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!

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.

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.

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.

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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

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PILOT AUTHOR KIT

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power. Pilot Author Kit "A" (less valves and cabinet). Cash or C.O.D., **£4/8/6.** Carriage Paid. **8/1** only
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tappings. S.G., detector and power. Output: 120 volts at 20 m/a. Cash Price **£2/19/6.** **5/6** only
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REGENTONE W.1.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
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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.

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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 TR	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
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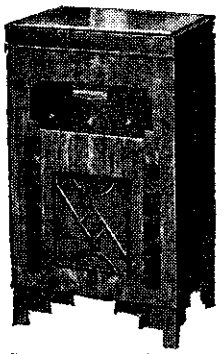
IMPORTANT *Part Kits, miscellaneous components or accessories are available Cash, C.O.D. or under our own Easy Way H.P. System. Send us list of your wants. We will quote by return without any obligation. Orders value over* **10/-** *Carriage or C.O.D. Charges Paid.*

1933 ADAPTAGRAM

Trade Mark

Constructed in Walnut with inlaid Walnut Veneers.



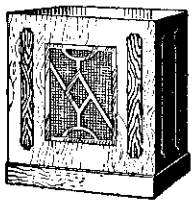
Dimensions: Height, 38¼in.; width, 21¼in.; depth, 15¼in.; panel size: 18 x 18in.; baseboard depth, 14in.; Speaker Compartment, 17 x 19½ in.; Clearance Between motor board and underside of lid 4in. Ready fitted with back Baffle Board, 3/6 extra if required.

● 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**

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Dear Sirs,—Please send me C.O.D./CASH/H.P.....

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Here's the Set for YOU!!

Amazing Reception—40-50 Stations

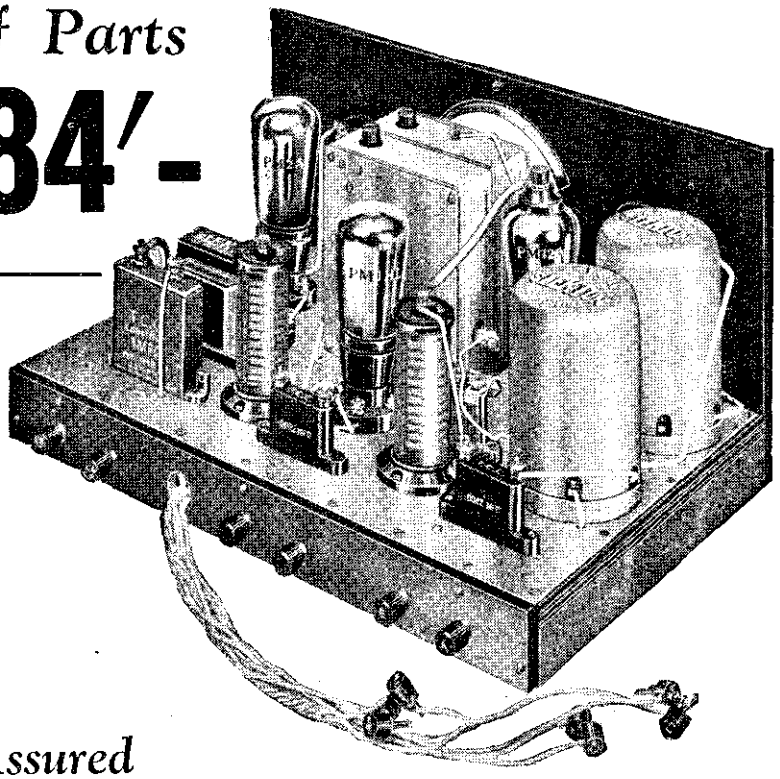
SLEKTUN *A Triumph of Easy Construction*

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.

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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.

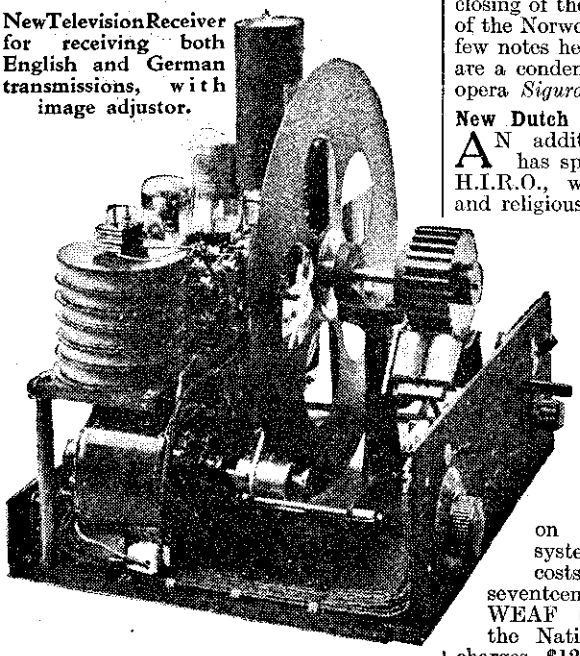
Fire Detection on Ships

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.

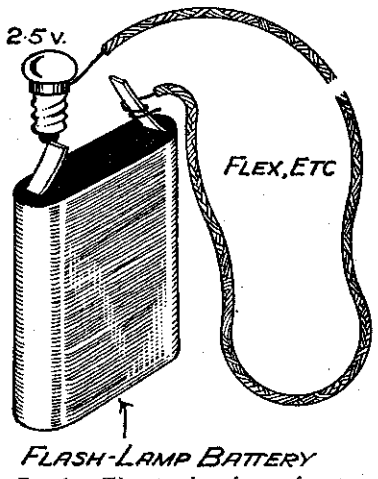


Fig. 1.—The simplest form of tester.

