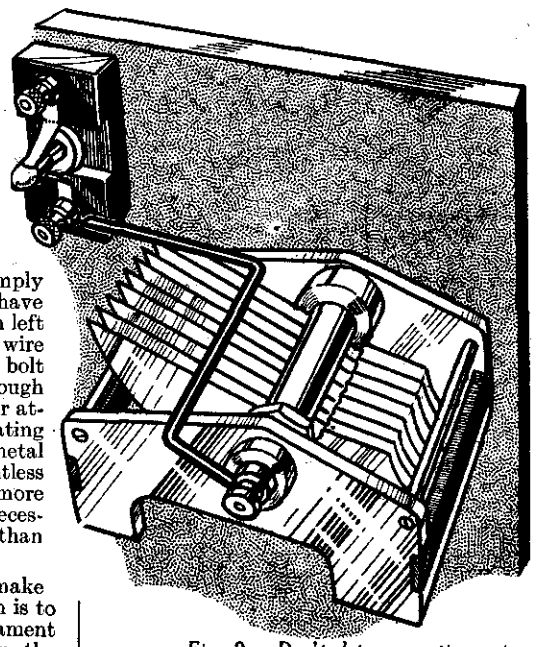


Fig. 9.—Don't let connecting wires foul the condenser vanes.

Firstly, in designing your cabinet always have sufficient height above the baseboard to accommodate the tallest valve you are ever likely to use. I myself have experienced trouble here and have had to take the terminal cap off a screen grid valve because the roof of the cabinet was a fraction of an inch too low. Always, if possible, arrange for the grain of the wood of the cabinet or baseboard to be across the axis of the fixing screws. Fig. 8 shows the fixing of a hinge. On the left the grain is vertical and the screws will easily pull out. On the right the grain is horizontal as it should be. There is no chance here of the screws going "round and round" when you go to tighten them as sometimes happens if they are driven into the end of the grain.

With amateur coil-making a common mistake is to wind the reaction coil the wrong way round. The symptoms are that signals are not very strong and when the reaction is advanced they get weaker instead of louder. This is easily remedied by reversing the leads, but it is just as well to know what is the cause if a set displays trouble of this sort. The passing of a connecting wire close over the top of a variable condenser (as in Fig. 9) is another silly mistake which could be easily avoided by having the vanes open during the wiring.

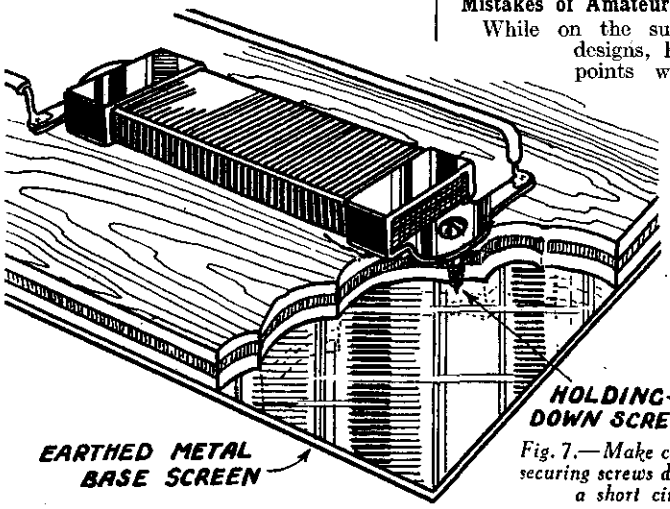


Fig. 7.—Make certain that securing screws do not cause a short circuit.

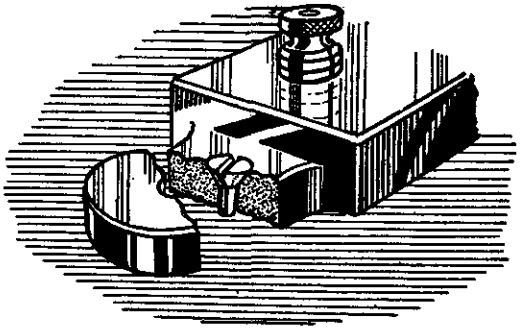
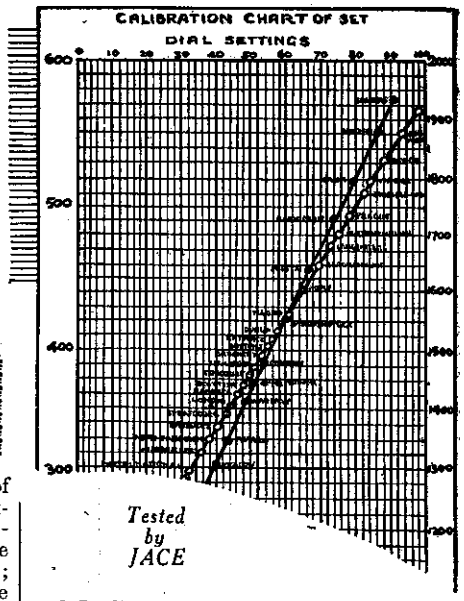


Fig. 5.—Use of the wrong screw will cause this! Don't use countersunk screws unless the lug hole is countersunk.

Receivers and their Records

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

The Portadyne "Atlantic" Portable S.G.4.

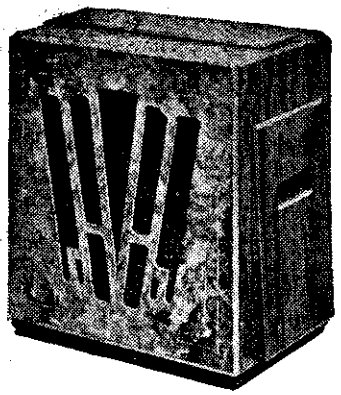


Tested by JACE

A SELF-CONTAINED battery-operated suitcase portable receiver must always make a popular appeal, for it can be used anywhere without being dependent, as is the case with other types of sets, on an aerial and earth.

Although its size and weight is such that it can be moved from room to room as desired, this does not necessarily imply that the range of the receiver has been sacrificed to its portability; on the contrary, in many instances the set of a portable type, with its enclosed frame aerial, may prove more selective, and more generally useful, than its more bulky competitors.

In their "Atlantic" suitcase model the makers have embodied a straight circuit comprising one H.F. stage tuned-grid



Another Portadyne. The Transportable Cabinet Model. The Portadyne Suitcase "Atlantic" Model reviewed in this article is illustrated below.

coupling, grid detector and two transformer-coupled L.F. amplifiers, with, in the last stage, a power output valve. A point of outstanding interest is the use in this circuit of a swinging coil to secure reaction, and two stages of transformer coupling to obtain sufficiently magnified signals through the Celestion loud-speaker fitted in the lid of the case. The receiver contains a high-tension battery of the standard capacity size, a 2-volt accumulator using jellied electrolyte—the unspillable type—and the necessary 4½ volts grid-bias battery.

Few Controls

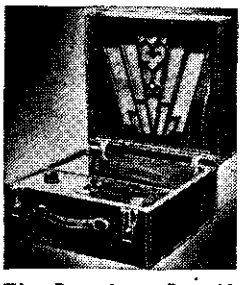
Although I have handled a number of wireless sets, I have not come across many with so few controls. On the panel of the Portadyne "Atlantic" you will only find *two* knobs and two thumb-operated drum dials. The left-hand knob acts as an "on-and-off" switch, and at the same time effects the change over from medium (200-800 m.) to long (1,000-2,000 m.) waves. On the right of the panel is the reaction and volume control. The method of tuning is an original one, and is one of the most interesting I have seen. In view of its novelty, it deserves a few words of explanation—and praise. The two milled-edge thumb controls are on each side of a scale clearly marked in wavelengths; in some instances, to facilitate matters, the names of the better-known stations have been indicated. A diagonal line runs throughout the main scale, and a similar but movable one is seen on the celluloid band attached to the left-hand condenser which tunes the frame aerial. All that is needed, therefore, to keep the two circuits in tune is to see that the movable diagonal line is imposed over the other one. The tuning is of knife-edge selectivity, which, combined with the directional property of the frame aerial, enables you to separate stations working on almost neighbouring wavelengths. This is not a hit-or-miss method; there is no need to twiddle the dials. It is a mere question of getting the two diagonal lines to correspond on the dial with the wavelength of the transmitter. A slight adjustment of the volume and reaction control knob will bring the broadcast up to the desired strength.

Reaction and Calibration

With the method employed, reaction is exceedingly smooth, a valuable asset when searching for the weaker or more distant transmissions. Moreover, I specially noticed that the wavelength calibration of the dial is remarkably accurate; it might possibly have proved an advantage had they been spread over a longer scale, but the thumb control is so easy that this did not prevent the capture of the more elusive broadcasts. Tested at a spot some thirteen miles from the Brookmans Park transmitters, there was no difficulty, whilst these two stations were working, in securing broadcasts from Hamburg, Breslau, or Poste Parisien. Mühlacker could not be separated from London Regional, but when the latter station was resting the Stuttgart concert was received at full loud-speaker strength. During daylight hours, Huizen (1,875 m.), Radio-Paris, Eiffel Tower and Brussels were tuned in; from 8.0 p.m. onwards some thirty Continental stations were logged whilst the two London programmes were on the air. They include such stations as Radio Normandie (Fécamp), Trieste, Turin, Breslau, Radio Toulouse, Frankfurt-am-Main, Sottens, Rome, PTT Paris, Beromünster, Prague, Brussels, Vienna and Budapest on the medium waves, with the addition of Leningrad, Oslo, Kalundborg, Motala, Warsaw and Hilversum on the longer waveband. Königs Wusterhausen was clear of both Daventry and Radio-Paris, and Motala free of interference from Warsaw, thus demonstrating the excellent sensitivity and selectivity of the receiver. Generally speaking, the tone of the loud-speaker was very pleasing, provided the volume was kept at a reasonable strength. The power emitted by the loud-speaker was amply sufficient to fill an average-sized drawing-room, and when speech was heard it was crisp, clear and of a natural quality.

For an efficient four-valve receiver of a suitcase model, the price of £12 12s. complete is distinctly advantageous, as the Portadyne "Atlantic" S.G.4, although of the portable type, is peculiarly efficient: its all-round performance is so good that it can be highly recommended as a "household" set.

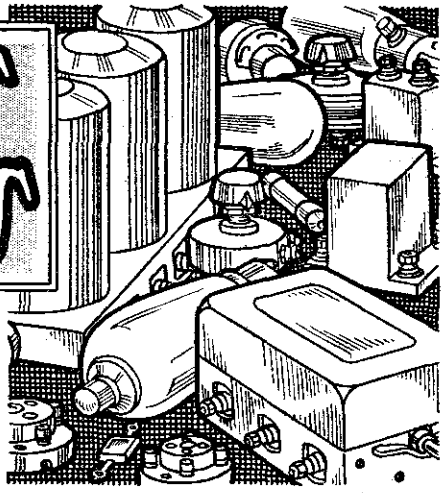
It is my opinion that every listener should own a portable set, even though he may also own an ordinary set operating from an outdoor aerial, for there are dozens of occasions when it is desired to listen to the wireless programmes in some part of the house remote from that in which the ordinary set is installed. Also, it may be that some member of the household is ill in bed; under such circumstances a portable is a great boon, for the two sets can be in operation at once. It is worth while reminding those who have not taken the trouble to read their wireless licences that the 10s. wireless licence enables a listener also to use one portable receiver.



The Portadyne Portable as reviewed in this article.

There is also the case of a listener who wishes, for example, to listen-in to, say, Radio-Paris, whereas the remainder of the family are keen on listening to an English programme. Here again the portable comes to the rescue. It is a useful stand-by when the ordinary receiver is out of action for some reason or another. In many other ways the portable comes to the rescue, and the great improvements in modern receivers rid portables of most of the bugbears to which they were heir five years ago.

REVIEWS of LATEST KITS



THE Radio Exhibition of 1928 marked the first nation-wide appearance of a kit of parts intended to be made into a complete receiver. This kit was known as the Cossor Melody Maker, and was introduced by A. C. Cossor, Ltd. Each year this enterprising firm has introduced a new and up-to-the-minute kit which has gained such popularity that to-day it is a case of—"think of a kit and you think of Cossor." Each successive year has marked the advent of a new kit containing notable improvements, up to the appearance of the present model, which is distinguished by the presence of a variable-mu valve. This year's range includes four separate kits, each based upon the same fundamental principles and employing a variable-mu valve, but differing inasmuch that two are for battery working and two are intended for use on A.C. mains; each pair consists of substantially the same kit, but one is with loud-speaker and one without.

The kit illustrated at Fig. 1 is the Model 337, which is the all-mains model with incorporated loud-speaker which is designed for use on A.C. mains only, 200-250 volts, 40-100 cycles. The circuit is shown at Fig. 5 and presents many interesting points. Let us commence the survey with the aerial coil, which, it will be noticed, has winding so arranged that the aerial is tapped in at predetermined points, which can be at any position on the coil that the designer wishes: this in itself is refreshing after the slavish centre-tapping that follows the use of the conventional three-point switching. A feature of great interest is the coil, which is in series with the aerial when switched for long waves, but is out of circuit when the set is switched for short waves. Presumably the purpose of this coil is to act as a choke to short-wave lengths when working on the

COSSOR MELODY MAKER KIT MODEL 337

long waves, to stop the former from butting in on the preserves of the latter. This refinement is a boon to listeners situated in the vicinity of a powerful regional transmitter as otherwise they would experience the annoyance of having half the long-wave scale covered with a mixture of the alternative transmissions.

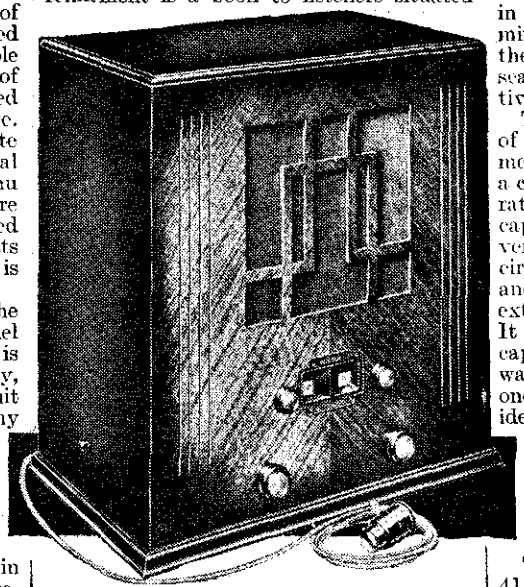


Fig. 1.—The Cossor Melody Maker All-mains Model No. 337.

KIT:
Cossor Melody Maker, All-Mains Model No. 337.

MAKERS:
A. C. Cossor, Ltd.,
Highbury Grove, London, N.5.

SPECIFICATION:
A.C. mains only, 200-250 volts, 40-100 cycles, Cossor variable mu MVSG, 41 MH and 41 MP valves, bi-phase rectifier, mains transformer tapped at 200, 220 and 240 volts, fuses in leads of rectifier anodes, metal chassis, built-in permanent magnet moving coil loud-speaker, capacity-controlled reaction.

PRICE:
£11.19.0, or without loud-speaker, £9.15.0

This coil is shunted across the grid cathode of the variable-mu valve, Cossor MVSG metallized, which is in turn provided with a centre-tapped anode coil, giving a step-up ratio of 2:1. This coil is provided with capacity-controlled reaction in the conventional manner. In connection with this circuit it is interesting to note that the anode to grid coupling condenser has an extremely low value—namely, .000025 mfd. It would seem that such a very small capacity would lower the volume on long waves, but the substitution of a larger one experimentally entirely discredited this idea. The advantage of such a low capacity is that the tendency for mains hum to be introduced in the screen-grid stage is minimized. The detector stage makes use of a Cossor 41 MH metallized mains valve, and is designed on conventional lines.

The output stage employs a Cossor 41 MP, which is an indirectly-heated power valve capable of an output that is more than adequate for domestic purposes. It is interesting to note that this valve gives more volume than any indirectly-heated pentode would do, as it has the distinction of having the highest sensitivity factor of any valve, which is largely accounted for by the phenomenal value of mutual conductance, which is no less than 7.5 m.A./v. The mains pack is designed around the Cossor 442 BU, which is a bi-phase rectifier of very robust construction having a flat

(Continued on page 244.)

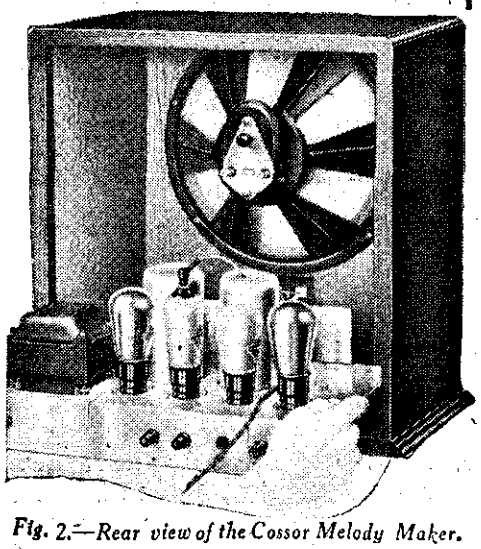


Fig. 2.—Rear view of the Cossor Melody Maker.

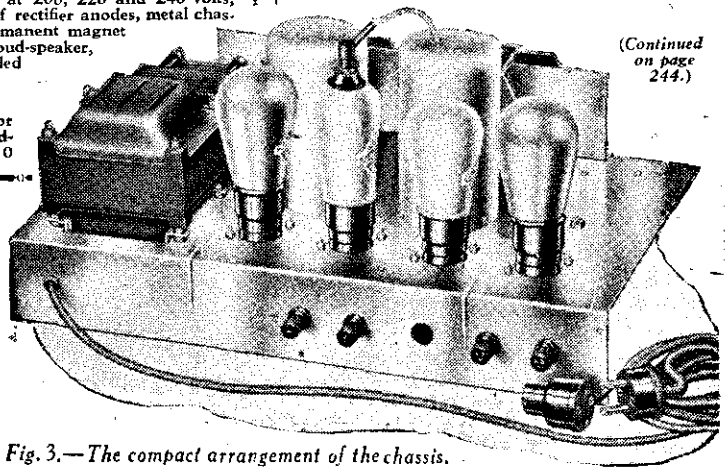


Fig. 3.—The compact arrangement of the chassis.

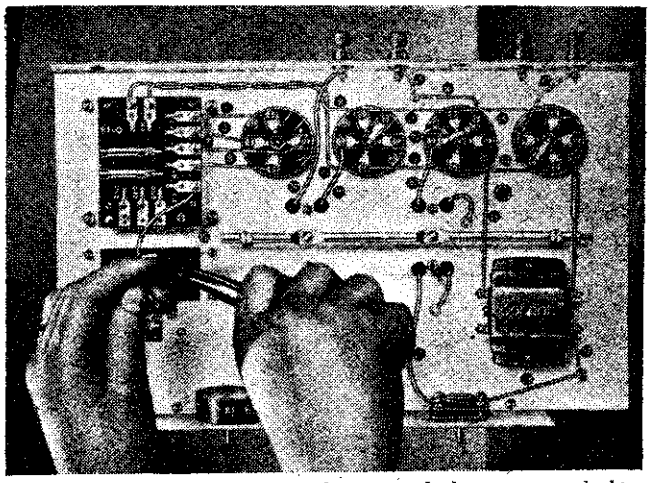


Fig. 4—One of the easy-wiring diagrams which accompany the kit.

(Continued from page 242.)

tape filament. This valve is fed by a specially-designed mains transformer which is tapped for working on 200, 220, or 240 volts; fuses are provided in each of the leads to the rectifier anodes. Smoothing is taken care of by a 30 henry constant inductance choke in conjunction with a 2 and 4 mfd. condenser. Further reference to Fig. 5 will show that the possibility of modulation hum is stamped out by an earth shield between the primary and secondary winding of the mains transformer.

A large and exceedingly well-printed chart is included with the kit which shows in a concise and definite manner the correct procedure of assembly. This chart is a mass of careful forethought that shows that every possible mistake that the constructor could make has been realized and guarded against. The various components are all boxed, while small parts are enclosed in envelopes bearing their description. The all-metal chassis is in two pieces, on which the components are mounted before the two sections are united by means of four bolts and nuts. These are, perhaps, a trifle inaccessible, but the fixing is easily accomplished if it is approached calmly; altogether, assembly is extremely simple and would not take the most cautious constructor more than about three hours. After the chassis has been duly assembled and wired it is slipped into the cabinet, as shown at Fig. 4, when the suggestion of a kit is entirely lost and a complete receiver is created, equal in every way to a factory-built job which would be far more expensive. Incidentally the kit illustrated is £11 15s., and is available without loud-speaker at £9 15s.

The test was carried out at 21 miles from Brookmans Park on an aerial 45ft. long, made up of 25ft. down lead and 20ft. horizontal in an area which is entirely normal and quite free from reception freaks. There are four controls (excluding wave-change switch), two tuning condensers, volume and reaction. The high degree of selectivity obtainable is dependent upon the correct use of the volume and reaction control; for maximum selectivity it is necessary to turn down the volume control until the the station is lost and bring it back by means of reaction; in other words, the volume control should be turned down as far as possible and reaction advanced as far as practicable without loss of quality. Too much stress cannot be laid on the advantages of the variable-mu valve, which, in addition to many other advantages, permits perfect volume control that will allow the local to be tuned down to a whisper without adversely affecting quality to the slightest extent. The use of separate tuning controls for each condenser has many advantages when the receiver is used under adverse circumstances, such as when using an indoor aerial, as that little bit of extra punch that makes all the difference between bad and good reception is not lost. This is not the case with a ganged receiver unless great care is used in trimming, which is, generally speaking, impossible with a kit. As was expected, the completed kit was highly selective and possessed excellent range. Station after station can be tuned in without interference upon a silent background which is delightfully free from any trace of mains hum. After listening for a considerable period, it must be admitted that the reproduction of both speech and music reaches a high standard well in keeping with the other qualities of this excellent all-mains receiver.

Viewed from the "home" standpoint the receiver leaves nothing to be desired It is selective, powerful, gives really excellent reproduction of both speech and music, has the appearance of a factory-built receiver when fitted into its walnut-finished cabinet, and consumes from the mains only one unit of electricity for every twenty-six hours that it is working.

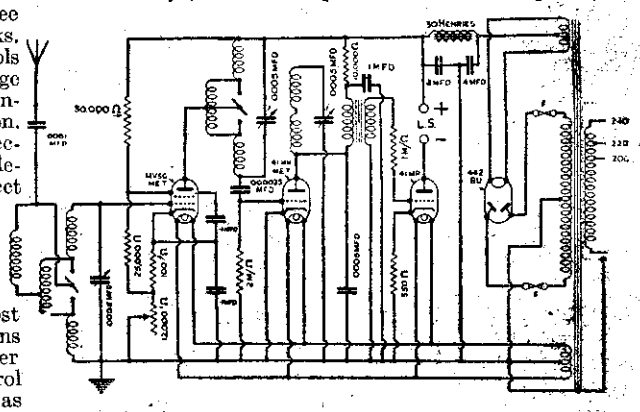
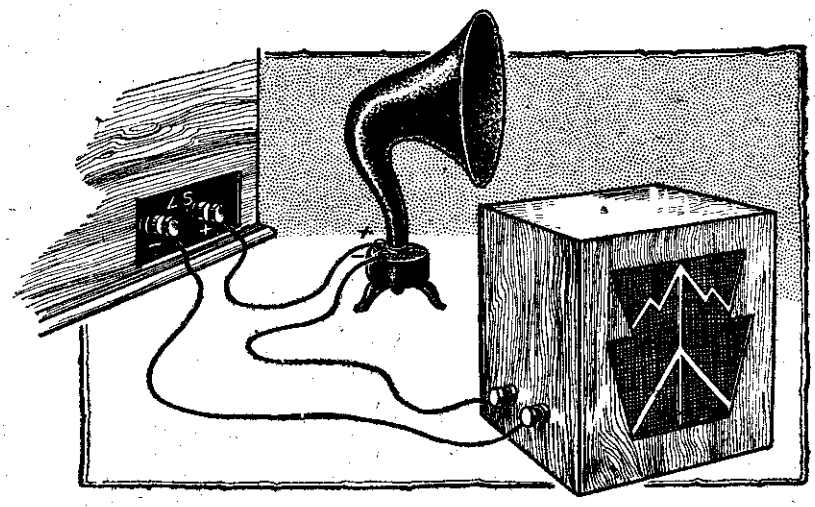


Fig. 5—Circuit diagram of the Cossor Melody Maker All-mains Model No. 337.



Balancing reproduction by means of two loud-speakers connected in series.

A USE FOR THE OLD SPEAKER

IF you have invested in a moving coil to replace the old horn or cone speaker the old one will probably have been relegated to the junk box. But have you tried using the two together? By connecting them in series it is often possible to get more pleasing reproduction than by using either of them separately. The reason is that most moving coils give emphasis (sometimes over-emphasis) to the low notes whilst the old moving iron speakers favour the upper register. By suitably combining the two, both ends of the scale are brought out in better proportion. Both speakers should be tried in different positions in the room until most pleasing results are obtained.

SIMPLE TESTS WITHOUT INSTRUMENTS

The first article on this subject appeared on page 97 of our issue dated Oct. 1, 1932

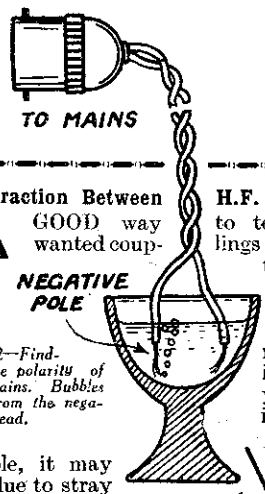


Fig. 2—Finding the polarity of the mains. Bubbles rise from the negative lead.

Interaction Between H.F. Circuits

A GOOD way to test for unwanted couplings between two tuned circuits in a set is by the absorption method. For instance, if your receiver is not very stable, it may be due to stray coupling between the aerial circuit and the intervalve circuit. To test if there is any interaction, remove the H.F. valve and join the aerial to the top end of the intervalve coil through a very small condenser, as in Fig. 1. Tune in a fairly weak station on the intervalve coil, and then tune in the aerial coil to the same wavelength. If there is an obvious reduction in signal strength as soon as this point is reached, it is evidence of an undesirable degree of interaction between the two circuits. On the other hand, no reduction in signal strength indicates minimum interaction. This test is not, of course, applicable where ganged condensers are used, since the two circuits cannot be independently tuned.

A Polarity Test

A simple way of testing the polarity of the mains is to dip the ends of the two wires in an eggcupful of water. Bubbles will rise from one wire. This is the negative pole. Naturally, you must be very careful not to allow the wires to touch one another or you will short-circuit the mains. For lower voltages, it may be necessary to add a pinch of salt to the water to increase its conductivity, but do not do this when testing the mains or too much current will pass and you may blow the fuse. Plain tap water is quite sufficient. The same test will distinguish A.C. from D.C. If the supply is A.C., there will be no difference between the behaviour of the two wires in the water.

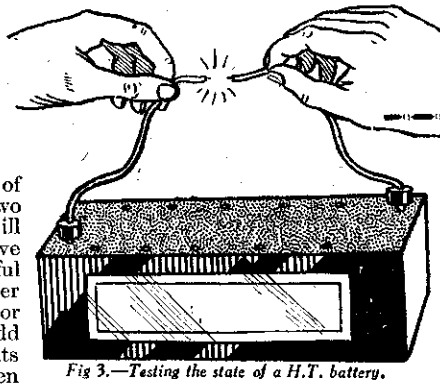


Fig 3.—Testing the state of a H.T. battery.

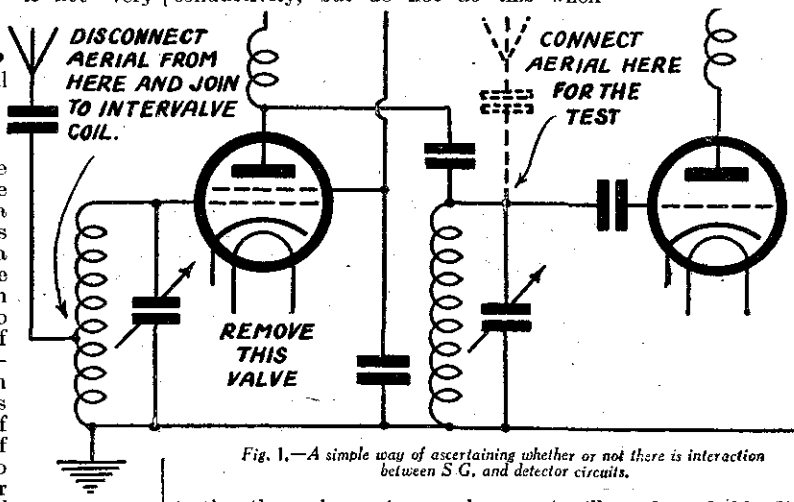


Fig. 1.—A simple way of ascertaining whether or not there is interaction between S.G. and detector circuits.

Testing the State of the H.T. Battery

Here is a test which will give you a rough guide to the state of your H.T. battery in the absence of a voltmeter. Disconnect the battery from the set and join a wire to each end, as in Fig. 3. Momentarily "short" these wires by quickly flicking the end of one past that of the other. The actual contact must be very brief, or you will harm the battery. If a bright, fat spark occurs when the wires touch, the battery is O.K., but if there is only a feeble flicker, then the battery is running down. Needless to say, you should not repeat this test more often than necessary, as some current is taken from the battery even with the briefest contact.

ODDS AND ENDS

Parallel Wires

At one time, and only a few years ago, we used to take elaborate pains in wiring up a set to make all bends right-angular, to ensure that no adjacent wires ran parallel to each other, and so on. Since then the pendulum seems to have swung pretty well in the opposite direction so that really neat wiring is seldom seen. But although the appearance of the wiring is not of great consequence, it is as important as ever to make sure that wires in grid and plate circuits, if near together, should not run parallel to each other. The capacity formed between such wires can be quite sufficient to cause instability, especially in a set giving a large amount of high-frequency amplification.

When Testing

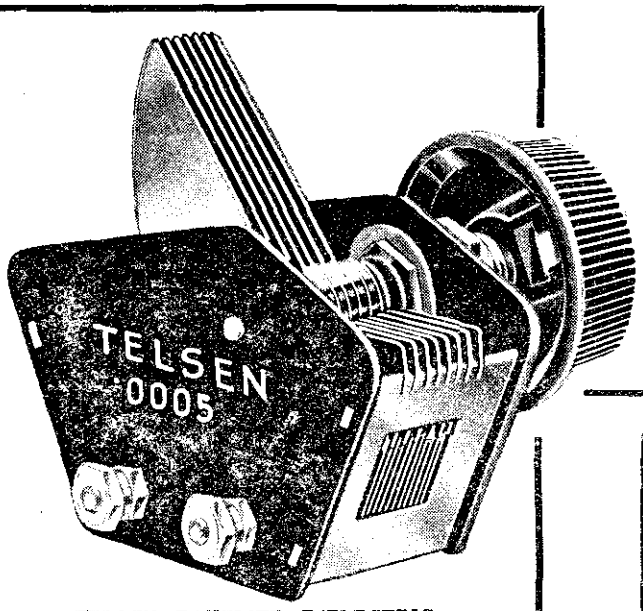
When you have assembled a receiver and are carrying out the preliminary tests, there are one or two little mistakes which are likely to occur if you are not careful. Do not, for instance, pull out the grid-bias plugs while the set is working so as to try a different value. This puts a great strain on the valves. The correct way is to switch off each time a change is made. Be sure not to touch the metal covering of a metallized valve with any bare wire, or with a metal screwdriver with which you may be adjusting some other part of the set, for you may cause a "short." Do not take off or move the covers of band-pass coils after the set is fixed in the case. You will most certainly upset the trimming unless you replace them in *exactly* the same position. Actually, of course, they should be pushed home firmly before carrying out the trimming and then left severely alone.

Anode Bend Detection

In the case of anode bend detection, first consideration must be given to the suitability of the valve for this form of detection. This can be judged by the shape of the grid volts / anode current curve supplied by the makers. The curve should, of course, have a sharp and pronounced bend at its lower end, and a long straight characteristic above. In operation, the valve should be worked at about the medium anode voltage recommended by the maker, and should be biased to well down on the bottom bend.

As a general rule the valve maker's recommendation as to the value of coupling condenser and grid-leak can be followed in the case of a leaky grid or power grid detector. For normal grid rectification, the valve should be operated usually at the lowest anode voltage which gives sufficient modulation output to load the following stage and at the same time renders reaction control effective, while for power grid detection the valve should be operated at its maximum rated anode voltage.

TELSEN BAKELITE DIELECTRIC CONDENSERS



TELSEN BAKELITE DIELECTRIC TUNING CONDENSERS

New design of great rigidity and exceptional compactness, ensuring the utmost efficiency in use even where space is very limited. The well-braced vanes are interleaved with a minimum of the finest solid dielectric, giving absolute accuracy of tuning. Supplied complete with knob.

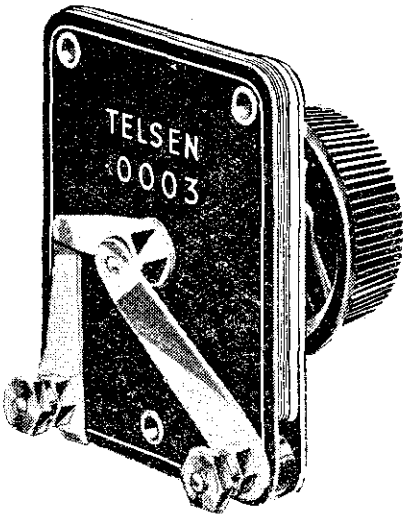
Capacities
.0005
.0003

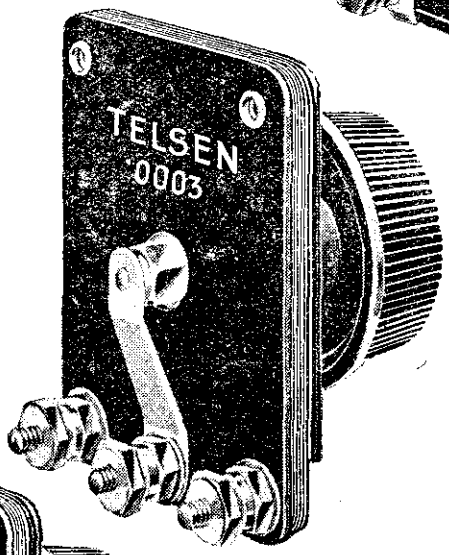
2/6

TELSEN AERIAL SERIES CONDENSER

The ideal volume and selectivity control, solidly constructed with very low-minimum capacity. The externally keyed switch-arm when rotated to a maximum position, connects with a contact on the fixed vanes, thus short-circuiting the condenser for maximum volume. Supplied complete with knob. Capacity .0003

2/3



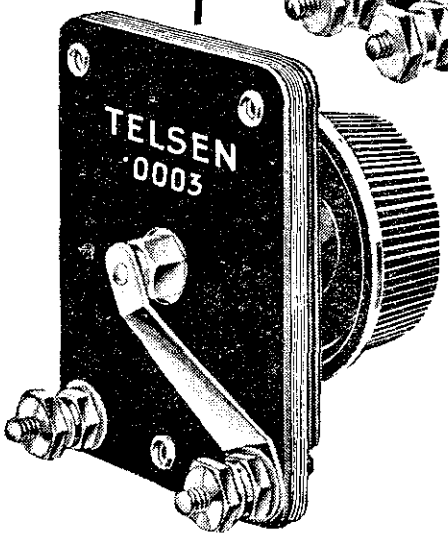


TELSEN DIFFERENTIAL CONDENSERS

Improved type of exceptionally rigid construction. The rotor vanes are keyed to the spindle and fitted with definite stops. A strong nickel-silver contact makes connection to the rotor, a positive connection being made to the stator vanes. Supplied complete with knob.

2/6

Capacities
.0003
.00015
.0001



TELSEN REACTION CONDENSERS

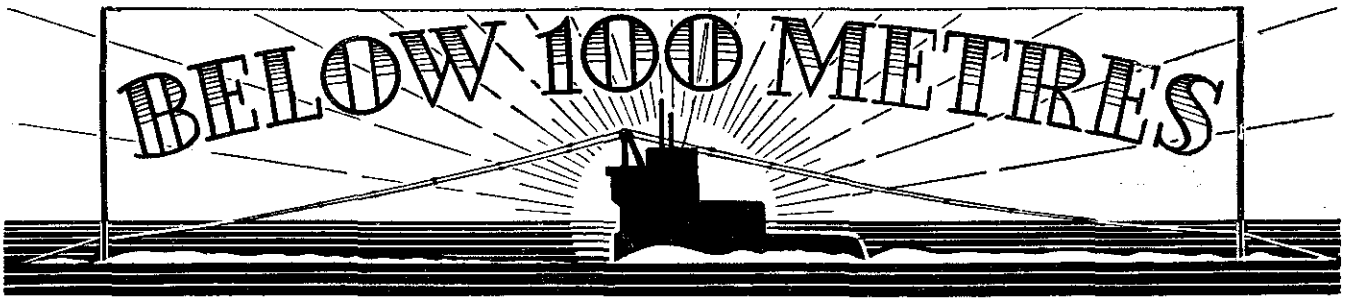
Capacities .0003 — **2/-**
,, .00015
,, .0001

,, .00075 — **2/6**
,, .0005

TELSEN
RADIO COMPONENTS

BUY A COPY OF THE TELSEN RADIOMAG - PRICE 6d.

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



IN short-wave reception, it is often the small and seemingly insignificant details that make all the difference between a set that is a pleasure to use and one that is a perpetual source of exasperation to its owner! Easy tuning, an entire absence of hand-capacity effects, velvety-smooth reaction, and freedom from grating or crackling noises due to faulty rubbing contacts, etc., are among the desirable features that make a really good short-waver pleasant and easy to handle.

These ideals can be attained without difficulty by paying careful attention to certain important details when designing, constructing, or adapting a set for short-wave work; and similarly, of course, one should look out for these points when buying short-wave apparatus ready-made. The ease or otherwise with which tuning adjustments may be made depends very largely on the capacity of the variable condenser or condensers in the set.

Condenser Capacities

With a .0005 mfd. condenser, for instance, such as is used in the majority of ordinary broadcast receivers, tuning on the short waves is exceedingly sharp and critical, so that very delicate and skilful adjustment is necessary when tuning-in stations. That is why, in sets, adaptors, or converters expressly intended for short-wave work, the variable condensers used have quite a low maximum capacity—say .00025, .00016, or even .0001 mfd. The smaller the maximum capacity of the condenser, the broader the tuning, and therefore the easier it is to tune in stations quickly and accurately without undue "fiddling."

In the case of any circuit intended exclusively for short wavelengths, therefore, it is strongly advisable to use variable condensers with a relatively small maximum capacity so as to facilitate adjustment. But what of sets that are only used occasionally for short-wave reception, being adapted for the purpose by plugging in short-wave coils in place of the ordinary broadcast coils?

A small-capacity variable condenser is inconvenient for use on the ordinary broadcast wavebands, as the range of wavelengths covered by it, in conjunction with any given coil, is too restricted. One way out of the difficulty is to compromise between the .0005 mfd. condenser that is customary for ordinary purposes, and, say, the .00016 mfd. used for short-wave work, by adopting some intermediate value, such as .0003 mfd., which does fairly well for both purposes.

Another plan that is sometimes resorted to is that of switching a fixed condenser into series with a .0005 mfd. variable one when working on short waves. This, of course, reduces the total effective capacity. Thus, for example, a .0005 mfd. fixed condenser in series with a .0005 mfd. variable one reduces the total effective capacity to .00025 mfd.

PRACTICAL HINTS ON SHORT-WAVE WORK.

By "RADIOMAN"

Trimmer Condenser

A simple expedient which may well be adopted is to connect a small independent trimmer or vernier condenser (having, say, one fixed plate and one moving plate) in parallel with the .0005 mfd. variable condenser. For short-wave work, the final adjustments can be made with great precision by means of the vernier condenser. Hand-capacity effects are seldom troublesome above about 25 metres with a well-designed modern short-wave set; but on shorter wavelengths—say around 16 or 19 metres—they may become a nuisance, unless special precautions are taken to avoid them.

Metal screening *may* help to eliminate hand-capacity effects—or it may make them a thousand times worse! A good deal depends on the earth connection used. With a poor earth, one sometimes finds that appalling hand-capacity effects occur whenever the operator's hands come anywhere near any part of the metal chassis or screening. That sort of thing, of course, renders satisfactory reception almost impossible.

Avoiding Hand Capacity

One of the most widely-used methods of avoiding hand-capacity consists of joining extension rods to the spindles of the variable condensers, so that the latter can be mounted several inches behind the control panel.

The type of extension-piece usually sold for this purpose consists of an ebonite tube with set-screws near each end. One end of the tube is secured to the spindle of the variable condenser, while a short metal spindle secured in the other end of the tube connects it to the slow-motion dial on the control panel. I have come across instances in which hand-capacity effects persisted in spite of the use of these extension rods; the signals would fade out whenever the dials (which contained a good deal of metal in their construction) were touched with the hands. In each case this trouble has disappeared completely on substituting a short spindle of solid ebonite rod in place of the metal spindle connecting the extension-piece to the slow-motion dial. Apparently there was an unexpected capacity effect between the ends of the two metal spindles which faced one another inside the tube.

Sometimes pronounced body-capacity effects occur through unwanted high-frequency currents finding their way into the low-frequency part of the set. When this is happening, one often finds that the tuning is upset and signals fade out whenever the headphone or loud-speaker leads are touched. The remedy is to improve the H.F. choking, by-passing and decoupling arrangements inside the set, and (the simplest and usually the most effective remedy) to connect a *high*-frequency short-wave choke in either or both of the output leads which go to headphones or loud-speaker. It may be necessary to connect a small-capacity fixed condenser between the anode of the output valve and earth, in order to get rid of the high-frequency currents that are blocked by the H.F choke or chokes.

Smooth Reaction

Smooth reaction depends on a number of factors, such as the resistance value of the grid-leak, the anode potential on the detector valve, the tightness or otherwise of the aerial coupling, etc. Connecting the return end of the grid-leak to the moving contact-arm of a suitable potentiometer (more correctly termed a potential divider), shunted across the L.T. or filament circuit, helps greatly to ensure smooth, efficient reaction control.

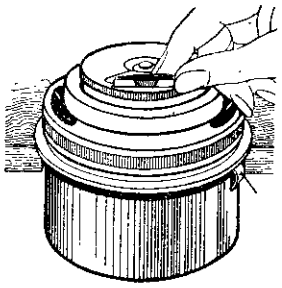
As an alternative to an ordinary potentiometer of the variable type, one can use a fixed potentiometer, having a single tapping at a suitable point on the winding. The ends of the resistance winding are connected to the filament circuit, and the return lead from the grid-leak is joined to the tapping. This is, of course, a slightly simpler arrangement than the variable potentiometer, but the latter, being adjustable, naturally gives finer control of the degree of positive bias applied to the grid of the detector valve. If the grid is made too positive, reaction is apt to be "ploppy," while if it is too negative, smoothness of reaction is obtained at the expense of signal-strength, to some extent. A happy medium must therefore be found in order to get the best results.

When a short-wave receiver is operating on or near the point of oscillation, it is so sensitive that, unless the connections to the moving vanes of the tuning and reaction condensers are well-nigh perfect, loud grating noises may be heard in the headphones or loud-speaker whenever transmissions are being tuned in. Variable condensers that are quite satisfactory and silent in operation on the ordinary broadcast wavebands often set up intolerable scratching or grating noises when used on the short waves. It is strongly advisable, therefore, when building short-wave receiving apparatus, to use condensers of a type expressly designed for short-wave work.

A CHAT ABOUT THE LATEST COMPONENTS

AUTOMATIC NEEDLE CUPS FOR GRAMOPHONES

THE illustration shows one of the new automatic needle cups for gramophones. One simply has to press the top of the device to obtain one needle. Each container holds about 200 needles of any design which may be poured in. It can easily be attached to any gramophone or radiogram, and is made for use as a separate unit. It automatically prevents the use of old needles, and is neater, tidier, and more dustproof than the open bowls usually supplied.



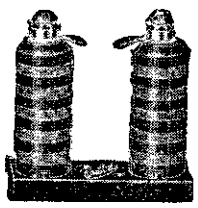
Automatic needle cups for radio-gramophones.

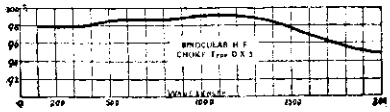
WATMEL H.F. CHOKE

The function of a choke demands that the inductance shall be high and the self-capacity low. The Binocular Choke, Type D.X.3, manufactured by the Watmel Wireless Co., Ltd., has an inductance of 200,000 mh, and a self-capacity of only 1.6 m. mfd. In addition to these admirable characteristics, the choke is wound in binocular form, which reduces the risk of interaction. This choke will be found to be useful wherever an H.F. choke is required, and costs 4s.

SHORT-WAVE CONVERTER

To enable users of ordinary broadcast receivers to tune in the short waves quite a number of adapters have been placed on the market. In practically every case these are simply one-valve detector circuits with a plug to enable it to be plugged into the L.F. side of the ordinary set. In a different category, however, is the Eelex Short-wave Converter manufactured by J. J. Eastick and Sons. This is an ingenious circuit arrangement, which can





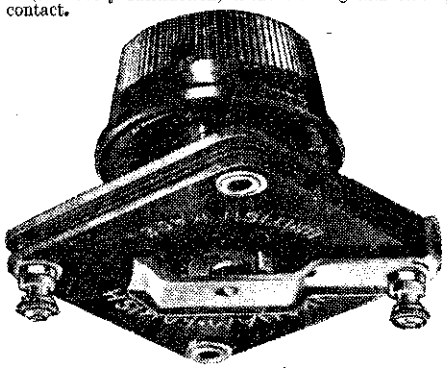
The Watmel Binocular choke.

only be used with a set employing H.F. stages. The combination then makes an efficient super-Heterodyne receiver, enabling good loud-speaker results to be obtained on wavelengths of 16-60 or 60-120 metres. The converter, with valve, costs £3, and additional models are made for use with mains receivers.

WATMEL RESISTANCES

Variable resistances are utilised for a number of different purposes, some of which entail current-carrying capacity, whilst others need a special type of winding to give a straight line variation of volume. The Watmel Wireless Co., Ltd., make resistances and potentiometers which will suit all purposes, and amongst these we would mention Type 1, which is a wire-wound resistance or potentiometer having a protected winding wound on a non-shrinkable former. A direct wiping contact is used in this model, which is made in various ratings from 1,000 to 50,000 ohms to carry 50 m/A to 15 m/A. The price of this type is 5s. 6d. Type 3 is of the non-inductive element type, with a wire contact. This is a smaller component than Type 1, but naturally will not carry the current, and is therefore made in much higher values, namely, from 50,000 ohms to 5 megohms. The price of this type is 4s. 6d. Both types will be found to give every satisfaction, silent working and clean contact.

The Graham Farish fixed condenser. These are tested on 750 volts D.C. and are guaranteed accurate to within fine limits.



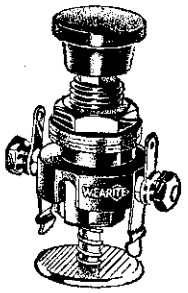
The Graham Farish "Litlos" variable condenser.

LITLOS VARIABLE CONDENSER

The bakelite type of condenser can be the source of rather large losses unless very carefully designed. Messrs. Graham Farish have spent considerable thought on the efficient design of this type of condenser, and the result is embodied in the Litlos variable reproduced on this page. The bakelite dielectric is very accurately ganged, and a solid brass pigtail is used to make connection to the moving vanes. Three types of this condenser are available, Log line, straight line capacity and differential, and various values up to .0005. The price, 2s.

WAVEMASTER CONDENSERS

The Webb Condenser Co., Ltd., of Hatton Garden, E.C.1, have sent us their latest catalogue of condensers. Variables with bakelite or metal end-plates; slow-motion drive variables; differential and ordinary types of reaction condenser, and two and three-gang condensers are well represented in this catalogue. The prices of these components are quite standard, and workmanship and finish are all that can be desired.



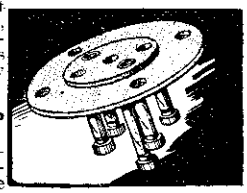
The New Wearite On-off Switch.

A NEW ON-OFF SWITCH

The ordinary type of push-pull switch has the disadvantage that it is not self-cleaning, and as a result the contacts oxidize and, by causing a voltage drop, reduce volume. Another disadvantage is that they are often out of round so that by rotating the switch one can often reduce or increase volume. The merit of the new Wearite on-off switch illustrated on this page is immediately apparent, for in place of the usual cylinder type contact, a disc is provided which makes very positive contact with the spring arms. The movement is definite, and by reason of its quick breaking and robust construction is a safe type to be used for both battery and mains receivers. The spiral spring behind the disc and around the spindle assures contact being cleanly made or broken. It costs 1s., and a push-pull wave-change switch, 1s. 3d. A change-over switch costs 1s. 6d.—all of them from Wright and Weaire.

CHASSIS-MOUNTING VALVE-HOLDER

The use of all-metal chassis for wireless sets, enables a lot of the wiring to be carried out below the base. The Clix valve-holder, illustrated, is intended for attachment to this type of receiver, and a large hole in the chassis enables the holder to be mounted flush with the top surface of the metal, and the filament wiring, etc., can be conveniently carried out below. Apart, therefore, from lightness and rigidity, these components will be found to greatly simplify construction.



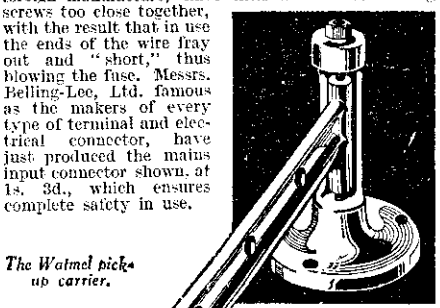
A new Clix chassis-mounting type valve-holder.

WATMEL PICK-UP CARRIER

One of the most important points in mounting a pick-up is the tracking angle, and the Watmel Pick-up Carrier is built so that not only is correct alignment assured, but weight is reduced, and by reason of the accuracy of the workmanship, vibration is reduced to a minimum. The price of this component is 7s. 6d., and a template is supplied to ensure that the carrier is mounted in the correct position.

MAINS INPUT CONNECTOR

No matter what device you use which works from the mains, it is important to ensure that the connection is safe. Many cheap mains connectors (usually those of foreign manufacture) have their internal connecting screws too close together, with the result that in use the ends of the wire fray out and "short," thus blowing the fuse. Messrs. Belling-Lee, Ltd. famous as the makers of every type of terminal and electrical connector, have just produced the mains input connector shown at 1s. 3d., which ensures complete safety in use.

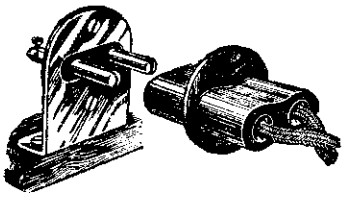


The Watmel pick-up carrier.

WEARITE DECOUPLING RESISTANCES

Two types of very accurate decoupling resistances have just been submitted to us by the famous firm of Wright and Weaire. A particular feature of these resistances is the ease with which they can be used in the construction and wiring of a receiver. The usual disadvantages of the Spaghetti type are non-existent and firm contact can be made at both points. The 400 to 2,000 ohms cost 1s., from 2,500 to 10,000 ohms 1s. 6d., from 20,000 to 50,000 ohms 2s., and 60,000 to 100,000 ohms 2s. 6d. The plug-in types are similar in every way to those described, but have been designed to facilitate rapid changing of resistance when change of other components calls for a change in resistance values. The base for the resistances costs 3d. each.

(Continued on page 250.)



A cheap mains connector—The Belling-Lee.

A Chat about the Latest Components

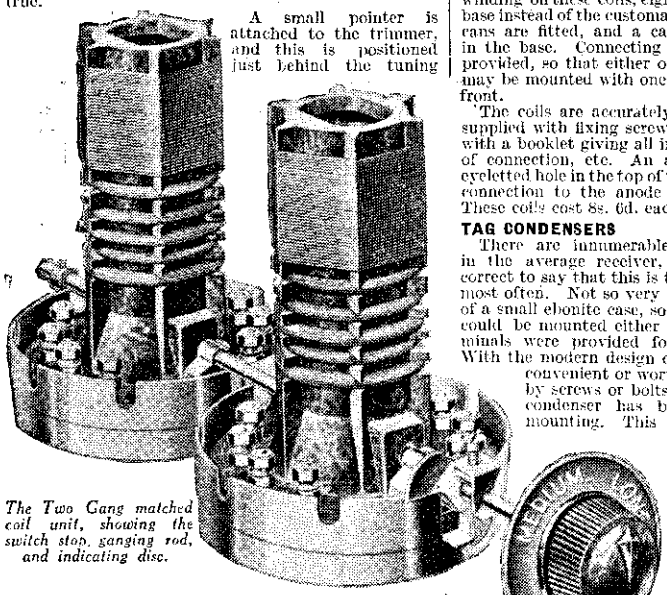
(Continued from page 248.)

New Telsen Components

We have recently been given the opportunity of testing a number of the new components manufactured by the Telsen Company. As the majority of our readers are aware, this firm manufactures, on an extensive scale, practically every type of component used in a wireless receiver, and these cover such items as valve-holders, fixed condensers, tuning coils, variable condensers, switches, slow-motion dials, etc. We give below a short report of some of these parts, which we have no hesitation in saying are of first-class workmanship and finish, and which show the result of careful thought and experiment.

GANG CONDENSER ASSEMBLY

The twin gang condenser assembly is a very ingenious piece of mechanism, comprising a drum dial and two log. variable condensers. The control knob is in two sections, the larger one rotating the moving vanes at both condensers, and at the same time an ivorine scale, which is illuminated from the rear. The smaller knob moves the fixed section of the left-hand condenser through a few degrees, to enable compensation to be made for slight inaccuracies in the two circuits with which the coils are used. The two tuning condensers are provided with compensators enabling preliminary balancing to be carried out. The most novel and interesting points of this assembly are the scale and "trimmer indicator." Unlike other makes of tuning dial, Messrs. Telsen supply two ivorine scales. One of these has a plain scale—0 to 100—whilst the other is calibrated direct in wave lengths, the short-wave band on the left of the scale, and long waves on the right. If used with the Telsen log. condensers, this enables direct reading of stations to be obtained. The scale is slotted so that it may be adjusted to give a true reading on one station, and then all other wavelengths will automatically fall true.



The Two Gang matched coil unit, showing the switch stop, ganging rod, and indicating disc.

A small pointer is attached to the trimmer, and this is positioned just behind the tuning scale. It therefore throws a shadow on the scale, so that the position of the trimmer is easily seen, and tuning made much simpler. The movement of the whole assembly is delightfully smooth, and this is a really first-class component, which we hope to include in one of our sets at an early date. Price 17s. 6d.

INTERVALVE COUPLING UNIT

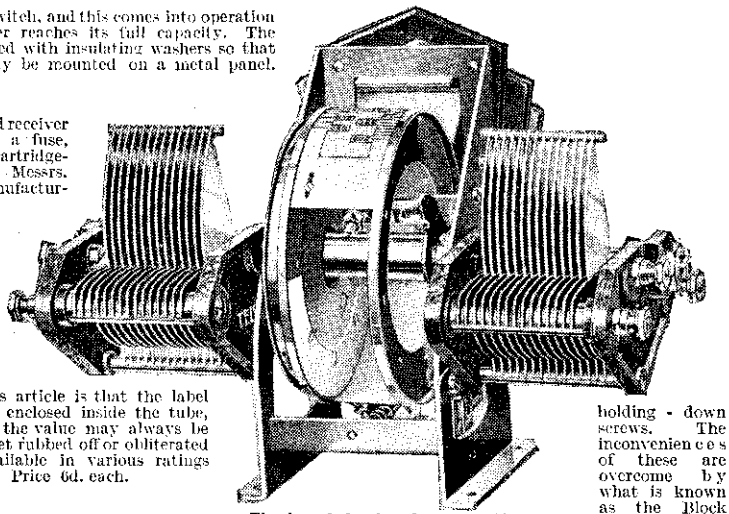
The new method of arranging a parallel-fed L.F. transformer has been incorporated in this unit with marked improvements over the usual type of coupler. The anode resistance has a value of 25,000 ohms, and the coupling condenser is .5 mfd. The transformer is of the high permeability nickel alloy core type, with an inductance of 40 henries. Owing to the efficiency of the design in this component, the step-up ratio is 10-1, and the response curve has a rising characteristic at the lower end of the musical scale, with a slight falling off at the upper end to reduce interference from heterodyne whistles, needle scratch, etc. This interesting component is so wired that, by connecting a choke with a value of 100 henries in place of the feed resistance, the amazing amplification of 225 is obtainable. Price 12s. 6d.

AERIAL SERIES CONDENSER

This is a further improvement on aerial condensers. Although having a maximum capacity of .0003 mfds., the design has been so arranged that it has the low minimum of .000006 mfds. A further useful point in a condenser of this type, which is used in the aerial lead, is a shorting switch, and this comes into operation when the condenser reaches its full capacity. The condenser is supplied with insulating washers so that the component may be mounted on a metal panel. Price 2s. 3d.

POWER FUSES

No mains-operated receiver should be without a fuse, and the small cartridge-type fuses which Messrs. Telsen are now manufacturing will be found very convenient to use. The fuses consist of a small glass tube 3/16 in. by 1¼ in. with metal caps. Inside the tube is a thin wire, accurately measured off to a definite current rating. A good feature of this article is that the label giving the rating is enclosed inside the tube, with the result that the value may always be seen, and will not get rubbed off or obliterated whilst in use. Available in various ratings from .5 to 3 amps. Price 6d. each.



The drum dial and condenser assembly, showing the rigid framework upon which it is assembled. The indicating pointer of the trimmer can be seen just inside the drum above the central shaft.

TUNING COILS

The new Matched Screened Coil is one of the best coils we have yet tested, and has been designed after long and careful investigation. Unlike the majority of screened coils on the market, these coils have an aperiodic aerial winding for both short and long waves, instead of a tapping into the long-wave section. This, of course, will tend to prevent "break-through." The coils are wound on a ribbed former having an overall diameter of 1¼in. and the short-wave winding is in solenoid form, with sectionalized windings for the long waves. A common reaction winding is provided. In view of the extra aperiodic winding on these coils, eight terminals are found on the base instead of the customary six. Aluminium screening cans are fitted, and a cam-operated switch is fitted in the base. Connecting rods for these switches are provided, so that either one or a number of the coils may be mounted with one switch control on the panel front.

The coils are accurately matched, and each coil is supplied with fixing screws, escutcheon, etc., together with a booklet giving all information, circuits, method of connection, etc. An additional refinement is an eyeletted hole in the top of the screening can to facilitate connection to the anode terminal of a S.G. valve. These coils cost 8s. 6d. each.

TAG CONDENSERS

There are innumerable uses for fixed condensers in the average receiver, and it would not be incorrect to say that this is the component which is used most often. Not so very long ago, this took the form of a small ebonite case, so designed and drilled that it could be mounted either vertical or horizontal. Terminals were provided for making the connections. With the modern design of receivers, it is not always convenient or worth while to fix the condenser by screws or bolts, and, therefore, the "tag" condenser has been produced for modern mounting. This consists of a thin bakelite casing, less than a quarter of an inch thick, inside which the plates and dielectric are fixed. Moulded into the ends are thin metal strips, provided at the end with rings. These ring ends are quite thin and, therefore, lend themselves admirably to mounting beneath terminal heads, etc. By arranging the distance between, for instance, the tuning coil base and the detector valve, the condenser may be used to bridge these two components, thus saving two wires, and only giving two connections to be made instead of four. Many other uses will be found for this component, which is made in all values from .0001 to .002 mfds. For those who for any reason prefer the old method of mounting, two holes are provided at the sides of this condenser. The price is 6d. each.

MANSBRIDGE BLOCK CONDENSERS

For the construction of a mains set, a number of large fixed condensers are essential. These take up a considerable space, besides requiring a number of holding-down screws. The inconveniences of these are overcome by what is known as the Block Condenser, which consists of a large metal case housing a number of condensers of the Mansbridge type. Three patterns of this block are available, having totals of 4, 6 and 8 mfds., each type being divided up into 2 mfd. sections. The connections are all brought out to the top, so that practically any desired value may be obtained by suitably connecting the lugs. The blocks are made in two types, 500 volt test and 1,000 volt test (this latter is not, however, made in the 8 mfd. pattern). Prices of these condensers will be found in the advertisement pages.

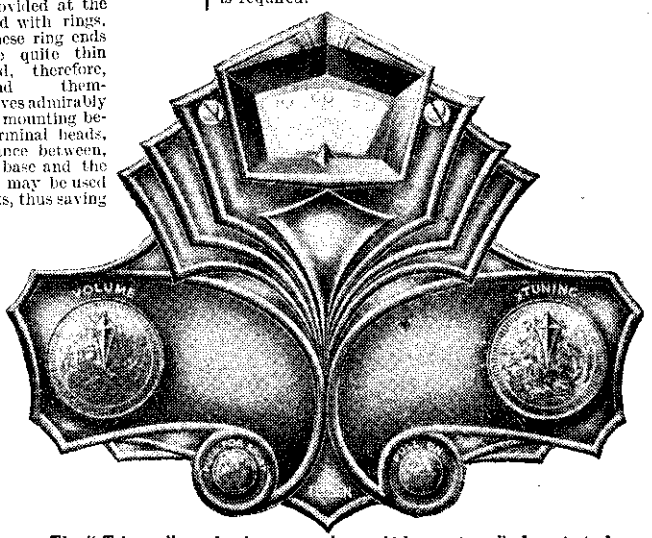
PRE-SET CONDENSERS

Pre-set condensers—sometimes known as "semi-variables," are found very useful for the experimenter. Provided the insulation is good, and the action smooth, they prove a boon in experimental "hook-ups." The Telsen Pre-set is provided with a locking ring, so that when adjusted to a suitable position, the adjusting screw may be fixed. Made in maximum capacities of .0001 to .002, these interesting components cost 1s. 6d., and are guaranteed low-loss.

H.F. CHOKES

There are two main uses for an H.F. choke in a receiver—to choke back H.F. currents for reaction purposes, and to provide a coupling impedance. For the former purpose the requirements are not, obviously, so important, and the Standard Telsen H.F. Choke will be found admirable for this purpose. An inductance of 150,000 microhenries, a D.C. resistance of 400 ohms, and a very low self-capacity, are indications of the efficiency of this choke. With a neat case enabling it to be mounted in the minimum of space, this item costs 2s., and will be found ideal for reaction purposes.

For a coupling impedance, a much higher inductance is necessary, and the Binocular Choke, with a value of 250,000 microhenries, certainly has a claim here. In addition, it is wound in binocular form, which reduces the external field and so prevents instability due to interaction. This component is obviously dearer, but is well worth the 5s. where a choke for coupling purposes is required.



The "Telornor"—a handsome escutcheon which contains all the principal controls of the usual receiver.

Practical Letters FROM OUR READERS

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

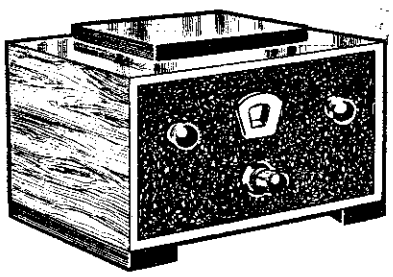
The Editor does not necessarily agree with opinions expressed by his Correspondents

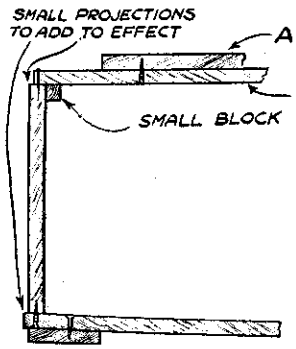
Burton-on-Trent Radio Society

SIR,—The Burton-on-Trent Amateur Radio Society, which has been formed to further the interest in radio reception in the district, hopes to cater for everyone, from the veriest beginner to the old hand. New members will be welcomed. All applications should be sent to the Hon. Secretary, W. A. Mead, G5YY, "Addiscombe," Branstone Road, Burton-on-Trent, or ring up Burton 835. The Society would also welcome lecturers from manufacturing firms. —W. A. MEAD, G5YY., Mem. R.S.G.B., Hon. Sec. (Burton-on-Trent).

An Appreciation from Camco

SIR,—If the first two issues of PRACTICAL WIRELESS are examples of forthcoming issues, then the success of this paper is undoubtedly assured. There is still a very large number of constructors who must welcome a publication such as yours, which is crammed full of good ideas, suggestions and advice, and we take this opportunity of wishing your journal every possible success.—W. J. SALAMAN, Sales Director (Carrington Manufacturing Co., Ltd.).





Diagrams illustrating letter from "Vic" (Barnstaple).

Instruction—not Sarcasm

SIR,—Please permit me to add my congratulations upon the excellence of PRACTICAL WIRELESS, and count on my being a regular subscriber.

I like your articles, which are free from sarcasm: your advice bureau is a boom; and, above all, I like the fact that your paper adheres to wireless instruction, and does not attempt to fill space with stuff which the wireless fan doesn't want.

Your chats are great, and do not give us a new circuit every week, rather tell us how to make the most of the set which took all our pocket-money to construct.—A. J. LAWRENCE (Newcastle).

The Neglected North

SIR,—I have read the current issue of PRACTICAL WIRELESS and must congratulate you on the articles contained therein.

However, to my mind, in all radio journals there appears to be neglect of the North of England and its problems, reception conditions, etc.

A "Northern Radio News" would, I am sure, be of interest.—R. BILLHAM (Dunston-on-Tyne).

Using Pentodes

SIR,—May I congratulate you on a fine effort. You have, to my idea, struck the right style: not too dull, and not too learned for the average radio enthusiast. While not exactly a novice, having been in radio since we had accumulators weighing (it seemed) a ton, I find it most refreshing in its style and have placed my regular order.

In regard to all the articles on pentode valves, perhaps my experience may interest you, if not your readers.

I have never yet seen a pentode advised in a set with two L.F. stages, as it causes overloading and instability.

Now (prepare for shocks), I have a well-known home-made set, det. and two L.F. transformer coupled stages, with a pentode in the final stage, and pick-up in the detector valve.

Granted, the volume control has to be tuned down a bit on the local, but on distant stations it is a revelation to my old power valve.

Furthermore (more shocks), I use no tapped output choke: merely an ordinary filter that I used for my power valve and a tone control of .01 fixed and spaghetti of 20,000 ohms across L.S. terminals, with a Harlie tone selector.

With 130-volts Standard No. 3 H.T. battery and a 66 R. Blue Spot, tone is nearly as pure as a moving coil, and nobody would say I was using this much-abused type of valve.

I don't say all makes of pentodes would act as satisfactorily as the make I have, but my valves (all three of them), are built different to others, I believe, and on the 'gram. I can make the ornaments rattle without any distortion.

Trusting this may interest you.—R. G. HARRISON (Newcastle).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—That an H.F. valve under-biased will result in flattened tuning.

—That long leads on the output side of a receiver can result in high-note loss.

—That ordinary vaseline applied to the terminals of an accumulator will prevent "creeping" and corrosion.

—That a tone control of modern design will enable that annoying heterodyne whistle to be suppressed.

—That if by touching a grid terminal with a moist finger a "plop" is heard, that valve is oscillating.

—That a full-size P.M.G. 100-ft. aerial has a natural wavelength of about 120 metres.

—That the reproduction from a cone loudspeaker may often by improved by painting the cone with a collodion (or cellulose) paint.

Mr. Richardson Bows!

SIR,—May I tender to you my best wishes, and thanks, for producing such a helpful weekly journal.

It is the best threepennyworth I have bought, with a free advice service, too. I wish you and staff every success in this new departure. W. B. C. Richardson's article was very good.—F. WEBSTER (Bristol).

Prison for the Editor and Staff?

SIR,—I have just finished giving No. 3 of PRACTICAL WIRELESS a preliminary "once-over," and have arrived at the following conclusions: (1) That you and your entire staff should be sent to prison for ten years, representing one year for each one of those you have withheld PRACTICAL WIRELESS from the radio-minded public. We have been waiting for such a publication for that length of time; (2) That it is the finest radio journal offered, or ever has been offered, to the public; (3) That it is worth 3s.; (4) That if the present standard of the contents is maintained, your circulation will be determinedly maintained and go on increasing and increasing. In fact, it's a stunner, and I honestly wish to congratulate you and your staff on its fine achievement.

What a wealth of information you are giving us! Hardly believable at the price! The details, the diagrams, the whys and the wherefores; do please keep it up, especially the diagrams. In short, please maintain the present standard. I won't ask you to do the impossible, and improve on it. I may add that this is the first letter I have ever sent to a paper. Again thanking you for "the goods" and such splendid reading—and diagrams.—A. G. K. SEIRER (Newport, Mon.).

A Constructor's Thanks

SIR,—Many thanks for putting a book like PRACTICAL WIRELESS on the market; it fulfils the need of every amateur like myself. With only the second number published, I, who before its advent was afraid to interfere with my set in case of causing damage, have been able with its help and diagrams to take it to pieces for cleaning and reassemble it successfully.

Wishing you every success.—G. BENNETT (Swansea, Glam.).

Radio Cabinets

SIR,—As a designer of radio cabinets, I was very interested in your article on Cabinets. Radio cabinet-making has become a special branch of the woodworking trade, and I should like to offer a few suggestions, if I may.

Enclosed is a sketch of your Fig. 8 as I should carry it out, with the "reasons why" indicated. No reflection on Mr. Richardson is intended, as his is a difficult job. It is worth noting that in Messrs. Telson's recent competition, out of 200

(Continued on page 256)

Practical Letters from Readers

(Continued from page 255.)

designs only fifteen were considered "passable." All kinds of designers entered—an architect gained second prize, another commercial cabinet designer and myself first and third respectively. The sample cabinets even had a "bumping" test, so it is evident that radio cabinet design and construction is no "picnic" nowadays. With every good wish that your paper may successfully live up to name.—"VIC" (Barnstaple).

Congratulations and a Suggestion

SIR,—Allow me to thank you for producing an instructive weekly at a moderate price. I thank you, too, for five very useful hints which I have already put to the test. Let me here say I mostly regret that, owing to illness caused through the late war, I shall not be able to have the pleasure of constructing your sets as much as I would like to. Of the two already published I like the Long Range Express Three, and I think two of my friends will take my advice and get the kits for me to construct for them. Now for the true reason for writing you. I'm a man whose sole interest in wireless is to build sets, find their faults and rectify them. I am called out to all kinds of sets and to me it is a great pleasure when I have a stiff problem. On many occasions I have sat up all night with them.

Well, here is a hint which I hope you will not resent me giving you. My experience is this, that there are thousands of people who have not got sets, but would like to own one. They are beaten by the *technical terms* and *technical circuit diagrams*. What they want is plain English and actual drawings of components with point-to-point connections. These are the thousands who are waiting to be educated as regards the ins-and-outs of wireless. I hope you will take them under your wing, as the editor of a new wireless paper, and become their wireless father, giving them plain advice and instructions. You will be helping these people twofold: first, you will be educating them, and, secondly, by giving them something they can understand, you will be keeping them clear of the few wireless sharks who make money out of the people's lack of knowledge.

Here's your chance. Keep to simple instructions in plain English, and I can see your paper having a huge circulation.—JOHN E. DEWS (Wakefield).

Radio Fads and Fallacies

SIR,—Most of the wireless set designers of to-day take it for granted that their readers are possessed of unlimited pocket-money, and can go on spending it on the newest gadgets that are put on the market. I have written on several occasions to these people protesting, and when I bought your first number, I hoped that perhaps a new paper would recognize this fallacy, and would at least reserve a page or two for those—the enormous majority of possible readers—who can *not* afford to spend money on the latest thing in coils or tuning units, etc. But here is your contributor, Mr. W. B. C. Richardson, with the air of a millionaire, gaily writing: "Another silly fad is that of saving obsolete apparatus—with the idea that they might come in useful. Throw them away—it is only a sign of meanness." For my part, I suggest to your readers that the silliness consists in throwing such "junk" away, and that it is quite possible to utilize even broken transformers and faulty variable condensers, and those old coils that were wound so carefully years ago; and I would urge that some of your experts would be adding enormously to your readers' interest if they would tell us how to make use of this accumulation of odds and ends, the debris of many years' experiments. It is absurd to suppose that no use can be made of this material. I have, for example, a little model "water-mill," the inside of which consists only of junk, which serves an invalid as a one-valve set. I know of a "birdcage" set, which hangs in the window, and looks like a birdcage—canaries and all. It works a loud-speaker on high or low wavelengths, and, again, its parts are only discarded "junk." I have seen, also, an "occasional" table in a lady's drawing-room (that is all that it appears to be on the surface); but it is really a three-valve loud-speaker set—again made of very ancient components. I believe that if you were to publish a series of articles on "What to do with your Junk," you would be filling a gap, and responding to a very real question which looms large in the minds of many of the amateur experimenters of the present day.—S. N. SEDGWICK (Liss, Hants).

A Few More Suggestions

SIR,—I would like to thank you very much for the first two copies of PRACTICAL WIRELESS. As a wireless enthusiast of several years standing, I would like to make one or two suggestions which I hope will be useful to you:

1. When reviewing new apparatus, do not forget to give figures. Adverts. tell us that everything is the best, but very few give figures to prove this.

2. May I suggest that a page weekly be used for "How to Make" chokes, transformers, home accumulator chargers, and, above all, a variable cut-off, heterodyne whistle filter.

3. Do not forget that a home constructor hasn't two or three pounds to spend on band-pass tuning, so let us have something different sometimes.

4. I think lots of people would welcome an article on the following: The exact performance of a set and speaker built in the same small cabinet one sees to-day, and the same set and speaker built into separate cabinets of respectable size. The thickness of material used to be taken into account for speaker.—C. P. HOPKIN (Peterborough).

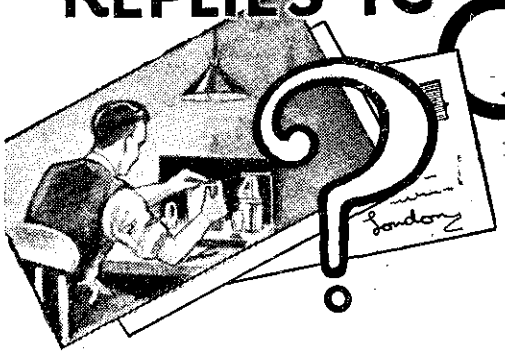
A Cure for Feed-back

SIR,—I am a wireless amateur of about ten years standing and must congratulate you on your new paper, PRACTICAL WIRELESS; not only are there plenty of articles and advice, but they are really useful and helpful. I shall certainly continue to take your paper.

Here is a hint for your readers: Sometimes when fitting a new coil, or especially a new detector valve, the set oscillates with the reaction condenser only in a few degrees. Thus, with the vanes all out, the feed-back is too much on loud signals. The cure is a small fixed condenser, about .0001, in series with the moving vanes of the reaction condenser and the plate of the valve. This lowers the condenser short circuit if the condenser vanes should happen to touch.—ERIC BASILIO (West Hove).

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff



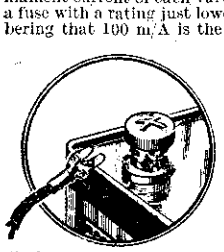
The coupon on page 260 must be attached to every query.

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.

SIZE OF FILAMENT FUSE

"I wish to fit a fuse in my battery-driven receiver to safeguard the valves from being burnt-out in the event of a short from the H.T. What size must this fuse be?"—(H. K. B. C., Bristol).

In the majority of receivers the filaments are wired in parallel, and you must therefore add together the filament current of each valve. You should then choose a fuse with a rating just lower than this figure—remembering that 100 m/A is the same as .1 amps.



Faulty or corroded battery connections will have a considerable effect on the reception of the set.

CORRODED CONNECTIONS

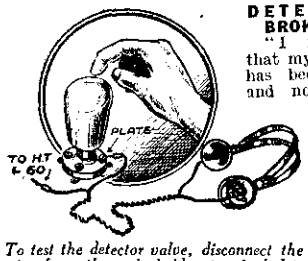
"I have noticed that the spade terminal attached to my accumulator gets covered with a green crystal deposit. Is there anything wrong with my accumulator, or is this the normal effect of working?"—(R. S. T., Heston).

The corrosion is a natural outcome of the effect of the accumulator acid on copper. It is, however, a thing which should be avoided, as it results in weakened reception. Thoroughly clean your spade-end, and the terminal, and then, after tightening the terminal on the spade, smear it all over with vaseline. A lead connection, in place of the copper, will avoid this corrosion difficulty.

PORTABLE LICENCE

"I have just purchased a portable receiver. Do I have to buy a licence for this set? I might mention that I already have a five-valve set for which I have a licence."

The Licensee, L. V. (Tynemouth), is permitted to use any number of receivers at the address mentioned on the licence, but not elsewhere. As a concession, one portable set may also be used under that licence, at an address other than that given on the licence, but this concession is for the convenience of the licensee on holidays, week-end car trips, etc.



To test the detector valve, disconnect the wire from the valveholder terminal lettered A or P, and connect one lead from a pair of headphones to the terminal, and the other lead to H.T. positive 60. Tap the valve with your finger and you should hear a ringing noise in the phones.

DETECTOR-VALVE BROKEN

"I rather fancy that my detector valve has become damaged, and not being lucky enough to have any test meters I wonder if you could tell me any easy way of testing whether it is broken?"—(P. M., Kneller-Hall).

The simplest test is illustrated here. Join a pair of 'phones in the Plate circuit, and tap the glass bulb gently with your fingertip. A ringing noise will be indicative of the fact that the valve filament is unbroken.

S.G. VALVES

"I have noticed that the two sets you have so far published employing screen-grid valves, do not employ the usual vertical screen with the valve pushed through it. Is this method not necessary nowadays?"—(A. R. T., Peckham).

The valves employed in our two sets were metallized, and this metal coating acts as quite a good screen *when it is earthed*. Certain types of S.G. valve are so efficient that complete separation of the anode and grid circuits is essential if stability is to be maintained. Careful design and choice of components will, however, enable a stable receiver to be constructed without the vertical screen arrangement.

H.T. CONDENSERS

"I have just had a set built up for me, and am rather puzzled by a peculiar effect. When I have finished listening-in, I switch the set off and can hear the switch click, but the signals keep on for a second or so and then fade out. Does this mean that there's a leak somewhere?"—(W. J., Hoxton).

The phenomenon you refer to indicates that your set is probably well constructed. Across the H.T. tappings you will no doubt find large capacity fixed condensers, and when these are of good quality they store up the current, and then when you switch off they discharge this "store," giving rise to the effect you refer to.

LONG-WAVE WINDING

"Why is it that the long-wave section of a coil is invariably wound in sections instead of in a single bank? I appreciate the fact that it could not be wound in solenoid fashion, but is there any reason why one good pile winding would not do?"—(F. T. P., Balham).

The reason is that a coil has to possess inductance and capacity in certain proportions if it is to be efficient. The inductance is decided by the amount of wire, and the capacity results from the effect between adjacent turns of wire. By splitting the coil up into a number of small sections we reduce the over-all capacity, and therefore, preserve the efficiency.

PRACTICAL WIRELESS DATA SHEET No. 5

TUNING COIL DATA

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

Outside diameter of former.	Wire gauge.	No. of Turns.	Length of Winding.	Inductance value (microhenries).
1.5"	28 D.C.C.	94	2.25	175
1.5"	30 D.S.C.	82	1.25	200
2.0"	28 D.S.C.	58	1.01	175
2.0"	28 D.S.C.	64	1.15	200
2.5"	24 D.S.C.	58	1.85	175
2.5"	24 D.S.C.	64	2.05	200
3.0"	22 D.C.C.	50	1.9	175
3.0"	22 D.C.C.	55	2.09	200

With a .0005 mfd. Tuning Condenser the 175 microhenry coil will cover a band of approx. 200 to 555 metres, and the 200 microhenry coil a range of 250 to 600 metres.

INTERFERING HUM

"I am troubled by bad hum from my mains set, which can be cured by disconnecting the aerial. A small indoor aerial works O.K., but does not give any range. Can the aerial pick up hum, and, if so, how can I remedy it?"—(A. P. P., Blackpool).

As the aerial certainly seems to help in picking up the hum it would seem that some outside source is responsible for this trouble. Therefore, make sure that your aerial does not run parallel with any conductor of A.C.; house lighting wires, tramway overhead wires, etc. You should also enquire whether any machinery is in use near you which would cause the interference. In the latter case you should get into touch with the owners of the apparatus, and if they are unwilling or unable to reduce the interference, write to the B.B.C.

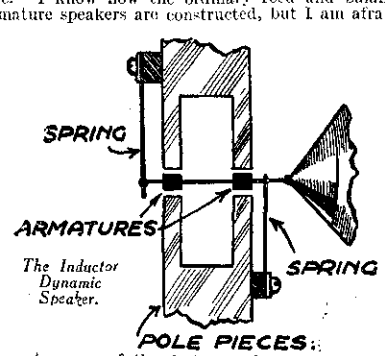
SPEAKER FOR SMOOTHING

"I have been given to understand that a moving coil type of loud-speaker may be used in an eliminator instead of the ordinary smoothing choke. As I am building an eliminator, and at the same time wish to purchase a moving coil speaker, I should like some information on this arrangement."—(F. J. P., Windermere).

To enable you to use the field winding of a loud-speaker for smoothing purposes, you must first of all choose a mains transformer and rectifying valve which will deliver a voltage much in excess of that required for your valves. The speaker must then be of the D.C. type, designed for this special purpose, which means that the resistance must be very high. The voltage dropped across the field will, of course, leave you with the normal mains output voltage. Suitable values are—mains transformer and valve to deliver 350 volts—speaker field resistance, 2,000 ohms.

INDUCTOR LOUD-SPEAKER

"I have seen a number of advertisements lately referring to a loud-speaker called an 'Inductor Dynamic.' I know how the ordinary reed and balanced armature speakers are constructed, but I am afraid I am not aware of the features of this arrangement. Could you explain the idea to me?"—(R. S., Brighton).



The Inductor Dynamic Speaker.

The illustration above should explain the principal points of the Inductor type of speaker. As will be seen, the reed supporting the cone is attached to two thin springs, held at opposite ends, and supported between two pole pieces. As the springs are held at opposite ends they may be very thin, and furthermore, the movement of the rod will be strictly horizontal. This results in a real "piston" movement, and it is claimed that the overall response is improved.

DEFECTIVE VALVE-HOLDER

"I recently took out the grid leak from my detector stage, with a view to substituting one of a different value. Imagine my surprise to find that it made no difference to reception, as signals came through all the time with no difference. Does this mean that there is anything wrong with the valve, or some other component?"—(S. A. V., Belsize Park).

Theoretically, the valve should not work without a grid leak, but actually this state of affairs does not exist. The most likely trouble is an inferior valve holder, which permits of a leak between the grid and positive filament socket. This of course, acts in the same manner as an orthodox grid leak, and permits the valve to function.

GRAMOPHONE SWITCHING

"I have seen several notes and circuits in your issues, but cannot understand the theoretical diagrams.

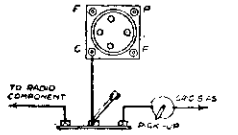
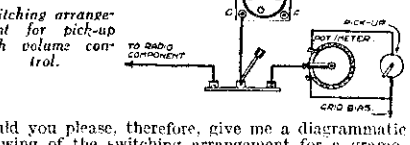


Diagram showing switching arrangement for pick-up without volume control.



Switching arrangement for pick-up with volume control.

Could you please, therefore, give me a diagrammatic drawing of the switching arrangement for a gramophone pick-up?"—(S. V. T., Hastings).

The two sketches above show the method of arranging a switch to connect a pick-up to the grid of a valve.

(Continued on page 260.)

Queries and Enquiries

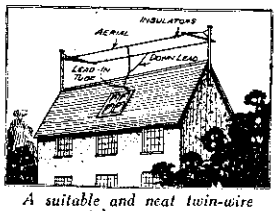
(Continued from page 258.)

One illustration shows the connection for a pick-up without volume control, and the other with such control. The radio component referred to in the sketches is the grid condenser, or the L.F. transformer. This will depend, of course, upon whether it is the detector-grid circuit or L.F. circuit.

AERIAL ARRANGEMENTS

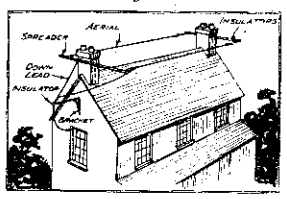
"I am unfortunate in not having any garden in which to erect an aerial. Could you suggest any other outdoor arrangement which I could build up so as to get results which would be better than an indoor aerial?"—(F. S., Barking).

There are two good methods which you could employ, and they are both illustrated (right). Where a chimney-stack is available at each end of the roof, poles may be fixed across to support two horizontal wires, spaced 4 or 5ft. apart. The wires at one end are joined together and taken down to the receiver. Vertical poles may be used in place of the chimney-stacks, and leads may be taken from the centre of the aerial if that course is more convenient.



A suitable and neat twin-wire aerial arrangement.