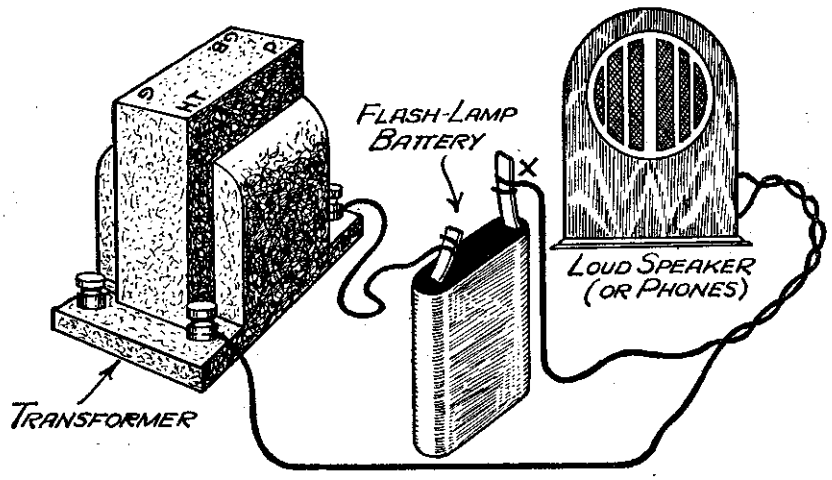


Fig. 2.—The way to test a transformer winding.

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

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,

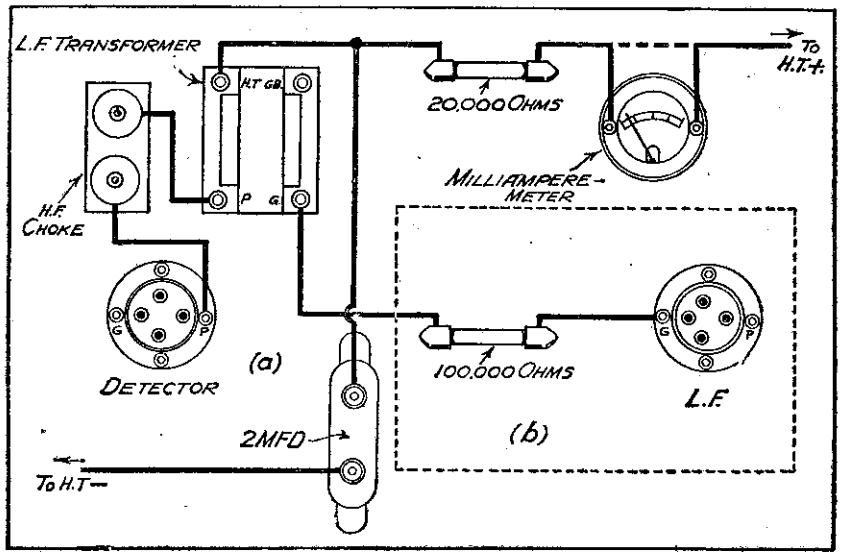


Fig. 3.—A decoupling resistance in the anode lead, and a resistance in the grid lead to cure instability.

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

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

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

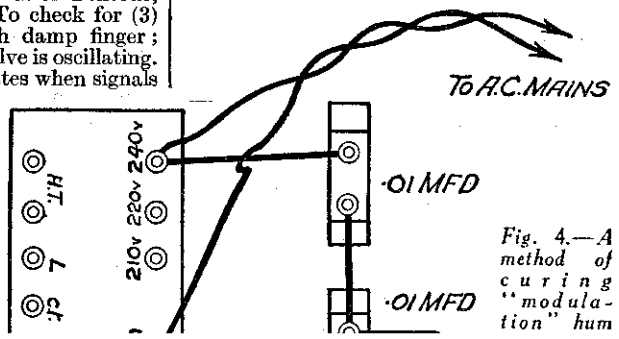


Fig. 4.—A method of curing "modulation" hum

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.

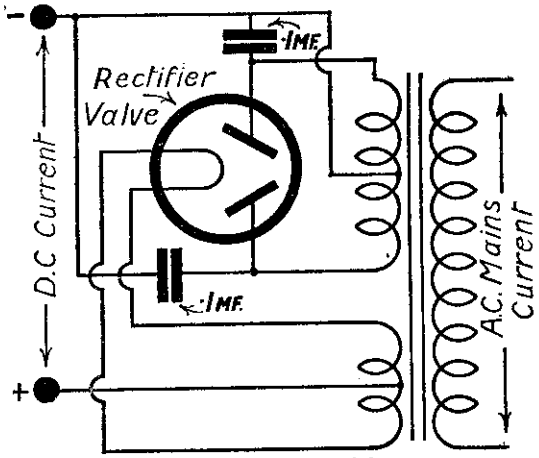


Fig. 1.—Rectifier hum can be cured by connecting two .1 mfd. fixed condensers between the two rectifier anodes and high-tension negative.

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

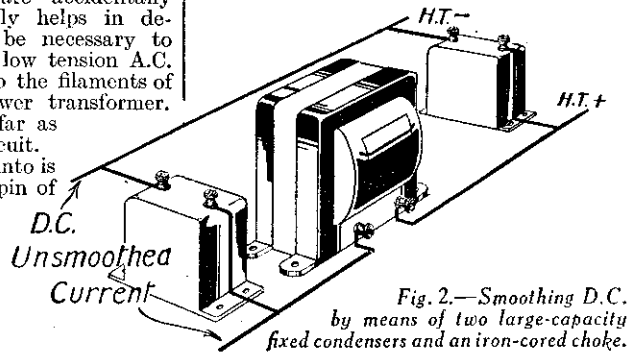


Fig. 2.—Smoothing D.C. by means of two large-capacity fixed condensers and an iron-cored choke.

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

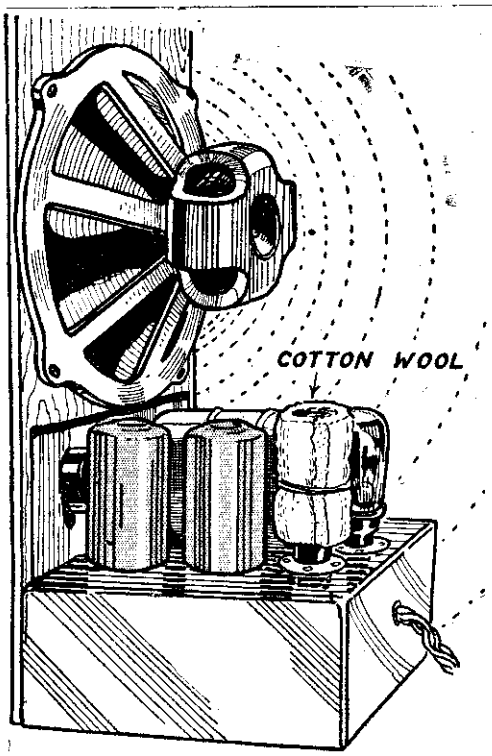


Fig. 1.—A jacket of cotton wool round the detector valve, so as to prevent sound waves from the speaker impinging on it, will often stop a microphonic howl.