Another twin-wire aerial arrangement.



SAFETY FUSE

"I have fitted a safety fuse to my battery receiver, as shown on the attached sketch. I can, however, get no signals. Have I put the fuse in the right place?"—(S. T. P., Leeds).

You have inserted the fuse in series with a filament wire, and this is not the correct position. The fuse should be inserted in the short lead which connects H.T. and L.T., and the wire to the filaments should be taken from the side of the fuse which is joined to the L.T. terminal.

SHORT-WAVE DIFFICULTY

"I have made up a short-wave set, using home-made plug-in coils with a slow-motion .0005 tuning condenser and a .0003 reaction condenser. So far I have not been able to get a single station, so I send you the circuit herewith and should be glad to receive any hints."—(B. P., Hythe).

A tuning condenser of the size you are using is much too large, even with a slow-motion dial. The largest condenser you should attempt to use is .0002, while best results will be obtained with a maximum value of .0001.

DUAL RANGE COIL

"Is it possible to make up a dual range coil at home? If so, could you give me details such as gauge of wire, number of turns, etc.?"—(G. M., Harrow).

An efficient dual range coil may easily be constructed at home, and full details of such a coil were given on page 13 of the Free Gift Book given away with No. 2 of PRACTICAL WIRELESS.

LONG RANGE EXPRESS

"In the blue print of the Long Range Express you show a lead marked 'To Fixed Plates of Aerial Tuning Condr.' with a note that this is braided flex earthed to chassis. I cannot understand either how you can earth braid, or if this is not what you mean, why you should earth the flex from the grid. Perhaps you can explain all this."—(M. D., Prestwych).

The braided flex is a length of ordinary flex covered with a metallic braid. The two ends of a length of this lead are bared, one end joined to the grid terminal of V1, and the other end to the fixed plates of the first condenser. The *covering* is then earthed by means of a clip attached to the metal chassis.

THERMAL SWITCH

"What is meant by a Thermo Delaying Switch, which I have seen advertised recently?"

You have got the term rather mixed. The switch is a delay-action switch working on a thermal action. It consists of a thin wire wound round, or in close proximity to, a bi-metal strip. When a current of a certain value passes through this small winding it heats up. At a certain determined temperature the bi-metal strip distorts or bends, and this is arranged so that this makes a contact and so completes a circuit. The switch is employed in mains operated sets to complete the H.T. circuit, only after the heaters have reached maximum temperature.

FREE ADVICE BUREAU
COUPON

This coupon is available until Oct. 29th, 1932, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 22/10/32.

The Heart of Your Set

(Continued from page 236.)

How to Select the Valve for the Output Stage

The choice of an output valve must be considered with reference to two main points—the volume of sound required (always assuming that the speaker is capable of giving that volume when correctly driven) and the design of the previous stages of the receiver. For moderate volume in a receiver where, owing to small input or restricted amplification, only a small grid swing is available for the output valve, a "power" type valve must be chosen. If greater volume is required a pentode must be used. In all receivers having one or more previous stages of amplification, a super-power triode capable of handling without distortion the big grid swings available should be selected, or a pentode can be employed providing the receiver incorporates some form of volume control so that overloading of the pentode can be avoided by reducing the grid input when necessary.

Of several triode output valves, all of which are capable of handling the signals with which they will be called upon to deal, those having the lowest impedance and the highest amplification factor will give the greatest output, the value of the mutual conductance or factor of goodness being the final deciding factor.

Decision in the case of a pentode again, must be made on a comparison of the mutual conductances of the available alternatives. In some cases, however, it may be necessary to take into consideration the battery consumption of the valve, and in the interests of economy in battery power, a valve taking a smaller anode current may have to be employed in preference to a more efficient valve requiring a somewhat larger H.T. consumption.

Detector Valves

There is a much smaller range of choice of detector valves than of valves for amplification and power output. In the first place, for all ordinary purposes, the only class of valve that can be used for detection is the triode. It is possible to employ both screened grid and pentode valves as detectors, but the circuits are not well known at the moment, and are seldom met with in commercially built sets. Moreover, British valve makers appear to be standardising on fewer types of detector valve—in fact, the special detector seems to be disappearing from the catalogues of many makers, and the so-called "general purpose" triode, suitable for both detection and low frequency amplification, is coming into its own again. For use as a normal leaky-grid detector, the "H.L." type has proved most satisfactory when followed by transformer coupling, or for an R.C. coupled detector when the anode resistance is of medium value, say, below 100,000 ohms. A valve of this type should, therefore, be chosen in sets employing no high frequency amplifier before the detector stage, unless a very high resistance R.C. coupling is used, when an "H" type, high amplification, high impedance valve will probably give better results.

AMAZING DISCOVERY

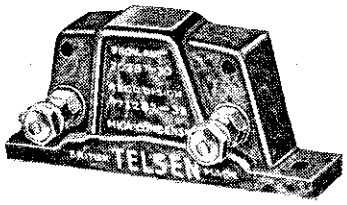
98% RADIO SETS "DOWN" IN EFFICIENCY THROUGH FAULTY GRID LEAKS OR MICA CONDENSERS!

A RECENT analysis of Kit sets and Home Constructor Receivers reveals the astounding fact that 98% were considerably 'down' in efficiency through faulty Grid Leaks or Mica Condensers. These tests were carried out by one of the foremost Radio Engineers in the Country on sets which the owners thought were working satisfactorily.

The above facts were brought to the notice of TELSEN Engineers who immediately commenced intensive research and experimental work to discover the causes. Every known make of Grid Leak and Mica Condenser was tested and examined in conjunction with all types of Receivers.

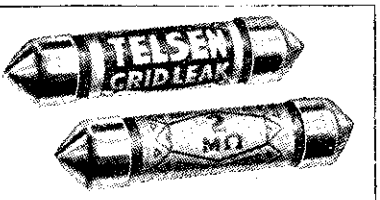
Invaluable information and new data were obtained from these investigations among which were startling revelations concerning the rapid deterioration and consequent loss of efficiency in these components.

The new TELSEN Grid Leaks and Mica Condensers are the direct outcome of this amazing discovery. They have been designed on entirely new lines and embody the new



TELSEN FIXED MICA CONDENSER
(Shown with Grid Leak Clips removed).

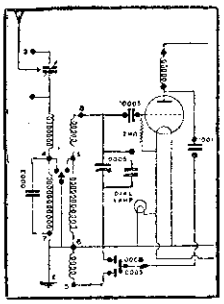
principles formulated by the Telsen Radio Engineers to overcome the numerous faults



Two views of the TELSEN GRID LEAK.

disclosed and to attain permanent efficiency.

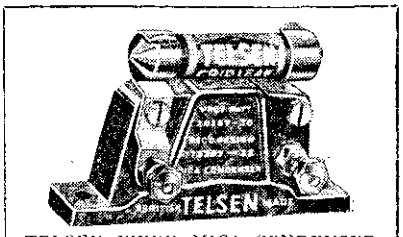
TRY THIS SIMPLE TEST



Tune in a station at the top of the medium wavelength band—say the Northern Regional. Note the signal level. Now connect a Telsen Mica Condenser (up to .0003 mfd. in value) across the aerial tuning condenser. Decrease the value of the tuning condenser until the same station is heard, and it will be found that the signal strength is equal to that previously obtained, proving that the Telsen Mica Condenser has an efficiency comparable with that of the variable air condenser, the most efficient type of condenser used in radio broadcast reception.

The new TELSEN Grid Leaks and Mica Condensers set a world's standard in lasting efficiency.

IT'S THE 'LASTING EFFICIENCY' THAT COUNTS



TELSEN FIXED MICA CONDENSER.
(Complete with Grid Leak Clips & Grid Leak)

WE HEAR

That well over a quarter of a million radio components are produced *every day* in the new Telsen Works (the largest and best equipped radio organisation in the world, employing in the neighbourhood of 8,000 workpeople)—and that even this record output is only barely sufficient to meet the enormous and still rapidly increasing demand for these popularly priced quality components.

★ ★ ★

That enormous numbers of home constructors are fitting the new Telsen Drum Drive and Ganged Condenser Assembly, whose single knob operated tuning scale, calibrated in actual wavelengths, makes station logging literally as easy as A.B.C.

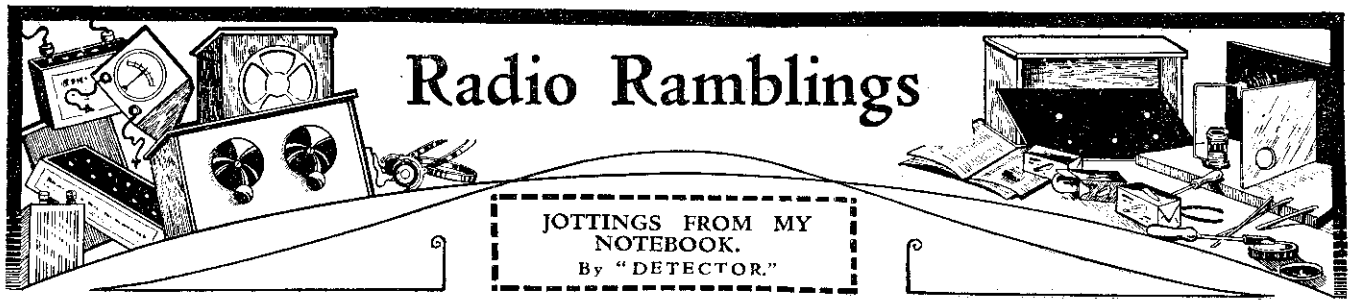
★ ★ ★

That the new Telsen Telornor (illuminated variable ratio slow-motion Disc Drive, whose handsome silver oxidised escutcheon plate permits of the very effective grouping of all controls) gives home-built sets the dignity and beauty of line of expensive commercial radio receivers.

★ ★ ★

That home constructors everywhere are thrilled with the performance of the sensational new Telsen JUPITER S.G.3 and AJAX 3 receivers, and that free 1/- blueprints and constructional details of these amazing sets are given with the Telsen Radiomag No. 3, price 6d.

Announcement of The Telsen Electric Co., Ltd.



Radio Ramblings

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

The Earth Connection

I HAVE recently run up against what appears to be almost an epidemic—of inefficient earth leads. In most cases the earth has looked O.K., but the set has given trouble due to low-frequency oscillation or some similar fault suggestive of an unsatisfactory earth connection. (The way to test an earth, by the way, is to touch the earth terminal of the set with a moistened finger; if this affects reception in any way the earth lead is failing to do its proper job.) In nearly every instance of a faulty earth the trouble can be traced to a corroded contact between the wire and buried plate, or water pipe, as the case may be. The cure is thoroughly to clean, and re-make the contact either by soldering or by tightly binding round the wire and then to *cover the joint* with a good coat of paint or varnish. This covering will protect the joint from further corrosion for two or three years at least.

Loud-speaker Demonstrations

I WONDER why so many radio dealers will persist in giving perpetual loud-speaker demonstrations (?) in their shops. I went into a shop recently and the noise was so great that I was obliged to shout at the top of my voice to make known my requirements. Hoping to take a rise out of the manager, I mentioned the fact that it was now contrary to regulations to use broadcast transmissions for public demonstration purposes, but he quickly reassured me that he was using gramophone records and was consequently well within the law. It is a pity that something cannot be done to stop this nuisance, for it is bound to have a bad influence on the radio trade. The trouble is that most dealers endeavour to obtain the greatest possible volume from an ordinary three- or four-valve set and a small moving-coil speaker. As a result, both set and speaker are grossly overloaded, so that good reproduction is absolutely impossible. If dealers really must give these demonstrations and "shout down" all competitors, why don't they buy or make a proper amplifier and speaker capable of giving a decent output? This would at least ensure that reproduction bore some resemblance to the original, even though it were sufficient to deafen customers—"and the dealers themselves," I almost added—but they seem to be quite immune from aural troubles. They must be, or they could never live through the continual din.

Metallized Resistances

I AM very fond of those little metallized resistances which were first brought on to the market last autumn. They are compact, non-inductive, and obtainable in a variety of power-ratings. If you ever manage to break one you will find that the resistance element resembles the lead of an ordinary pencil and passes through the centre of the otherwise solid porcelain rod. The ends of the resistance element are connected to metal end caps like those of the usual grid-leak. These resistances can thus be used by fitting them in an ordinary grid-leak holder, but they possess the added advantage of having a short connecting wire projecting from each cap. In most cases it is possible to attach them directly to the set by means of the connecting wires, but it is sometimes found that the wires are not long enough to reach the appropriate terminals. It then becomes necessary to extend the wires by some means or other. The most obvious is to solder longer pieces of wire to them; but I prefer another method. I fit a small terminal to the wire and connect up to this in the usual way. This method simplifies the changing of one resistance for another of different value when experimenting. (See Fig. 1).

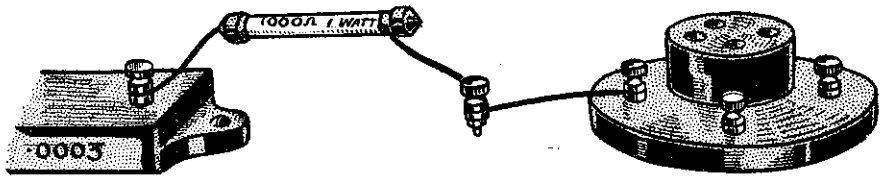


Fig. 1.—Using an extension lead to facilitate the connection of wire-end resistances.

Power Rating of Resistances

YOU have noticed that most of the resistances used for wireless purposes are now sold in a variety of power ratings from 1 to 10 watts, and have perhaps wondered exactly what these figures are intended to convey. As the resistances of lower rating are cheaper, it is customary to use the lowest which is sufficient for the required purpose. The power consumption (in watts) can always be obtained from the formula:—

$W = C^2R$

where C is the current in *amperes* and R the resistance in ohms. When choosing a resistance, though, it is wise to allow a safety factor of 20 per cent. or so.

By way of example, let us suppose that a 500 ohm bias resistance is required for an A.C. power valve having an anode current consumption of 50 milliamps (.05 amp.). The power taken by the resistance will be $.05^2$ multiplied by 500, or .0025 times 500, which is 1.25 watts. Adding to this a 20 per cent. safety factor we find that a suitable resistance should have a power rating of not less than 1.5 watts. As another example, we will suppose that a 50,000 ohm resistance is required for decoupling the anode circuit of a detector valve taking 1 milliamp (.001 amp.). The power dissipation of the resistance will now be $.001^2$ times 50,000, or .05 watt, so a 1 watt component (the lowest rating generally made) would be more than sufficient.

Another Cause of Mains Hum

IT would be impossible to give a list of all the things which might cause hum in a mains set, for one is continually running up against new ones. The method of treatment also varies in almost every case. Whilst testing a well-known make of commercial four-valve A.C. set recently, I was amazed to find that the hum was so bad as to make reception of even strong stations most unpleasant. I had recently used a similar set with every satisfaction, and knew that the mains supply was not unduly "rough." Valves, speaker, and sundry other things were suspected, but no fault could be found. Eventually the back of the cabinet was removed to gain access to the "works," and the cause of trouble was at once apparent. This particular set was fitted with a very long length of flex to connect up with a distant wall plug, but the owner had recently moved the set on to a table nearer to the plug. To avoid cutting off a length of the connecting flex, the latter had been coiled up and tucked away inside the set. It so happened that the coil was quite near to an L.F. transformer and induction was responsible for the hum finding its way into the transformer windings. (See Fig. 2.)

(Continued on page 263.)

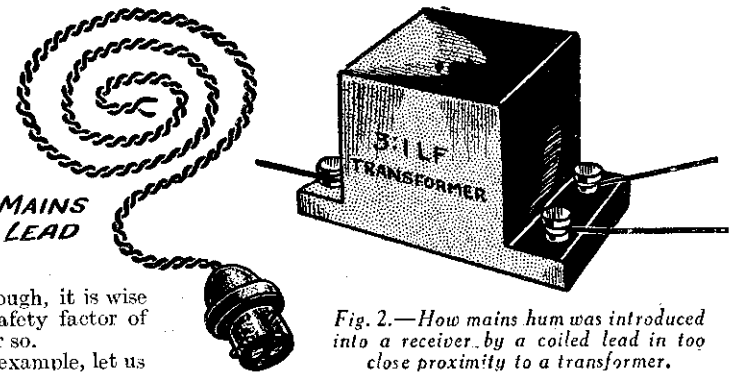


Fig. 2.—How mains hum was introduced into a receiver by a coiled lead in too close proximity to a transformer.

Radio Ramblings

(*Continued from page 262.*)

Safety Fuses

I HAVE often been rather surprised to find that apparently experienced amateurs did not know where to fit a safety fuse in a set. Now, the object of the fuse is to allow sufficient anode current to flow to the valves, but to prevent the flow of any current high enough to burn out the valve filaments in case of an accidental short circuit or wrong connection. It is fairly obvious then that the fuse should be fitted between the high-tension battery and the low-tension supply. Actually it could be fitted in either the positive or negative high-tension lead, but it is generally inserted between H.T. and L.T. The simplest way to fit a fuse to a set not so equipped is to employ one of those combined with a battery wander plug. It is then only necessary to replace the negative H.T. wander plug by the combined plug and fuse. This type of fuse has the further advantage of being readily accessible. (See Fig. 3.)

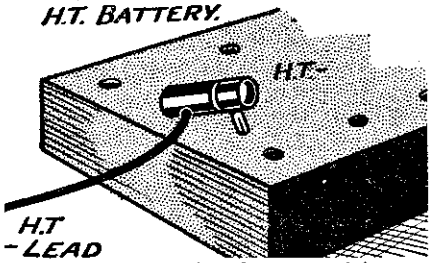


Fig. 3.—The Belling-Lee type of fuse.

Break Through and How to Cure It

(*Continued from page 219.*)

happens that when reducing the setting of such a condenser a point is reached where break-through occurs. This is because the natural wavelength of the primary circuit, which in the particular coil used would normally be well above the break-through range, is lowered sufficiently to bring it into the danger zone. Obviously, this cannot occur with the second method since the natural wavelength of the primary circuit is already below the medium-wave band, and the reducing of the condenser setting would only tend to lower it still further. Where, however, trouble of this sort does arise the only cure is to increase the setting of the series aerial condenser and make up for the reduced selectivity by decreasing the coupling between the primary and secondary circuits. If the coil is a home-made one, this can easily be arranged, either by reducing the number of turns in the tapped portion C, in the case of Fig. 4, or by placing the windings C and D farther apart, in the case of Fig. 5.

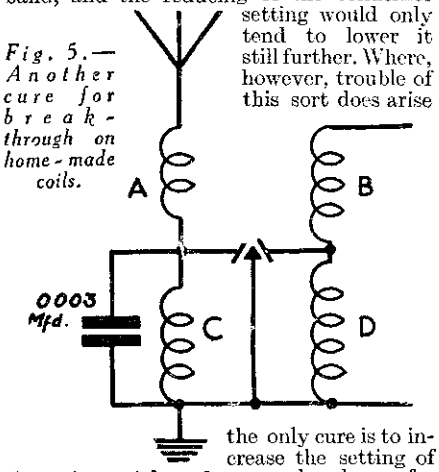


Fig. 5.—Another cure for break-through on home-made coils.

CATALOGUES RECEIVED

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state 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 must be enclosed.

B AND-PASS COILS

CONSTRUCTORS using band-pass tuning will find the latest British General list of particular interest. A new device listed consists of brackets which enable a pair of ordinary condensers to be coupled up efficiently. A new range of B.G. filter coils are in three types, the first being a band-pass aerial coil, the second, a band-pass H.F. coil, and the third a screened H.F. coil designed to match with either of the other two. The aerial band-pass filter is a mixed-coupled filter in which great attention has been paid to compactness without sacrificing efficiency. Other components included in this list are dual-wave coils suitable for ganging, transformers and H.F. chokes.

LOEWE RADIO COMPONENTS

ALTHOUGH noted principally for their vacuum type resistances, the Loewe Radio Company also manufacture a number of other lines, and their new catalogue, just received, gives a number of interesting examples. Paper condensers—with details of the various tests to which they are subjected; valves, both of the multiple type, and rectifying valves; receiver chassis; gramophone pick-up; volume control; loud-speaker and loud-speaker chassis, are well illustrated, and copious details are given. It is explained that the majority of the components are protected by Letters Patent.

"UTILITY" COMPONENTS

PARTICULARS of a fine range of "Utility" steel-ganged condensers is given in the new season's catalogue of Wilkins and Wright, Ltd. The chassis is built of heavy gauge steel, and the spindles run in ball bearings of ample size which ensure smooth action. All ganged condensers are matched to less than one-half per cent. For super-het. sets a model is supplied which incorporates a specially-designed section for tuning the oscillator circuit. These condensers are obtainable in the two, three or four-gang type. Other high-class components shown in the list include a new straight-line dial, anti-capacity switches, drum dials and the "Utility" Micro-Dial with a ratio of 100 to 1. This dial, with its fine vernier adjustment and smooth action is specially suitable for short-wave tuning.

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.

ADVERTISEMENT INDEX

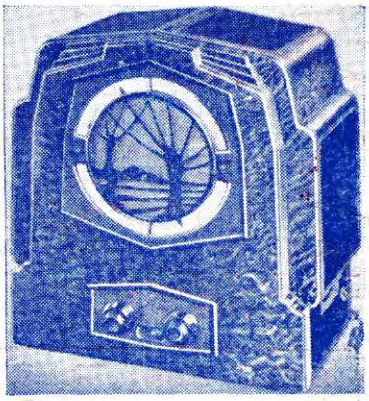
The new EKCO 5v. Super-Het

STATIONS BY NAME

Seven tuned circuits—yet single knob tuning. Selectivity so pronounced as to permit Stations by *Name!* Simply turn a pointer to the name of the station you want. An unlimited choice of stations from home and abroad at all times. Tone so superb that, in direct comparison with living artistes, the audience could not distinguish the difference between EKCO and reality.*

This new model is housed in a most beautiful walnut figured bakelite cabinet, complete with built-in moving-coil speaker. All-electric, just plug in to the electric light or power supply and switch on—that's all.

MODEL S.H. 25
Price 24 Guineas
or 12 monthly payments of £2 6s. 3d.



* Direct Comparison Demonstrations by famous artistes between Record—Radio and Reality, using standard EKCO Receivers, were sweepingly successful at Radiolympia, Manchester and other parts of the country.

A few extracts from many testimonials:

"Every station on Dial at full loud-speaker strength." Glasgow.

"Reproduction as near the original as I have ever heard." St. Albans.

"Best we have ever handled. Performance really amazing." Cardiff.

"Separated all stations with ease. Extraordinarily natural tone." Norwich.

"Every station on Dial recorded. Tone beautiful. A revelation." London.

EKCO

ALL-ELECTRIC RADIO

To E. K. Cole, Ltd., Dept. P.3.
EKCO Works, Southend-on-Sea.
Please send me illustrated FREE literature of EKCO All-Electric Radio.

NAME .....

ADDRESS .....

P.W. Gift Stamp No. 4

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Practical Wireless, October 29th, 1932

SPECIAL BEGINNER'S SUPPLEMENT INSIDE

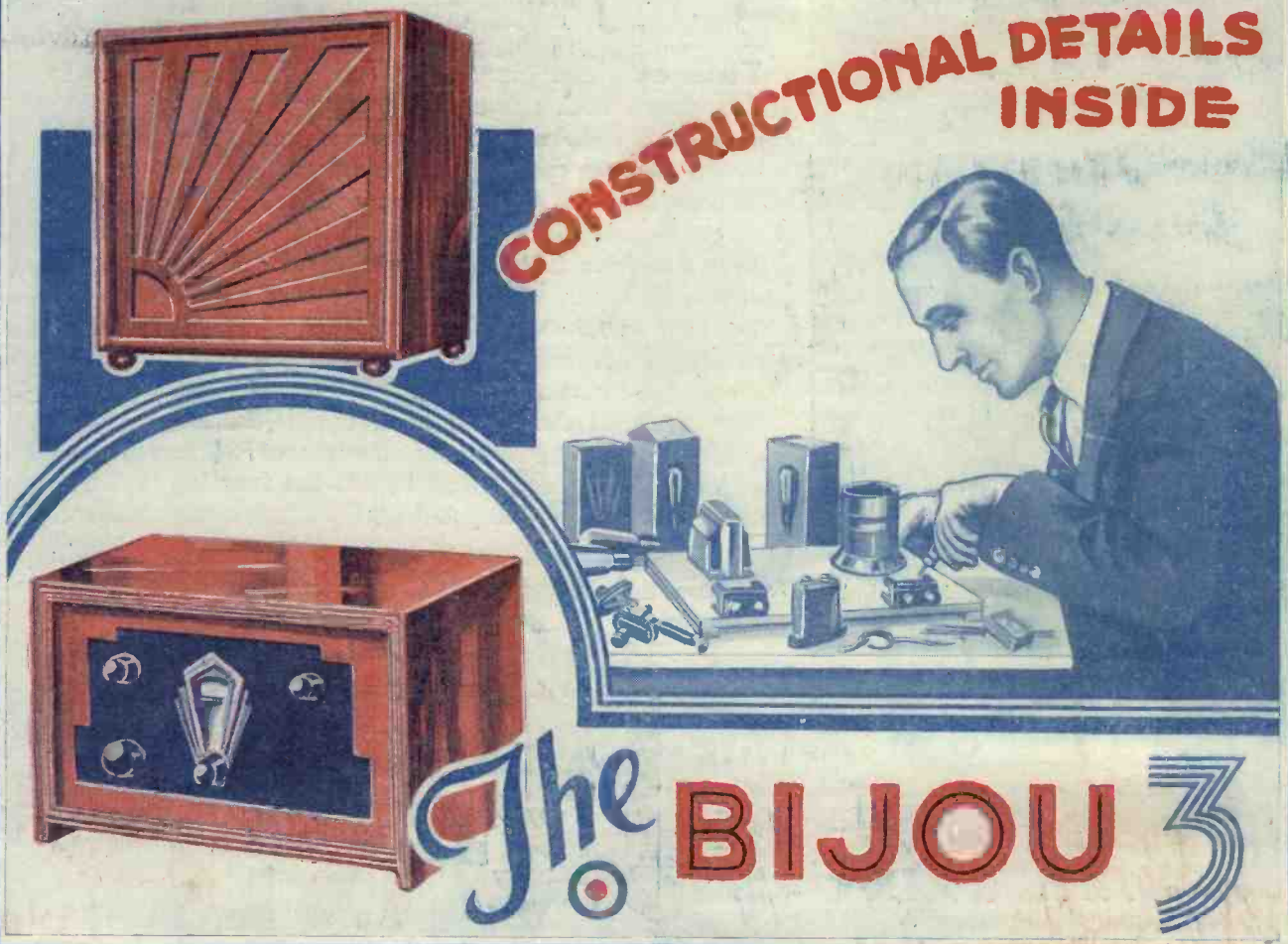
Practical Wireless

3D

Published by
GEORGE NEWNES LTD.
Vol. 1—————No. 6
OCTOBER 29th, 1932

CHEAP BUT EFFICIENT

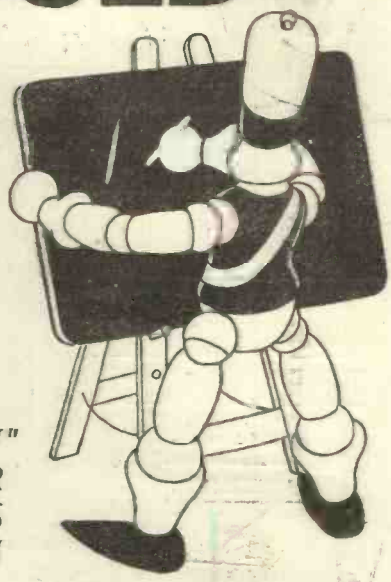
CONSTRUCTIONAL DETAILS INSIDE



The BIJOU 3

FACTS YOU SHOULD KNOW . . .

About the MAZDA A.C. RANGE



LOOK FOR "EDDY" IN YOUR DEALER'S WINDOW

There are three brand new and outstanding valves in the Mazda A.C. range.

THE AC/SI VM. *A sensitive variable-mu screened grid valve, specially suitable for mains operated transportable sets.*

THE AC/SG VM. *A super-sensitive variable-mu screened grid valve designed specially for circuits employing grid bias volume control. Cross-modulation in the H.F. stages is reduced to a negligible amount by its use.*

THE PP 3/250. *A large output power valve requiring only a moderate anode voltage, which will deliver ample volume to large moving-coil speakers.*

Full details of these and other useful Mazda A.C. types will be found in the Mazda catalogue, sent FREE on request. ***Mazda Valves are fitted by all the leading receiver manufacturers. All good radio dealers stock them.***

EDISWAN RADIO

The amazing

MAZDA THE BRITISH VALVES

100% BRITISH—Designed by British Engineers

The Edison Swan Electric Co. Ltd. 155 Charing Cross Rd. London. W.C.2

Mazda Radio Valves are manufactured in Great Britain for The British Thomson-Houston Co. Ltd., London and Rugby.

V.166

SEND US YOUR HINT AND WIN HALF-A-GUINEA! See page 284

Practical Wireless

EDITOR:
Vol. I. No. 6. || F. J. CAMM || Oct. 29th, 1932.
Technical Staff:
H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.M.I.E.E.
Frank Preston, F.R.A., W. J. Delaney, W. B. Richardson.

ROUND THE WORLD OF WIRELESS

French Train Radio Unpopular

APPARENTLY, passengers travelling in French trains equipped with wireless receiving apparatus are not supporting this new service. *Radio-Fer*, the company which has installed the instruments on various expresses running between The Havre and Paris, may be compelled to suspend operations. Travellers have complained that the relay of solely French transmissions provides insufficient interest during the journey.

Dutch Wired-Wireless

WIRED-WIRELESS installations by which Dutch listeners may hear the Hilversum, Huizen and other broadcasts through the existing system, is making great strides in Holland. The relaying stations are allowed to switch their subscribers over to a number of foreign stations, but the Dutch Government has forbidden the re-transmission of any broadcasts emanating from a Russian source.

Berne Broadcast to U.S.A.

ON Sunday, October 23rd, Berne will broadcast a special concert for listeners in the United States. The re-transmission will be carried out through the Prangins short-wave station on 31.31 metres (9,580 kc/s) from which it will be picked up and put over the American network.

Argentine Broadcasting Stations

IN the Argentine Republic there are forty-three broadcasting stations, of which some seventeen are situated in Buenos Aires. All with the exception of one controlled by the Municipality are privately owned and operated. The majority of the studios subsist entirely on revenue derived from broadcast publicity, such items being inserted, in a similar way to that adopted by Radio Toulouse, between items of the programme. Concerts mainly consist of gramophone records supplied for the purpose by local dealers. Generally speaking, singers and musicians are very poorly paid, and but few artists of repute are willing to face the microphone. In view of the mixed foreign population in Buenos Aires, many stations put out special programmes in English, French, German and Scandinavian languages.

Spanish Political Broadcasts

SINCE the advent of a Republican Government in Spain the broadcasting stations generally have kept their listeners in closer touch than hitherto with political activities. Every Friday night Madrid EAJ7 relays debates taking place at the Municipal Concert House, and on special occasions a re-transmission is made from the Spanish Cortes (parliament). In such instances listeners to Madrid EAJ7 may frequently hear very excited discussions between 10 p.m. and midnight G.M.T.

Hilversum Time Signal

THE Hilversum (Holland) broadcasting station has adopted time signals in many ways similar to our Greenwich "six pips." The exact Amsterdam time is put out at G.M.T. 7.55 a.m., 2.55, 6.55 and 10.55 p.m. The signal consists of a series of morse V's (. . . —) followed by four dashes, then five dots, the final "pip" indicating the fifty-fifth minute of the hour. Dutch time is twenty minutes in advance of Greenwich mean time.

Radio L.L. Suspends Transmissions

UNDER penalty of having its transmitting licence revoked by the French Ministry of Posts and Telegraphs, Radio L.L., a private station in Paris broadcasting on 370 metres, has been compelled to suspend its simultaneous short-wave transmission on 33 metres.

B.B.C. West Regional Station

EXCEPT for one or two minor details the erection of the two 500-foot aerial masts of the B.B.C. West Regional Station is now complete, and in the course of a few weeks work will begin on the installation of the transmitter. It is expected that preliminary tests may be carried out towards the early part of next spring.

New High-power Station at Nanking

AT Nanking (China) the Telefunken Company has installed a new 75-kW. transmitter to broadcast on 440 metres. The station will also be used for Wireless Telegraphy.

Better Reception of Foreign Stations

RECEPTION conditions during the past two weeks have improved so greatly that many transmissions which had not been heard by listeners in the British Isles since last winter have again been captured. Amongst these may be mentioned Riga, Reval, Ljubljana and Reykjavik. It should be borne in mind that the latter station (on 1,200 metres) works to Icelandic time, namely, Greenwich mean time *less* one hour, and that in consequence the studio is usually on the air until 1.0 a.m. In addition, in view of its increased power, broadcasts from Rostov-on-the-Don (U.S.S.R.) on 848.7 metres can now be logged on almost every evening between 9.45 and 10.15 p.m. G.M.T. The station possesses a male and also a female announcer.

Another Golden Voice!

THE wife of Mr. A. W. Macnamara, founder and managing director of the Telsen Electric Company, presented him with a son on the 12th inst., at Bushwood Nursing Home, Birmingham. We tender our heartiest congratulations.

Tests from New Egyptian Station

THE power of the Abu Zabal (Egypt) transmitter now in course of construction will be 10-kilowatt aerial. Although it is anticipated that tests may be carried out during October-November it is hardly likely that the station will be ready for operation before March, 1933. The transmitter is connected to Cairo by special cable.

Russian Listeners' Tax Reinstated

IN order to encourage the development of radio in Russia, the Soviet authorities suspended the listening tax for a period of two years. As, however, some difficulty may be experienced in defraying the expenses of the many high-power transmitters which are being erected according to the five-year plan, the tax has been reinstated.

Round the World of Wireless (continued)

Electrostatic Loud-speakers

HAVE you tried an electrostatic loud-speaker yet? They are not particularly new, since they were first introduced in practical form at the 1931 Radio Exhibition, but they don't seem to have quite "caught on" yet. Perhaps the reason is that they are unconventional and of rather unwieldly proportions, but they do represent a definite advance in many ways. When I was at the recent Radiolympia, an attendant on one of the loud-speaker stands proudly demonstrated the various models to me, and assured me that the quality was better than that of any moving-coil speaker ever made. I was not in complete agreement, but I must confess that the reproduction of the higher musical frequencies, especially those of the violin and piccolo, was undoubtedly superior to that of any moving coil I have yet tried. Since the show I have tried a few models of these electrostatic speakers in my own laboratory, but despite many serious efforts, I have failed to obtain satisfactory bass response. By working an electrostatic and a good moving coil in conjunction, though, I have obtained a better tonal "balance" than by any other method, the electrostatic speaker giving "brilliance" and the moving coil bass and "mellowness." I would recommend the combination to any of those who are in search of perfection (a fine ideal !) in sound reproduction.

Electrolytic Condensers

CONSEQUENT upon recent price reductions, electrolytic condensers should become very popular. Size for size, they have a larger capacity than condensers of the ordinary type, and are more efficient for smoothing purposes. It should be remembered, however, that they are only suitable for use on D.C. current, since they are polarized. That means they must be correctly wired up to the positive and negative leads, otherwise they will be ruined. The outer metal case forms the negative electrode and the single terminal the positive.

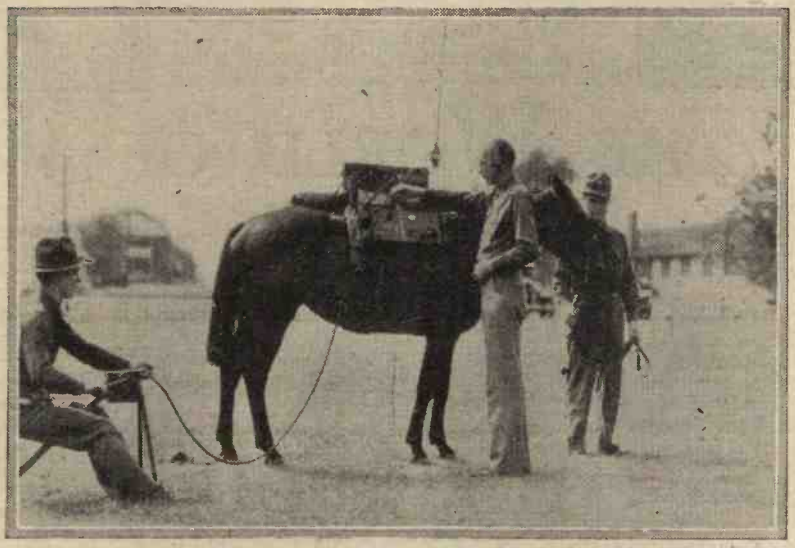
Ear or Meter?

A MILLIAMETER is sometimes connected in the anode circuit of the output valve to detect the presence of distortion, the idea being that a "kicking" needle indicates that distortion is taking place. This gives to some the impression that the needle must remain dead still if good reproduction is to be obtained. The idea is far from true, for it is impossible to make any adjustments which will result in a perfectly steady reading when loud signals are being received. Unless the operator is quite "au fait" with the working of his set and corresponding milliameter indications, it is much better to rely on the ear than upon the meter for judging the quality of reproduction.

90,000 Milliwatts Undistorted Output

I HAVE an old radio friend who is chief engineer in one of the programme relay stations now in operation in most of the larger towns. Recently he showed me round his station, which at the moment supplies about a thousand homes with radio music. The apparatus consisted of two "automatic" receivers, which were self-tuned so that any one of six selected stations could be received by the movement of a switch and four separate push-pull amplifiers. Each amplifier gave sufficient output for 250 loud-speakers, or, in other words, about 90,000 milliwatts, and consumed 600 *milliamps* high-tension current. On connecting a hot wire ammeter in one of the main loud-speaker supply leads, I was not very surprised to find that it gave a maximum reading of over half an ampere, the current falling to about .2 ampere on soft passages. This current was, of course, entirely of a high-frequency nature, and had nothing to do with the steady anode currents consumed by the valves.

A ONE-HORSE POWER RADIO SET!



Picture shows a mobile transmitter and receiver for mounting on a horse or mule. It is here shown in operation with a metal fishing-rod antenna for transmitting and receiving. Contrast the portable antenna with the huge metal antenna tower. Power for broadcasting is supplied by the hand generator shown at the left. The illustration demonstrates how wireless is linking up remote parts of the world with civilisation.

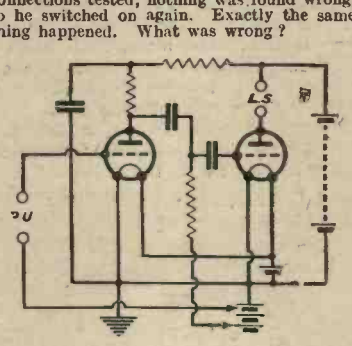
The Telornor

MESSRS. TELSEN have struck a good idea for reducing the work of the set builder by introducing an artistically-designed bakelite panel plate and slow-motion condenser drive, on which can be mounted all the controls for an average set. The Telornor, as it is called, has provision for on-off and wave-change switches, a tuning condenser and a reaction condenser.

SOLVE THIS!

PROBLEM No. 6.

Simpkins made up a Gramophone Amplifier, the Circuit of which is reproduced below. When it was tried out signals were loud but gradually became distorted and then ceased. The amplifier was switched off, all connections tested, nothing was found wrong, so he switched on again. Exactly the same thing happened. What was wrong?



SOLUTION TO PROBLEM No. 5.

Owing to the use of a metal panel, the switch would be in electrical contact with L.T.—(which, of course, is earthed). The connection of L.T.+ to the switch would result in a short circuit unless an insulating bush was fitted to the switch. This, then, was where Simpkins had gone wrong—he had omitted the bush.

The S.G. Anode Connection

IF you use a metallized screened-grid valve, don't forget to employ some form of insulated anode connector. Since the metallized bulb is connected to H.T. negative, there would be a definite short circuit of the H.T. battery if the anode lead were to touch the bulb. This precaution is also worth while even when using a valve with a plain glass bulb, because the anode connection is always liable to fall down and touch another terminal or wire when making adjustments.

Dual Compensated Loud-speakers

I HAVE just been testing a new season's all-mains Radio-Gram, fitted with a dual compensated loud-speaker unit, and it has left a very favourable impression on my mind. The speaker unit really consists of a pair of moving-coil speakers, one of which is designed to emphasize the high notes, while the other deals with the bass. The resulting tone is very fine, and I am now fitting one of these units in my own "home" receiver. You might be interested to know that both Messrs. Rola and Magnavox make these compensated reproducers at a price little higher than that of the average large single instrument.—JACE.

The following three readers receive books in connection with Problem No. 4:—

Mr. P. Booth, 273, Oldham Road, Limehurst, Ashton-U-Lyne, Lancs; Mr. C. E. Hurd, Lytheys, Esher Road, Hersham, Surrey; Mr. H. R. Lydiatt, 247, Fore Street, Edmonton, N.18.

AN INEXPENSIVE FOUR-RANGE TEST METER

Below is Given a Description of a Useful Instrument with a Variety of Uses which can be Made for About 15s.

By FRANK PRESTON, F.R.A.

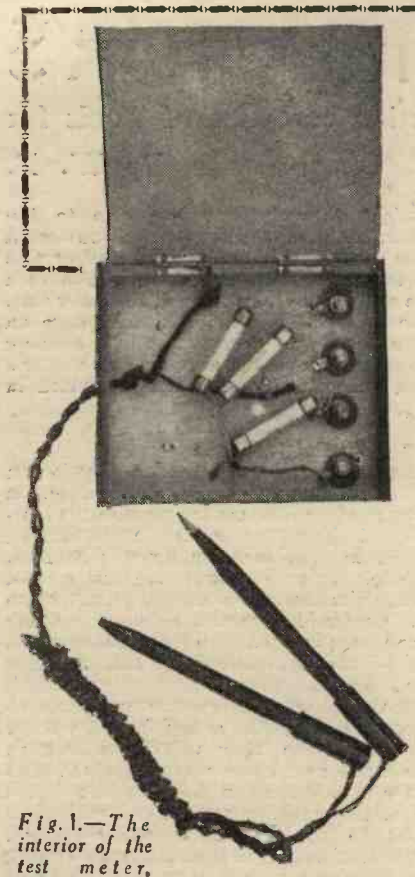


Fig. 1.—The interior of the test meter, showing the resistances and wiring.

HOW often have you wished you had a voltmeter to test the high-tension and grid-bias batteries, or a milliameter to measure the anode current consumption of a power valve? Scores of times, no doubt, but you have probably thought twice about buying them, and then decided in the negative, due to the high price of such instruments. The little home-made test meter of which you see photographs on this page will measure 0 to 10 milliamps, 0 to 10 volts, 0 to 100 volts, and 0 to 200 volts, and yet it costs only fifteen shillings to make. It can be used to carry out practically any measurement required in a wireless set, and its accuracy is ample for all requirements. Actually the degree of accuracy on the 200-volt range is within about a half of one per cent., but in no case does the figure exceed five per cent.

Making the Tester

The complete unit is built in a small cigar box, and the parts required are:

1 low-resistance milliameter reading up to 10 milliamps.

3 metallised resistances; 1-1,000 ohms, 1-10,000 ohms and 1-20,000 ohms (Dubilier 1 watt).

4 insulated sockets (Belling Lee).

1 wander plug (Belling Lee).

2 test prods (Bulgin).

Length of twin red and black flex.

No particular make is specified for the milliameter, because any reasonably good instrument will serve, and most experimenters will have one already. That used by the writer was bought for 7s. 6d., so this price can be taken as a kind of basis. Of course, it is possible to pay three or four pounds for a very accurate meter, but such a price would not be justified in this case. After well glass-papering the cigar box, the four insulated sockets and milliameter are mounted on the base, which serves as a "panel." The holes for the sockets, by the way, should be 5/16in. diameter. Next, a ¼in. hole is made through the panel near each meter terminal, and also between the meter and the sockets. The very simple wiring can be followed on the photograph, and is also shown in the diagram of Fig. 3. The resistances are attached to the sockets by soldering their connecting leads to the tags provided. All three resistances are connected together at one end by twisting and soldering their other connecting wires. Two other wires are also soldered to this junction; one passes through the panel and is attached to the positive terminal of the meter and the other is joined to the fourth insulated socket. A long connecting wire is used between the meter and the test prods, so that the latter can easily be poked into awkward corners if necessary. The flex is passed through a ¼in. hole made in one side of the box and has a knot made in it so that it cannot be pulled out. The black lead is then passed through the panel and connected directly to the negative terminal of the meter; the red lead is also passed through the panel, but has a wander plug attached to its end. Finally, a strip of paper is glued across the panel near the sockets, and this is marked in ink to show what range is covered by each.

Using the Instrument

In use, the wander plug is put into the socket appropriate to the range required, and connection to the set is made by the very convenient test prods. When used as a voltmeter, the instrument has a very high resistance, and can safely be connected across even the smallest high-tension battery without any fear of placing too heavy a load on the battery cells. Its resistance is sufficiently high to permit of accurate measurement of eliminator voltages, but, as is always the case, the eliminator must be connected to the set so that it is "under load." When using the 10-volt" range, a reading of 1 milliamp will correspond to 1 volt; on the "100-volt" range 1 milliamp will correspond to 10 volts, and on the highest range 20 volts will be indicated by a 1 milliamp deflection. If desired, other scales could be drawn on the dial of the meter, but this is not essential.

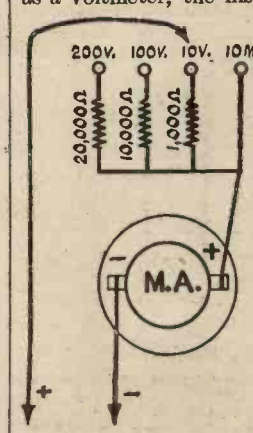


Fig. 3.—Diagram of connections.

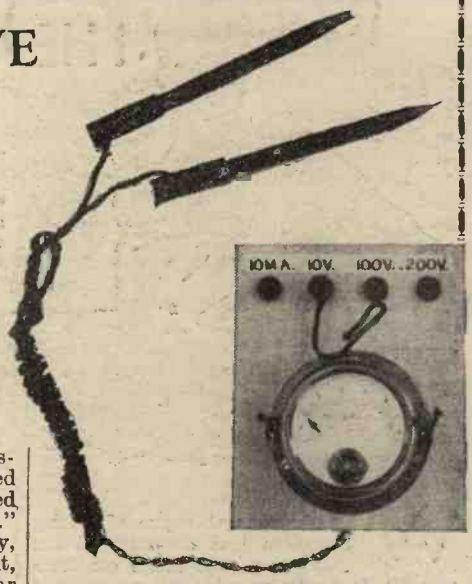


Fig. 2.—The complete four-range test meter with test prods.

How it Works

Having decided to make this almost indispensable gadget, you will wish to understand how it is possible to cover all the four ranges with one meter. The explanation is simple, and depends on Ohm's Law, which defines the relationship existing between current, voltage, and resistance. Stated in straightforward language, Ohm's Law says that the current flowing in a circuit is (in amperes) equal to the applied voltage divided by the circuit resistance in ohms, or more directly, C=V/R. It will be seen from this that if a pressure of 10 volts is applied across a resistance of 1,000 ohms, the current flowing will be 10 divided by 1,000 or 1/100th of an amperc. This is equivalent to 10 milliamps, since 1 ampere is equivalent to 1,000 milliamps. If the voltage is increased to 100 and the resistance to 10,000 ohms, the current will still be 10 milliamps. Increasing the voltage to 200 and the resistance to 20,000 ohms, will also give the same result. In these calculations we have omitted the resistance of the meter itself, but, provided that this does not exceed 50 ohms or, so it will not affect the results to any noticeable extent.

Using Different Meters

The above explanation will make it clear that a meter giving a full scale deflection of more, or less, than 10 milliamps could be used so long as appropriate resistance values were chosen. So if you already have a milliameter of different type to that specified, you can use it for the test meter described. If you *should* have any difficulty in working out for yourself the suitable resistance values, remember that you can always apply to the PRACTICAL WIRELESS Advice Bureau with the assurance that your needs will receive prompt attention.

THE HOME CONSTRUCTOR'S

An Article on the Selection and Use of Tools for

By W. B.

WITH the present vogue of placing complete kits of parts at the disposal of the home constructors, it is quite possible to assemble a receiver entirely with the aid of a screwdriver and a pair of pliers. I say "assemble," because one cannot, in any sense of the term, call it "building" a set. However, the average constructor's interest is not usually limited to the completing of a kit set, and for most of his work he needs a certain number of simple tools.

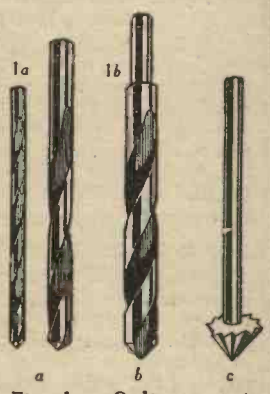


Fig. 1.—Ordinary twist drills; one with a shouldered shank; and a rose bit.

The Complete List

In detailing the list of tools you will require I shall assume that you will be undertaking the whole work outside the construction of the actual components. To feel perfectly equal to any job, I think you ought to have the following: A set of twist drills, a hand drill, screwdrivers, brace and centre-bits, a centre-punch, a counter-sinking bit, a pair of pliers, an awl, a soldering outfit, a measuring rule, and a file. This may appear at first to be rather a lot, but I will endeavour to explain briefly where each comes in, with special reference to their use in the completing of awkward or unusual jobs.

Fig. 2.—A geared hand drill.

Drills and Drilling

Usually, the first job in construction is drilling the panel and baseboard, or in some cases, the chassis. As you may be dealing with wood, ebonite, or metal, it is essential to have a set of twist drills. These are designed to cut metal, so it follows they will quite easily drill softer materials. Fig. 1*a* and *b* shows what twist drills look like. They are used in the hand drill (shown in Fig. 2). As, however, the average machine will not take a drill with a larger shank than ¼in., the type shown in Fig. 1*b* has been evolved. These can be obtained in 5/16in. and ⅜in. sizes with a shank only ¼in. in diameter. You should get a set of the ordinary type in sizes up to ¼in., and also one of these narrow shank ones for drilling ⅜in. holes for condenser spindles, etc. They are quite cheap, and it pays over and over again to buy good ones. Some cheap foreign makes are not ground at the right angle at the cutting edge, and you can drill away until thoroughly exhausted before completing a hole. A good make "bites" instantly and cuts quickly without much pressure being needed. The best way to use twist drills is to apply light pressure and turn the drill fairly fast. Metal can be drilled straight through from one side to the other, but with wood or ebonite you should stop as soon as the point of the drill starts to come through. You should then turn the work over and drill from the other side. The hole will then have a clean edge on both sides. To prevent the drill slipping about when starting a hole make a small nick with the centre-punch illustrated in Fig. 3.

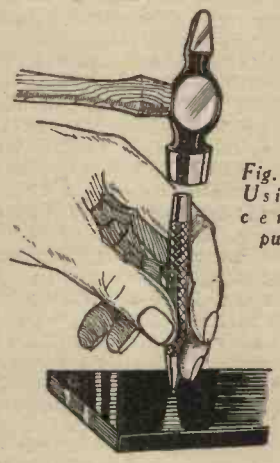


Fig. 3.—Using a centre punch.

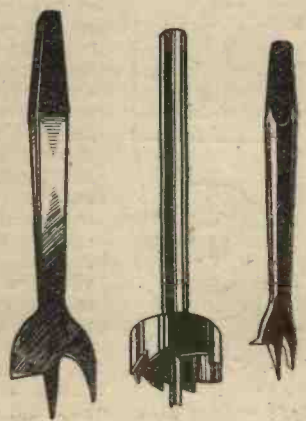


Fig. 5.—Centre-bits, and a panel cutter.

Use of the Ratchet Brace

In building sets on wooden chassis you will need to drill holes about 1¼in. in diameter for the chassis-mounting valve-holders. You may also need holes through which to pass such components as H.F. chokes. This is where the brace and centre-bits illustrated in Figs. 4 and 5 come in. Centre-bits are also better for drilling small holes in wood than the metal-worker's twist-drills just mentioned. Like all drills used for soft materials, they should be taken out as soon as the point shows through and started afresh from the other side, otherwise they will burst through the wood and leave a ragged hole. The brace that is used to hold the bits should be of the ratchet type, as this will allow holes to be bored in awkward corners. Instead of having to turn the handle round and round as with the ordinary brace, it can be used by turning it backwards and forwards through part of a circle only. Actually you set it to "free-wheel" in one direction, so that the bit pauses as you make each back stroke and advances as you make each forward stroke. Fig. 4 shows a hole being bored in a restricted space by means of a ratchet brace. For drilling large holes in sheet metal or ebonite a centre-bit is not really suitable, although it can, of course, be used if great care is exercised. A better instrument is a panel cutter. This is illustrated in Fig. 5. It

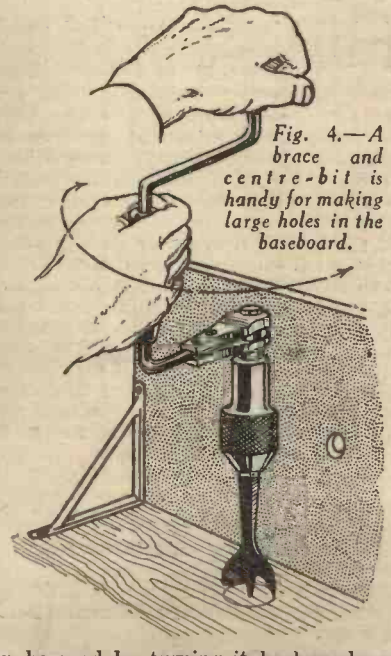


Fig. 4.—A brace and centre-bit is handy for making large holes in the baseboard.

WIRELESS TOOL KIT

the Amateur Constructor and Experimenter

RICHARDSON

is held in a brace in the same way as a centre-bit, but it must have a small hole drilled first to take the guiding spindle.

The Best Type of Screwdriver

In putting together the panel and baseboard or chassis and in the mounting of the components, the screwdriver is probably used more than any other tool. The right choice, therefore, is of great importance and has a direct bearing on the speed and ease of assembly. You will need at least two different patterns: one for general use and one very small one for tightening up grub screws, etc. The general-purpose one should be long, and preferably have a screw-holding device so that the screw can be carried direct to the starting hole on the end of the driver. This refinement is a great help when fixing a screw in an awkward corner where it is impossible to reach with the fingers in order to steady it. Figs. 6 and 7 show two different types in use. One has a metal sleeve which grips the head of the screw, and the other has a double blade which springs apart. The blade is closed and inserted in the slot in the head, when the pressure against the sides of the slot holds the screw until it is placed in position. The second screwdriver may well be of the all-metal type, which is held in the palm of the hand as in Fig. 8. It is operated by twirling the knurled collar between the fingers and thumb.

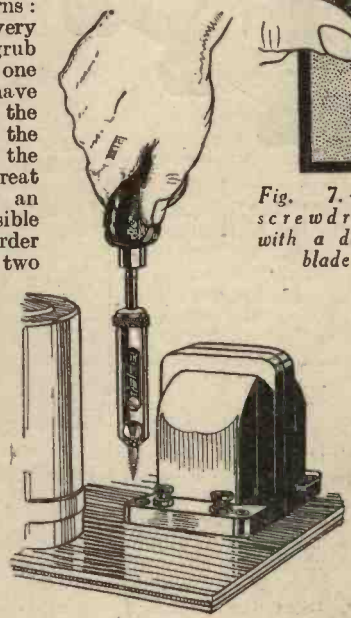


Fig. 6. — A special screw-driver which grips the head of a screw.

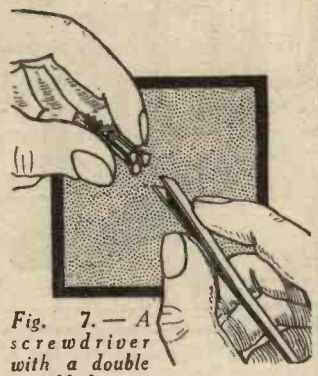


Fig. 7. — A screwdriver with a double blade.

When purchasing make sure the blade is not more than ⅛in. wide, otherwise you will not be able to get at some of the miserably tiny set-screws which are to be found on most control knobs and dials.

Improving a Bradawl

With screwdrivers one naturally associates a bradawl for making the screw holes. If an ordinary small bradawl is used you will find it a good idea to sharpen it to a four-sided point, as in Fig. 9. This will make it easier to use than with the ordinary chisel point, besides producing a tapered hole more suitable for the job. Personally, I always sharpen my awls thus and find the resulting tool more useful than either a bradawl or a gimlet.

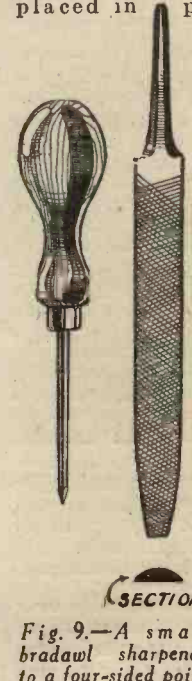


Fig. 9.—A small bradawl sharpened to a four-sided point is useful for making small holes. A half-round 6in. file is also useful.

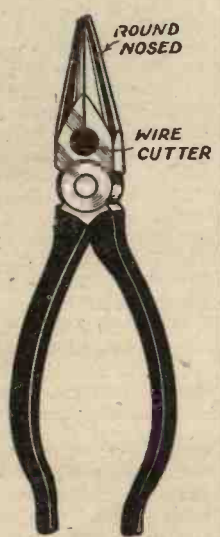


Fig. 10.—A pair of round nose pliers with wire-cutter.

Round or Flat-Headed Screws?

The question of whether round or flat-headed screws should be used for holding-down purposes depends on whether the holes in the components are countersunk or not. I think that generally a neater appearance is obtained with flat-headed screws sunk flush with the surface. If you wish to use flat-headed ones, and the holes are not already countersunk, you can soon make them so yourself with the aid of the rose countersinking-bit shown with the twist drills in Fig. 1.

To complete the list of what I consider *necessary* tools for the construction of the chassis and the mounting of the components, you must not forget a rule for measuring and a small file for cleaning-up purposes. Saws are not needed unless you cut out your own panels or make your own cabinets. A fretsaw, however, is useful in cutting tuning-dial apertures, but is not absolutely essential, as this can also be accomplished by drilling a number of holes round the outline and cutting away the waste with a pen-knife. This is shown in Fig. 11.

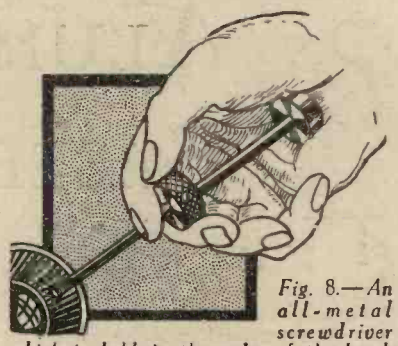


Fig. 8.—An all-metal screwdriver which is held in the palm of the hand.

Uses of Round-Nosed Pliers

In wiring up you will need a pair of round-nosed pliers and a soldering outfit. The pliers should be fairly sturdy and not of the long, thin-nosed variety. They should also be fitted with a wire-cutting device. Such a tool is illustrated in Fig. 10 and will serve a number of purposes. It can be used to cut the wire, bend it into a neat loop to pass over the terminal, and then to tighten up the terminal when the wire is in position. If you use any other type you will need more than one pair. Pliers without cutters mean you have to have a pair of nippers as well. Again, small types with very thin noses are not strong enough to tighten nuts or terminals.

Soldering Irons

If you have electricity laid on, there is no better type of soldering iron than the electric one. You can now get one for quite a reasonable price and you will find it cheap to run. There is, of course, no chance of burning the iron, and therefore no need for continual tinning. Besides that it cuts out all the running from and to the gas-ring or fire and the waiting while it heats up. You just switch it on and get on with the job. If you are forced to use the ordinary type of iron you will find the small file previously mentioned useful for cleaning up the facets of the bit when re-tinning.

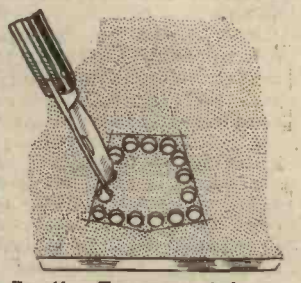


Fig. 11.—Trimming a hole in a panel with a pen-knife.

Optional Tools

To the which has so far been given may be added one or two other tools which, although not absolutely necessary, are nevertheless very useful. First, there is the tapered reamer shown in Fig. 12. It is held in a brace and used to ream out (enlarge) holes which may be a fraction of an inch too small. One of these is often very handy when a hole is required which is larger than that made by a particular bit but smaller than one produced by the next larger size. A wire-gauge is another useful tool which may be used for checking the stated gauge when buying wire for coils, or may be used to determine the thickness of sheet metal. For small jobs an old pair of scissors will answer for snips.

Fig. 12.—A tapered reamer.

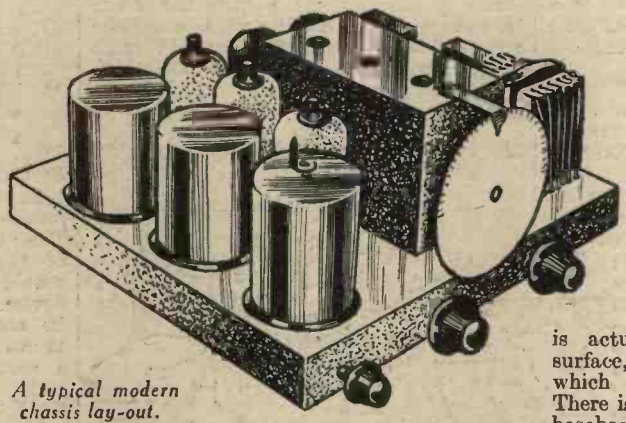
? ALUMINIUM CHASSIS—OR BASEBOARD? ?

An Article Explaining a Method of Easily Making a Chassis Type of Receiver

By HAROLD DOWNING

THE majority of wireless fans may have noticed that the better class of modern wireless set is what is known as "chassis-built." That is to say, the conventional wooden baseboard is not used, but in its place is a sheet of metal, not necessarily flat, on to which the various components are bolted. You may have wondered why this form of construction is favoured, and whether it is more efficient.

If you examine one of these sets you will find that practically all the components are in metal boxes—including the tuning coils. The chassis is also usually in the form of a tray, some of the smaller components and the majority of the wiring being underneath. This makes for ease of construction, and this is one of the reasons underlying its use. Efficiency, however, plays a great part in this form of construction, for the following reasons:—



A typical modern chassis lay-out.

Tuning Coils

A tuning coil, to be really efficient, must be of certain dimensions, depending on its place in the circuit, the wire with which it is wound, etc. For an aerial tuning coil the efficiency is highest when the diameter is greater than the length (for the normal broadcast band that is). The tuning coil in the chassis-built set is wound on a small former, about 1in. in diameter, and very fine wire is used. It is, therefore, inefficient *if used alone.* In a receiver having an H.F. stage, however, two coils at least are required—one for the aerial circuit and one for the inter-valve circuit. If band-pass aerial tuning is used, then there will be three coils in all. Now, a large coil has a large field, and in order to preserve the efficiency of such a coil, nothing must be included in its field which will affect its characteristics. Therefore, three coils would take a great deal of arranging, to avoid interaction, and, furthermore, would take up a great deal of space. If they were crowded near each other, the efficiency would be lost. It is here, therefore, that the "canned coil" proves its worth. Whilst individually each one is not so good as a large coil, when three are employed they can be designed with characteristics, when screened, which enable three of them to be placed in the space occupied by the one large coil; and then, owing to the complete isolation of each one, the overall efficiency is much greater than that of the unscreened coils. Furthermore, as the earthed screen surrounding the coil completely isolates it from external influences, two or more coils may be tuned by two condensers joined together (or ganged), the circuits remaining matched over the complete tuning scale. This, then, is one of the important features of the chassis-built set.

Stamped-out Chassis

When a manufacturer decides upon a design of receiver, he has at his disposal certain components, and with the chassis size decided upon, this may be stamped out, complete with holes, to take bolts to accommodate every component, so that the work of assembly may be carried out by inexperienced persons, bolts being passed through the necessary holes, and nuts screwed up. This is much easier than driving home wood-screws in a wooden baseboard. Furthermore, the metal work may be used as the earth connection for any point which needs earthing. A number of wires are saved by this means, a soldering tag being placed under the bolt head holding some component in place, and this being used as a connection.

The above details should be sufficient to show that it is worth while building a receiver having one or more H.F. stages on the chassis plan. (If no H.F. is used, there is no need for screening, and the ordinary type of set is satisfactory.) There is no need to be a metal worker to build such a set, and the following details will enable you to remake your own receiver, or build one of the future sets described in these pages, which will result in a more compact outfit, and, if properly carried out, a more efficient set.

First of all, for the chassis. Ordinary wood may be used for this—preferably five-eighths ply to avoid warping. On to this screw a sheet of thin aluminium foil, which is obtainable from any good-class ironmongers. Copper may be used (and will in fact simplify matters by enabling soldering to be employed for certain earth connections), but on no account use sheet tin. This is actually sheet iron, having a tinned surface, and iron has certain properties which make it unsuitable for screening. There is no need to cover both sides of the baseboard—the top will be sufficient. Do not be tempted to put your own coils inside an empty condensed milk tin, as these also are iron, and are unsuitable for screening. Unless your coils are small in size, leave them as they are, or you will have difficulty in obtaining a screen large enough to go round them *outside their field* or you will spoil their characteristics. Buy a set of canned coils if you wish. A ganged and screened tuning condenser assembly will enable "one knob control" to be used, and this is a great help in tuning.

Valve-holders

Be very careful about the choice of valve-holders. Some of these have the screws to which the connections are made fixed in such a way that the heads are level with the bottom of the holder. This may cause them to come into contact with the metal base, and so short-circuit the voltage supplies. Watch all parts having such connecting screws, and make quite sure there will be no shorts. The terminals may be attached to a terminal strip in the usual way, or some of the moulded terminal mounts may be used. The panel also may be of metal, provided that the components which are mounted upon it are of the type having a one-hole fixing bush, which is metallically connected to a part which has eventually to be earthed. If this is not so, then a small ebonite insulating bush must be fitted to the panel to accommodate the one-hole fixing bush.

Sufficient has been written to enable you to understand the features underlying the design of the chassis-built set, and to redesign your own receiver if you wish.

A Useful Liquid Potentiometer

A HIGH resistance potentiometer can be used for a variety of purposes, but the expense of a good one often makes it a prohibitive item. It is possible to make a satisfactory substitute for experimental purposes for a few pence, by the following method, which, although not new, may be interesting to readers who are unacquainted with this form of resistance. Procure a small glass or similar vessel about 2ins. in diameter and nearly fill with water. Cut a strip of ebonite, bakelite or other insulating material long enough to rest across the mouth. At each end fix a terminal with a length of bare copper wire suspended in the water. The path between the terminals constitutes our resistance, which amounts to many thousand ohms. A third electrode is now made, similar to the other two, and mounted in a slot between the two fixed electrodes. This is the potentiometer arm. As an input volume control, connect the fixed terminals across aerial and earth. Connect the earth of set to earth, and the aerial of set to the moving arm. The movement of the latter between the two fixed electrodes will be found to give an even control of volume from zero to maximum. Though simple, this is a sound device and has a virtue not possessed by other potentiometers; it is quite noiseless in operation and contact is perfect. Other uses for this high resistance unit will be apparent.—B. S. J. WALLACE (Norbury).

THE PENT-AMP.

A Simple, Easy-to-make Amplifier, Using a Pentode, Clearly Described in Simple Language

By W. J. DELANEY

THE apparatus described in this article is a single-stage amplifier, utilizing the pentode type of valve. As most readers probably know, this type of valve has a very large amplification factor and a comparatively small consumption of H.T. current. This results, therefore, in the ability to construct a single stage of L.F. amplification which will work a loud-speaker quite satisfactorily; and the amplifier described in this article may therefore be added to a single valver so that the combination will give quite sufficient L.S. volume for the normal home requirements. It should be noted, however, that the pentode valve will not handle a very large input, and therefore this particular amplifier should not be added to a set in which there is already one stage of L.F. amplification, or distortion will be noticed due to overloading.

One drawback to the pentode in the past has been the shrillness of the reproduction, due to the emphasis of high notes, and in this amplifier a tone-controlling device has been fitted, which will enable the user to adjust the tone of the reproduction to suit the particular loud-speaker in use.

Fixing the Components

Obtain the components, as specified in the list of parts, and lay out the valve holder and other baseboard components on the baseboard, fitting the valve in its holder, and so making quite sure that there is ample room for the parts and the grid battery. When you have got the parts satisfactorily arranged, fix them down with screws. There should be no difficulty in carrying out this part of the construction if you follow the layout shown in the wiring diagram, Fig. 4. The circuit diagram is given in Fig. 1. Drill the panel and terminal strip as shown in Figs. 2 and 3, the holes being drilled to accommodate the terminals, volume control and on-off switch. As these parts are not standard in size no dimensions have been given. Mount the terminals and screw this strip of ebonite to the rear edge of the baseboard; mount the panel components, but do not attach the panel until all the baseboard wiring has been carried out. This makes that part of the work considerably easier.

Wiring Connections

Carry out the wiring in wire of the Glazite type, paying particular attention to the connections to the small pentode safety decoupler. The volume control is usually fitted with three terminals, one being connected to the arm of the control, and the other two to each end of the resistance element. In the amplifier described one of these terminals is not used. The terminal joined to the arm of the control is connected to the .01 condenser, and one of the other terminals is then joined to the plate terminal of the valve holder. Cut off a short length of ordinary lighting flex, and after baring one end, make a small loop, just large enough to go over the terminal on the side of the pentode valve-base. To the other end of this flex attach a wander plug, which is fitted in the top of the safety decoupler. This device enables the flex to be permanently attached to the pentode, and the valve can then easily be removed from the holder for dusting or any other reason by simply removing the wander plug. At the same time, the voltage is reduced through the decoupler, giving stability and avoiding one terminal on the terminal strip. The value of the resistance also ensures the correct voltage on the grid.

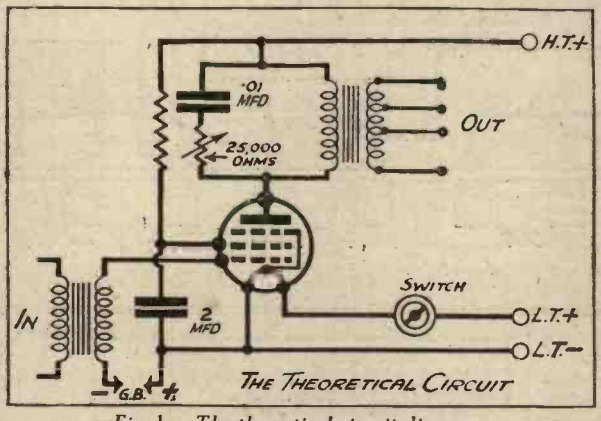


Fig. 1.—The theoretical circuit diagram.

It will be noticed that there is no H.T.— terminal fitted. The reason for this is that some single-valve sets have the common negative terminal earthed, whilst others have L.T. positive earthed. If, therefore, the two L.T. terminals in the amplifier are joined to the corresponding two terminals of the single-valve set, the H.T.— lead will be automatically joined in circuit. If, however, the amplifier is used with a crystal set, it will be necessary to connect the H.T.— lead to L.T.— terminal. It must be understood, moreover, that this is only to be done when a crystal set is used, otherwise a short-circuit may occur.

Using the Amplifier

When the wiring is completed, plug a Cossor pentode into the valve holder, and plug the safety wander plug into the decoupler. Connect the 'phone terminals of your present set to the input terminals of the

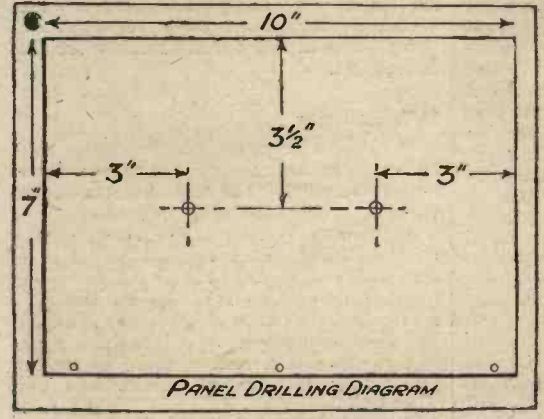


Fig. 2.—How to drill the panel.

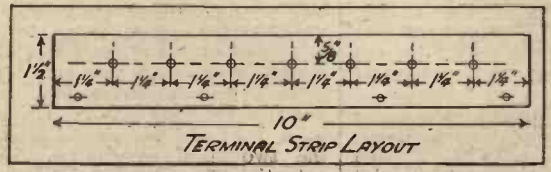


Fig. 3.—The terminal strip.

amplifier. Adjust the grid-bias plugs to the correct sockets, according to the valve-maker's instructions, and the H.T. positive plug into the maximum voltage recommended. If a high-resistance loud-speaker is used, join the two leads from the output terminals to the pair of terminals on the transformer marked "high resistance." If a low-resistance speaker is employed, the leads will, of course, be joined to the other two terminals. Switch on, and tune in your local station on the receiver. If the reproduction is too shrill, adjust the control knob until the tone is suitable. The value of the resistance given should enable you to get satisfactory reproduction unless a very poor loud-speaker is used. In the latter case it may be necessary to adjust the values of the control and the fixed condenser. However, for normal use, those given are most satisfactory.

It will be noticed that this specification and description relate to a pentode with the extra connection taken to a terminal on the side of the valve base. Where it is desired to employ one of the later types of pentode which utilises a five-pin base the only alterations necessary will be in connection with the valve holder. Instead of a four-pin a five-pin holder will have to be obtained, and the connection from the safety decoupling resistance will then be joined to the extra terminal.

As mentioned in the opening paragraphs, a pentode valve should only be employed after a detector stage, as the addition of any L.F. stages in front of a pentode often gives rise to trouble from overloading. In cases where an existing receiver already employs L.F. stages and it is desired to fit this pentode amplifier to increase the strength of very weak distant stations, some form of volume control must be fitted to the receiver so as to limit the strength of the local stations if the Pent-amp is left connected as a permanency. If the Pent-amp is to be operated from a common H.T. source it would be advisable also to decouple all previous stages.

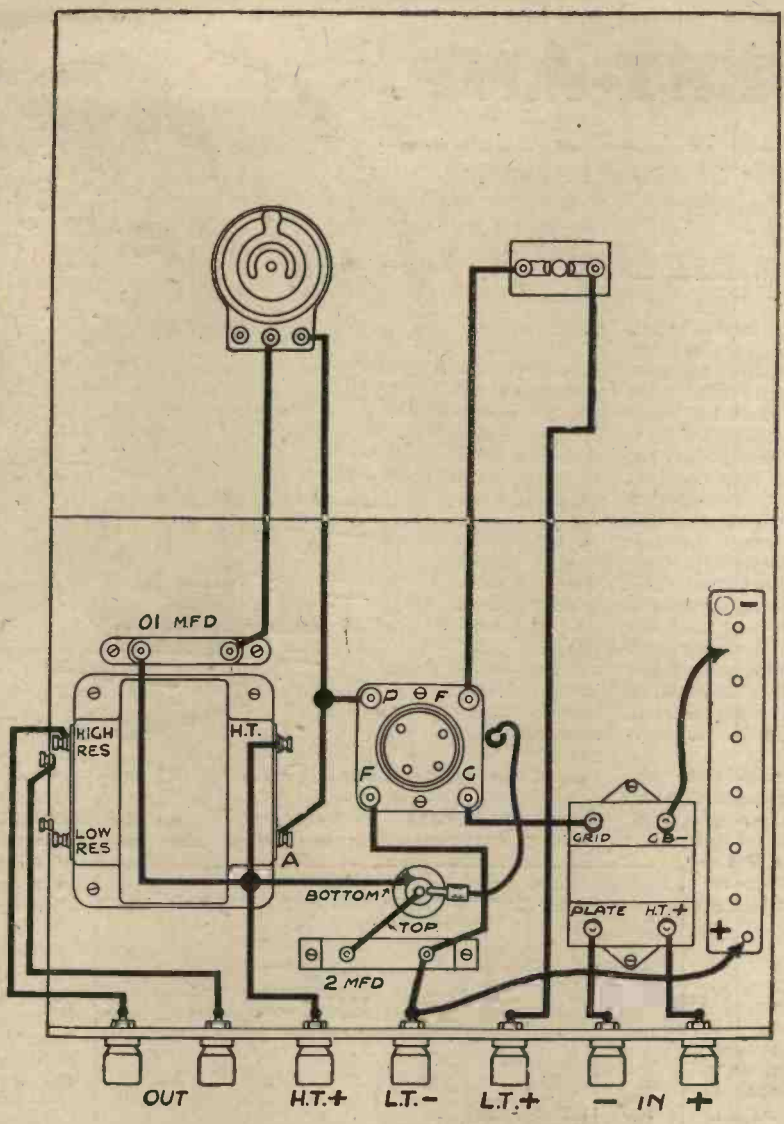


Fig. 4.—Wiring diagram of the Pent-Amp.

LIST OF COMPONENTS

1 panel, 10in. by 7in. (British Hard Rubber Co.).
1 baseboard, 10in. by 7in.
1 valve holder, Benjamin.
1 L.F. transformer, Varley Nicore II.
1 pentode output transformer, Varley D.P.5.
1 fixed condenser, 2 mfd., T.C.C.
1 fixed condenser, .01 mfd., T.C.C.
1 pentode safety decoupling resistance, Bulgin.
1 volume control, 25,000 ohms, Varley.
1 "on-and-off" switch, Busby.
7 terminals: input, output, G.B. —, G.B. +, L.T.—, L.T. +, H.T. +, Belling-Lee.
1 strip of ebonite, 10 in. by 1½in. Wire, screws, grid-bias battery, etc.

ODDS AND ENDS

FOR the past week I have been using a very antiquated set that a friend asked me to try. It was a set that none of our readers would be seen dead with, but it drew my attention to a very interesting point that some of you may have already noticed when using a set having the old direct coupled aerial tuning. Perhaps you have noticed that with modern powerful sets and modern powerful stations the aerial has become less and less important and, unlike the old crystal set days, we do not give a hoot for its being long or high so long as it is reasonably selective. Well, a few weeks ago my aerial fell down and as my set seemed to work O.K. and, as I was very busy, it just stopped down !—a rather terrible admission for a radio writer to make, although I might make the excuse that the aerial wire was insulated. With this old set, however, it was a different story, and I decided to put the aerial back up again and replace the rotten rope that had been the cause of the trouble in the first case. I asked my wife to get me some rope and, visiting one of our great stores—you won't need me to tell you the name of the millionaire founder—she brought me enough rope to hang myself and several aerials as well for sixpence ! The aerial duly reinstated, I began work on the set and, when I got it working, I automatically made a note of the dial readings on some of the more powerful stations. (I always do this on any strange set for future reference.) The next night I tuned in and found all the stations had moved about two degrees ! You needn't all tell me that the condenser dial had shifted because that was what I thought, but when the next night the dials readings had almost gone back to the original readings I thought again ! To cut a long story short, I found out that the rope supporting the aerial was stretching and contracting with the alternate dry and wet weather we happened to be having and the aerial was alternately getting nearer and farther away from the earth, making a sort of variable condenser action. At least that is what I put it down to, but I am open to contradiction, although no prizes are offered for other solutions !

TALKING of aerials reminds me of a visit I paid to the top of Eiffel Tower during quite a heavy wind. Looking down the straight aerial wires that run down to insulators sunk in the ground in the Champ de Mars I was somewhat alarmed to notice the rise and fall of the wires due to the movement of the Tower in the wind. As the tower is some 900 feet high, the movement is fairly considerable and accounts for the large amount of "sag" left in the aerial to allow for this movement.

H.T. Batteries

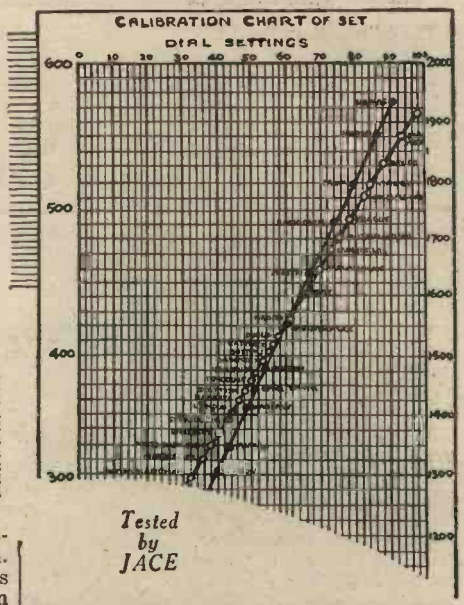
It is false economy to use cheap H.T. batteries, because their discharge rate is too meagre to supply the requirements of the valves.

An H.T. battery should not be judged by the reading it gives on a voltmeter. It may easily register 80 out of a possible 120 when three months old ; yet its discharge rate has probably dropped, and, as a consequence, it is not fit to be kept in service. Some H.T. batteries will function well till the very last hour of their normal discharge, and then cease to apply a serviceable potential.

Receivers and their Records

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

Kolster-Brandes 3-Valve D.C. Mains Receiver (Model K.B. 304)



Tested by JACE

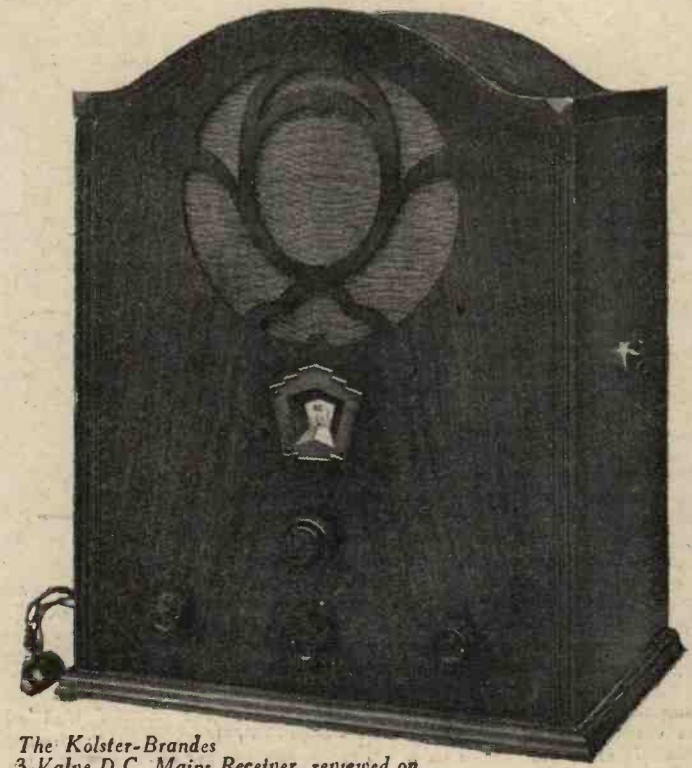
IN my opinion the outstanding features of this receiver are its high degree of selectivity, sensitivity and brilliancy in reproduction of both music and speech. The set, which is chassis built in a pleasing walnut cabinet, consists of a straight circuit incorporating an Osram D.S.B. screened grid, H.F. valve, D.H. metallized detector and a D.P.T. pentode output valve.

Between the detector and output valves a resistance-fed transformer coupling is used in order to obtain good quality. All valves are controlled by fixed series resistances to supply the right voltage, with, in addition, a suitable resistance lamp. In order to safeguard against any possible risk of electric shock by the operator, the removal of the back of the receiver, if inspection is desired, automatically breaks the electric supply to the receiver. This safeguard is a useful one in the event of an omission to switch off before any part of the interior of the set is touched.

The lay-out of the individual components has been carefully thought out; all coils are effectively screened. Particular attention has been paid to provide an efficient smoothing system, and this, in conjunction with other details, achieves results comparable with those obtained by some of the better types of A.C. receivers. In operation, there was very little trace of hum. The moving coil speaker, to which is attached a large input transformer, is on the top part of the cabinet, behind the grille.

In front, immediately below, you will see the controls. They consist of a slow-motion ganged condenser of which the illuminated dial is clearly calibrated in wavelengths. This main tuning control also embodies a concentric trimmer which is adjusted until exact tuning is obtained. Below, there is the wave change switch for "long" or "short" wavelengths, to the right and left of which separate volume and reaction controls have been placed.

Although, at first sight these four—or should I say five?—knobs might appear fearsome to the raw beginner, their use is rapidly learnt and the adjustment thus obtained so accurate that they will enable him to capture transmissions which in the ordinary way would prove much more difficult in a receiver fitted with fewer individual controls.



The Kolster-Brandes 3-Valve D.C. Mains Receiver, reviewed on this page.

Moreover, by this means it is possible to avoid or reduce interference to a very great extent, as in the case of transmissions on neighbouring wavelengths the volume control can be brought into play with just the right amount of reaction without risking unnecessary loss of sensitivity in the receiver. This separate handling of the two controls will prove very helpful when searching for distant transmissions. On test, for a three-valve combination the receiver gave an excellent performance, as some thirty stations were logged at full loud-speaker volume, whilst the local London broadcasts were on. The wavelength range is a liberal one, enabling us, as it did, to hear transmissions below 220 metres and also to permit perfect tuning in of Budapest.