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.

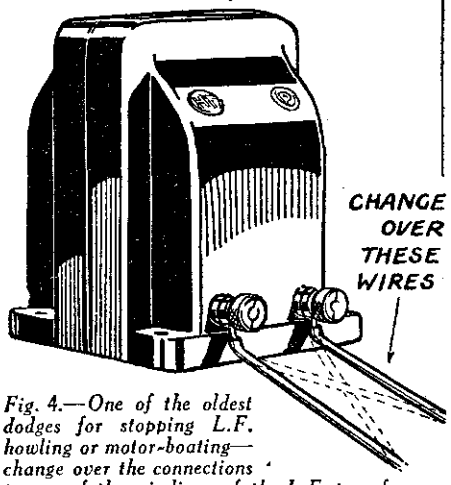


Fig. 4.—One of the oldest dodges for stopping L.F. howling or motor-boating—change over the connections to one of the windings of the L.F. transformer as shown by dotted lines.

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.

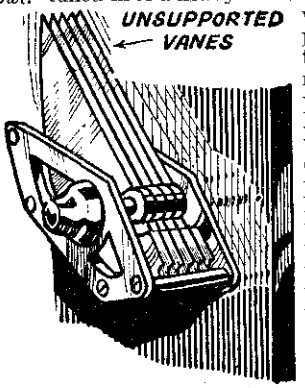


Fig 2. — Vibrating condenser vanes may cause a microphonic howl.

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.

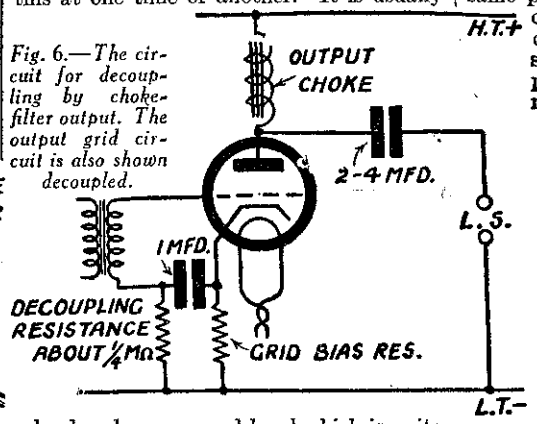


Fig. 6.—The circuit for decoupling by choke-filter output. The output grid circuit is also shown decoupled.

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.

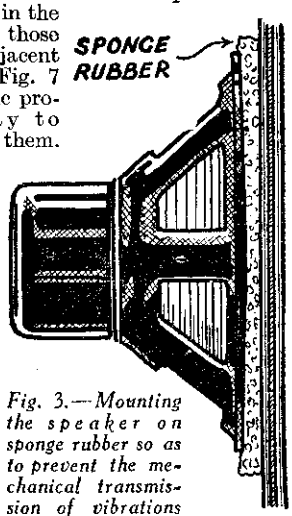


Fig. 3.—Mounting the speaker on sponge rubber so as to prevent the mechanical transmission of vibrations to the set itself.

—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.

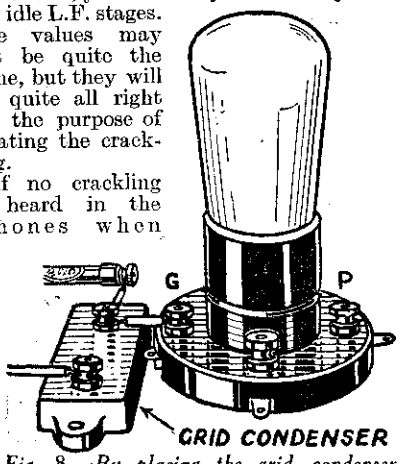


Fig. 8.—By placing the grid condenser close to the valve-holder the lead from grid to condenser is kept short—which makes for stability.

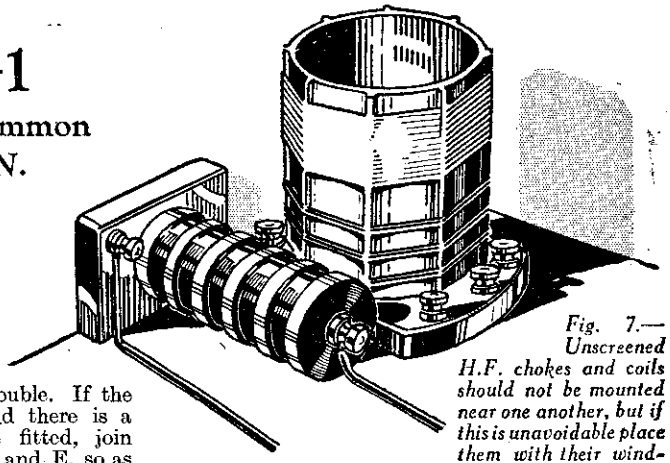


Fig. 7.—Unscreened H.F. chokes and coils should not be mounted near one another, but if this is unavoidable place them with their windings at right angles to prevent interaction and H.F. howling.

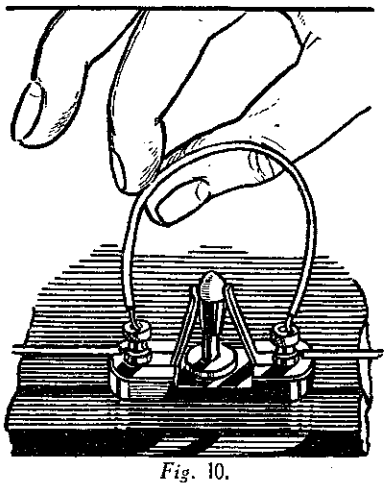


Fig. 10.

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.