No trouble was experienced in receiving broadcasts from the main B.B.C. National and Regional stations and in separating them from their immediate neighbours, such as Langenberg, Prague, Sottens, Bordeaux-Lafayette, etc. In addition, Florence, Rabat, Riga, Sundsvall, as more seldom-heard stations, were also logged. On the "long" waveband, starting with Rostov (Don) on 847.8 m., almost the entire range of transmitters now in operation was clearly tuned in. Some difficulty at the outset was encountered in separating Warsaw from Eiffel Tower and Kônigs Wusterhausen from Paris, but this was accomplished by judicious use of the reaction and volume controls. On the whole, the calibration of the condenser dial was found to be reasonably accurate, the slight discrepancy in some instances, being accounted for by the trimmer; the actual differences in the readings were unimportant. Terminal sockets are provided for the connection of an additional speaker of almost any type, and a jack is fitted in the back of the set to permit the use of a pick-up for the electrical reproduction of gramophone records. In this event, however, it should be used in conjunction with an external potentiometer volume control.

In every respect the quality was satisfactory, and ample volume was readily obtained with the majority of transmissions, musical broadcasts in particular being very well received; speech was also good. The receiver is well built, compact, of pleasing finish and appearance, and should give all-round satisfaction. The price of the Kolster-Brandes Three-Valve D.C. model is £18 18s.

In addition to the model above referred to, the listener who only has access to D.C. mains is also provided for by the K.B. "Pup," which is a two-valve receiver incorporating an adjustable type phone loud-speaker. Of course, it is understood that Kolster-Brandes manufacture a large range of battery receivers, and receivers intended for operation from A.C. mains. These range from the simple two-valver (the K.B. Kitten), which costs only £3 15s., to a six-valve super het. for A.C., which costs £24 17s. 6d.

The Conclusion of the Series.

Previous articles appeared in Nos. 3, 4 and 5.

THE HEART OF YOUR SET

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

SO far, this short series has dealt with those valves whose filaments are heated with the current provided by an accumulator, the filaments themselves acting as the cathodes of the valves. In sets operated entirely from mains power, some modification of the cathode system generally is necessary.

Dealing first with A.C. mains sets, it is obvious that no great difficulty arises in obtaining a low-tension supply at, say, 4 volts from the house mains, by means of a small step-down transformer. But valves of the normal 4-volt battery type cannot be used on a "raw" A.C. low-tension supply successfully, for the result would be an unbearable hum from the loud-speaker. The reason lies in the fact that if the filament were fed with an alternating current, the electrical potential of the filament would be constantly changing, and the anode current would be similarly modulated, giving rise to a "musical" note in the speaker, corresponding with the frequency of the alternating-current supply.

Indirectly Heated Cathode

This difficulty is overcome by employing an indirectly heated cathode. Instead of using the filament itself as the cathode, it is surrounded by a tube of nickel treated with radio-active material. The heat generated in the filament by the passage of the A.C. low-tension current is transferred to the cathode, but as this independent cathode is electrically insulated from the heater, all portions of its surface are at the same potential, and no mains hum is introduced.

The indirectly-heated cathode principle can be applied to valves of every class—and is used universally for screened-grid high-frequency amplifiers, for detector and early stage low-frequency valves, and for some types of output valve. It is possible, however, to use directly heated valves in the output stage, because what little hum might be introduced at that point is not subject to further amplification. A good range of both triode and pentode output valves of the directly heated type suitable for use on A.C. mains receivers is available.

The essential connections to indirectly heated A.C. valves are identical with those of battery valves, except that all grid circuits are returned not to the filament circuit, but to the cathodes. There are A.C. valve types corresponding to all the types of battery-heated valves, but in general their characteristics are considerably better than those of their battery-heated counterparts. This is accounted for in part by the very generous electron emission which can be obtained from the comparatively large-surfaced cathode, and in part by the fact that the cylindrical cathode construction permits very much closer spacing between the electrodes than is possible in a valve containing a fairly long filament which has to be arranged in some form of zig-zag.

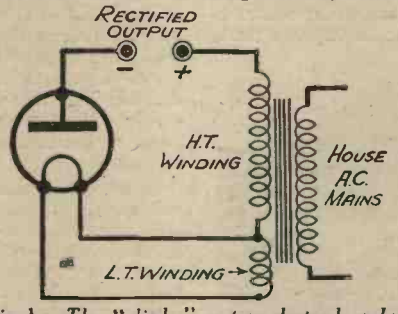


Fig. 1.—The "diode," or two-electrode valve, used as a rectifier in an A.C. mains set.

High Efficiency Obtainable

As examples of the high efficiencies obtained from valves of the indirectly heated A.C. type, it may be stated that few battery-operated screened-grid valves have amplification factors approaching the 500 figure, but amplification factors of 1,000 and even more are quite commonly found among A.C. screened-grid valves. Similarly, in the case of A.C. detectors, the amplification factors of valves corresponding to the "H." and "H.L." classes may be as high as seventy-five or even more, while the general-purpose type of A.C. valve usually has an amplification factor of the order of thirty-five.

Choice of valves for use in an A.C. mains set should be made on precisely the same lines as when selecting battery-operated valves, although owing to the much higher efficiency of the indirectly heated valves the choice of alternatives is not so large. This is in some measure due to the fact that the range of battery valves reflects, to a great extent, the history of radio development during many seasons, it being necessary to make and supply valves suitable for the many different circuit arrangements which have successively held the field.

Sensitivity of Indirectly Heated Valves

In the case of mains sets, however, which are of comparatively recent introduction, accumulated experience, and the availability of super-efficient valves, has resulted in a greater degree of standardisation in circuits and general receiver design, and there is therefore a corresponding tendency towards the limitation of the number of valve types. A further factor is that because of the greater sensitivity of the indirectly heated valves, fewer stages are required—especially on the low-frequency side. Most

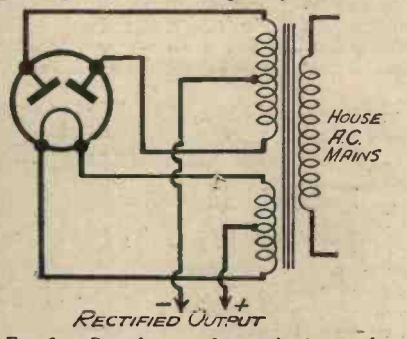


Fig. 2.—Rectifying valve with two anodes fed from a centre-tapped transformer.

British valve manufacturers find that practically all normal requirements so far as detectors and early stage low frequency amplifiers are concerned, can be met by two or at the most three types of three-electrode valves.

(Continued on page 313.)

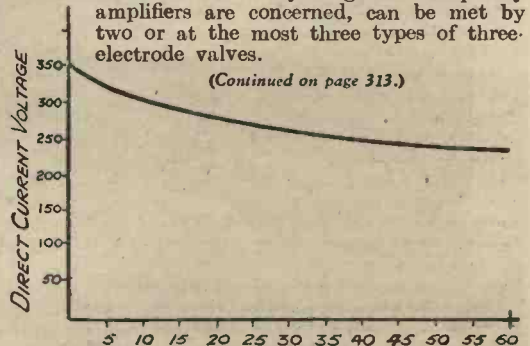


Fig. 3.—Typical performance curve of a rectifier valve.

THE BEGINNER'S SUPPLEMENT

Conducted by F. J. C.

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 circuits or terms used in connection with wireless we extend a cordial helping hand.

SIMPLE EXPLANATION OF THE VALVE

IF the glass bulb of a valve, the filament of which has burnt out, is carefully broken by first wrapping it in a piece of cloth and lightly tapping with a hammer, the result will be most interesting. For the interior construction may be examined and, in conjunction with the following description, the various parts understood. In a modern valve of the type illustrated in Fig. 1 there are three distinct parts; these, as shown in the Figs., are 2 the filament at the centre, surrounded by 3, the grid, which in its turn is surrounded by 4, the anode; these three parts are known as electrodes. Inside the bakelite base from which the valve pins project is cemented a glass pinch; embedded in this are five stout supporting wires, four of which run from the electrodes right through to the valve pins, two of these four to the filament pins, and one each to the anode and grid pins respectively; the fifth wire acts as a support for the filament, and helps to hold it in its correct position between the spirals of the grid.

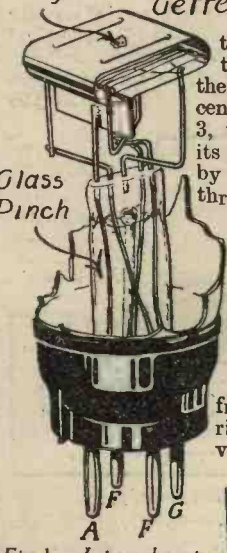


Fig. 1.—Internal parts of a modern valve.

The Filament

The filament may well be dealt with first, since it plays one of the most important parts in the operation of the electrodes, although it is only a fine thread of wire upon which generally the life of the valve depends. The functioning of the valve is commenced by passing a low-tension current from an accumulator through the filament; this has the effect of heating it. When the filament has reached the correct temperature it throws off minute electrical negative charges which are known as electrons. The electrons pass through the grid, and are attracted to the anode, they flow thence back to the low-tension battery. To attract these negative electrons to the anode from the filament, the anode is kept positively charged, for it is a well-known fact that in electricity a positive charge attracts a negative charge. To positively charge the anode, it is connected to the positive side of a high-tension battery, the negative side of the battery being connected to low-tension negative. In this way the voltage to the filament is unaltered, but the voltage of the anode with respect to the filament is greatly increased and with it the electron flow.

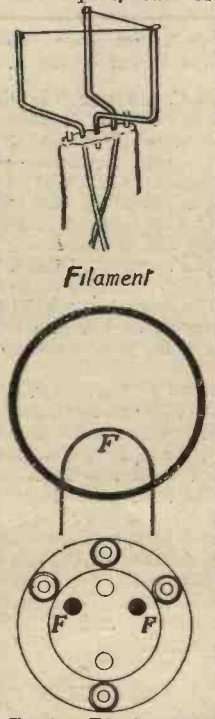
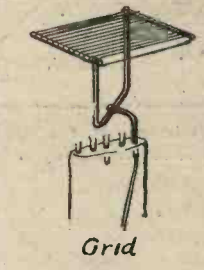


Fig. 2.—The filament.

The Grid

The grid is a spirally-wound length of wire (see Fig. 3), and, as before stated, is between the filament and the anode. To this the incoming wireless signals are applied. These signals are alternatively negative and positive; this changing of polarity tends to control the electron flow from the filament to the anode, for when the grid is positive it acts like a small anode, and because it is nearer to the filament its attraction for the electrons is much greater; but this also means an increase in anode current. The grid, however, is just as often negative, and has the effect of repelling electrons leaving the filament, for like repels like. A negative grid will therefore mean a decrease in anode current. It may be seen, then, that if the grid is biased negatively with a grid-bias battery as much as possible, it will tend to stop any positive signal voltages from making the grid positive; grid current is thus prevented although the controlling action of the grid is maintained. If over- or under-biased, however, the grid will not be able to deal with the applied signal voltages, and distortion will be noticeable. Now it is possible to understand why with correct amount of grid bias the anode current consumption of the valve is cut down and the H.T. battery is therefore being used as economically as possible. The grid serves to interpret the wireless signals, the periodicity of which varies with the different wavelengths of the broadcasting stations into which the set is tuned; this is called the carrier wave. In a wireless wave of 300 metres the frequency of this carrier wave is in the neighbourhood of 1,000,000 cycles per second, which is far above the frequency audible to the human ear. A microphone current is modulated into this carrier wave at the broadcasting station, and this produces the sound waves of speech and music; this current has, of course, a much lower frequency. The action of the detector valve in a set is to demodulate these two variations of current—*i.e.*, separate them, retaining the sound waves (low frequency) and dispersing the carrier waves (high frequency current). These low-frequency currents are the variations which, when amplified by a power valve, go to actuate the loud-speaker.



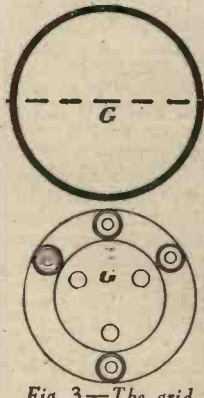


Fig. 3.—The grid.

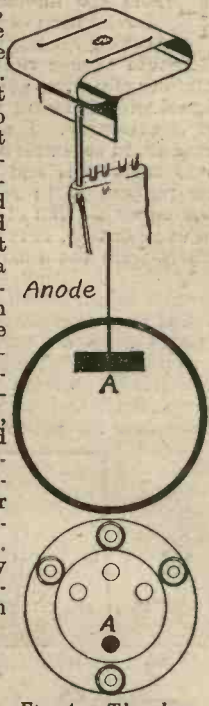


Fig. 4.—The plate.

The electrodes which constitute the valve would not be able to operate if it were not for the fact that they do so in a vacuum—that is to say, all the air is exhausted from the valve. Valves in which a trace of gas is allowed to remain are classified as "gassy" or "soft," and are apt to become unstable, besides having a very short life. In the process of manufacture the valve is connected to pumps and as nearly as possible evacuated and hermetically sealed. It is then brought into close proximity to a high frequency coil, the high-frequency currents of which tend to heat the electrodes; this

has the effect of releasing any gases remaining in the metal of the electrodes, and when the temperature becomes sufficiently high a small piece of magnesium, previously fixed inside the valve, is ignited and burnt. The combustion of the magnesium absorbs the remaining traces of gas in the valve. The process of combustion causes a portion of the metal to be deposited upon the inside of the glass bulb in the form of oxide of magnesium, which gives that silvered effect which may be seen in the upper part of all valves. The operation of final exhaustion by magnesium is called "gettering," and the magnesium is known as the "getter."

Metallized Valves

The latest development in modern valves of the screened grid and detector types is the coating of the outer surface of the glass bulbs with a finely-divided metal powder. This appears to be applied in a dry state to the tacky surface of a coat of varnish. Its effect is to eliminate the usual aluminium shield, and must be earthed in the same way as such shield. This earthing is already arranged in the valve by the manufacturers. The effect of the metal coating is to isolate the valve electrically and prevent stray currents from interfering with other surrounding components.

The screening provided by this metallic coating is quite as efficient as is obtained by enclosing the valve in a metal box, so long as the valve holder is correctly wired up. If you examine one of these metallized valves you will find, attached to the coating just above the base of the valve, a small disc or ring. This sometimes bears the letter E. From this disc or ring a thin wire can be seen passing into the holder, and the metallic coating covers both disc and wire. The filament leg beneath this disc *must* be joined to the earth terminal of the set to enable the screening to be effective.

ALL ABOUT DECOUPLING

A Simple Explanation of the Need for Decoupling, and How it Works

FROM the number of queries which have been sent in by readers asking questions about decoupling, it would appear that there are quite a number of readers who do not fully understand what is meant by the term, or why it is necessary. I will therefore try to explain, in as simple a manner as possible, just what it is and does. First of all, its purpose is to separate, electrically, the anode circuits of each valve, or, put in another way, to take the H.F. currents direct from the anode to earth in order that they shall not be passed back into a valve in a succeeding stage. This may sound very complicated, but with the aid of *the illustrations* you will find it is quite a simple affair. We have stated that it is the H. F. currents which have to be disposed of, and we will, therefore, have to explain the nature of these first.

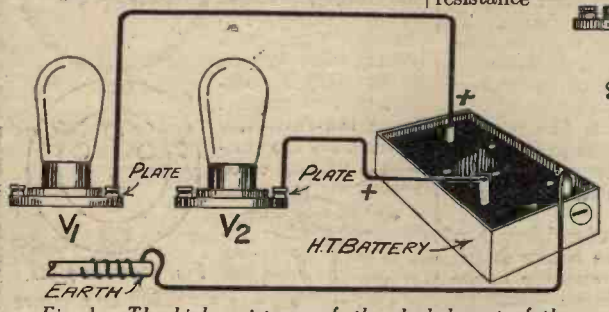


Fig. 1.—The high resistance of the shaded part of the battery will give rise to motor-boating or "feeding back."

H.F. Currents

Now the H.F. currents are in the form of oscillations; that is, they flow "backwards and forwards" at a terrific rate—actually, more than 12,000 times per second, and this is termed frequency. When an alternating current is applied to a condenser, the effect is as follows: One terminal of the condenser is at one moment negative (which means it has a superfluity of electrons or particles of electricity), and the other plate will be positive (which means it has a shortage of electrons). If, now, the state of affairs is reversed—that is, we reverse the potentials applied to the condenser terminals—we shall be in the same position as before, except that now the terminals will be of opposite potential. The effect of this, therefore, is that oscillating currents *apparently* pass through the condenser, or, in other words, a condenser does not offer a barrier to oscillating currents. This is the first point in our explanation.

If a voltage is applied to a wire, a current will flow, and the *thickness* of the wire will govern the amount of current which will flow. The thinner the wire—or, in other words, the greater resistance—the less the current, which means to say that a resistance offers a barrier to current.

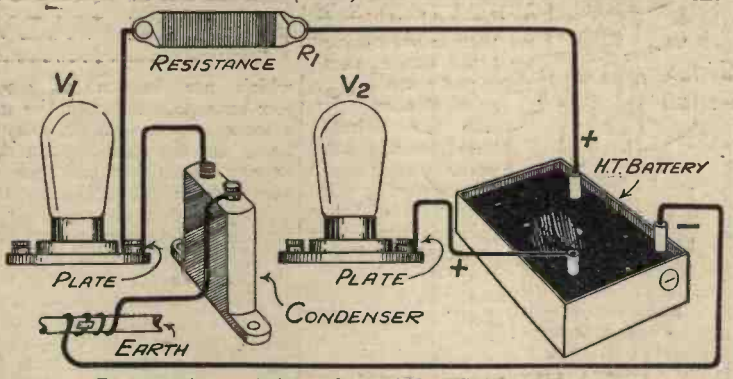


Fig. 2.—Here a "decoupling resistance" has been added, which will act as a barrier to H.F. currents.

Now H.F. currents are present at the anode of the valve, and if no decoupling components are fitted. these currents will pass to earth *via* the H.T. battery.

A Run-down Battery

When a battery has been in use for some time the cells, owing to the chemical change which has taken place, develop a high resistance, and, as we have just seen, this will offer a barrier to the H.F. currents. In the diagram we have shown the resistance of a run-down battery by a shaded area, and you will see that the anode of the first valve is joined to one end of the battery, whilst the anode of the other valve is joined to the tapping before the shaded area. It will be obvious, therefore, that the H.F. currents from V1 will pass into the battery, but owing to the high resistance of the shaded area will pass back to the anode circuit of V2, and it is this feeding back which gives rise to "motor-boating," or L.F. oscillation. Fig. 2 shows the same arrangement, only with this time a decoupling resistance and condenser inserted in the anode circuit of V1.

What happens now? The resistance R1 will act as a barrier to the H.F. currents, and they will, therefore, be unable to get round to the H.T. battery; and as a condenser is joined between the anode and earth, this will offer an alternative path, with the result that there will be no H.F. currents present in the battery, and, therefore, stability is assured.

SOME FACTS ABOUT WIRELESS LICENCES

THE Post Office Licence must be obtained by every listener who is in a position to receive the broadcast programmes. If an aerial is erected a licence is necessary, even although no set is connected to it. The Authorities take the line that the intention is to receive the programmes, hence the aerial.

The licence also covers the use of a portable receiver, but another licence is required for a receiver which is taken to a further dwelling. If you have two receivers, one permanently connected to the aerial, and a portable in addition, only one licence is required.

In addition to the Post Office Licence, it is also necessary to have a licence from Marconi's Wireless Telegraph Company, Ltd., for the use of their patents (if such patents are employed in the receiver). Most manufacturers hold such a licence, and the receiver should carry a small licence plate stating that the due royalties have been paid.

The home-constructor is not immune from this levy. If you construct a receiver for your own use, and make use of any of the above company's patents, you should write to them for a licence plate, which will be supplied on payment of the royalty. If in doubt about the employment of patents, send them a wiring diagram of the receiver. The Post Office Licence is 10s. per annum; the home-constructor's Marconi Licence is 12s. 6d. per valve; and the Manufacturer's Marconi Licence is 5s. per valve.

STANDARD PANEL SIZES.

THE following are the sizes in inches recommended by the B.E.S.A. and used by home-constructors:
6 x 9, 6 x 12, 7 x 14, 7 x 18, 7 x 21, 8 x 12, 8 x 16, 8 x 20, 8 x 26, 8 x 30.

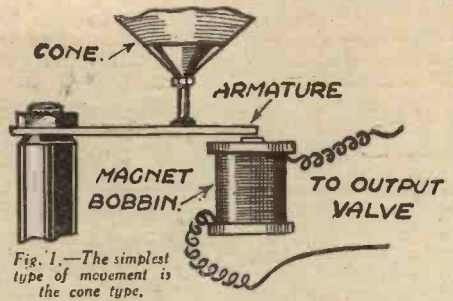


Fig. 1.—The simplest type of movement is the cone type.

THE LOUD-SPEAKER—

Various Types and Their Principles—I

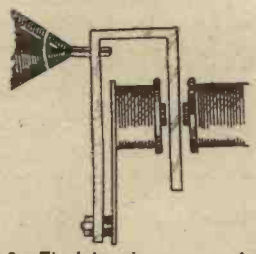


Fig. 2.—The balanced armature. As will be seen, the armature is less rigidly arranged between the two magnets.

A GLANCE through a wireless catalogue when trying to decide on the loud-speaker to buy for your set, will leave you, perhaps, rather puzzled at the different types of speaker. There is the simple cone type; the balanced armature; the inductor dynamic, and the moving coil. Well might the novice or new-comer to radio say, "What is the best type of speaker to get for my set?" In this article we shall touch briefly upon the four above-mentioned types of loud-speaker, describing how they work, and their respective merits, so that you can decide just whether you have got the wrong type of speaker for your set, or what type you will buy for the new set you are going to make up.

The Reed

The simplest type of movement is the one illustrated in Fig. 1. It consists of a strip of iron, fixed at one end, the free end being above and close to the pole of a small magnet. To the strip of iron, or armature as it is properly called, is fixed a thin rod on to which a cone diaphragm may be fixed. The windings of the magnet are connected in the output circuit of the last valve of the set. As the current changes, due to either speech or music passing through this magnet winding, so the pull on the armature is varied, with the result that the vibrations are transferred to the cone, and so the sounds are heard by us. It will be obvious that the armature will always tend to return to its normal position, and this natural restoring force gives rise to its first fault, namely, resonance. Again, the current fluctuations due to a very low note, such, for instance, as the beat of a drum, are very great, and should result in a large movement of the armature. As the armature is rather rigidly held, it must be arranged close to the pole-piece in order that the weak impulses may affect it. Therefore, on a low note it tends to come into contact with the pole-piece, giving rise to "chatter," a fault which is also noticed when very loud signals are received. It will be seen from this, therefore, that this type of speaker is only suitable for receivers with a fairly weak output, and one which is not designed to reproduce the very lowest notes in the musical scale.

The Balanced Armature

This idea was brought out to try and avoid the principal fault of the first type of speaker, namely, resonance. As will be seen from Fig. 2, the armature is now less rigidly arranged in between two magnets. There is, therefore, an equal pull in each direction, and this tends to make the armature move about a central position, avoiding the natural restoring force which we noticed in the simple type of movement. The gap between the magnets may be fairly large, and so greater signal strength can be dealt with without the risk of "chatter." This type of speaker is, therefore, most suitable for receivers employing two or more valves, and designed more on "quality" lines than the usual cheap set.

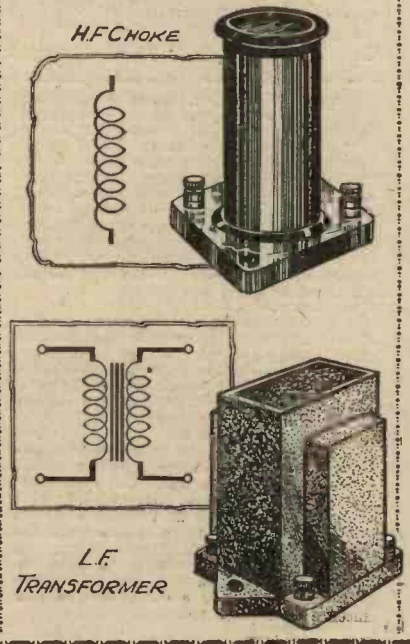
The Inductor Dynamic

The inductor dynamic is the nearest approach yet obtained to the ideal in moving iron speakers. In both of the previous movements it is obvious that as the iron armature is fixed at one end, there must necessarily be a certain amount of resistance to overcome in order to vibrate the armature, and the tendency of the armature to return to its position of rest is always present, no matter what electrical impulses are at work. This prevents the slow oscillation necessary to produce, say, a pedal note on the organ, and, in addition, the cone is not operated in a direct push-and-pull movement. The actual direction of the cone's movement, to produce true tones, should be what might be termed a "piston" movement; that is, it should move in a horizontal plane. Now, as one end of the armature in the speaker movements so far described is fixed, it is obvious that the operating reed is taken through a small arc during its to and fro movement. This gives rise to a form of distortion.

To overcome all these defects in a moving-iron loud-speaker seems rather difficult. However, a certain inventor set to work and the result of his endeavours to produce the ideal moving-iron movement is known as the Inductor Dynamic Speaker. The actual arrangement is the subject of Letters Patent, and only a few firms in this country are licensed to manufacture it. There are four pole pieces to the magnet system, and two armatures. The two armatures are held together by means of rigid, but light rods, and the armature assembly is held at the *front and back* by very light springs.

Wireless Shorthand—1

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.



Why "Non-Inductive"?

WHEN one comes to study the list of parts required for a modern set, one is at once struck by the number of fixed condensers and resistances specified as being non-inductive types, and a question which flashes through one's mind is Why "non-inductive"? The answer would not be hard to find if a condenser or resistance of the ordinary pattern were taken out of its case and dismantled. The condenser would be found to consist of a "sandwich" of tin foil and waxed paper made up into a flat roll; inside the case of the resistance would be found a coil of fine wire on a small former, the whole thing rather resembling a high-frequency choke. It will be clear that either the condenser or choke would resemble a tuning coil and could therefore have the same property—inductance. And if an inductance is connected in a complete circuit it will tune to a certain frequency; if it is in a tuning circuit it will entirely upset the normal tuning by creating "resonance peaks," and at certain frequencies will absorb much of the energy from the tuned circuit. It is for this reason that the coupling condenser and by-pass resistance of a band-pass circuit must always be non-inductive. A similar thing applies to the by-pass condenser, usually wired from the screening grid of an S.G. valve to earth. Stopping resistances inserted in the grid lead of L.F. valves to prevent the passage of H.F. impulses into the amplifier must also be non-inductive, for if not they would only be effective at certain frequencies. In some cases (principally where a high resistance is used) the resonance peak might fall within the range of audible frequencies, when serious distortion would result.

CHOOSING YOUR TUNING COILS

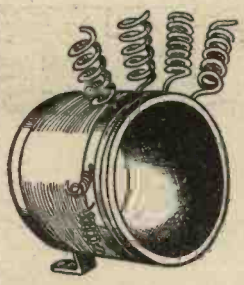


Fig. 1.—The single layer wound solenoid coil.

IN view of the large number of different types of tuning coil at present on the market, many readers, no doubt, have trouble in deciding upon the various merits of the coils, and are in doubt what particular type of coil to buy for their set. The following article should enable one to decide just which particular make or type will fulfill the particular needs of the set or locality in which each reader finds himself.

The Simplest Coil

The simplest type of coil is, of course, the single layer wound solenoid (see Fig. 1)—that is the tube of either ebonite or some similar insulating material, having a diameter of three inches or so, round which is wound a certain amount of wire much in the manner of a cotton reel. For the simplest type of set, such as a crystal receiver, this is undoubtedly the best type of coil. If provided with tapping points so that the damping of the crystal and aerial may be distributed effectively over the coil, it will be found most efficient. Its drawbacks are, firstly, the large space taken up, and, secondly, the extent of the electrical field which surrounds the coil. In the case of valve sets, the efficiency of the coil will be lost unless a very large baseboard is employed, owing to the proximity of other components such as variable condensers, etc. Any metal body (especially if earthed) in the field of the coil causes losses, and this brings us to the first consideration in choosing a coil for a valve receiver—namely, a small external field. This means that the coil has to be either of small dimensions, or that it must be wound in some manner which limits the field.

Fig. 2.—The honeycomb type of plug-in coil.

The Honeycomb Type of Plug-in Coil

In the former class we have the "honeycomb" type of plug-in coil, where the turns of wire are limited to a small former, and are wound over and over upon themselves, giving low self-capacity, but high inductance. (Fig. 2.) This coil is very efficient, especially if wound with good thick wire or high-frequency cable (Litz wire), and its chief drawback is the need for coil changing to cover various wavelength ranges. For a receiver which is designed to cover a narrow band—such as a local station receiver—it forms a very convenient arrangement. The coil illustrated in Fig. 3 is enclosed in a bakelite case, which prevents moisture and dust affecting the characteristics of the coil, and gives a more robust coil. This is no doubt the best type of coil to use in any circuit where a single coil is required. Although its field is not so large as the solenoid, care must be taken to avoid coupling with other coils, and, therefore, it is a good plan to arrange all coils, no matter at what distance they are placed, at right-angles.

The Dual-range Coil

The next type of coil to be considered is the dual-range coil. This has been brought out to avoid the inconvenience of changing coils when listening to the long-wave stations, such as Daventry, Radio-Paris, etc. The principal commercial forms of this coil are of the solenoid type, the large amount of wire required for the long waves being wound into slots on the former, each slot accommodating a pile of windings. This arrangement enables a lot of wire to be put into a small space without increasing the self-capacity of the coil too much. Further, this type of coil is usually provided with a base (or pins to fit into a base), and is, therefore, held in such a position that the surrounding components of the receiver cannot be included in its field. In other words, the coils are mounted vertically (Fig. 4.) A further method of winding these coils to avoid the "field" trouble is to use two small formers, mounted side by side, and to wind half of the winding on one coil, the remaining half being wound on the other former *in opposition*. In this way the field of one coil neutralizes the field of the other. This is known as "astatic" winding. (Fig. 5.)

Fig. 3.—A coil enclosed in a bakelite case.

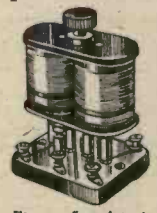


Fig. 5.—Astatic winding in which the field of one coil neutralizes the field of the other.

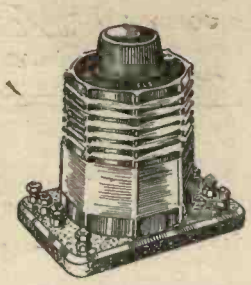


Fig 4.—A dual-range coil.

The Governing Factors

The size of the wire, the size of the former, the spacing between adjacent turns, and other factors all help in varying the characteristics of a coil, so that in receivers employing two tuned circuits, it is necessary to obtain two coils having exactly similar characteristics if the two tuning condensers are to remain in step. Manufacturers to-day are making coils which are so accurately wound that the characteristics are guaranteed to 1 per cent., and for circuits employing more than one H.F. stage these coils are necessary, as then one can obtain condensers joined together, or "ganged," which are also guaranteed to 1 per cent., and, therefore, only one tuning knob is required to tune as many as four circuits.

Selectivity

To obtain the utmost selectivity, either to get distant stations when operating a receiver close to a high-powered station, or to separate stations on a very close wavelength with a receiver having H.F. stages, the latest type of coils to be put on the market will be found essential. This is the band-pass coil, and this was fully dealt with in the Free Gift Book given with No. 2. The coil consists actually of two coils, of practically identical characteristics, and with a good ganged condenser provides one-knob control of a receiver and yet enables such stations as Mühlacker and London, for instance, to be separately tuned—without any loss in quality. Where selectivity is sharpened up by the use of reaction, distortion occurs owing to what is known as "side-band cut-off." The peculiar construction of the band-pass coils, however, prevents this, but maintains the same degree of knife-edge selectivity.

"Shock-excitation"

When situated close to such high-powered stations as Daventry, etc., it is often found that the station can be heard all over the tuning dial, no matter what type of circuit is employed. This is due to what is known as "shock-excitation," which means that the oscillations from the transmitter are so strong that they strike the actual coil in the set, and so set up impulses which are not tunable. To obviate this, the modern coils are now supplied in a metal can; but do not think that you can get a similar result by putting a cocoa tin over your coils.

SOME BATTERY QUESTIONS ANSWERED.

WHAT is a Storage Battery?—A storage battery is a device which may be used repeatedly for the storage of energy. Energy, in the form of electricity, is put into the battery when it is charged and given up in the same form when the battery is discharged.

What are its Essential Parts?—Two unlike plates (positive and negative) in a solution (electrolyte). The electrolyte acts upon the plates and gives to the positive a tendency to deliver current and to the negative a tendency to absorb current.

What is the Electrolyte?—It consists of a mixture of pure sulphuric acid and distilled water. If you are filling your own batteries and "breaking down" strong acid to the required strength, the following precautions should be observed:—Vessels should be of glass, earthenware or lead, and *never* of any other material. Pour the acid *slowly* into the water. *Never* water into acid. Stir *well* with a stick or wooden spoon, and allow to cool before taking gravity readings.

Dirt and moisture allow the current to leak away, and reduce the efficiency of a battery. They also tend to start corrosion by attracting and absorbing minute quantities of acid.

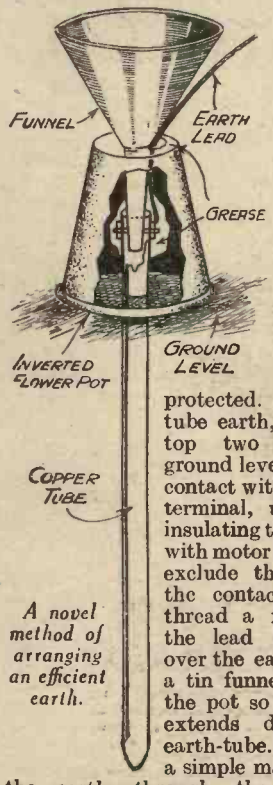
Corrosion is best prevented by removing all traces of acid from terminals and connections (by wiping with a rag moistened with ammonia) and then coating all metal parts with pure vaseline.

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

An Efficient Earth.

A FAULTY earth can make a great difference to your reception, and an hour spent in overhauling your earthing system will not be wasted. For your lead use copper wire, if possible, and the thicker the better. The insulated wire used by electricians in house wiring is cheap and quite good for the purpose. Trouble is generally experienced at the actual earth connection, due to rain and weather causing deterioration, and to prevent this the connection must be well protected. Use a copper-tube earth, and leave the top two inches above ground level. Make a tight contact with a strong spade terminal, using plenty of insulating tape and smother with motor grease. This will exclude the air and keep the contact clean. Now thread a flower-pot along the lead and invert it over the earth-tube. Insert a tin funnel in the hole in the pot so that the spout extends down into the earth-tube. It now becomes a simple matter to moisten the earth through the funnel, when necessary, and at the same time the water and the weather are excluded from the electrical contact.—R. A. BOOTH (Cambridge).



A novel method of arranging an efficient earth.

Avoid Cheap H.T. Batteries.

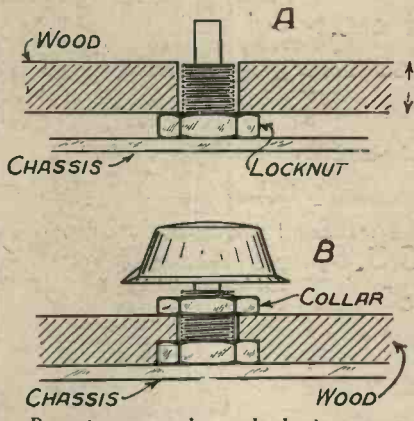
WHISTLING noises often complained of are usually due to defective cells in the H.T. battery. Cheap batteries of foreign make are mainly responsible for these disturbances. A "dolly" comes awash or a cell dries up, causing the whole of an anode circuit to be upset, owing to the resistance introduced in the circuit by the faulty cell. If this cell is near the negative end—say between zero and the first socket—it can easily be cut out by advancing the negative wander plug to the next socket. If the fault is at the positive end the positive plug can be shifted in the same way. Sometimes one or two cells in the centre of a block H.T. battery become faulty. In this case they can easily be cut out by bridging them with a short length of flex and a couple of wander plugs. If you want maximum results from your set, choose a H.T. battery of a well-known make. There are several on the market which can be relied on to give a steady output with an even voltage decline in all cells.

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."

Recessing a Cabinet Front

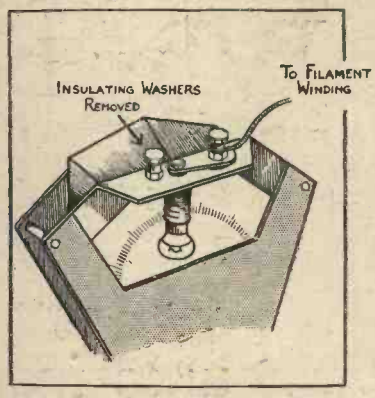
TO my annoyance, on several occasions I have found that, having constructed a chassis, upon sliding it into the cabinet, the bushes and spindles of most components will not reach through the front panel (A), which is very often of ⅛in. plywood (used generally to avoid box resonance and shrinkage). This can be overcome by recessing the back of cabinet front (B) sufficiently to accommodate locknuts and thus allow bushes to project enough to fix the collars and knobs.—"VIC" (Barnstaple).



Recessing a panel to take back nuts on components.

Illuminated Dials

IT is often quite practicable for constructors of A.C. sets to light the bulbs of illuminated dials off the transformer filament winding. In most cases the framework of the dial is at earth potential, while there are two terminals provided for the illumination of the bulb. Remove the insulating washers from one of these terminals, thus connecting one side of the bulb to earth. Connect the insulated terminal to one side of the 4-volt transformer winding. As the centre of the transformer winding is connected to earth, the bulb will light up, having a 2-volt current flowing through it. If a 3.5 flashlamp bulb is fitted, the illumination will be found quite sufficient, although the bulb will be working under its rated voltage.—A. SMETHURST (Manchester).

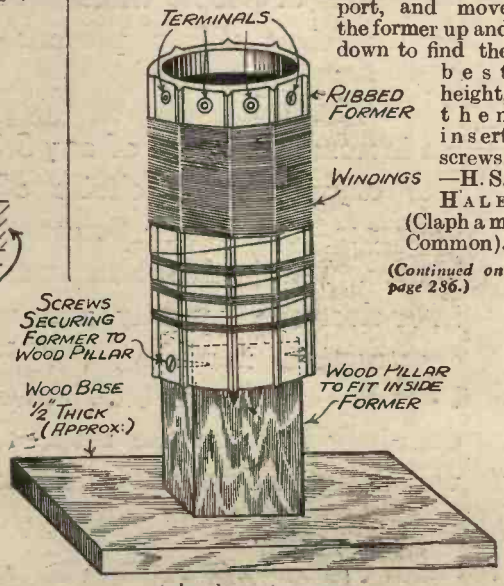


A neat method of fixing a bulb for an illuminated dial.

A Simple Coil Support

HERE is a useful coil support for home-wound coils of the usual ribbed former type. When using a metal chassis or metal-covered baseboard, these supports will be found to increase the efficiency of the coils a great deal. The best way of affixing is to bore the holes in the former first, then use a piece of folded paper to wedge the former on to the support, and move the former up and down to find the best height, then insert screws. —H. S. HALE (Clapham Common).

(Continued on page 286.)



A handy coil support.

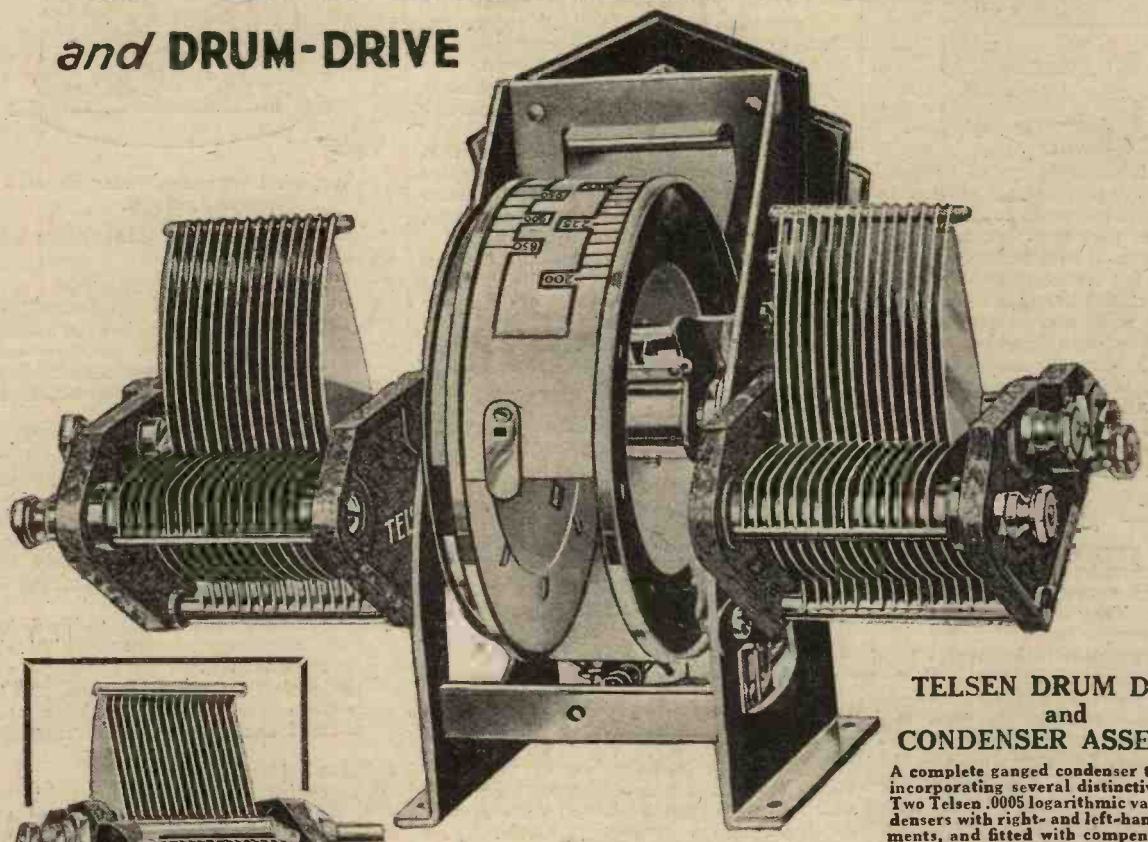
* SPECIAL NOTE

WIRELESS CONSTRUCTORS' ENCYCLOPÆDIA

Owing to a misprint in the earlier copies of the Subscription Voucher for the Presentation Volume of the above, the binding for the Edition De Luxe was given as "water-proof moroquette." The notice should have stated "quarter moroquette," forming an equally artistic and durable style.