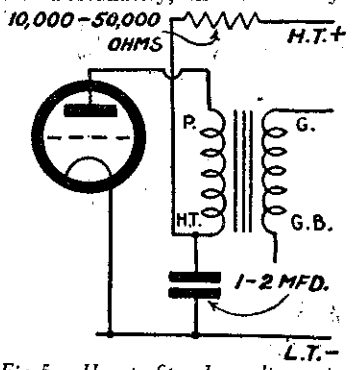


Fig. 5.—How to fit a decoupling resistance and condenser to stop motor-boating.

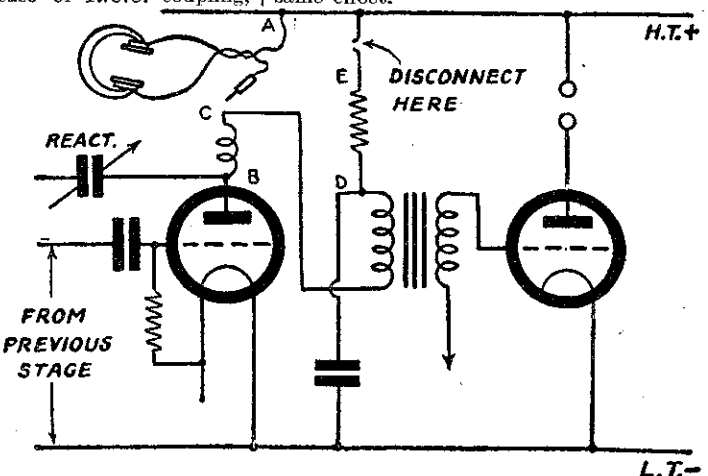
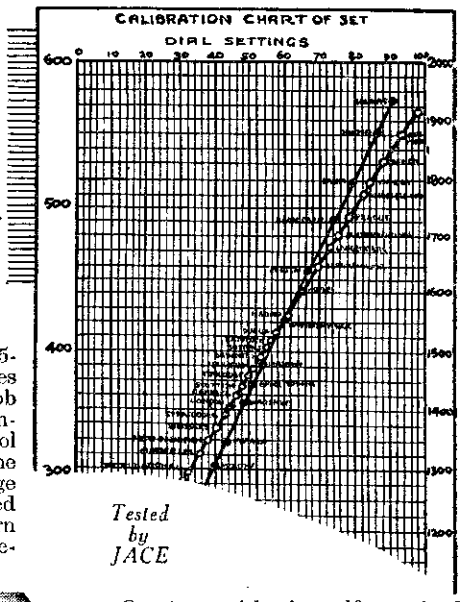


Fig 9.—How to test for "crackling" noises. To test the H.F. and detector stages disconnect H.T. from E and join 'phones across A and B. To test H.F. choke as well join 'phones across A and C. To include transformer join them across A and D. To include decoupling resistance join across A and E.

Receivers and their Records

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

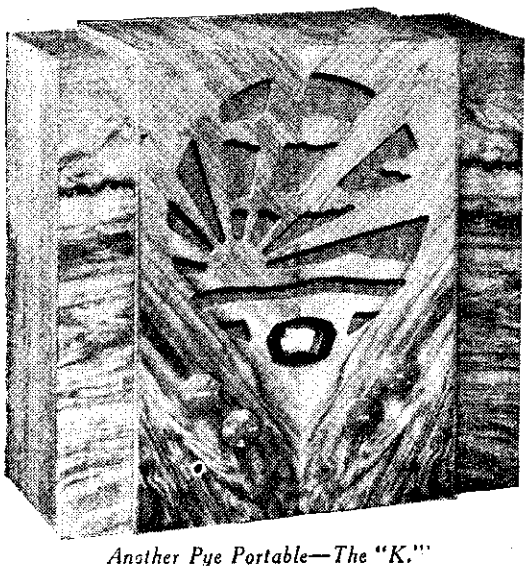


Tested by JACE

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

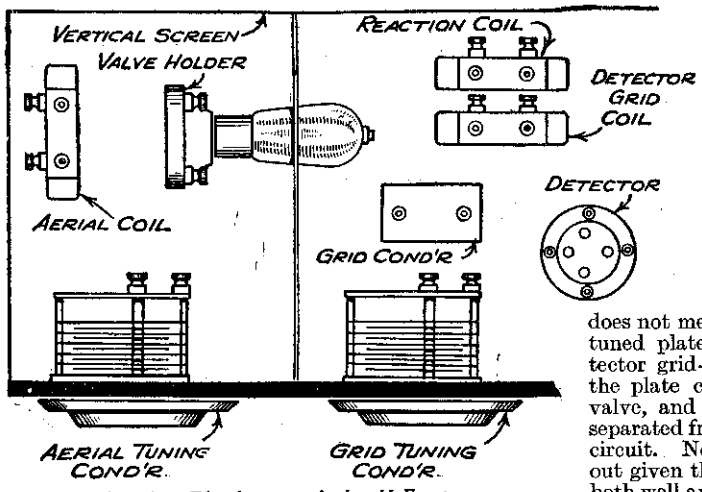


Fig. 1.—The layout of the H.F. stage.

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.

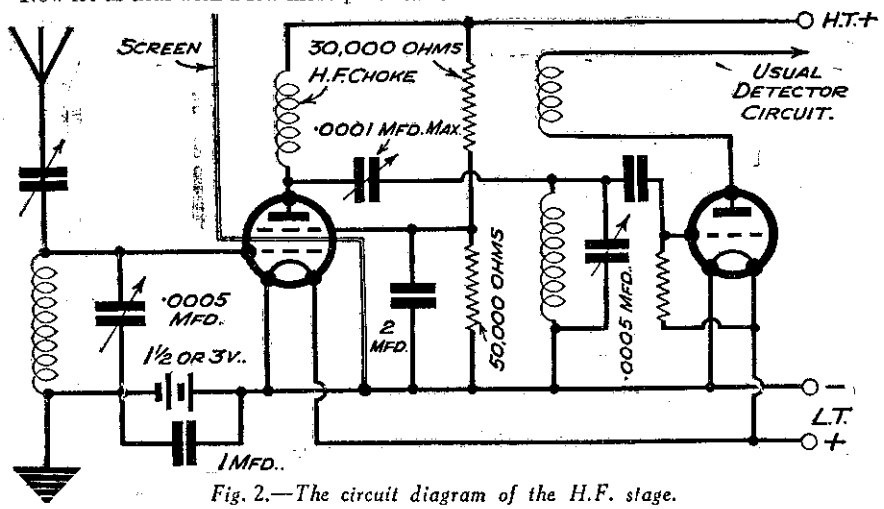
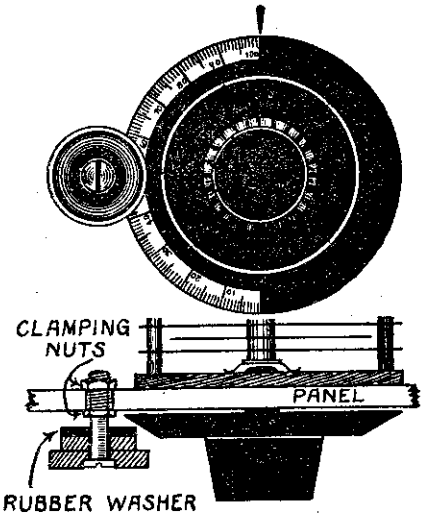