TELSEN LOGARITHMIC CONDENSERS

and DRUM-DRIVE



TELSEN DRUM DRIVE and CONDENSER ASSEMBLY

A complete ganged condenser tuning unit incorporating several distinctive features Two Telsen .0005 logarithmic variable condensers with right- and left-handed movements, and fitted with compensators, are mounted and ganged together, through a rigidly constructed drum-drive control. Mounted on the same spindle axis as the main tuning drive is a trimmer, giving a swinging movement of about 20 degrees to the stator vanes of the right-hand variable condenser, enabling perfect matching of the condenser to be maintained throughout the tuning range. Two scales are supplied, one marked in wavelengths and one in graduations from 0-100. The scale is illuminated and is easily removable when it is desired to fit one of special calibration. The escutcheon is handsomely finished in oxidised silver, with knobs of the push-on type. Provision is made for panel and baseboard mounting; full instructions for mounting, together with a double-ended spanner for fitting the variable condensers, are included with every unit.

17/6

TELSEN LOGARITHMIC CONDENSERS

The 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, the vanes being held at both ends. Generous bearings obviate backlash or end-plate. Models with left-hand and right-hand movements respectively incorporate a compensator (max. cap. 60 micro-micro-henrys).

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 DRUM DRIVE

Embodies numerous refinements, including a cord drive, arranged to reduce wear to a minimum and to prevent over-run, and a rocking stator trimmer, which gives a variation of 20 degrees, and visual indication of setting. For use with Telsen screened coils, an extra scale, marked in wavelengths, is supplied free. Illustration shows escutcheon, handsomely finished in oxidised silver. **8/6**

TELSEN

RADIO COMPONENTS

BUY A COPY OF THE TELSEN RADIOMAG - PRICE 6d.

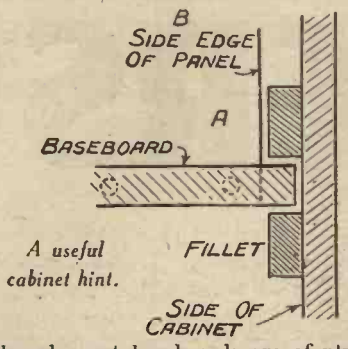
ANNOUNCEMENT OF THE TELSEN ELECTRIC CO., LTD., ASTON, BIRMINGHAM

Radio Wrinkles

(Continued from page 284.)

A Cabinet Hint

IT is quite usual for manufacturers to provide only one "fillet" each side of the case for the set baseboard to rest on. Now,



A useful cabinet hint.

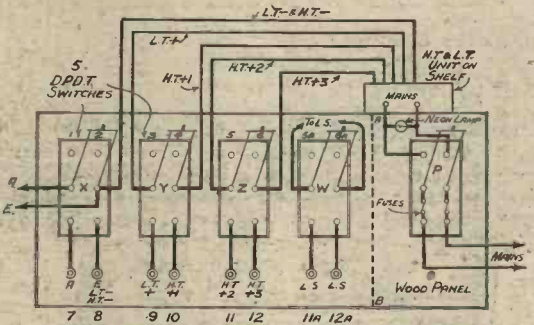
although most baseboards are of plywood these do not always remain true—it may be of interest to readers to know that quite a lot of makes of plywood "wind." (This term "wind" is used to denote a diagonal twist). It is a far better scheme to brad and glue another fillet (A) above (or below) the first one at such a distance that the baseboard will slide into cabinet between the two strips, thus holding the baseboard true and firmly, but also allowing of easy removal. One should note that the front panel must be set in (B) enough to allow for the width of this fillet.—"MAKER" (Barnstaple).

Uses for Old Coils

PRESENT-DAY motor-car ignition coils, even when discarded and unfit for further original use, form a very rich source of potential wireless wealth. They can usually be picked up for a copper or two at any garage, and are well worth the investment. Starting from the outside, the ebonite case (about 6in. x 2½in. dia.) forms an excellent coil former. It is first-class ebonite and cuts easily. Under this is a stalloy shroud, 2ft. long and already cut into strips 6in. x ½in.—useful for transformer or choke cores. The long ribbon of insulating fibre under this shroud need not be thrown away. Small circles under the valve holders cut to size may save a valve being burnt out through its legs touching the metal baseboard. The uses to which the primary winding of the coil may be put are obvious. Two ounces of 20 S.W.G. d.c.c. wire never need go begging. Between the primary and secondary windings is laid a length of oiled silk about 3ft. x 6in. The sort of stuff which you want particularly badly at night when the shops are closed, for binding transformer windings or headphone bobbins, or, at a pinch, for covering a cut finger. The secondary winding is, to most people, a perpetual source of wonder. It's an everlasting supply of 38-40 S.W.G. enamelled wire. There seems to be miles of it! Even after making up several dozen yards of home-made Litz wire, and providing all your cronies with material for H.F. chokes, there is still sufficient left on the core to make it into quite a hefty L.F. choke for mains units. You can even wind first-class tuning coils with it if used four strands at once, making sure that all ends are securely joined up.—J. B. (Whitley Bay).

Experimenter's Switchboard.

THERE must be many experimenters like myself who are constantly trying out various circuits, and yet like to have a set for family use at one's instant disposal. For this purpose I have rigged up a switchboard on the wall above my bench with five double-pole, double-throw switches. The top connections of these (1, 2, 3, 4, 5, 6, 5A, 6A) are permanently connected to the "family" set. The lower connections (7, 8, 9, 10, 11, 12, 11A, 12A) to terminals at bottom of switchboard. With switches all "up" the family set is in operation; with switches "down" (except mains) connection is made to the experimental terminals; with switches "out" altogether, everything is dead to enable any alterations to be made in a moment with safety. In this way one can always cut into a broadcast programme for a special item without disturbing the experimental set. The mains switch should, of course, be either up or out, although if put down by accident the set will still be dead. It will be noticed that fuse wire is connected between the centre and bottom terminals of the mains switch. Care must be taken, of course, not to touch any metal of this switch or one will receive the full supply voltage as a shock, and if it is desired (especially where there are children about), a special enclosed switch of any suitable make should be put in here. The

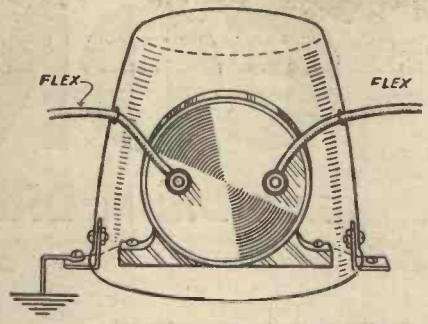


Showing general arrangement for an experimenter's switchboard.

object of the neon lamp is to prevent the mains switch being left on by mistake when making alterations, as it will then glow—its consumption is only 5 watts. This switchboard is equally suitable to those who work from batteries only, in which case the part to the right of the line AB can be dispensed with, the batteries being put on the shelf in place of the eliminator. An added refinement would be a fuse in the H.T. circuit.—A. E. D. KENNARD, A.C.G.I. (Harrow).

Screening Small H.F. Chokes

IN a number of circuits using a screened H.F. choke I had three chokes, but these were all of unscreened pattern. To remedy this I obtained an old aluminium cup from a Thermos flask and cut it as shown in sketch. The result was quite



An efficient improvised screen for small H.F. chokes.

satisfactory. — JOSEPH MATTHEWS (Ashington).

An Alternative Aerial Connection

AS a general rule the aerial circuit of a set is designed to supply the strongest signal to the grid of the detector valve. This holds good when dealing with distant stations, but is not always satisfactory when receiving local stations.

Sometimes the volume control can take care of the very strong signals from the locals, but in many cases distortion is introduced. A good way of getting over this is to fit a second aerial connection. This second circuit can be arranged to apply only average signals instead of very strong ones to the grid of the valve.

A simple method is to include a fixed condenser of very small capacity in the aerial wire to the coils when the second connection is used, and this is often effective, provided the capacity is small enough.—A. J. B. (Harrow).

A Valve-holder Switch

AN ordinary valve holder can be made to fill a variety of uses. For instance, in the aerial circuit it can be used in place of a switch. By plugging in to the sockets, the aerial can be shorted to earth when not required, passed through the condenser, or taken direct to the set, as will be clear from the accompanying sketch, Figs. 1 and 2. If an aerial extension is required indoors, a five-socket valve holder can be used, and connection taken to the extra terminal. For the purpose of switching two loud-speakers a valve holder can also be used, as shown in Fig. 2.—C. VARLEY (South Shields).

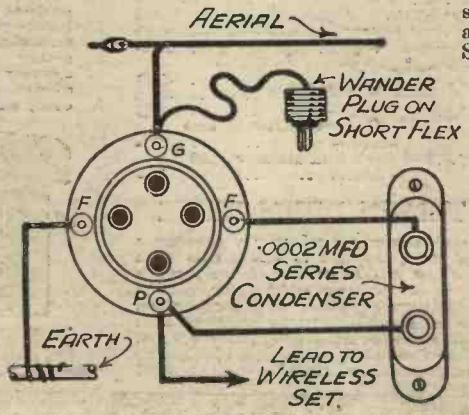


Fig. 1.

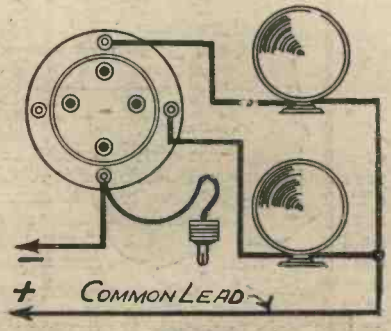


Fig. 2.

Two methods of using a valve holder as a switch.

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The radio set of the year +

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TEN DOMINATING FEATURES OF THE MOST UP-TO-DATE SET

1. Very latest type of three-valve circuit (Screen Grid, Detector and Pentode).
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5. Latest type moving-coil speaker.
6. Selectivity and volume control.
7. Connections for gramophone pick-up and additional speaker.
8. Figured walnut bakelite cabinet.
9. Westinghouse Metal Rectifier in A.C. Model.*
10. All electric—just plug in to your electric supply and switch on—that's all.

+ these Gramophone features

1. A powerful and silent electric motor.
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4. Automatic Stop and special regulator
5. Beautiful modern walnut cabinet.

Model R.G.23—3-valve Receiver with moving-coil speaker and electrically-operated Gramophone.

A.C. MODEL 30 gns.

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Also ask your Radio Dealer to show you EKCO 5-valve Super-Het Consolette Model S.H. 25 at 24 guineas and Radio-Gram Model R.G. 25 at 42 gns. (or by Easy Payments).

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SMOOTHING CHOKES IN FILTER CIRCUITS

By G. H. WRAY, F.C.S.

IN constructing an eliminator, whether for A.C. or D.C. mains, the object is to render available for the receiver a supply of direct current, free from all ripple or fluctuations which may produce an audible note in the speaker. With this object in view, the smoothing circuit of the eliminator therefore becomes its most important part. Ripple is always super-imposed on D.C. mains, and is also present in rectified A.C., which may be considered as still an alternating current in view of its pulsating character, and before it is possible to use the supply as a source of high tension for the receiver, it must be smoothed by the unstinted use of capacity and inductance, and there are certain minimum capacity and inductance values to be used in order to adequately smooth the output. Capacity is introduced into the circuit by means of fixed condensers, and inductance by the use of chokes, and it is to an explanation of the effect of the latter in a circuit that this article will be confined. A choke in its most simple form consists of a coil of wire wound over an iron core, (Fig. 1), and its position in a typical smoothing circuit is shown in Fig. 2.

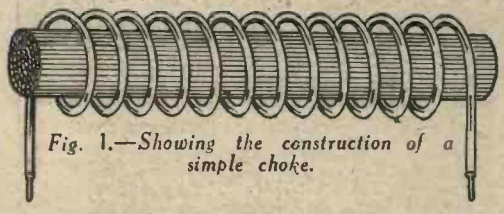


Fig. 1.—Showing the construction of a simple choke.

Inductance Value

Constructors building up eliminators from component parts, to instructions given in the wireless press or by manufacturers of eliminator parts, are usually confronted with the statement that the choke should be of ample size, and should have an inductance of, say, 30 to 40 henries when carrying the maximum plate current taken by the wireless receiver, and that it is advisable to specify the plate current consumption when ordering the smoothing choke.

What exactly does this mean and, first of all, what is inductance? Inductance is always present in alternating current circuits, it is much increased if the coils have iron cores, and is greatest in circuits containing electro-magnets. The inductance expresses the magnitude of that property of an electric circuit, whereby it opposes any change in the value of the current flowing through it. This opposition is due to the fact that any change in the current involves also a change in the magnetic field set up by the current, which produces an electro-motive force in the circuit in such a direction as to oppose the change. This electro-motive-force is similar in its action to an inertia of the current, and is due to the inductance of the circuit. The unit of inductance is named the henry. It is the inductance in a circuit, when the current is changing at the rate of one ampere per second and producing in that circuit a difference of electrical pressure of one volt. Its physical nature is a rate of change of magnetic field strength through the circuit. This is a technical definition of the term inductance, and of its unit the henry, and many readers would probably welcome a more homely and less involved explanation.

Effect of Inductance in a Circuit

Many changes in electrical conditions can be faithfully reflected in mechanical or water analogies, and a clearer conception of the effect of inductance in a circuit can be obtained by viewing the subject in this manner. For instance, a heavy mass, such as a motor car or a train, cannot instantly be set in motion, energy has to be imparted to it gradually. Neither can it be brought to rest instantly when it is moving rapidly, its energy of motion has to withdrawn by degrees. While it is in rapid motion its progress is smooth and uninterrupted, that is, its movement is free from jerks or fluctuations. This quality which a moving body possesses is called its mass or inertia.

The same thing applies to an electric current in a circuit. An electric circuit stores up energy in consequence of its inductance or electric inertia, and a current cannot be established or destroyed in it quickly, without in some way dissipating or using the stored up energy. This quality possessed by an electric circuit, in virtue of which a current flowing in it has energy, is called its inductance. So long as a direct current in a circuit is not changing in strength, inductance has no effect, but while the current is growing or while it is dying away, the presence of inductance greatly affects it. When a current is increasing, inductance causes it to increase more slowly, and when a current is dying away, inductance tends to prolong it. In all cases the effect of inductance is to oppose fluctuation or any change in the strength of the current, and the function of the choke in the smoothing circuit is, therefore, to absorb by means of the inductance of the circuit, the ripple or pulsations of the current flowing through it.

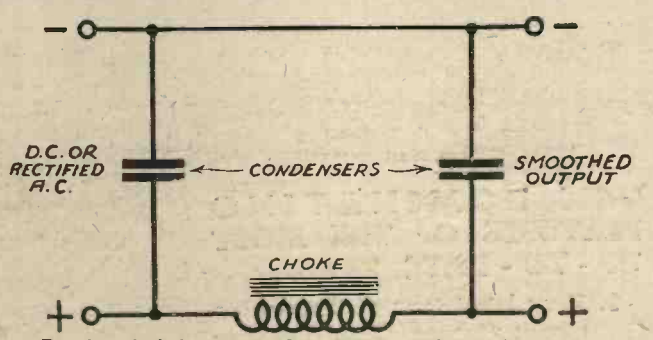


Fig. 2.—A choke connected up in a typical smoothing circuit.

The reason that the maximum plate current which a choke is required to carry should be specified when ordering the choke is that the inductance varies inversely with the current. That is to say, the inductance becomes less if the current is increased, and if the current is reduced the inductance becomes greater. The inductance, however, does not vary inversely in direct proportion to the current. It is sometimes asked, what is the difference between inductance and induction. They are really the same thing, it is a question of cause and effect. Inductance is the property possessed by an electric circuit, and induction is the effect produced by that property.

THOSE of you who are new to mains-operated sets should be reminded that the switching on of both L.T. and H.T. when mains are used is not such a simple operation as it appears. In particular is care needed when the valve filaments are fed by accumulators, the anode current being obtained from some form of eliminator. When the latter is the case the filament current should always be switched on first and the H.T. afterwards for if the high tension current is allowed to pass before the filaments have had time to warm up and attain full emission, peak voltage is produced and considerable damage may be done to the valves and probably fixed condensers. With a fully mains-operated set the danger is not so

Round the World of Wireless

(Continued from page 270.)

pronounced as the switching in both circuits is simultaneous but it is not generally known that valve life can be prolonged if some way of deferring the passing of high tension current is used until the filaments have warmed up. It is possible to buy a novel little switch called a thermal delay switch for a few shillings, which holds back the H.T. for about 30 seconds during which time most mains-valves' filaments will have warmed up sufficiently. The switch is built on the principle of those little thermal switches known as flashers which intercepts the current passing to electric signs at regular intervals and causes the lights to "go in and out." A small heater wire, through which a current passes, raises the temperature of a bimetal strip causing the strip to bend. A spring retains its movements for the required time until the flexing strip overcomes the force of the spring when it closes the switch contacts and the high tension current passes. Three types are made, for D.C., A.C. dry rectifiers, and for A.C. valve rectifiers respectively, and the instrument is rightly described as a modern safeguard for modern apparatus by the makers, A. F. Bulgin & Co., Ltd.

THE BIJOU THREE

A Cheap and Efficient Little Receiver with a Splendid Performan

Front view of the Bijou, showing controls and the neat Clarion Cabinet.

DESIGNERS have, from time to time, produced receivers of the so-called "midget" type, but these have been in the majority of cases a compromise. We have set out to design an *efficient* receiver, which could be housed in a really small cabinet, and yet would give really first-class results—giving, for instance, the choice of several stations on the loud-speaker. The photographs and illustrations will give some idea of the compactness of this set, and it will be seen that there is no waste of space in any direction, and the set can justly be called "a midget."

The Circuit

The circuit is clearly shown, and it will be seen to employ the usual three-valve arrangement of S.G. detector and pentode valves. The tuner is an ingenious "all-in" device, employing an aperiodic aerial coil with variable coupling, short and long wave grid coils, and a common reaction winding. The change-over from short to long waves is accomplished by the same spindle that varies the aerial coupling, and this also operates the on-off switch. The S.G. valve is aperiodically coupled to the detector valve, and this is transformer-coupled to the pentode. Stability is assured by decoupling the detector stage, and a by-pass condenser is employed from the screening grid to earth.

The Receiver

The receiver itself is built on the semi-chassis arrangement, the baseboard being raised on small fillets of wood, and some of the wiring being carried out below the base. This enables the wiring to be carried out neatly, and also simplifies the connections. The valve-holders are of the chassis-mounting type, which are quite simple to mount, and are rigid. The variable condenser has a slow-motion drive, and the panel also carries a small variable condenser for adjusting the aerial, if it is found necessary.

Three-quarter rear view of the Bijou Three.

Construction

Now that all the main details have been described, we may proceed with a description of the actual constructional work. The components are listed, and should all be obtained before any of the work is undertaken, as it is always advisable to arrange every individual component in its position before fixing, so as to make quite certain that enough clearance is left at each point for valves, condenser vanes, etc. The three holes for the valve-holders should be drilled first, and then the small holes through which the connecting wires pass. Attach the small fillets at the sides, and then mount the valve-holders. See that these are the correct way round before screwing down, and note that the five-pin holder is at the extreme left of the base (viewed from the rear). Attach the remainder of the parts, leaving the coil till last, so as to avoid damage to the wiring. The panel should next be marked out, and the escutcheon attached, with the condenser. While this is being done, and until the rest of the receiver is completed, the vanes should be kept closed up to avoid risk of bent plates or other distortion. Mount the other condensers, and you are then ready for wiring-up.

Wiring

The wiring diagram on page 292 shows clearly the arrangement of all the leads, and no troubles should arise in this connection. The leads to the valve-holders should be put in first, and in view of the smallness of the slot in the legs, only one wire should be put in. Therefore, trace out the leads, and cut off such a length that the wire will cover the full distance. Then scrape bare at the points where contact is made. This instruction applies particularly to the filament wiring.

When connecting up, plug H.T.2 into the maximum tapping on the H.T. battery; namely, 100 to 120 volts. H.T.1 should be tried in any socket from 27 to 50 volts. If the set tends to oscillate too readily, use a low voltage; but if it does not oscillate, use a higher figure. The higher the voltage you use on the screening grid the greater will be the magnification until you reach the optimum point. Do not, however, use more than 55 volts if you wish to get long life from the H.T. battery, as the total plate current also increases with the voltage. G.B.— should be plugged in at 4½ volts on the grid bias battery.

When you have inserted the valves, joined up the aerial, earth, and L.T. battery, turn the control knob on the left of the panel a few degrees to the right. This will switch on the valves and at the same time put the receiver into a sensitive condition on the medium waveband. Set the control of the condenser above this knob in a position where the moving vanes of the condenser are about half-way out. Now rotate the main tuning control, which is the lower knob in the metal escutcheon, and you will soon find your local station. Provided you are using an outside aerial, and this is not too large, you will find tuning is fairly sharp. The left-hand knob, as it is rotated further to the right, will increase the strength of signals, but will also flatten the tuning—or, in other words destroy the selectivity. The reaction knob (that on the right of the panel) will increase the strength of the signal, but if turned too far the set will burst into oscillation. The most sensitive condition is just before the oscillation point. You will have noticed by this time that there are three controls affecting volume: the coil control, the aerial condenser, and the reaction condenser. The two former controls have also the effect of varying selectivity, so that to receive certain stations which are normally jammed use will have to be made of all three of these controls. The coupling coil must be set to such a position that the signal strength is just below that which is finally required, and the reaction control used to bring the volume up.

Once the idea of handling these controls has been grasped, it will be found quite simple—although the description of the working may seem rather complicated.

No description of actual results will be given, as so much depends on local conditions, etc. It may be mentioned, however, that at a test it was possible to get Radio-Paris, really loud, with no interference whatever from Daventry 5XX.

LIST OF COMPONENTS

- Panel 12in. by 8in. (Brit. Hard Rubber Co.).
- .0005 Variable with Slow Motion Dial (Telsen).
- .0003 Compax Variable Condenser (Polar).
- .00015 Compax Variable Condenser (Polar).
- 2 1 mfd. Fixed Condensers (T.C.C.).
- .0001 Fixed Condenser (T.C.C.).
- Dual Range Aerial Coil (Ready Radio).
- H.F. Choke (S.G. Type, H F 4) (Bulgin).
- L.F. Transformer (Lissen Hypernik).
- 3 Chassis Type Valve-holders (two 4-pin and one 5-pin) (Clix).
- 2 Terminal Mounts (Belling Lee).
- 30,000 ohm Spaghetti Resistance (Lewcos).
- 4 Terminals (A rial, Earth, L.S. —, L.S.+) (Eelex).
- 1 1 meg. Grid Leak (Graham Farish Ohmite).
- 3 Valves (S.G. 218, 210 D and 220 Pen.) (Six-Sixty).
- Cabinet and Baseboard, 12in. by 6in. (Clarion Bijou).
- 2 Coils Glazite.
- 100-volt H.T. Battery (Ediswan).
- L.T. 2-volt Accumulator (Lissen).
- 1 9-volt Grid Bias Battery (Ediswan).
- 1 5-way Belling Lee Battery Cord.
- 2 Wander Plugs (G.B. — and G.B. +) (Eelex).
- Short length of Flex.
- Screws, etc.
- 1 Loud-speaker (Ormond R. 450 in Cabinet).

Calibration Notes for Builders of the Bijou Three

IF you regularly follow the measurement charts issued by the Brussels Laboratory of the Technical Committee of the U.I.R. you will have noticed that stations in general are getting much better behaved with regard to the important matter of keeping to their allotted frequency or—if you prefer it that way—wavelength. Most of the big stations are checked by a U.I.R. wavemeter and their frequency graphs are nowadays beautifully "straight

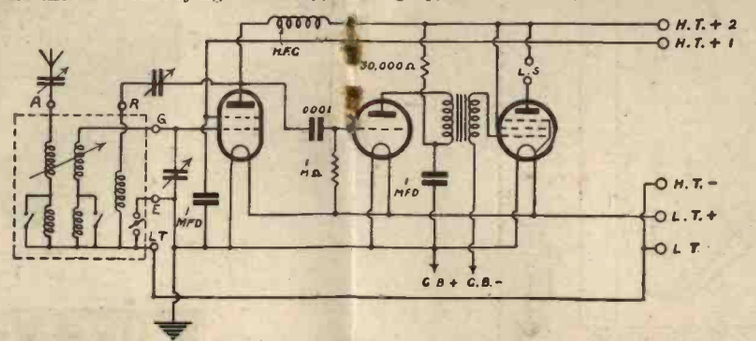
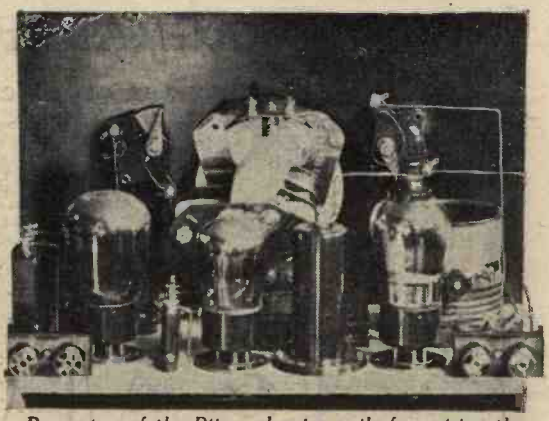


Fig. 1. Circuit Diagram of the Bijou.

line." Turn up the charts issued as recently as two years ago and you will have a shock! Some of the most reputable stations were terrible offenders in those days and some of their charts read like those of an influenza patient's temperature. With an overcrowded ether, however, no tolerance can be allowed and the powers that be watch with eagle eyes any departure from the allotted frequency. The overlap on either side of a wavelength is fairly large and the nine frequencies separation is proving none too generous with all our selective sets and better transmitting equipment. Incidentally don't forget that the most reliable way of identifying unknown transmissions is by the use of a wavemeter. These are fairly simple to make and handle, although the calibration trouble seems to some people to be insur. mountable. The most important point is the obtaining of a really good variable condenser with really accurate "straight line frequency" characteristics, and with clear open dial markings. You tune in as many stations of known frequency as possible and by means of a graph plot out the dial readings corresponding with the frequencies you thus obtain. A straight line drawn through the points you obtain will complete your calibration.



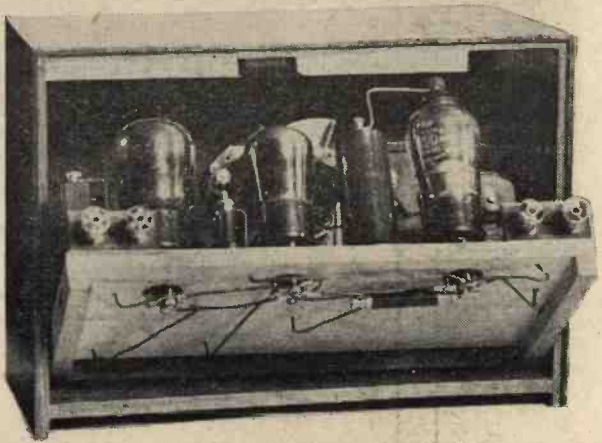
Rear view of the Bijou, showing rails for raising the baseboard to clear valve-holders, etc.

Wavelength Comparator

IN talking of accuracy in measurement be it in wavelengths, feet or pints, it is easily understood that absolute accuracy is somewhat of a phantom. All our scientists can do is to cut down the inaccuracy to such an infinitesimal percentage of the whole as to have a negligible importance. It is largely a matter of proportion and we would not demand the accuracy of measurement in buying a foot of wire (assuming you were in Aberdeen) as one would require in buying a foot rule. It is all a matter of relativity as Mr. Einstein would say, but it is obvious that somebody has to keep a fairly accurate check on measurements of all kinds if sharp practices are to be avoided. This brings me to the fact that attempts have been made recently to find out how nearly a yard our Imperial Standard Yard is. After a lot of research work certain indefatigable members of the staff of the National Physical Laboratory have devised a complicated apparatus which uses by optical means the red rays of cadmium for a basis of lineal measurement. It is known that the red rays emitted from a cadmium lamp have a natural wavelength and the apparatus, known as a wavelength comparator, takes advantage of this fact. In order to be certain of the definite wavelength of a ray of light the ray has to be monochromatic in character—that is, of course, a ray of one colour and not complex like sunlight which covers the whole known chromatic scale of colours—and there are over 1,400,000 waves of the red ray in the Imperial Standard Yard. As it is possible, with the wavelength comparator of course, to measure something slightly better than one-twentieth of one wave, the accuracy of the yard has been determined with an error of only one-millionth of an inch. When dealing with measurements of this kind it is not surprising that the room temperature has to be maintained at a predetermined level, and as modern industry is demanding more and more in the way of measurement accuracy this can be accounted as good work.

EVEN readers of PRACTICAL WIRELESS have, we feel sure, at some time or another experienced trouble with their radio. Sometimes, of course, the problem is easy of solution: a new valve or battery, a repaired lead, or a re-made connection, and the station is there for the turning of a knob. But at other times, things have assumed a more serious aspect. Results may have been bad or even unobtainable altogether; the manufacturer disappeared, a spare part obsolete, the favourite old speaker "dis"; and the test meter damaged. It is then that the news of a firm of really specialised repairers comes as real solace to a troubled spirit.

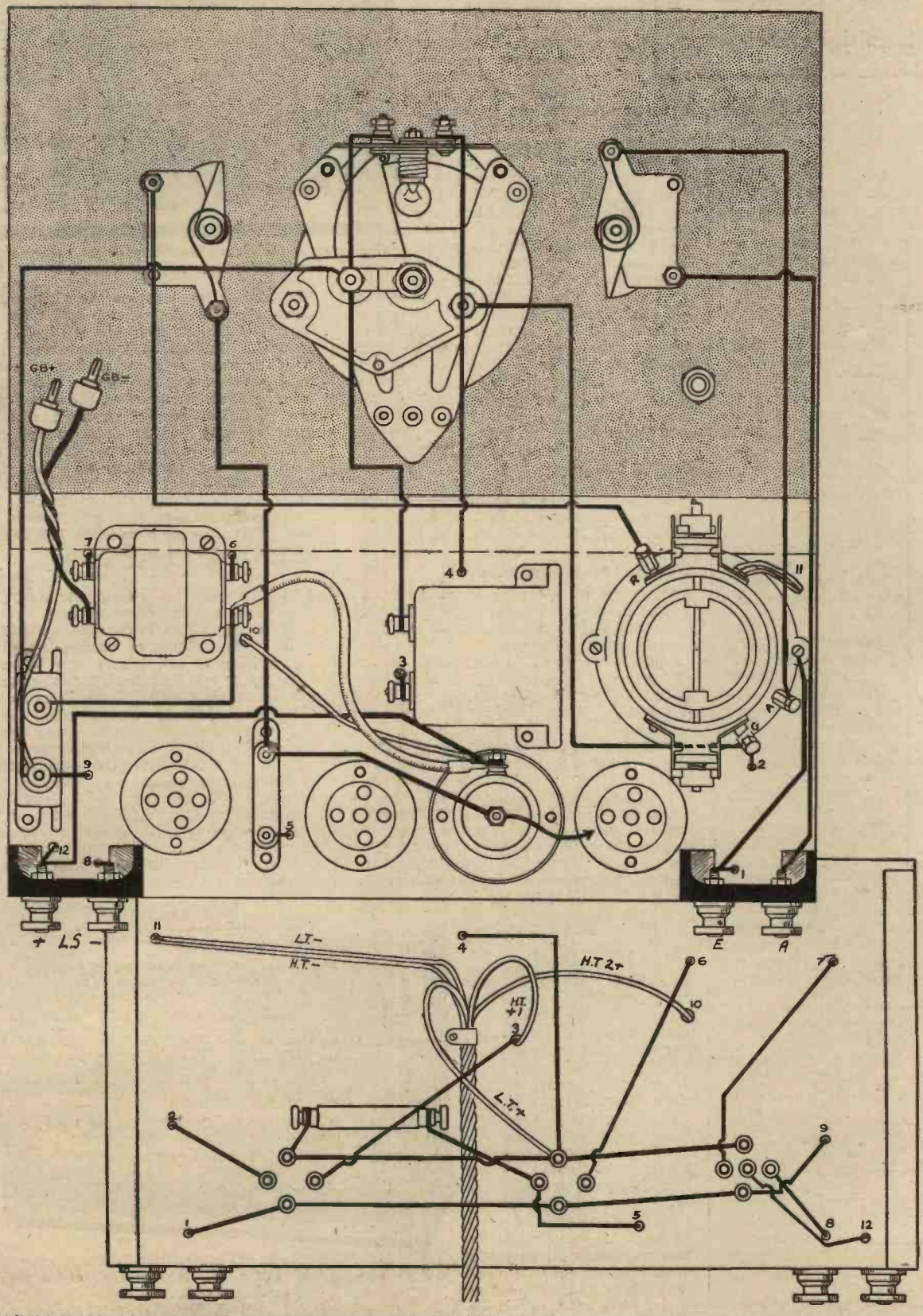
You can have the address on applying to the Editor.



Rear view of the Bijou with baseboard tilted to show sub-baseboard wiring.

WIRING DIAGRAM FOR THE BIJOU THREE

For Explanatory Text see pages 290 and 291



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CHOOSING A MODERN VALVE—2

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

Twenty-five Miles of Valves

The screen-grid valve is actually a three-electrode valve with an extra grid interposed between the normal grid and anode for the purpose of minimising the condenser effect between them. This figure has been reduced to an incredible figure. In many cases as low as .001 micro-microfarads. This means very little to all but mathematicians, but there is a simple way of getting an indication: If the capacity of a standard .0003 grid condenser were to be equalled by gathering together sufficient screen-grid valves, it would be necessary to collect 300,000 valves, which, end to end, would reach for over 25 miles.

There are three considerations when choosing a screen-grid valve—impedance, slope, and inter-electrode capacity. The former will depend almost entirely on the coupling that is to follow it. If a two-volt type is required and the coupling consists of an untapped tuned anode, it is unlikely that a type that gives exceptional results with a tapped tuned anode will give a very brilliant performance; it must, of course, be a two-volt type, and possibly of similar make, but it is wrong to assume that any type of screen-grid will give equally excellent results in any type of circuit.

If the coupling is an untapped tuned anode (see Fig. 1) care must be exercised, as the circuit is inclined to be somewhat unstable, and if screening happens to be rather limited a valve with a moderate slope is a safe proposition: for this type of circuit a valve of high impedance is required, round about 300,000 ohms, and the lower the interelectrode capacity the less chance there is of instability.

If the coupling is the very popular tapped tuned grid as shown at Fig. 2, a low impedance valve with a high slope may be used. It is interesting to note that the former possesses the unique feature that if it is worked without grid bias it will give its maximum efficiency, and consequently is probably the only valve that gives a higher slope under working conditions than shown by the quoted characteristics. The reason is that about ninety-nine per cent. of valves give a lower efficiency when working in the set owing to the application of grid bias, which reduces the slope: for some quite incomprehensible reason characteristics are quoted from measurements taken of the valve with 100 volts high tension and no grid bias, a condition under which the valve will probably never be used; it is surely time that this extraordinary farce was discontinued.

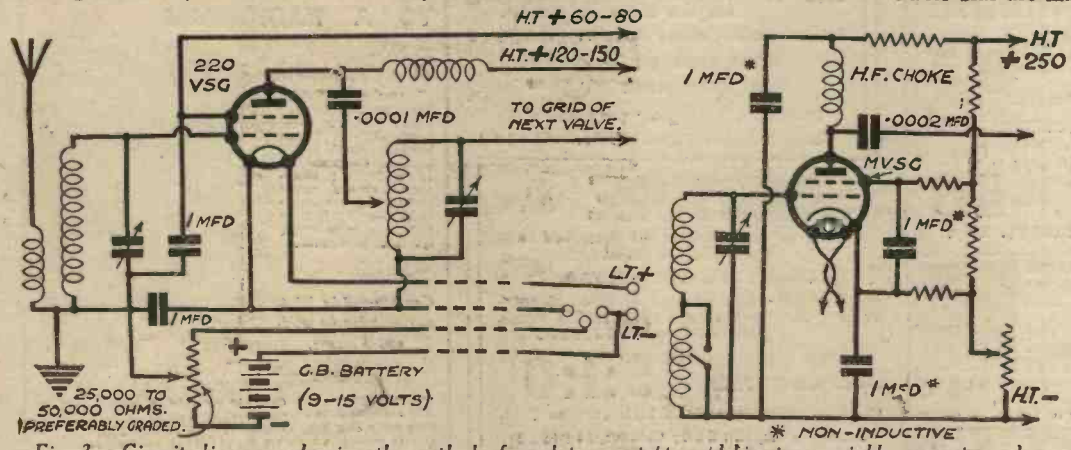


Fig. 3.—Circuit diagrams showing the method of applying variable grid bias to a variable mu mains valve and one of the battery type.

Choosing a Mains Screen-Grid Valve.

When choosing a mains screen-grid valve it is vital to make sure that the bias resistance in the set is suitable, as if it is too low for the valve-distortion and flat tuning will result, while if it is too high, swamping from the local station will result. When building up a mains receiver from this or any other journal it is even more essential to use the valves specified than when constructing a battery model. The newcomer to the screen-grid series is the variable mu, which has already taken a strong hold, and quite rightly. It is probable that by this time next year out of every ten screen-grid sets built nine will contain the variable mu.

The Variable Mu Valve

This is simply a screen-grid valve that has the construction of the grid so modified that it is possible to use about ten times the value of grid bias before the valve stops amplifying. Thus, by means of a variable grid bias control, the grid swing of the valve, and also the slope, can be varied at will. This provides the only known form of volume control that does not upset tuning or ganging and also avoids the bugbear of the screen-grid valve which is a special form of interference known as modulation. This trouble differs from ordinary jamming as the interference always disappears when the wanted station closes down. What actually happens is that the screen-grid valve becomes overloaded, and the two programmes get modulated on the one wavelength. Fig. 3 shows the method of applying variable grid bias to a variable mu mains valve, and also to a battery type. Of the former, three types are of special interest—the Mullard, Osram and Cossor. The Osram has a slightly higher impedence, and is suited, particularly, to untapped couplings. The other two have much the same characteristics.

A very good variable mu valve in the battery class is the Cossor 220 VSG, and this has very good characteristics. It has set a stiff pace, as it has a slope of 1.6, which is very high for a two-volt valve, when it is realised that it is difficult to produce a high slope with a variable mu. This valve will definitely increase the selectivity of any receiver provided that the arrangements for variable bias are made.

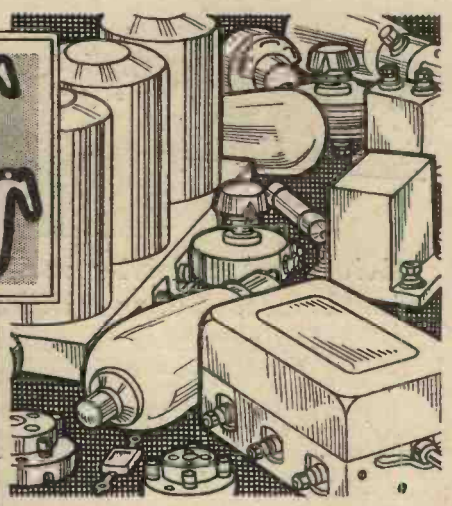
Detector Valves

There is probably more confusion concerning valves suitable for the detector stage than any other position. Certain types of special detectors are available, but most of these take an anode current that is too high for the average low-frequency transformer, with the result that there is a serious loss of bass. Let it be quite clear that the letters H.F. and L.F. that are sometimes associated with the type numbers mean absolutely nothing, as an "H.F." type is usually the best in the low frequency position, while the majority of non-screened grid portables use one "L.F." and one "H.F." in the two high-frequency stages. Given a suitable circuit any valve will work reasonably well as a detector, and there are circumstances where a screen grid, a pentode or a super-power are the best types to use.

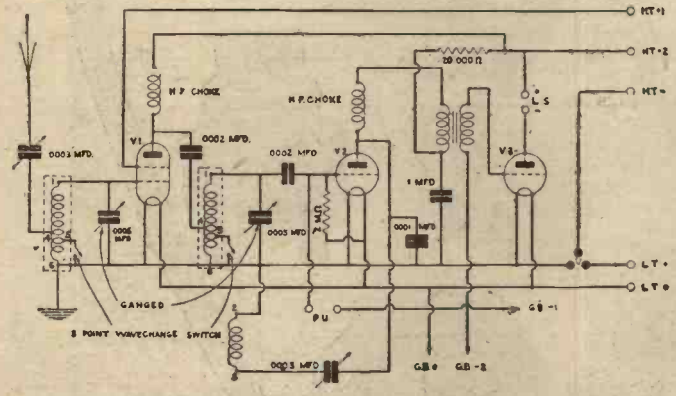
When choosing a detector valve, bear two facts in mind—the impedance and the high tension current. I shall next week show a curve of a battery valve eminently suitable as a detector—the Cossor 210 H.F. Four values of high-tension voltage are plotted, 75, 100, 125, and 150, while along the bottom various values of grid bias are shown, and up the side a progressively increasing scale of anode current in milliamps. The purpose of this curve is to show at a glance all that there is to know about the valve, and the expert can tell the impedance or any other characteristic without any other information; from the amateur's point of view this is not necessary as the characteristics are invariably quoted, but the curve is an invaluable guide to the all-important subject of anode current and grid bias. To read a curve it must first of all be decided what the anode current is to be. In the example to be given, suppose it is to be 125, now take the 1-volt grid-bias line and follow it vertically until it hits the curve in question at the 125 line, and at the point of junction follow the line horizontally to the right-hand margin, when it will be seen that the anode current is three milliamps. Now repeat the procedure with the two-volt line, and it will be seen that with this bias the anode current is a little over 1½. If the same thing is done with the 3-volt grid-bias line a difference will be noticeable, as it hits the anode line at a curved portion.

(To be continued.)

REVIEWS of LATEST KITS



WIRELESS, which now ranks as one of Britain's greatest industries, has no doubt provided a task for the "mass" manufacturers, and during the past two or three years their products have found an enormous market amongst the home constructor of slender means. The "Scout" three-valve screened-grid receiver shown on this page is a set whose superlative qualities have been made possible only by the combined efforts of a number of well-known radio manufacturers. The circuit diagram shows that only three valves are used, one of which is a screened-grid high-frequency amplifier, followed by a high-quality detector, which is transformer-coupled to the output valve.



The circuit diagram of the "Scout."