Fig. 2.—The circuit diagram of the H.F. stage.

THE HALF-GUINEA PAGE — Radio Wrinkles FROM READERS

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

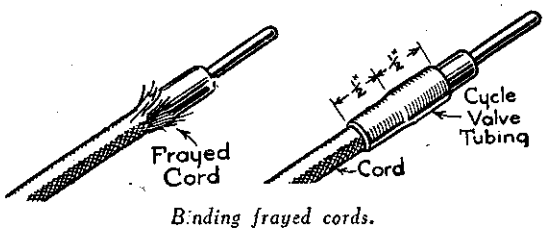
WHEN cords such as those used for battery and speaker leads become frayed, it is a good plan to cover the frayed ends as shown in the accompanying sketches. Procure a pennyworth of cycle valve-tubing and cut this into 1in. lengths. Bind the frayed cord with cotton and then slide a piece of valve tubing 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

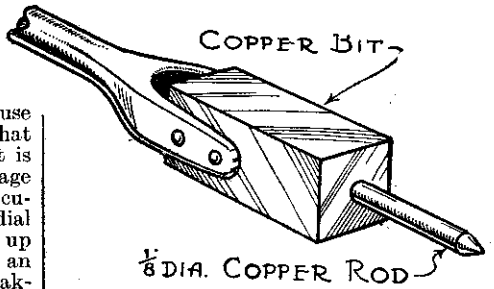
IF your set is near a window—placed there with the object of keeping your aerial and earth wiring short—it is probably back to the light and the dials are difficult to read. It is a good plan to place tiny spots of white enamel against the readings of your usual programmes, and also on the pointer on 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.

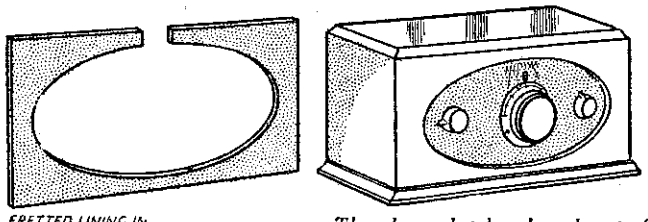
Soldering in a Restricted Space

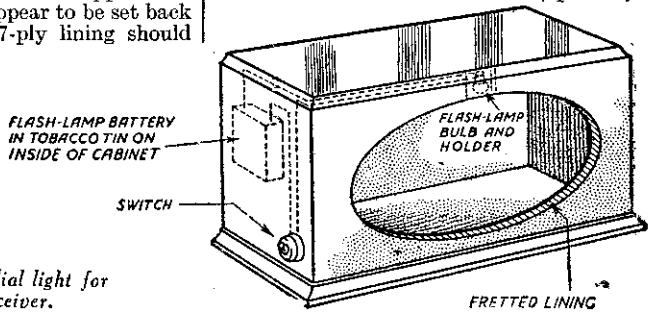
IT is sometimes necessary to use a very small bit on a soldering-iron owing to restricted space. The bit may only be about ⅛in. diameter. Such a small bit by itself loses its heat very quickly, and the following idea will be found to help considerably. A small soldering-iron is made in the usual manner, 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.

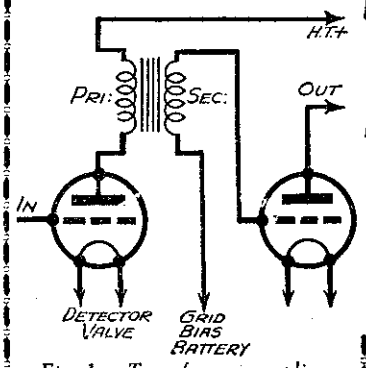


Fig. 1.—Transformer coupling.

THE WHY—AND THE WHEREFORE

A Series of Weekly Articles Dealing With the Functions of the Various Components of a Broadcast Receiver

By JACE

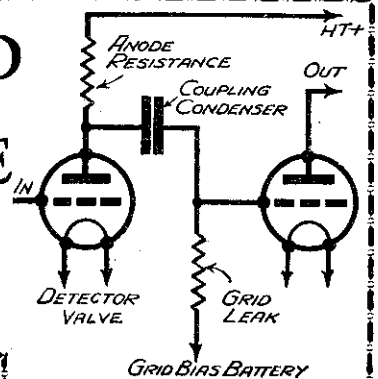


Fig. 2.—Resistance-capacity coupling.

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.

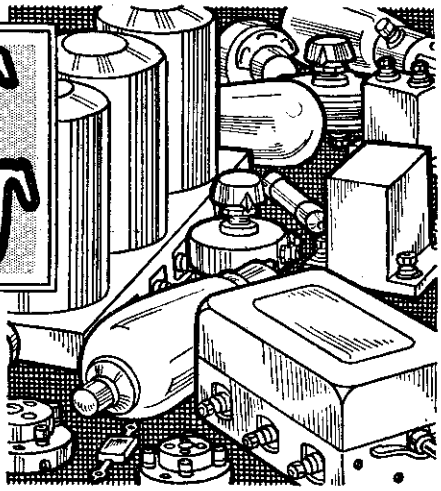
Further Information

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.

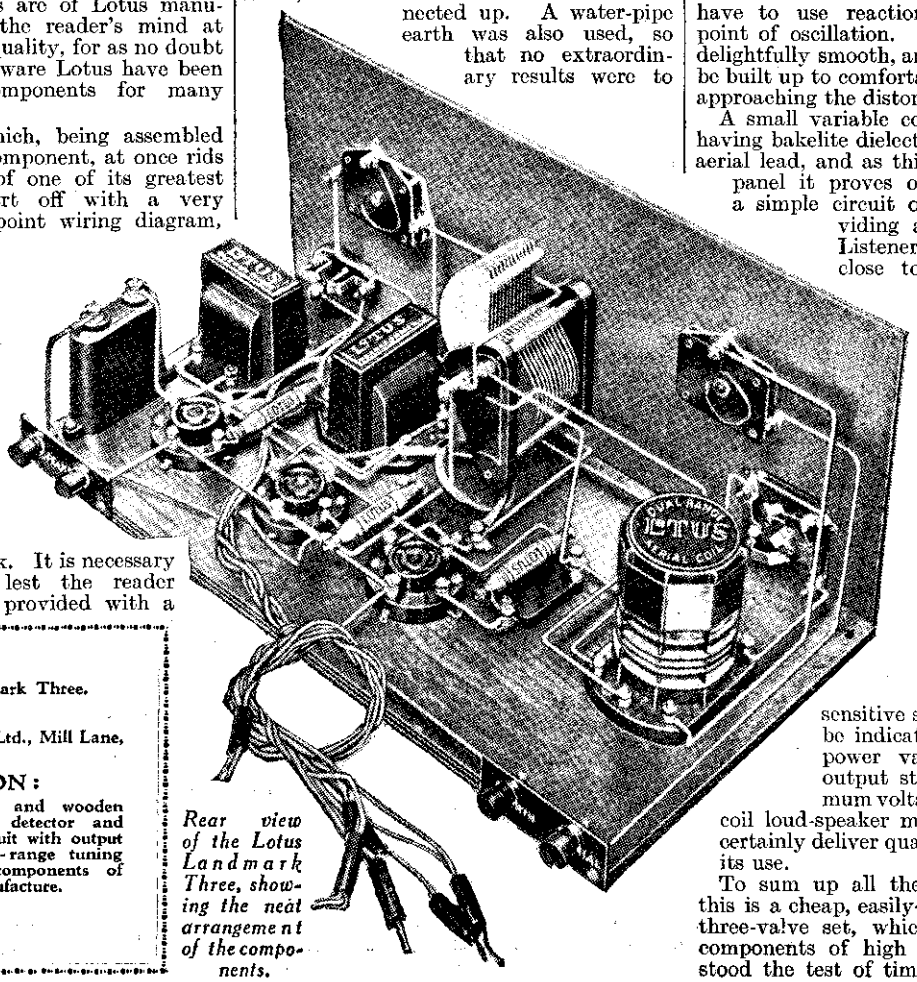
Results

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.

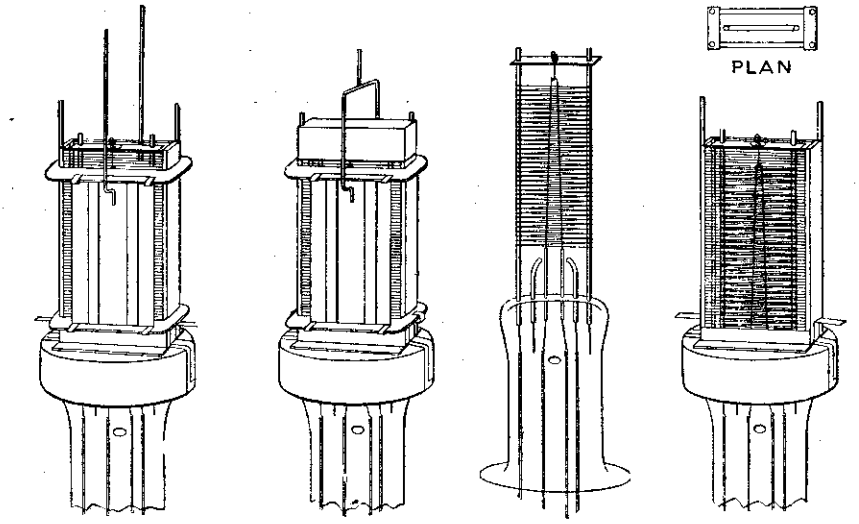
It was shown last week that a varying voltage applied to the grid of a valve produces corresponding variations in the current flowing through the valve and in the external anode circuit. It should be noted that a rise in signal voltage increases the anode current and a decrease in signal voltage decreases 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

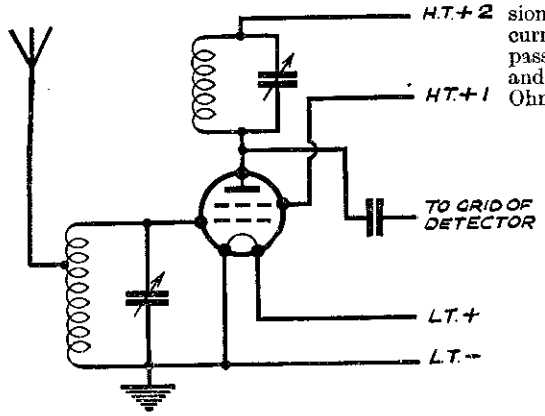
The number of volts change in anode voltage which would have the same effect on anode current as a one-volt change in grid voltage is termed the amplification factor of the valve. This does not mean that a valve having an amplification factor of 40 will increase the signal to 40 times its original strength, 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.