The Valves

The screen-grid high-frequency stage is essential to any set which is intended for reliable foreign station reception, and it is upon the efficiency of this stage that the real distance-getting properties of the set depends. The tuning is simplified, as only one knob controls the two tuning condensers. To ensure ease of handling, however, a variable series aerial control is provided, which serves a triple function. It can be used to control both selectivity and volume, and at the same time it acts as a trimmer on the aerial-tuning circuit, thus providing a measure of compensation for any slight discrepancy which might arise due to incorrect ganging of the dual condenser. A glance at the photograph will show that the number of components used has been kept down to minimum, so making the set easy to construct. As a fact, the set only takes a couple of hours to assemble.

KIT:
The Slektun "Scout" S.G.3.

MAKERS:
Slektun Products Ltd., 21, Douglas Street, Vauxhall Bridge Road, S.W.1.

SPECIFICATION:
Battery set, two-volt, wooden chassis with aluminium foil screening attached. Incorporating Slektun super transformer and coils, Cyldon ganged condenser with sector vision escutcheon, T.C.C. fixed condensers, W.B. valve holders and switches, and ready-drilled panel.

PRICE:
Complete kit of parts, 84s.

THE SLEKTUN "SCOUT" KIT

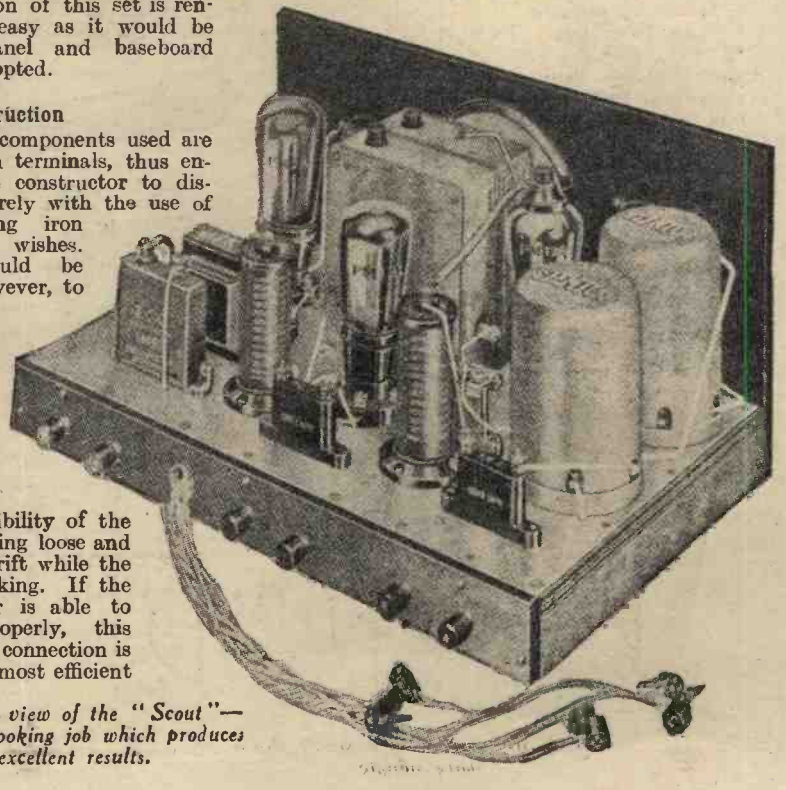
The Chassis

In the "Scout" receiver a form of chassis construction has been employed, but in order to facilitate the assembly of components, the chassis has been made of wood, and aluminium foil screening is provided. As it is a simple matter to puncture the foil where necessary with a bradawl or any other pointed instrument, the construction of this set is rendered as easy as it would be were a panel and baseboard layout adopted.

The Construction

All the components used are fitted with terminals, thus enabling the constructor to dispense entirely with the use of a soldering iron if he so wishes. Care should be taken, however, to see that all terminal heads are screwed down hard on to the wire and that there is no possibility of the wires working loose and coming adrift while the set is working. If the constructor is able to solder properly, this method of connection is by far the most efficient and also the neatest. All soldering, however, should be done with great care.

It will be noticed that point-to-point wiring has been adopted throughout, as, although square wiring undoubtedly looks very neat, it is very hard to do properly, and is apt to cause instability due to feedback through minute capacities between adjacent wires.



An interior view of the "Scout"—a compact-looking job which produces excellent results.

Testing Out the Set

The test was carried out on a small aerial about fifteen miles from Brookmans Park, and the reception was remarkably good, as more than forty stations were received at good loud-speaker strength, many without the use of reaction. A very noticeable feature of the set was the selectivity on medium waves. By making full use of the series aerial condenser it was possible to receive Mühlacker with only a trace of the London Regional station as a background. The quality of reproduction was exceedingly pleasant, and the volume given was enough to work a moving-coil loudspeaker at full strength

BELOW 100 METRES

SOME USEFUL SHORT-WAVE CIRCUITS

An article which explains, in simple language, how you can make the best use of Short-Wave Transmissions.

By FRANK PRESTON, F.R.A.

ALL keen amateurs are now devoting a good deal of attention to the "sporting side" of Radio, as short-wave work is frequently called, and it will be the object of this article to show how short-wave reception can be carried out in the most satisfactory and inexpensive manner. It is proposed to suggest two or three suitable circuits, and to explain how a few simple modifications can be made to existing short-wave sets to improve their effectiveness. As a normal broadcast receiver cannot conveniently or economically be modified to enable it to operate on short waves, it becomes essential to build a separate set or to employ some form of "adaptor" in conjunction with the receiver. To those who intend to do a fair amount of short-wave work, I strongly advise a separate receiver designed specially for the purpose, but I fully realise that there are many to whom the expense of such a set would be out of proportion to its usefulness. Those in the latter class must therefore be content with a short-wave adaptor which can be used in conjunction with the L.F. amplifying stages of the broadcast receiver. Such an adaptor, if well made, will give extremely good results and will have a world-wide range, but will have to be connected to the receiver each time it is to be used.

Short-wave Adaptors

There are two entirely different kinds of short-wave adaptors, and the circuits of each are shown at (a) and (b) in Fig. 1. The circuit of (a) is that of the more usual type of adaptor, where the valve replaces the detector valve of the ordinary set; the detector valve is removed from its socket and replaced by the plug of the adaptor, and, apart from transferring the aerial and earth leads to appropriate terminals on the adaptor, no other alterations are required.

The circuit shown at (b), although in appearance very similar to (a), operates in an entirely different manner. It is only suitable for use with receivers having one or more S.G. stages, because it acts as a combined detector-oscillator and transforms the receiver into a short-wave superheterodyne. The S.G. stage(s) functions as an intermediate frequency amplifier, whilst the detector and L.F. stages operate exactly as before. It will be noticed that two H.F. chokes are used in this super-heterodyne adaptor; the short-wave (H.F.C.1) one prevents the passage of signal frequencies into the amplifier, and the ordinary broadcast choke (H.F.C.2) serves to couple the adaptor to the set on the choke-capacity principle. As with any superheterodyne the tuning of the intermediate frequency amplifier must remain fixed after it is once adjusted to its optimum setting. The optimum tuning position will depend principally upon the tuning system of the adaptor, but will generally be found to correspond to about 500 metres or a frequency of 600 kilocycles. When the correct intermediate frequency has been found, results can be improved by changing the choke H.F.C.2 for a coil tuned to the intermediate frequency.

An efficient short-wave adaptor.

Worth-while Modifications

Both the circuits mentioned above might well form the bases of complete short-wave receivers, for they only require the addition of suitable amplifiers. As explained, the valve of circuit (b) would require to be followed by at least three other valves (S.G.-Det.-L.F.), and would therefore make a comparatively expensive receiver. And my experience goes to show that for most purposes the superheterodyne is not the best type of circuit for very short-wave work, although it is probably unsurpassed for reception on wavelengths of, say, 100 metres upwards. The leaky-grid detector circuit given at (a), however, can be made into a very good complete short-wave receiver by the addition of one L.F. valve only. The circuit of such a set, plus a few minor refinements, is shown at Fig. 2. The basic circuit of the first valve follows that of Fig. 1 (a), but the refinements confer many noticeable advantages. As the improvements may be applied to almost any short-wave receiver or adaptor they are worthy of closer consideration.

In the first place a small capacity, semi-variable condenser has been inserted in the

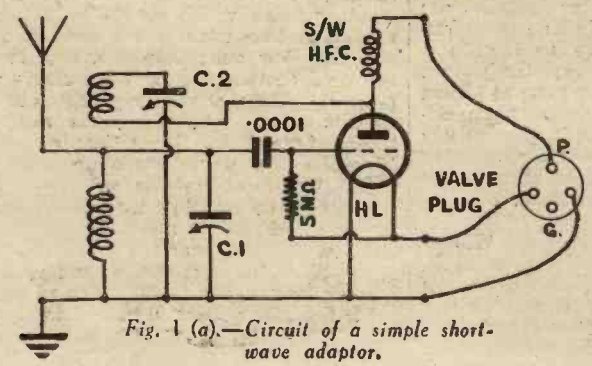


Fig. 1 (a).—Circuit of a simple short-wave adaptor.

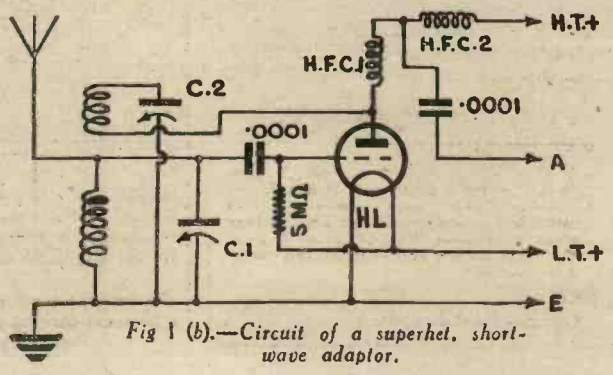


Fig 1 (b).—Circuit of a superhet. short-wave adaptor.

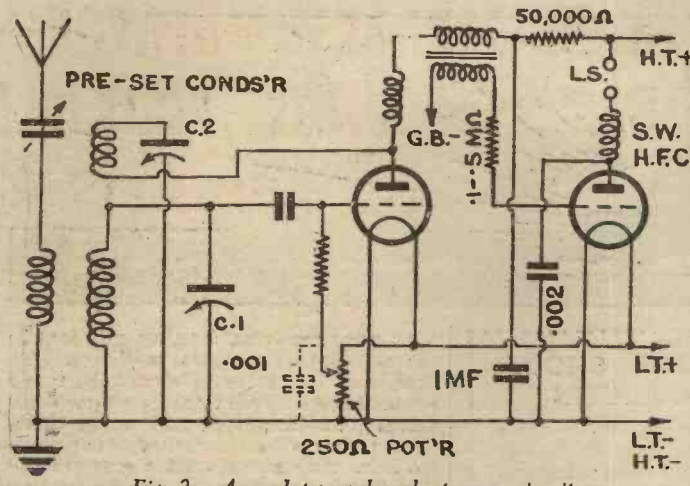


Fig. 2.—A good two-valve short-wave circuit.

aerial lead. This tends to make the detector oscillate more readily, by reducing aerial damping on the tuned circuit. It also makes the reaction setting more uniform over the whole tuning range, and eliminates "dead spots" which are occasioned by resonances in the aerial system. One particular setting of the condenser will usually be found to be correct for any particular tuning range. The maximum capacity of the condenser is not critical but, generally speaking, should be about .0001 mfd. for wavelengths down to 20 metres, and about 20 *micro*-micro-farads (or .00002 mfd.) for wave-lengths below 20 metres. Instead of connecting the aerial to the tuned grid coil, it is taken to one end of an aperiodic winding which is inductively coupled to the tuned coil. This gives an effect similar to the series aerial condenser by reducing aerial damping and eliminating resonances. The size and position of the winding are best determined by trial, but as a rule it should have from half to three-quarters the number of turns used for the grid coil, and should be separated from the latter by half an inch or so.

The next modification is in respect to the grid-leak connection. It is usual to connect the grid leak to L.T. positive, and although this is generally better than taking it to L.T. negative, it is not by any means ideal. The optimum detector bias is usually found to be somewhere between L.T.— and L.T.+, so a 250 ohm potentiometer is connected between the latter points, and the grid leak is joined to the potentiometer slider; by adjusting the potentiometer the absolutely best bias potential can be obtained. Incidentally, it might be added that it is sometimes an advantage to connect a .001 mfd. condenser between the grid leak and earth as shown in broken lines.

Decoupling the L.F. Circuits

Besides the improvements suggested for the detector circuit there are a few which can advantageously be applied to the L.F. amplifier. The first of these is to insert a "stopping" resistance in the grid circuit of the valve following the detector. The resistance, which should be a non-inductive one of from 100,000 to 500,000 ohms, prevents any stray H.F. currents from leaking into the amplifier and so causing instability. It need scarcely be mentioned that the detector anode circuit should contain a decoupling resistance and by-pass condenser, for these are included in all up-to-date sets.

It is a good thing to connect a condenser of about .002 mfd. between the anode of the last valve and earth, because this is useful in by-passing any H.F. currents which leak through to this point. The condenser prevents the set from howling when the loud-speaker or 'phones are touched. In the case of 'phone reception, it is often advisable also to include a short-wave H.F. choke between the 'phones and the anode of the last valve, as shown in Fig. 2. The choke serves as an additional H.F. filter, and is particularly useful in a sensitive set where movement of the head affects tuning, or where hand-capacity effects are troublesome.

A Screened-grid Stage—Is It Worth While?

It is generally recognised that an S.G. valve can give no appreciable degree of amplification on short waves, and for this reason many experimenters draw the conclusion that no benefits are to be derived by the inclusion of such an amplifier. In my experience, though, and I am not alone in my belief, an S.G. stage is definitely worth while on all wavelengths down to 10 metres, at any rate: at the moment I am in some doubt as to its value for wavelengths lower than this, because my experiments in this respect are not yet complete. "But if an S.G. valve gives no amplification what advantages can it confer?" you will no doubt ask. It will produce a delicacy and fineness of reaction control unobtainable with any non-S.G. regenerative detector circuit, and will very noticeably improve stability. As all short-wave fans know quite well, the accurate control of reaction is the biggest factor in increasing the amount of amplification possible from the detector. And it is obvious from what has been said earlier on in this article, that almost every refinement to the normal short-wave circuit is directed towards the improvement of reaction control.

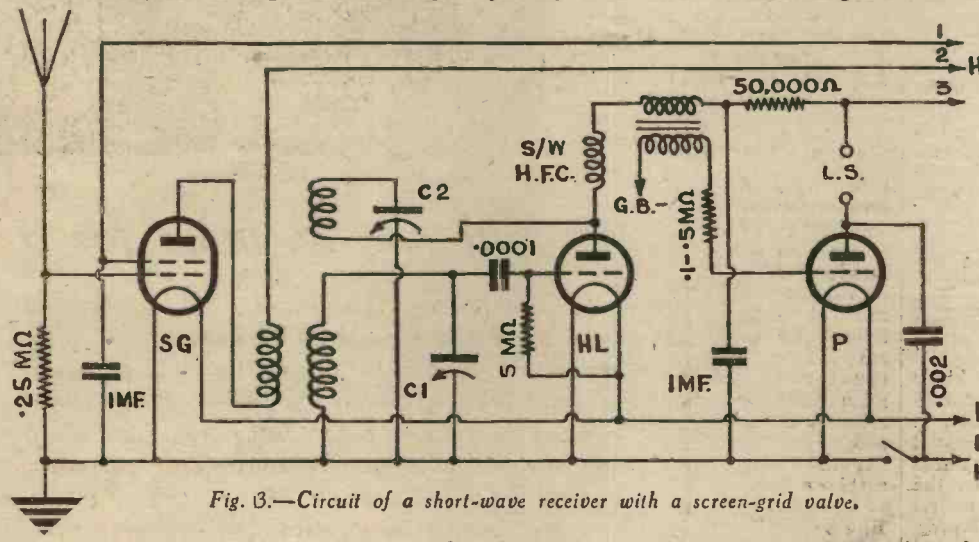


Fig. 3.—Circuit of a short-wave receiver with a screen-grid valve.

An S.G. Short-Wave Receiver

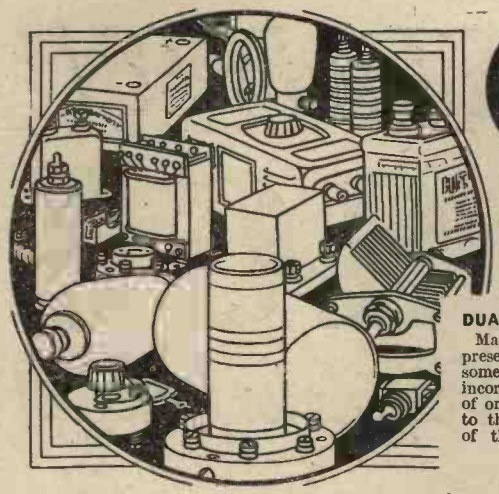
Fig. 3 shows a 3-valve short-wave receiver consisting of an S.G. valve followed by a detector and a single L.F. amplifier.

The aerial circuit is not tuned, but a .25 megohm resistance (which must be non-inductive) is used to give aperiodic aerial coupling. It would be almost a practical impossibility to tune the aerial circuit as well as the inter-valve circuit, due to the difficulty of making the two extremely critical adjustments simultaneously. But since the S.G. stage would not give any appreciable amplification in any case the aperiodic coupling is almost as efficient as a tuned circuit, and selectivity does not enter into the question because that of the single tuned circuit is quite adequate for all purposes. Transformer coupling is employed between the S.G. and detector valves, because this is found to be considerably better than tuned grid coupling, which is more popular in receivers for use on longer wavelengths. The L.F. stage is practically the same as that shown in Fig. 2.

General Points in Short-wave Receiver Design

The design of a short-wave receiver is very similar to that of a really efficient set for use on the broadcast bands, but much more care must be exercised in eliminating all sources of capacity loss, and in making all connections absolutely firm and tight. There is no need to solder connections so long as terminals and connecting wires are scrupulously clean. Another point which should be borne in mind is that the tuning capacities employed are very low and, therefore, any movement of components or connections will probably change the capacity of the circuits so much as to make accurate tuning impossible. It is thus advisable to make the whole structure perfectly rigid. The most suitable values of components are indicated on the circuits shown in Figs. 1, 2 and 3, and these should be adhered to with fair accuracy. The layout is also of importance, and when a receiver is being constructed, no deviation should be made from the published instructions.

(To be concluded next week.—Ed.)



Comments on Components

ETA VALVES

THREE new valves are just announced by the Electrical Trading Association—the D.W.3, D.W.9 and D.W.8. These are of the 4-volt type, D.W.3 being directly heated, and the other two indirectly heated. D.W.3 and 9 are both pentodes, the former having an amplification of 80, and the latter the extraordinary figure of 180. These valves will take up to 300 volts H.T., and although the anode current is 20 and 30 m/A, the undistorted output is 1,500 and 2,000 milliwatts respectively. D.W.8 is a variable-mu screen grid valve of the indirectly-heated type, with an amplification of 400. The prices of these valves are 15s., 16s., and 15s. 6d. respectively.

FRANKLIN CONDENSERS

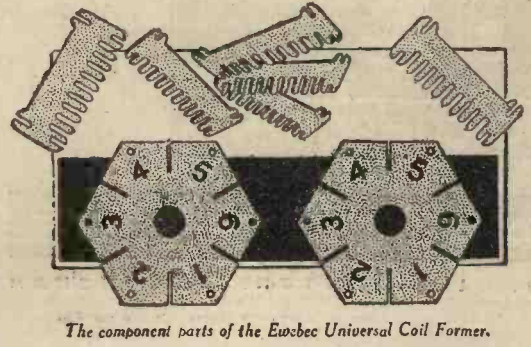
Some interesting types of condenser are announced by Franklin Electric Co., Ltd., amongst which are the small variables with bakelized paper dielectric. These are made in three values—.00015, .0003 and .0005 mfds. These are very neat and compact, and take up very little room at the rear of the panel. The price is 2s. 6d. For a compact receiver the tubular condensers will be found extremely convenient. These are made in three values, .1, .25 and .5mfd., and in two types, 500 volt A.C. test and 1,500 volt D.C. test. The prices are 1s., 1s. 4d. and 1s. 8d. respectively in the lower rating, and 1s. 6d., 2s. and 2s. 6d. in the 1,500 volt type.

UNIVERSAL COIL FORMERS

Readers who make their own coils will be interested in the new "Ewebec" Universal Coil Former, which will enable anyone to wind a coil to suit a given wavelength in a few minutes. These coil formers consist of hexagonal discs, in which are cut six slots, and six comb-shape pieces suitably slotted to assemble into the completed coil former illustrated on this page.

A set of parts for making one of these coil formers costs only 1s. 4½d., post free, and by means of them one is enabled to make extremely neat coils. It only takes a few seconds to assemble one of these formers. The top and bottom discs are numbered and the parts are assembled by taking one hexagon and one slotted spacer, and sliding the slotted spacer into the hexagon between numbers one and two. The spacer is inserted with the straight edge outside, if a single layer coil is required. Having assembled the first spacer, take the other hexagon and slide it into the other end of the slotted spacer already in position again using the slot between the numbers one and two. Now take another slotted spacer and insert it opposite the one already in position, when the remaining four spacers can be inserted.

It will be seen that it is possible for a few pence to make a complete series of coils suitably for all wavelengths. Such coils will have an extremely low loss, and when incorporated in the set, look extremely neat.

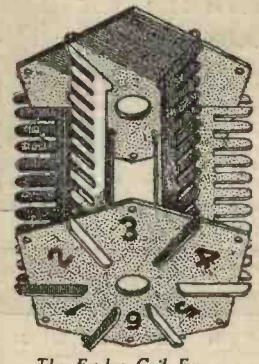


The component parts of the Ewebec Universal Coil Former.

DUAL-RANGE AERIAL COIL

Many and varied are the types of dual coil at present on the market, each one differing in some respect from the others. The new Formo coil incorporates a feature which certainly has the merit of originality, and is one which will doubtless appeal to the home constructor. We refer to the colouring of the shielding can, separate identifying colours being used for aerial coil, H.F. coil, etc. Red is used for the aerial coil, blue for the H.F. coil, and green and yellow for the first and second band-pass coils. In addition to this scheme, a coloured connection chart is permanently fixed to the top of the actual coil, and this shows the wiring circuit and position of each individual terminal. The aerial coil consists of aerial, secondary and reaction windings, the latter being common to both wavebands, and the two former windings being fitted with a short-circuiting switch for the change in wavelength. Four alternative aerial tapping points are provided, and these are conveniently arranged on the plug and socket principle on the ebonite base. Alterations may thus be carried out without removing the shielding can. The switch knob is clearly marked, and provision is made for ganging. The makers give all the data relative to these coils, inductance, H.F. resistance, etc., so that nothing need be left to guesswork when fitting these coils into a circuit. The price is 7s. 6d. each. The aerial coil, ganged with an H.F. coil, on an aluminium base, costs 16s.

Formo Dual-Range Aerial Coil, showing disc on top of coil bearing circuit diagram.



The Ewebec Coil Former assembled.

A.C.—D.C. CONVERSION UNITS

Owing to the extension of the grid system throughout the country, a considerable number of supply companies have changed their supply to the standard voltage and frequency, and D.C. areas are in many cases being switched over to A.C. One of the greatest bugbears in such change-over work lies in the difficulty experienced with radio apparatus.

To meet the special circumstances the General Electric Co., Ltd., has given close study to all the factors involved and has solved the problem by developing units which will allow existing receiving apparatus to be continued with satisfactory results. The company came to the conclusion that owing to the wide variety of eliminators that are employed, it would be impracticable to replace these by alternatives of the A.C. mains type, and that it would be considerably more economical to substitute a unit which would give the equivalent of the original D.C. supply. Accordingly the Gecophone BC 1534 A.C to D.C. Conversion Unit has been designed specifically for such a purpose. This unit is capable of giving an output up to 30 m/A. of smooth D.C. supply, eminently suitable for feeding existing D.C. eliminators and in general giving more silent operation than was originally obtained with the D.C. mains supply. It is constructed on standard eliminator lines, an Osram U.10 valve being employed as a rectifier. The primary of the mains transformer is arranged to accommodate 200/250 volts and the D.C. output is controlled by tappings on the H.T. secondary of the transformer feeding the anodes on the rectifier valve.

The unit is housed in a black crystalline enamel container, is neat in appearance and complies in all respects with I.E.E. Regulations.

ERIC RESISTORS

For anode couplings and other purposes where current has to be carried, a good type of resistance is essential. The Eric fixed resistors, of which we have just received samples, are very handy components. Made in 1, 2 and 3-watt types, colour coded, tag identified and with wire ends, these components will be found ideal for both grid-leaks and voltage-dropping or grid-bias resistances. The element is composed of carbon and rare earth, the actual value being arrived at by varying the quantities of minerals. Stability is obtained by a complicated process by which humidity and loose gases are expelled, after which the resistor is impregnated. By this process all risk of variation, due to climatic conditions, are obviated. A further point is that these resistors are very much under-rated; for instance, No. 2 resistor is rated nominally at one watt, whilst the 100-hour rating is exactly double that wattage.

The neat Ohmite resistances manufactured by Graham Farish, Ltd.

To ensure perfectly silent operation, the tips of the resistor are copper-impregnated, so that a really sound joint may be made at the wire ends. A final point is that an unqualified guarantee is given by the makers against open-circuiting. The price is 1s. per watt.

TIME SWITCH

It is very annoying to switch on a receiver to hear some particular item, only to find that you are too late. Various suggestions have been put forward for overcoming this trouble, and the Utex Manufacturing Co., Ltd., have produced a time switch, which is said to take care of all troubles. We hope to have the pleasure of testing this device and reporting on it in a future issue.

AMAZING DISCOVERY

98% RADIO SETS "DOWN" IN EFFICIENCY THROUGH FAULTY GRID LEAKS OR MICA CONDENSERS!

A RECENT analysis of Kit sets and Home Constructor Receivers reveals the astounding fact that 98% were considerably 'down' in efficiency through faulty Grid Leaks or Mica Condensers. These tests were carried out by one of the foremost Radio Engineers in the Country on sets which the owners thought were working satisfactorily.

The above facts were brought to the notice of TELSEN Engineers who immediately commenced intensive research and experimental work to discover the causes. Every known make of Grid Leak and Mica Condenser was tested and examined in conjunction with all types of Receivers.

Invaluable information and new data were obtained from these investigations among which were startling revelations concerning the rapid deterioration and consequent loss of efficiency in these components.

The new TELSEN Grid Leaks and Mica Condensers are the direct outcome of this amazing discovery. They have been designed on entirely new lines and embody the new

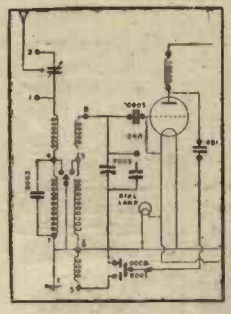
TELSEN FIXED MICA CONDENSER
(Shown with Grid Leak Clips removed).

principles formulated by the Telsen Radio Engineers to overcome the numerous faults

The TELSEN GRID LEAK.

disclosed and to attain permanent efficiency.

TRY THIS SIMPLE TEST



Tune in a station at the top of the medium wavelength band—say the Northern Regional. Note the signal level. Now connect a Telsen Mica Condenser (up to .0003 mfd. in value) across the aerial tuning condenser. Decrease the value of the tuning condenser until the same station is heard, and it will be found that the signal strength is equal to that previously obtained, proving that the Telsen Mica Condenser has an efficiency comparable with that of the variable air condenser, the most efficient type of condenser used in radio broadcast reception.

The new TELSEN Grid Leaks and Mica Condensers set a world's standard in lasting efficiency.

IT'S THE 'LASTING EFFICIENCY' THAT COUNTS

TELSEN FIXED MICA CONDENSER.
(Complete with Grid Leak Clips & Grid Leak)

WE HEAR

That well over a quarter of a million radio components are produced *every day* in the new Telsen Works (the largest and best equipped radio organisation in the world, employing in the neighbourhood of 8,000 workpeople)—and that even this record output is only barely sufficient to meet the enormous and still rapidly increasing demand for these popularly priced quality components.

★ ★ ★

That enormous numbers of home constructors are fitting the new Telsen Drum Drive and Ganged Condenser Assembly, whose single knob operated tuning scale, calibrated in actual wavelengths, makes station logging literally as easy as A.B.C.

★ ★ ★

That the new Telsen Telornor (illuminated variable ratio slow-motion Disc Drive, whose handsome silver oxidised escutcheon plate permits of the very effective grouping of all controls) gives home-built sets the dignity and beauty of line of expensive commercial radio receivers.

★ ★ ★

That home constructors everywhere are thrilled with the performance of the sensational new Telsen JUPITER S.G.3 and AJAX 3 receivers, and that free 1/- blueprints and constructional details of these amazing sets are given with the Telsen Radiomag No. 3, price 6d.

Announcement of The Telsen Electric Co., Ltd.

Radio Ramblings

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR."

Tramway Interference

A WEEK or so ago I was talking about the interference in radio receiving sets caused by electrical apparatus, and it seemed to me to be a strange coincidence that I should have a practical demonstration put before me quite unintentionally. It happened a few nights ago when I was on a visit to a friend's house, and as my visit had nothing to do with wireless, it was not until I prepared to leave that he switched on his set. I should, however, say first of all that he lives in a newly-developed suburb situated between two small districts connected together by a single-line electric tramway system. As I was putting on my overcoat we chatted about wireless matters, but as it was getting late I suppose I must have shown some impatience, for my friend said: "Don't go for a minute; there won't be a tram along for a few minutes." "They run to a time-table, I suppose?" said I. "Well, they may, but we can hear when one is coming, in here," replied my friend, pointing to the loud-speaker. "We can hear a tram as soon as it gets to the Cross, and it takes three or four minutes to get from there to the stop on the corner." I was so interested that I said I would stay a bit longer and listen to this self-heralding tramway system, and sure enough after a while we could detect a faint rustling, crackling sound coming from the set. Suddenly it stopped. The tram had stopped at "the Cross," my friend explained, and it soon began again with increased strength. The noises gradually became louder in a crescendo of "mush," and soon we could feel the vibration of the tram as it passed the house, after which the rattle from the speaker slowly grew less and then faded away altogether. "Now you'll have to wait another ten minutes for the next," warned my friend. Well, it was worth it!

Varied Remedies

THE best thing you can do if you suffer in this way is either to use an indoor aerial or else alter the direction of your outside one until the interference is cut down to a minimum, because I have found that in the majority of cases the bodies responsible for the trams are very conservative and do not listen to listeners' complaints with a very sympathetic ear. I am pleased to note, however, that on a new trolley-bus service at Teddington every vehicle has been fitted, at some expense, be it noted, with a choke-filter arrangement for the sake of neighbouring listeners. This is to be commended, and the owners of the Teddington service should be praised and their buses patronized. Sometimes, if your A.C. is drawn from a station of somewhat old design, your supply may be a little "raw"; and while most of the modern power stations distribute electricity above reproach in this respect, there is still some very rough "juice" being sent out in some places. Interference of this kind is continual at all times, but it can be cured by inserting an arrangement across the mains as shown in Fig. 1. The condenser should be 2 mfd. tested to 500 volts, mains type, and the two coils, virtually chokes, should be about 50yds. of ordinary insulated lighting cable coiled up and bound with Empire or insulating tape. You can insert this arrangement across the mains wires

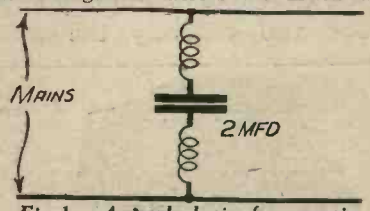


Fig. 1.—A simple device for removing interference from the mains.

running to your set, but better results would be obtained if it were fixed nearer to your meter. In the latter case do not attempt to fix it yourself or you may land yourself in serious trouble. Get the suppliers of the electricity to send an electrician out. He will do the job for you and the charge will be very little or even nothing at all.

Checking H.T. Voltages

WHEN you fit a battery eliminator to your set the voltages you are supplying to the various tappings are often a matter of guesswork. By means of Ohm's law you can calculate the approximate voltage passing through each tapping, but your calculation depends on the accuracy of the maker's estimate of the output of the eliminator and on the valve maker's estimate of the current consumption of the valve. The obvious way to get a really accurate result is to measure the voltage; but another snag crops up here. Very, very few listeners are the fortunate possessors of a suitable voltmeter. The average voltmeter possesses a very low resistance and the voltage drop across the

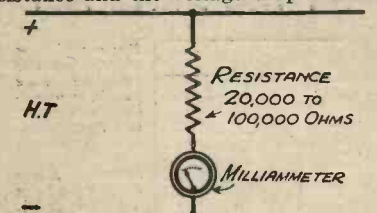


Fig. 2.—Measuring H.T. eliminator voltage with a milliameter and a resistance of known value.

eliminator terminals when such an instrument is applied is so large that the reading obtained is probably far more inaccurate than that obtained by calculation. If, however, you can obtain a milliameter you can take a reading across the H.T. terminals to be measured by placing the milliameter in series with a resistance of known value across the H.T. The diagram, Fig. 2, shows how this is accomplished and the reading of the meter should be noted. The meter should read up to five milliamps if your eliminator gives a fairly hefty output. You all know Ohm's law which says $R=\frac{V}{C}$ where R is the known resistance, V the voltage, and C the current passing, in this case in milliamps. We wish to find the voltage, so we work the equation out to $V=RC$, which tells us to multiply the reading of the milliameter by the known resistance. It is well to choose a resistance of between 20,000 and 100,000 ohms, and supposing you use a 100,000 ohms resistance (use one of reliable make and the error will not be very large) and the meter reads 1 milliamp, the voltage obtained will be 100, and so on. There is one point I should like you to remember, however, and I hope you know it before I tell you. Always take the reading while the set is working and the valves are lit, otherwise the reading obtained will be abnormally high.

Wireless Receivers and the Next War!

READING a newly-published book about the next war (!) recently, I was struck by the thought that, should there ever be another war, would the Post Office take advantage of the clause that used to be, I believe, on the back of our old licences regarding the use of wireless apparatus in wartime? They have the power to close down any "receiving station"—that's your and my set—but what a job they would have in hand nowadays. Figures issued from Madrid show that there are 140 million people regularly listening to Broadcasting and that there are wireless sets in 34,500,000 homes, half of these being situated in N. America, and most of the other half in Europe.

Overloading

A FEW days ago I was called in by a friend to look at his newly-constructed three-valve band-pass receiver. He didn't make any complaints at first, but proudly tuned in numerous Continental programmes. Later he tuned in at two different points at least four degrees apart on the condenser dial. My friend explained that he had tried every possible setting of the trimming condensers, but could not get rid of the "double-humped" tuning on the local station, although other stations were tuned in quite sharply and with ample selectivity. It took me a long time to convince him that his set was tuning quite accurately, and that the "double-humping" was due to the first valve being overloaded when the set was tuned to exact resonance with the transmission from the powerful station. In the end, to prove my point, I connected a small fixed condenser in series with the aerial lead-in to reduce the input, whereupon tuning immediately became normal. This experience might be useful to you, and will at least show that it is unwise to utilize a powerful signal for ganging purposes.

(Continued on page 308)

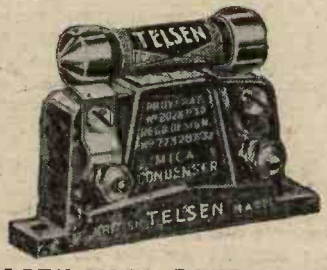
TELSEN MANSBRIDGE AND MICA CONDENSERS

THE 100% PERFECT CONDENSERS

TELSEN TAG CONDENSERS

Of extremely compact and sturdy construction. May be mounted on either insulated or metal panels by utilising the two baseboard 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**



TELSEN MICA CONDENSERS

Represent an important advance in technique: H.F. losses have been practically eliminated, even in the larger capacities. Enclosed in a very attractive moulded case, adaptable to flat and vertical mounting. Grid-leak clips, which may be mounted in series or in shunt, are supplied at no extra charge, with capacities of .0001, .0002, and .0003 mfd.

In capacities of .0001 mfd. to .002 mfd. **1/-**

Also .006 mfd. **1/3**

TELSEN PRE-SET CONDENSERS

Very low minimum capacity, giving a wide range of selectivity adjustment when used in the aerial circuit. Substantially made, easily adjusted and provided with locking ring. High insulation and low loss.

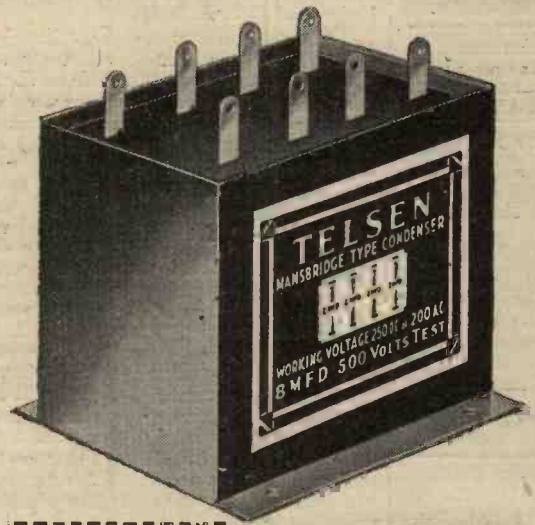
In maximum capacities of .0001 mfd. to .002 mfd. **1/6**

TELSEN MANSBRIDGE TYPE CONDENSERS

Made by the most advanced processes from the finest materials, triple sealed and guaranteed non-inductive, and subjected during manufacture to stringent tests up to Admiralty and Post Office standards. Offered in two types—the capacities from .01 to 2 mfd. in bakelite cases and in blocks of 4, 6 and 8 mfd. in metal cases with soldering tags.

Cap. mfd.	500 volt test	Cap. mfd.	500 volt test
.01	1/6	.25	2/-
.04	1/9	.5	2/3
.1	1/9	1	2/3
		2	3/-

THEY SET A WORLD'S STANDARD IN LASTING EFFICIENCY



TELSEN MANSBRIDGE BLOCK CONDENSERS

Contained in metal cases with fixing holes. Like all Telsen Mansbridge Condensers, they are triple sealed and guaranteed non-inductive, being tested during manufacture to Admiralty and Post Office standards. Made in three types, each having total capacities of 4, 6 and 8 mfds., each type being divided into 2-mfd. sections, so that several arrangements of capacity may be obtained. Soldering tags provided for each section.

Cap. mfd.	500 volt test	1,000 volt test
4	5/6	9/6
6	8/-	14/6
8	10/6	

TELSEN

RADIO COMPONENTS

IT'S THE 'LASTING EFFICIENCY' THAT COUNTS

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

Radio Ramblings

(Continued from page 306.)

Operating Receivers from D.C. Mains

A WIRELESS friend of mine had a nasty and unexpected shock the other day whilst following the apparently safe occupation of weeding his garden. He was working in one corner and quite by accident ran against the aerial lead-in with his face. Luckily his cheek and the wire were only in contact for a fraction of a second, but it was quite long enough to make him give a wild yell and to use unbecoming language. He was baffled to know how the aerial could possibly be charged with electricity for, although he was using a newly-constructed D.C. mains receiver he thought that every precaution had been taken to make it quite safe. It was only after making a number of enquiries that he discovered that the positive supply main was earthed at the power station. As a result the negative was "alive" and, being connected to the aerial (through the tuning coil), it was capable of giving a nasty shock. The whole trouble was easily corrected by putting a .0001 mfd. fixed condenser in series with the aerial lead. As a further safety measure a 2 mfd. condenser was also wired in series with the earth lead. As a matter of fact, when feeding any set from the D.C. mains, either direct or through an eliminator, it is always wise to isolate the mains from both acrial and earth by fitting condensers as just mentioned. Not to do this is against the rules of the electric supply companies and is in contravention of the conditions of fire insurance policies.

Polarity of G.B. Batteries

I HAD rather a surprise the other day on replacing the grid-bias battery of my favourite battery set. Apart from changing the battery, no other alterations were made, but when I switched on after making the usual connections reproduction was something terrible. Music, which was usually reproduced with splendid clarity, sounded like that from an old-fashioned hurdy-gurdy, and the announcer sounded rather as if he had swallowed a hot potato or was suffering from a severe attack of tonsilitis. I suspected the power valve of having gone soft, but replacement by a new one disproved this theory. The first L.F. valve was tested and also found to be in perfect health, so I thought I had better apply a few systematic tests. Naturally the first thing was to measure the anode current; my heart came into my mouth, for the needle shot up to 30 (the maximum reading) with a click. The normal H.T. consumption was known to be in the region of 15 milliamps., so it was perfectly obvious that there was something wrong with the biasing arrangements. I thought I must have mixed up the positive and negative G.B. leads, but inspection revealed no fault there. It was not for some time that the solution dawned on me—the battery had been wrongly marked by the makers. I proved this by testing for polarity with a leaf of pole-finding paper and found that the negative socket was clearly marked "+." Quite apart from the inconvenience that such a mistake might cause to a non-technical listener, it would easily have been the cause of the low frequency and power valves being ruined. Had the high-tension battery been up to full voltage there is little doubt that the valves would have suffered.

An American Receiver—and a Moral

ON his return from America, a seafaring friend of mine recently brought home a present for his wife, this time *not* a parrot to console her during his absence, but something perhaps more efficient, a super radio set with eight "toobs." It was an all-mains set, and was simply bristling with gadgets of all kinds. It was fitted with a tone control, and a weird and wonderful knob that served the multi-purpose of on and off switch, volume control, and with a push-pull movement as a pick-up on and off switch. Well, they prepared for a quiet evening's enjoyment, when, to my friend's disgust he noticed that on a plate inside the set was the caption—"110 v. 50 cycles." Now you may or may not know that the standard voltage "over there" is 110 volts, but my friend did not know this, and as his voltage was 230, 50 cycles, he came round to me to ask if it was in order to switch on. My answer was decidedly in the negative, at which he asked what he could do, as he had visions of much of his hard-earned pay floating away, at least it had already floated, but he had expected something for his money. I would not like to insult my readers by asking them to guess what I told him to do, as it is fairly obvious, but at any rate I will say this, it was a most difficult job to find a radio shop with a two to one step-down power transformer in stock. We covered many miles in our search, but eventually tracked down one of foreign make. It did not take long to get the set working O.K. and I left him as pleased as Punch. The next night he was round again, and as soon as I saw him I thought that probably the transformer had burned out. But, no, this time it was something else. He couldn't get Daventry—nor Radio-Paris—nor Eiffel Tower—nor Warsaw—nor . . . . in fact, he couldn't get any long-wave stations. Once more I am sure you know the answer. They don't use long wavelengths for broadcasting in America, and the set was limited to the medium waveband. This time I told him to go to America and see if he could buy a long-wave adaptor. I did not suppose for a minute that he could, but I wanted to get back to my dials. If there is a moral to all this it is Buy British.