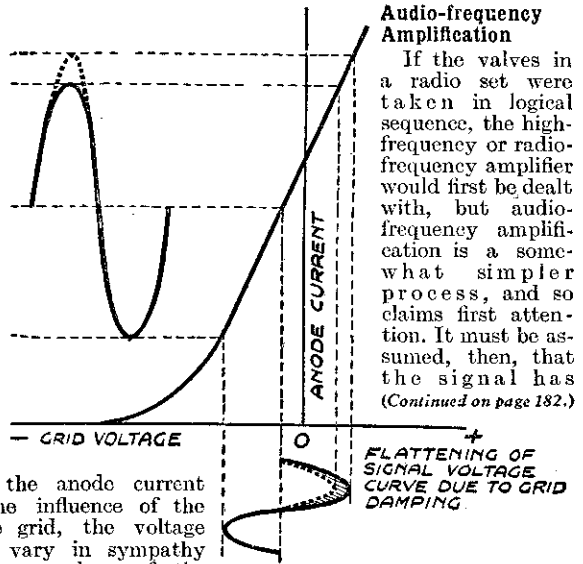
The amplified voltage in the anode circuit may be employed to excite the grid of a further valve, and thus obtain additional amplification, or the audio-frequency power in the anode circuit of a low-frequency amplifier may be utilised to operate a loud-speaker. Different types of valve are required for 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.



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.

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.)

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.

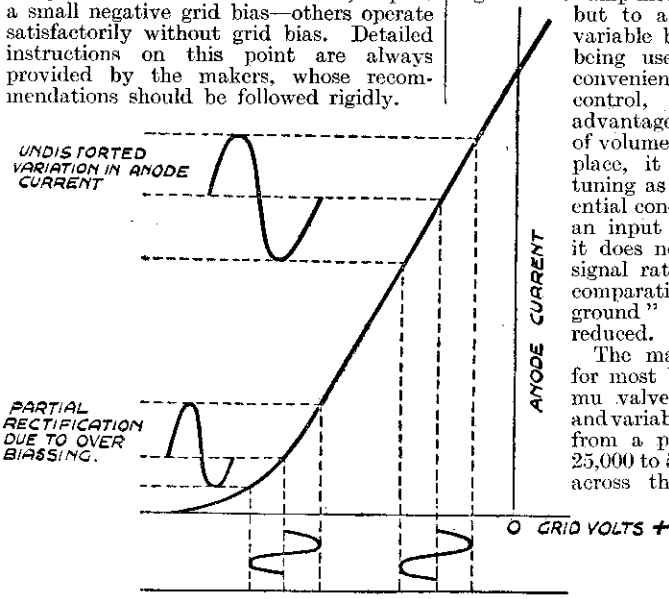
Low-frequency amplifying valves (other than output valves, which will be dealt with separately) fall roughly into two classes—high-amplification valves, having amplification factors of the order of 40 to 50, and medium-amplification valves, the amplification factors of which range from about 10 to 30. 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
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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

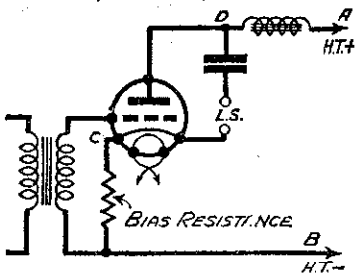


Fig. 1.—A resistance inserted in the cathode lead of an indirectly-heated valve.

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

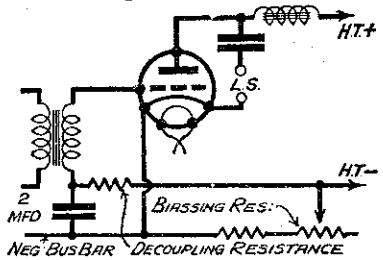


Fig. 3.—An alternative arrangement of Fig. 2, in which the cathode is maintained at the normal negative potential.

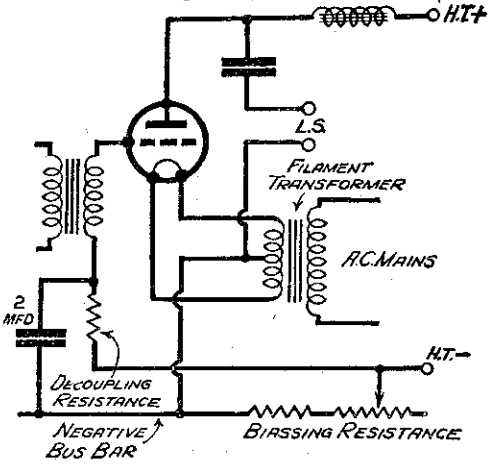


Fig. 4.—A battery-heated valve arranged in the same manner as Fig. 3.

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

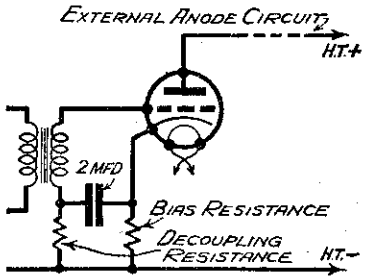


Fig. 2.—The arrangement of Fig 1 with a de-coupling circuit added.

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 :—

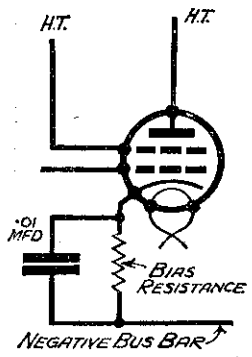


Fig. 5.—The biasing resistance arranged in the cathode lead of an S.G. valve.

$$\text{Value of biasing resistance in ohms} = \frac{\text{Desired bias in volts}}{\text{Anode current in amps.}}$$

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.

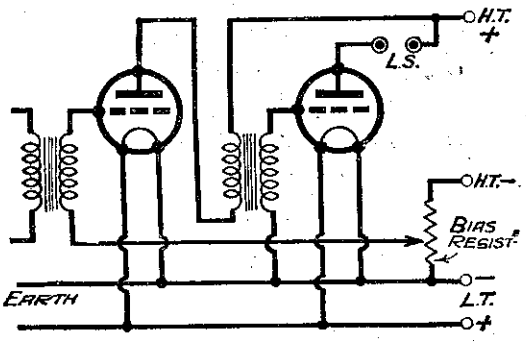


Fig. 6.—A common resistance connected up to provide bias for two battery-heated valves.