Precautions with All-Mains Apparatus

HOW often have you obtained a "nasty one" when fiddling with the mains supply to your all-electric set? You knew, of course, that you should have switched off beforehand, but it is human nature to be lax with quite dangerous apparatus, and this was pointed out with some force by Dr. Stephen Jellinck, in addressing the International Congress of Electricity in Paris. To support his statements he brought along a formidable array of figures, and he proved that ordinary people could easily stand one hundred times the amperage of direct current over current of similar voltage of A.C. In case this should not be of sufficient warning to you when handling A.C., he went on to say that with a direct current shock one was liable to be rendered unconscious by the first "knock-out" effect, whereas with A.C. a series of convulsions were possible, due to the change of direction of the current. He said that nervous people often possess perspiring hands, which invariably intensifies the effect of the current.

(Continued on page 311.)

MAKING WIRING CONNECTIONS

ALTHOUGH it is a common practice nowadays to wire sets without soldering, I am sure there are quite a number of wireless constructors who always solder their joints, in spite of remarks that a looped joint is every bit as efficient. To such readers the following hint may be useful. The usual procedure in wiring a set is to wire the base-board components first, the panel components next and then to screw the panel to the baseboard. Finally the remaining wiring is completed. Sometimes, however, these latter joints are very awkward to get at, especially with a hot soldering iron. Moreover, one slip may mean serious damage to a component, and I have myself often ruined a choke or coil trying to solder such joints. For instance, in the accompanying diagrams it would be difficult to solder a piece of wire to the switch S without doing damage to the adjacent components (Fig. 1). If the wires shown dotted were to be connected the job would indeed prove difficult. A method of getting over the difficulty is as follows: The panel is only loosely screwed to the baseboard, and the wires A, A1 and B, B1 shaped to make the necessary connections in the usual manner, leaving small bends to fit the soldering tags. The panel is now removed and the ends A, A1 soldered to the switch, care being taken that they are in the correct direction. (No difficulty is experienced in this process.) The appearance will now be as shown in Fig. 2. These joints are cleaned and, on permanently fixing the panel to the baseboard, the ends B, B1 of the wires will fit the soldering tags of the other components. If they do not quite do so, the wires can easily be bent slightly. Finally, the ends B, B1, are soldered to the tags and in this way a thoroughly efficient job can be made without the slightest damage to components.—E. HARDING (Southampton).

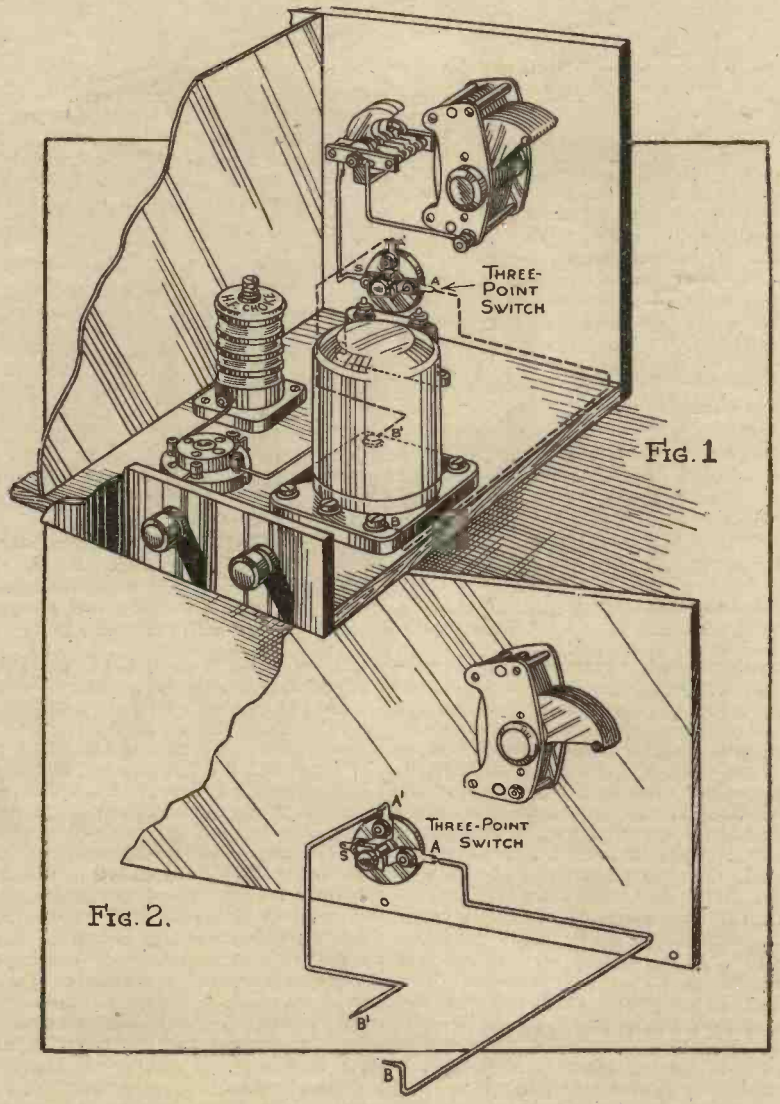


FIG. 1.

FIG. 2.

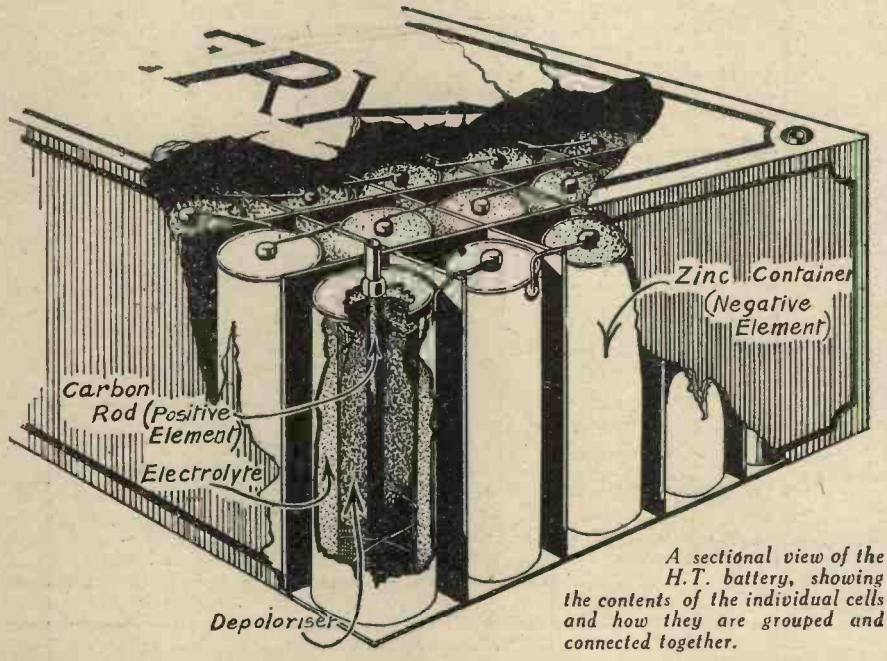
BATTERIES and their WORKING

By GILBERT E. TWINING

In a Modern Valve Set there are Two Distinct Types of Batteries Used—the High-tension Dry Battery and the Low-tension Accumulator

Low-tension Accumulator

DEALING first with this type of battery, it is used for accumulating or storing electricity. Its working depends upon the chemical changes undergone by certain substances when subjected to the action of an electric current. The charging current, *i.e.*, the current which feeds electricity into the accumulator, produces a gradual chemical change in the active elements of which it is constructed. When this charging current ceases, so also does the decomposition, and if the terminals of the accumulator are connected to a circuit a reversal of the process commences until the battery is exhausted and has to be recharged. The essential parts of the well-known 2-volt accumulator, which is used for heating the filaments of the valves in a set, consist of two unlike plates, a positive lead plate and a negative lead plate. These plates are immersed in a solution of sulphuric acid and distilled water, known as the electrolyte. The only difference between the positive and negative plates is in the composition of the active material, the positive is known as lead peroxide, and when fully charged is a rich brown in colour, whilst that of the negative is lead protoxide, and the colour is slate grey.



A sectional view of the H.T. battery, showing the contents of the individual cells and how they are grouped and connected together.

Keep Fully Charged

When treated with ordinary care its efficiency and capacity should deteriorate very slowly. To keep the accumulator up to standard it should be kept as fully charged as possible and charged at regular intervals, a full charge being indicated by both plates gassing fairly freely, the voltage rising to approximately 2.5 volts. A battery should never be completely discharged or left for any length of time with a low voltage, as this tends to cause buckling and sulphation of the plates, also the effective areas of the plates are reduced, and so will require charging more frequently. Sulphation appears on the plates in the form of a white deposit of lead sulphate. Slight traces may be removed by a prolonged charge at a reduced rate, but if not checked immediately it will probably mean new plates. Never let the level of the electrolyte fall below the top of the plates, keep it up to the level marked on the outside of the battery case by the makers. The drop in level is caused by evaporation of the water only. Sulphuric acid does not evaporate; therefore, if the specific gravity is still correct, it is only necessary to top up with distilled water. Loss of the acid does occur, however, but only when the accumulator is gassing freely when on charge, thus causing what is known as "spraying" through the filler cap, which cap it is advisable to remove from small accumulators when charging to allow for breathing. The only other loss is, of course, by the spilling of the electrolyte, which may be made up by the addition of acid of the correct specific gravity stated by the makers.

Testing with Hydrometer and Voltmeter

Testing the condition of a battery should be done with a voltmeter in conjunction with a hydrometer. The voltmeter test must be taken under load—that is to say, when the set is operating, otherwise the reading will be misleading. The hydrometer's graduated float will give readings to determine the specific gravity of the electrolyte.

When purchasing a low-tension accumulator for a set, make certain it is of adequate capacity and quite capable of handling the current demanded by the set without frequently having to be re-charged. The size for normal use is about 20 ampere hours, but it is preferable and more economical to select one of at least 30 to 40 ampere hours actual capacity. An accumulator of insufficient capacity will be overloaded, and it should be noted that if the discharge of the battery is too great the paste will be driven out of the grids of the plates, and in a three or four-valve set this will considerably shorten its life.

Always buy an accumulator with large non-corrosive terminals and preferably one having bright red and black tops, care being taken to see that they are of the non-interchangeable type, that is to say, having different sized threads, making it impossible for the red terminal top which is positive to be screwed on to the negative terminal thread and vice versa. Even if terminals which are said to be non-corrosive are left in a very dirty state they will corrode; the best cure is to clean all traces of acid away and scrape the terminals and connections bright with a file or pocket knife, afterwards wiping over with a rag dipped in ammonia and then smear freely with vaseline.

The High-tension Battery

There are several grades and prices of H.T. batteries on the market, and it behoves everybody to consider well before buying any but those manufactured by firms of repute. It should be understood that the very life of the battery is governed by several important points. A battery of 120 volts is made up of 80 cells of 1½ volts each. These cells are connected in series; that is to say, the positive of the first is the positive or + of the battery, the negative of this cell being joined to the positive of the second cell, the negative of which goes to positive of the third, and so on until the requisite number of cells are connected up, the sum of which make up the voltage required, ending, of course, with the negative or —. It can be seen now how simple it is for the manufacturers to make provision at different points on the top surface of the battery, enabling it to be tapped for intermediate voltages. The larger the elements in the cell the lower is its resistance which enables the current of the cell to have a greater output. It must stand to reason, then, that the larger these cells are made—and this must consequently increase the over-all dimensions of the battery in its cardboard or tin case—the better will the aggregate number of cells stand up to the consumption of the valves. That is the reason why a "triple" capacity battery of the same voltage is bigger than one of "standard" capacity.

Capacities of Batteries

There are three different ratings made, "standard," "double," and "triple" capacity. The following is a list of capacities most economical for the number of valves in a set:—

"Standard" capacity for 3-valve sets taking up to 6-7 milliamperes.

"Double" capacity for 4-5 valve sets taking up to 10-16 milliamperes.

"Triple" capacity for multi-valve sets taking anything up to 30 milliamperes.

The battery having a "double" capacity does not cost twice as much as the "standard," although, if used on the same set will give twice its life. Another good feature of the larger capacity is that its voltage drops more slowly; this means a more uniform output and a better performance of the set. A big H.T. battery, the initial cost of which is very little more than its smaller brother, if taken over a long period, is much more economical to run.

The composition of the cell is made up of a carbon rod, positive element, the electrolyte (which is in paste form), and the zinc container or negative element, see illustration. The action of the paste—and this is a mixture of sal-ammoniac and certain other ingredients—supplies the electrical current. This action in time tends to eat away the zinc and is one of the things which govern the life of the battery, for the corrosion of the container cannot be renewed without dismantling the whole battery. The paste electrolyte is very important, for if this dries up the whole chemical action of the battery ceases, and it becomes dead. The grid bias battery consists of a number of cells of exactly the same nature as the H.T. battery, *i.e.*, of the dry Leclanché type.

Radio Ramblings

(Continued from page 308)

Dry Battery Guarantee

TALKING of the wireless trade brings me to a little point that has not received the publicity it might have had, being as it is a striking commentary on the progress that has been made in dry-battery design and manufacture through the needs of radio. It is an announcement issued to traders and retailers by a large British concern who make, among other components, a large range of dry batteries, including those for supplying H.T. to wireless sets, to the effect that from now on a "shelf life" of six months is guaranteed. If any battery shows signs of distress when put into commission it will be replaced if the printed date-form attached shows that it has been in stock under the six months. Behind this announcement lies the years of research and progress that have gone into the H.T. battery business. Years of work that now enable a battery maker to have sufficient confidence in his products, which, mark you, are of an extremely perishable nature, to guarantee their ability to "keep" even when in stock six months. What a step forward this would have seemed in the early days of wireless, when buying a H.T. battery was as much of a gamble as the purchase of a valve—neither guaranteed until you got home with them!

New Short-Wave Station at Prangins

THE activity on the short waves increases daily, and even television is being tried out "down there." Shortly enthusiasts will be listening weekly for the new League of Nations station at Prangins, near Geneva. Every Sunday from 10 o'clock in the evening onward a statement of the week's work and progress of the League will be broadcast in English, French, and Spanish, and the programme will be relayed throughout North, Central, and South America and the Far East. So long as the station sends out a good report of the League's doings in their efforts to keep war at a distance we shall not need to begrudge some of the staff the comfortable jobs that some of them undoubtedly have.

REPLIES TO QUERIES and ENQUIRIES

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

The coupon below must be attached to every query.

by Our Technical Staff

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.

UNSELECTIVE SET

"I have a 3-valve set which is very unselective, and I am also unable to receive foreigners. How can I remedy this?"—(W. C., Yorkshire).

If connecting a small condenser (.0001 mfd.) in series with the aerial does not give you the desired selectivity and bring in the foreigners, we suggest that you seriously consider building a more selective set, such as the "Long Range Express Three" described in our issue for September 24th.

LOOSE CONNECTION

"My set has recently developed a howl which varies in tone with the controls. It is a 3-valve set and the H.T. is supplied from the mains. It appears that a loud signal or a slight tap will start it howling. Can you tell me the cause and cure for this?—(L. C. D., Epsom).

You are apparently suffering from a loose connection. We advise you to look carefully at your aerial and earth terminals, and also make sure that your valves are making good contact in their sockets.

"Is it practicable to use a short-wave adaptor (detector stage) with A.C. indirectly heated valves?"—(P. W. C., Surrey).

If both adaptor and receiver are worked with A.C. valves the two can be operated together. In this case a four-pin plug-adaptor will be necessary. The pin which is missing must, of course, be the grid pin. If the adaptor is worked from batteries, many complications might occur, and it is not recommended it should be used.

TUNABLE HUM

"I have recently built a mains three-valver, S.G., Det. and L.F. stages. All parts are of good make, and the mains side is well smoother. In addition, each stage is efficiently decoupled. In spite of this, however, when I tune in the London station I get a terrible loud hum. This only occurs on the London station, and the set is quite silent all over the dial. Can you explain this, and perhaps indicate a cure?"—(R. B., Edmonton).

The fault is known as a modulated hum, and is caused by the strong signal from your local station modulating the hum from the mains side of the set. The cure is quite simple and cheap. You require what is known as a Buffer condenser. This consists of two condensers of, say, .1 mfd., joined in series. The junction of the two condensers is joined to earth, and the other terminals are joined to the two anodes of the rectifying valve. Special condensers are obtainable for this purpose.

POOR M.C. REPRODUCTION

"I have just bought a moving coil speaker, after being assured that it would give 'perfect' reproduction. I am very disappointed in the results, as it is giving reproduction worse than my old cone. Can you help me? The speaker is a ——— (one of the largest firms in the country)."—(S. V. P., Tranmere).

The speaker gives more accurate reproduction, and this accounts for the poorer quality. Your receiver delivers distorted results which were covered by your old speaker. For instance, certain frequencies may be cut off in the receiver, but the speaker had a resonance at those frequencies, resulting in an apparent even response. Your M.C. speaker, giving a true straight line response, now shows up this cut-off—hence the apparent distortion of the speaker. You will have to adjust your set to give straight-line response, and then you will reap the benefit of the new speaker.

UNMATCHED OUTPUT

"My loud-speaker does not match my output valve, and I want to match up without buying a new valve, as all my voltage droppers, grid bias resistances, etc., are now fixed. Is there any way of doing this?"—(F. R. P., Brompton Road).

An Output Matching Transformer, obtainable from any of the firms who specialise in such components, will solve your trouble. A transformer, with variable ratios would be most useful, as you could then change the valve, if necessary, at some future date, and still be enabled to match up.

"I have an A.C. eliminator giving H.T. also a 4-volt 3 amp. raw A.C. for I.D.H. valves which is not in use as I have ordinary 2-volt battery valves. To save scrapping these could I use the 4-volt tapping with a suitable metal rectifier and a resistance to reduce to 2 volts?"—(C. S., Southsea).

The cheapest way would be to buy a 4-volt 1 amp. valve (making sure your H.T. supply is enough for valve chosen) and supply the filament from your eliminator. When doing this a resistance of 2 ohms (capable of carrying 2 amps) must be connected across the H.T. terminals.

"Why is a potentiometer of only 400 ohms used in the detector circuit for controlling the potential on the grid. The potentiometer is usually connected across the L.T. supply (in the case I am thinking of it is a 6 volt) and the slider taken to the grid of the valve. Part of the pot., therefore, acts as a voltage reducing resistance. The full voltage, when the pot. is at the positive end is 6 volts plus. Now the current taken by the grid is only in the shape of micro amps. (one millionth of an amp.). If we take Ohm's Law, therefore, to have a control of, say, 3 volts on the grid it would want about a 10,000 ohms. resistance. With the old type valves 400 ohms might have been alright, but it still seems to be the practice to use 400 ohms, whether it is a 2, 4 or 6 volt accumulator used. On a S.G. variable-mu valve a potentiometer of between 25,000 to 50,000 ohms is used, and what difference should there be between this and the detector valve where the grid control is concerned?"—(S. J. H., Croydon).

You have apparently not yet fully understood the operation of a leaky grid detector valve. For efficient operation, the grid has to be slightly positive, *with respect to the filament*. The potentiometer across the L.T. supply enables this adjustment to be carried out, by moving the slider from one end to another, the total difference across the potentiometer being equal to the voltage of the L.T. battery. No current flows to the grid, and therefore you cannot apply Ohm's Law. For the S.G. valve, only small variations in potential can be used and, therefore, a high value across a larger battery will enable small differences to be adjusted.

"In a 3-valve set Det. and 2 L.F. (both transformer coupled) the reaction on the long wavelength seems to be peculiar. The coil is a commercial one and covers both wavelengths. When the set is tuned to the short wavelength the reaction knob turns left to right and is the same up to the Daventry National, but any station on a higher wavelength cannot be reacted on unless the knob is turned to the *left*. I have a H.F. choke and by-pass condenser in the plate circuit of the Detector valve."—(J. E., Ilford).

We would advise you to have your coil tested. If this is in good order, make sure your grid leak and condenser are of the correct value. Two transformers, if not of reliable manufacture will cause instability, producing such a result as you are experiencing.

"I am desirous of constructing a 4-valve high-quality receiver and wish to use the following valve combination:—1 variable-mu, H.F. Stage, Detector, 1 L.F. and push-pull output. I want valves of the Mazda PP5/400 class for the output, but am dubious of the current consumption. Will you kindly inform me whether my power supply of 500 volts 120 m/a will be enough to supply the above-mentioned combination, using, of course, automatic grid bias. Should the output valves take too much, perhaps you will recommend a suitable type to use in their place?"—(L. L., London).

As the voltage has to be dropped you will just about be able to work these valves at full pressure from your present output. A resistance of 400-500 ohms, capable of carrying 120 m/a will be necessary in the H.T. lead supplying the two PP5/400 valves. The maximum H.T. voltage of these valves is 400 volts and the current at this pressure and correct bias is 60-62 m/a each.

"I wish to instal a moving coil speaker to work my 2-valve receiver. Reception is quite good at present, but I intend to replace my power valve with a pentode. My mains eliminator just supplies sufficient current for this valve and detector. I propose to mount the speaker in the cellar behind a lath and plaster wall in which a large hole is to be cut as the usual baffle board aperture. By making the front of the board on which the unit is mounted a close fit up against the wall I hope to make the wall serve as a large baffle. The wall is about 1½in. thick, and provides the only convenient place. I should be glad if you would give me your opinion on my proposals, especially as to whether any precautions are to be taken in incorporating a pentode valve and whether I am likely to experience any undesirable resonance from the plaster wall."

This method of mounting is quite satisfactory. The only precaution necessary when burying the speaker is to make sure that it is complete with an output transformer suitable for the pentode valve.

SIZE OF FILAMENT FUSE

"I wish to fit a fuse in my battery-driven receiver to safeguard the valves from being burnt-out in the event of a short from the H.T. What size must this fuse be?"—(H. K. B. C., Bristol).

In the majority of receivers the filaments are wired in parallel, and you must therefore, add together the filament current of each valve. You should then choose a fuse with a rating just lower than this figure—remembering that 100 m/A. is the same as .1 amps.

"PRACTICAL WIRELESS" DATA
Sheet No. 5

TUNING COIL DATA (Long Waves)

Cut this out each week and paste it in a notebook

Outside Diameter of Former	Wire Gauge	No. of Slots	No. of Turns Per Slot	Sizes of Slots.	Inductance Value (microhenries)
1.0in.	36 D.S.C.	5	69	1/16in.	1,600
1.0in.	36 Enam.	5	80	wide	2,100
1.5in.	36 D.S.C.	4	57	⅛in. deep	1,600
1.5in.	36 D.S.C.	4	65	separated	2,100
2.0in.	34 D.S.C.	4	45	by ⅛in.	1,600
2.0in.	34 D.S.C.	4	51		2,100

With a .0005 mfd. Tuning Condenser the 1,600 microhenry coil will cover a band of approximately 800 to 2,000 metres, and the 2,100 microhenry coil a range of 850 to 2,100 metres.

NEW LOTUS CONDENSER

Slow-motion Condenser. Constructed throughout of aluminium, this component is highly efficient, perfectly smooth and noiseless in operation. A ball-drive integral vernier device is concealed in the spindle, and both direct and slow drives are controlled by the double knob-dial supplied with the condenser. With braided pigtail connection to rotor. Specially suitable for superhets. The reduction gear is 7 in 1. Two capacities are made, .0003 and .0005, and the price is 6s. 6d. each.

POTENTIOMETERS AND RESISTANCES

A USEFUL range of wire-wound pot.-meters and resistances is shown in a leaflet we have just received from Watmel Wireless Co., Ltd. These components are of high-class manufacture, and the pot.-meters, owing to the high-inductance value of the resistance, are specially suitable for all purposes of voltage regulation, volume control, etc. Another component listed is a special wire-wound fixed resistance for use in circuits requiring a non-inductive winding, such as in free-grid biasing, potential dividing and for de-coupling. These resistances are obtainable in capacities from 100 to 100,000 ohms.

FREE ADVICE BUREAU
COUPON

This coupon is available until Nov. 5th, 1932, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 29/10/32.

The Heart of Your Set—

(*Continued from page 278*)

Of these two types, one is generally a high-magnification valve with a fairly high impedance, and should be selected for receivers having no high-frequency amplifying stage. The other general-purpose type has an amplification factor of the order of thirty-five, and an impedance of the order of 10,000 to 12,000 ohms, and should always be used as the detector in multi-stage receivers.

For use in the output stage, there is among the A.C. valves no counterpart of the small battery-heated "power" valve. Triodes capable of giving outputs comparable with those of the normal super-power battery valve are available in both indirectly heated and directly heated forms, but most mains sets are fitted with three-electrode or five-electrode output valves giving very much larger outputs. The reason, of course, is that power drawn from the electric light mains is much cheaper than that generated chemically in batteries, and it is, therefore, possible, for quite a reasonable expenditure on current, to employ valves giving an output which could only be taken from batteries at prohibitive initial and running costs.

The problem of designing valves for use in D.C. mains-operated sets is much more difficult of solution than that of producing satisfactory A.C. valves. It is true that the trouble of mains hum is not so pronounced when D.C. mains are used, but the problem arises in the arrangements for low-tension supply. One solution to this is to use ordinary directly heated filament valves, running all the filaments in series. Apart from the disadvantage that all the cathodes are at different potentials, and in some cases many volts above earth, very great care in manufacture has to be taken to ensure that all the filaments have the same *current* rating. Even when this is achieved, a further complication arises because the filament of the valve situated at the low potential end has to carry not only its normal low-tension current, but also the anode current of the other valves, while the filament of the next valve has to carry the anode current of all the valves following it, and so forth. In order to ensure correct filament temperature, therefore, it is usually necessary to shunt each filament with a carefully calculated resistance.

Types of Valves Available

In spite of these difficulties, there are a number of commercial receivers designed for series-run directly heated valves, and suitably matched valves in screened-grid, detector and pentode types are produced by certain valve makers. The modern solution, however, is the application of the indirectly-heated principle to direct current mains valves. As, however, it is not possible to use a cheap and simple transformer to give a low-tension supply at a voltage of the order of 4, it is common practice to wind the heaters for operation at a somewhat higher voltage, of the order of 20, all the heaters in one receiver being run in series, with a line resistance to absorb the difference between the mains voltage and the pressure required by the valve heaters. Some elementary precautions, as regards smoothing and good insulation of other portions of the receiver from the mains supply, are all that is really unusual in the circuit arrangements.

Directly heated D.C. mains valves, for the same reasons that apply to A.C. valves, are not manufactured in a great multiplicity of types. Most makers supply one, or at the most two, screened-grid types, one or two detector types, and a pentode and a triode output valve.

The Diode

Only one other type of valve demands attention before closing this short review. This is the diode, or two-electrode valve. Commonly called the "rectifying" valve, this is the direct descendent of the original Fleming valve, and contains two electrodes only—the filament or cathode, and the anode. Its use in receiving sets is restricted entirely to rectifying the house alternating-current supply to provide a uni-directional current which, after suitable smoothing, can be used for the high-tension supply.

It will be clear that a valve of this type, possessing a filament and one anode, will, by virtue of its power to pass current in one direction only (from filament to cathode within the valve), rectify any alternating supply applied between the filament and anode, the anode becoming the negative terminal of the high-tension supply, as indicated in the diagram Fig. 1. Greater smoothness of output can be obtained by using a rectifier having two anodes, insulated from each other within the valve, and fed from a centre-tapped transformer, as shown in Fig. 2.

Fig. 3 gives the typical form of the performance curve of a rectifier valve. It will be noticed that for a given A.C. voltage applied to the anode, the rectified voltage varies with the load. If a small current is drawn from the rectifier, the D.C. voltage will be high, but will fall off as the current output is increased. British valve-makers are now standardizing on a few representative sizes of rectifier, the standard outputs being 60 milliamperes at 250 volts, and 120 milliamperes at 350, 500 and 1,000 volts. The first-mentioned is the size used in most domestic receivers, while the 120 milliamp, 350-volt, type is required for the larger radio sets and radio-grams, the remaining types being of special application to powerful equipments such as public address apparatus.

It should, of course, be remembered that the rectifying valve is being fed from a transformer, and therefore it is absolutely essential that the valve and transformer are chosen together. In other words, if a valve to give 120 m/A is chosen, the transformer also should have a rating just as high. A fixed condenser of 4 mfds. capacity is also now being standardized across the rectified output.

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

Practical Letters

SIR,—I have been in possession of PRACTICAL WIRELESS for about two hours and I have already given my newsagent a permanent order for it. I consider it the best wireless weekly or monthly that I have had, and I have taken the whole lot of radio books in during the last three years. It is written in non-technical terms, which makes it the most wanted of wireless books. It does not require a semi-expert to understand any of the information it contains. Perhaps later you will be able to run a page weekly on common faults and how to cure them, taking a part of the set each week. I wish PRACTICAL WIRELESS and all its staff a prosperous future.—H. W. JOHNS (Walsall).

Congratulations and Some Criticism

SIR,—Congratulations for a great paper—keep it up! The most notable thing I found about it was the amount of real reading it contains between two covers.

And now, with your permission, I will offer some suggestions.

Firstly: "New sets fully analysed!" A splendid idea! Better than dozens of sets which nobody ever builds.

Secondly: The clarity of the diagrams, a pleasure to the eye.

Thirdly: Your Wireless Constructors' Encyclopædia; very enterprising and very appropriate.

Fourthly: The "Long Range Express." From the "not-too-clever" fellow's point of view, this looks an "up-to-the-second" sort of set, and you seem to have set yourself a high standard to live up to, but—please don't specify the metal panel and baseboard too often. Remember the home constructor's stock-in-trade is wood. One part of your policy which I do not agree with is that you specify one make of component. There is no reason for it (within bounds), and the majority of home constructors can't afford new components every time. Please give at least one alternative make.—ROBERT F. GRAY (Aberdeen).

An Appreciation

SIR,—I have read with much pleasure your issue of PRACTICAL WIRELESS for September 24th. I feel that this paper fills a pressing need for amateurs like myself, who make sets and components for themselves. Other papers have, in the past, been good from the practical wireless man's point of view, but are now either too technical or too much of a manufacturer's catalogue. Your articles on Band Passing and Pentodes were excellent, as also "My Favourite Circuit, and Why."

Being interested in short-wave work I was somewhat disappointed at not finding an article on this subject, but I have no doubt that articles will appear in the future. I therefore sincerely wish you every success with your new paper.—D. C. GUNN (Whitchurch, Glam.).

A Bouquet from Loewe

SIR,—We were interested to receive this morning a copy of No. 1 of PRACTICAL WIRELESS and we should like to take the opportunity of wishing your paper every success. There is still a large market of home constructors to be catered for, and we most heartily endorse your policy to offer the constructor one particular set of components only and not to advocate alternatives.—THE LOEWE RADIO COMPANY, LIMITED (A. COHNREICH, Director).

A Reader's Thanks

SIR,—I should like to record how much I enjoy your new PRACTICAL WIRELESS. I found more "meat" in it than in many shilling books I have had, and was much impressed by its contents. I feel sure you have hit on a much wanted need. It is so different in a good way from the others. I need hardly say I am after the Encyclopædia. I posted my coupon this morning.

I feel very pleased to have had the pleasure of coming across you; the name of F. J. Camm gives me joy. Success to PRACTICAL WIRELESS.—J. GARDNER (Wavertree).

Re Criticism of Programmes

SIR,—I thank you for your paragraph, on page 121 of this week's PRACTICAL WIRELESS," *re* Criticism of Programmes, and I am pleased to know it will be absent from your columns. Owing to the vindictive criticism of the B.B.C. in some of the journals I used to take, I was compelled to give them up. Therefore I thank you for this assurance.—H. THOMAS (Coventry).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—That the coupling condenser used in an R.C.C. unit must be of the mica variety to ensure that the grid is efficiently insulated from the H.T. supply.

—That a transformer will only transform alternating current (A.C.) and not direct current (D.C.).

—That even a straight wire has inductance and capacity.

—That a pentode valve may be used as a combined oscillator and detector in a sup.-het. receiver.

—That paralleling valves is no remedy for an overloaded output stage. Push-pull is the only way out.

—That the human voice covers a band of frequencies from 64 to 1,024 cycles per second.

—That an inductive resistance offers an impedance to A.C. currents which is greater than its D.C. resistance.

—That extension handles of ebonite are preferable to a metal panel for avoiding hand-capacity effects in short-wave work.

—That the average mains set consumes less current than the average electric lamp.

—That a hydrometer is more essential than a voltmeter for testing the condition of an accumulator.

Another Appreciation

SIR,—I feel I should like to offer a few words of appreciation for the first issues of PRACTICAL WIRELESS; it has satisfied a long-felt want in that it caters for the very beginner as well as the more advanced amateur. Its hints are most helpful, being set out very explicitly. In short, it is a real live wireless weekly, and may it enjoy the success it deserves.—E. A. SITLER (Welling).

Using Gas-pipes as Earths

SIR,—We have noted that on page 84 of your second number of PRACTICAL WIRELESS references are made to the use of gas connections as a means of earthing wireless sets, more particularly by those who use indoor aerials.

We thought it advisable to let you know that this practice is strongly disapproved of within the gas industry for the following reasons: (1) The experience of many users of wireless sets is that an earth effected through the gas-pipes is much less satisfactory than when earthed in the normal manner. Gas-pipes are not in continuous metallic connection with the ground, owing to the many joints in the pipe-run. These joints are made with material which is essentially of a non-conducting character, although the amount of joint material is not sufficient to render the pipe-run entirely non-conducting, which explains why they can act as earths, although imperfect ones; (2) The use of gas-pipes as earths is accompanied by very real risks. We have actual knowledge of serious trouble being caused due to the fusing of the gas pipes and consequent fire. In addition, there is the risk due to lightning, and, inasmuch as the user of the wireless set would be the sufferer, it would seem wise that he should be warned against the practice.

Several gas companies have realized the need of warning their consumers against the practice of earthing on to the gas-piping, and the following is typical of the wording of some of the notices that have been issued by gas undertakings:

"EARTH WIRES FOR WIRELESS RECEIVING SETS

"To use gas-piping for attaching the Earth Wire from the above apparatus is a dangerous procedure, and *should never be done*. In the event of the Aerial being struck by lightning, or in the case of a leakage of electricity from an ALL-MAINS Set, there is considerable risk of the piping being fused, which would cause an escape of gas, and probably fire. Gas consumers are warned to refrain from this dangerous practice, and should on all occasions arrange for a separate earthing system."

Having regard to the obvious aim of your paper namely—to aid users of wireless sets to get the very best possible results—you will no doubt regard the above information as of value to your readers.—Yours faithfully, J. F. WALKER, General Secretary, British Commercial Gas Association.

Practical Letters from Our Readers

(*Continued from page 314.*)

More Congratulations and Suggestions

SIR,—As one who has dabbled in wireless since before the War, may I congratulate you on the production of "a long felt want" in PRACTICAL WIRELESS.

I have taken in most of the wireless journals since their commencement, more as a habit I think, and I am now discontinuing them in favour of yours, which, judging from the first two numbers, promises to give me what I have long wished for. In the papers in question the idea seems to be that one wants to make a fresh wireless set every week and, worse than that, one is forced to use Jones' or Smith's dual coil or some similar gadget. It isn't everyone who can afford to buy special coils for every set they make: besides which, they probably have a workroom stocked with numerous components already. By all means recommend components, but, if possible, give details so that those of a practical turn of mind could make them or adapt components they already have. If I might make a suggestion or two I think it would be a good idea if you published hints on values of grid leaks, condensers, etc., for different conditions: improvements one could make to existing sets: articles on impedance, etc. Some of these are embodied in your first issues, and I am hoping that you will continue the good work.

With best wishes for its success.—GEO. E. WELCH (Wakefield).

Articles for Amateur Transmitters Wanted

SIR,—Having been connected with the radio industry since 1920, or about two years before the inauguration of broadcasting, I have made it a practice to take the first few copies of any new wireless periodical, and I can confidently say that no issue has impressed me so much as your No. 2 which I have just purchased, and, in consequence, I am ordering No. 1 and all future issues.

The style is excellent and the method of explanation easily understandable by the man in the street. Unlike most wireless writers you do not either describe sets of elaborate and intricate design whose cost is prohibitive to the ordinary reader. I shall certainly make a point of introducing your excellent publication at the next meeting of our Society.

In conclusion I would like to ask if it would be possible for you to devote some space to the amateur transmitter? Owing to the vast number of broadcast listeners the transmitter has of late years been very much neglected by the wireless press, and this is, I think, a pity, inasmuch as there are quite a large number of amateur licence-holders these days, and with the publication of so much matter on S.W. reception there are bound to be a large number of interested listeners who, hearing our signals, would like to know at least a little about *our* side of radio.

Should you be able to devote a little space to our interests, readers could help you by supplying you with notes or photos of their stations.

Wishing your publication continued success.—E. W. RAYNER, G610 (Hon. Sec. Sth. London and District Radio Transmitters' Society.)

An Early Experimenter's Thanks

SIR,—I wish to thank you and your technical staff for the very practical manner in which you have compiled your new weekly, PRACTICAL WIRELESS. It is undoubtedly the best threepennyworth I have as yet come across. Wireless has been my hobby since it was first broadcast by the Westinghouse Co., from Trafford Park, Manchester, and to-day there are very few broadcasts in this small world of ours that I cannot receive from 5 metres upwards, so you will understand that I am not without a little experience, and well able to recommend your new issue to all who are interested in wireless. They simply cannot go wrong if they read the articles therein. For instance, turn to page 86, issue No. 2 (an aerial behind a picture)—this, like all other articles in PRACTICAL WIRELESS, is quite correct; my best aerial is enclosed behind a 30in. x 20in. oil painting, and brings in foreign stations galore, as well as all B.B.C. stations.—C. WOLMOUGH (Barrow-in-Furness).

Non-practical Matter Not Wanted

SIR,—May I use the medium of your "Letters from Readers" page for the dual purpose of thanking you for giving us a really "practical" paper, and for criticizing those readers who seem to desire that this practical side shall be sacrificed bit by bit in favour of reading matter which can be obtained elsewhere by the minority who need it.

I refer particularly to Mr. Coley, of Tonbridge, who is the thin end of a wedge, very easily inserted but hard to remove if encouraged. I can recommend him to other wireless books in which he can read about the latest records; about talks with foreign listeners, and the miles of cable laid in such-and-such a broadcasting station; but I cannot recommend him to a better threepennyworth of "practical" wireless than the book into which he is endeavouring to introduce non-practical matter—even an extra pennyworth a week of it.

No! Give us sets to try out; our own coils to wind; how to make mains and other transformers; useful testing gadgets and tips; ultra-short-wave, home-made, transmitting sets on a small scale, and thus encourage the practical man to experiment and learn.

Please don't stint the practical articles and fill up with details of the latest giant valve (twice round St. Paul's sort of stuff), or a page of latest records which 50 per cent. of your readers can't afford or have no wish to buy.

I hope Mr. Coley, and others upon whose corns I may have stepped, will forgive me, and that you, Sir, will realize there is sufficient of truth in what I say to warrant publication.

Every success to PRACTICAL WIRELESS.—"SEPTIMUS" (Leyton).

A Suggestion

SIR,—I send this little word of encouragement regarding your paper, with which I am delighted. If you keep up the standard of the paper as you have commenced, I'm sure it will be a great success. Here is a suggestion for what it's worth: Begin in one issue with a crystal set, complete the description in the following issue, and then deal with other circuits, including multi-valve sets, in the same way. I'm sure from the beginning you have made that you will rise to the occasion.—WALTER WALLACE (Orkney).

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.

FORMO SPECIALITIES

THE new range of components shown in the latest Formo list should appeal to all discerning constructors. Amongst the components listed are dual-range aerial and band-pass coils, L.F. transformers, multicouplers, and dual and triple gang condensers. The ganged condensers can also be obtained mounted on a common base-plate with either two or three matched ganged coils with coupled switches. In the triple gang condenser each assembly is provided with an ordinary trimmer. The list also includes a range of Formo "Hymeg" fixed condensers of various capacities up to 14 mfd.

"ATLAS" MAINS UNITS

A COMPREHENSIVE range of "Atlas" mains units is listed in the latest folder issued by H. Clarke and Co., of George St., Patricroft, Manchester. Some are combined H.T. units and L.T. chargers, while a new A.C. model is also provided with grid-bias tappings. Other models are designed for delivering H.T. only, and one D.C. unit is provided with an ingenious switching arrangement which ensures the full voltage being delivered even when different amounts of current are being taken from the unit. It is for working on 200-250-volt mains, and the output is 15 to 25 milliamps. Other "Atlas" components included in the folder are an L.F. transformer designed for parallel-feed circuits, a new permanent magnet loud-speaker, short-wave coils, and a pentode choke.

"SIX-SIXTY" PRODUCTS

IN a neat folder we have just received from Six-Sixty Radio Co., Ltd., 17-18, Rathbone Place, Oxford Street, W.1, the complete range of their well-known valves is listed. Particulars are given of various cabinet receivers, some with balanced armature loud-speakers and others with P.M. moving-coil speakers. Also described in the folder are an A.C. mains unit having a maximum output of 40 milliamps; cone units; a valve and set tester; and the S.S. Multistat, a neat device which operates as a radio and gramophone volume-control and a radiogram change-over switch.

T.C.C. CONDENSERS

FIXED condensers of various types and for all purposes are shown in a new folder issued by Telegraph Condenser Co., Ltd., Wales Farm Road, North Acton, W.3. Small mica condensers with capacities of from .00005 to .25 mfd.; high voltage electrolytic and paper condensers; smoothing condensers; and a special line of sub-divided block condensers are included in the folder, together with tables giving the dimensions, capacities, and prices of each component.

VARLEY RECEIVERS

AFTER years of research work Messrs. Varley have produced their fine range—the Varley "Square Peak" Mains Receivers and Radio Gramophones, the outstanding features of which are quality of reproduction, selectivity, and simplicity of design. The three-valve receiver (S.G., detector and pentode) is provided with band-pass tuning and a built-in moving-coil speaker, and is housed in a beautifully-finished figured walnut cabinet. The "Square-Peak" super-het model is a five-valver with one-knob tuning, and is obtainable either as a table or console model. The all-mains radio-gram. is also equipped with a five-valve super-het set and moving-coil speaker, while the gramo. motor is a Garrard model. Full particulars of these high-class receivers are given in an attractive booklet we have just received from Messrs. Varley, Kingsway House, 103, Kingsway, London, W.C.2.

Broadcast Query Corner

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

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

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

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.

ADVERTISEMENT INDEX

P.W. Gift Stamp No. 5
* See Note on Page 284.

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