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

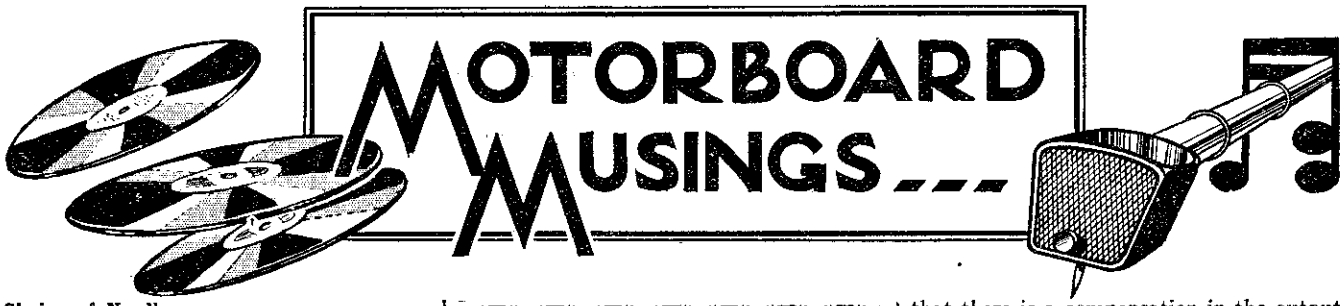
IT is only two years since the Scottish National Radio Exhibition was inaugurated as an annual event, but when the third of the series opens in the Waverley Market (Wednesday, October 12th) it will come as a familiar and firmly-established institution.

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.



MOTORBOARD MUSINGS...

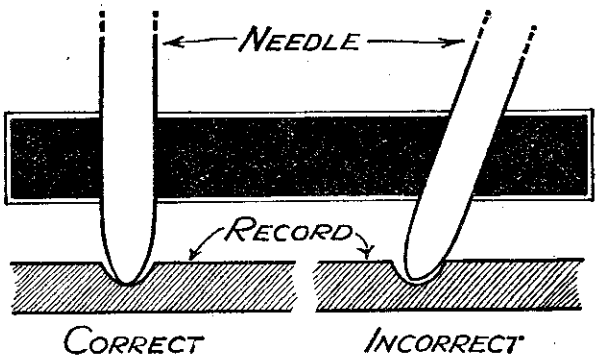
PARAGRAPHS OF INTEREST TO THE RADIO-GRAM USER

Choice of Needle

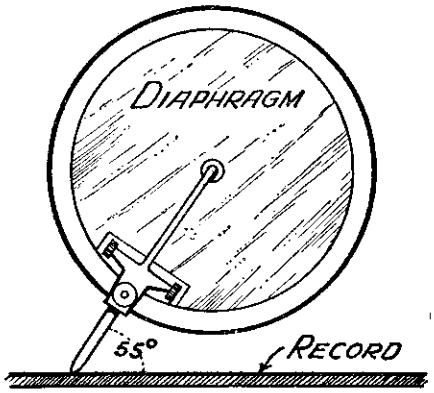
THERE are a large number of different types of gramophone needle on the market, and each claims some special advantage. Steel needles are divided into three main types—soft, medium and loud; whilst there are several varieties of "permanent" needle in addition to those of the fibre type. The majority 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.



This illustration shows the effect of a needle which is not vertical.



The correct angle for a needle—with either ordinary acoustic sound-box or electric pick-up.

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.

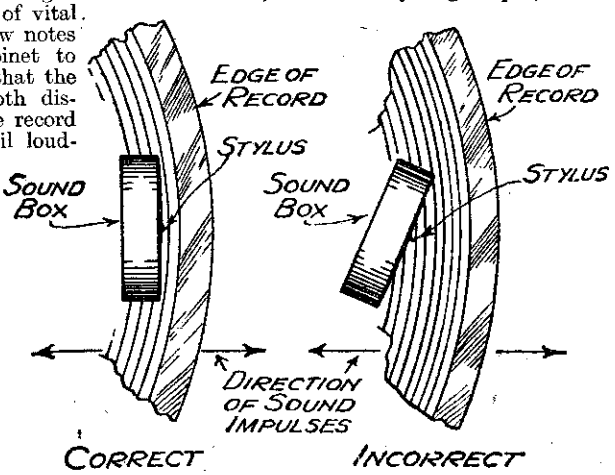
Balancing the Output

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

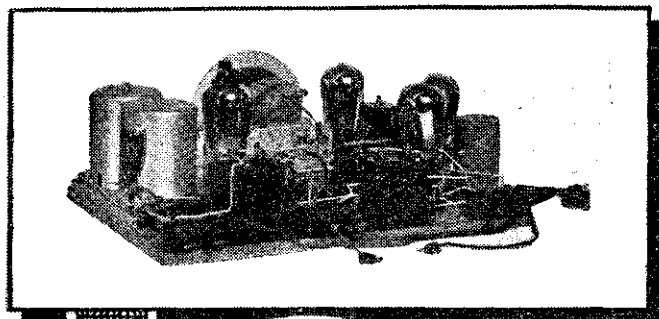
(Continued on page 212.)

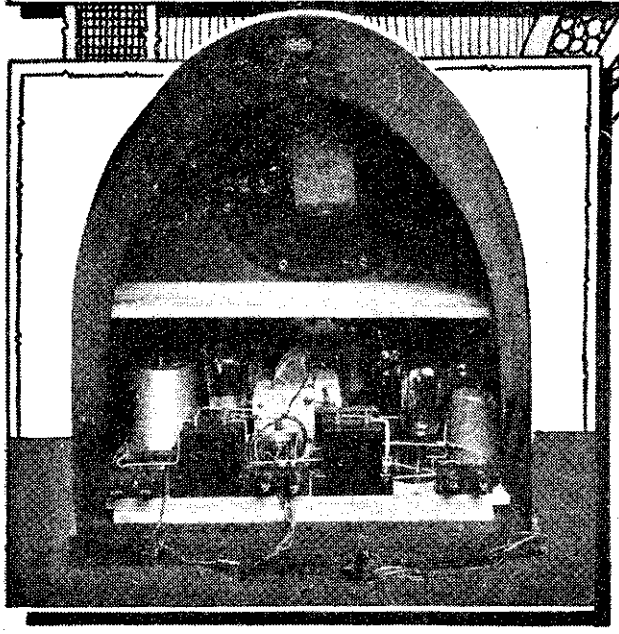


The "tracking" angle—which was fully explained in a recent issue. Note how the sound-box or pick-up must be parallel with the sound grooves.

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.

Full-Size Blue Print Wiring





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.

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.

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

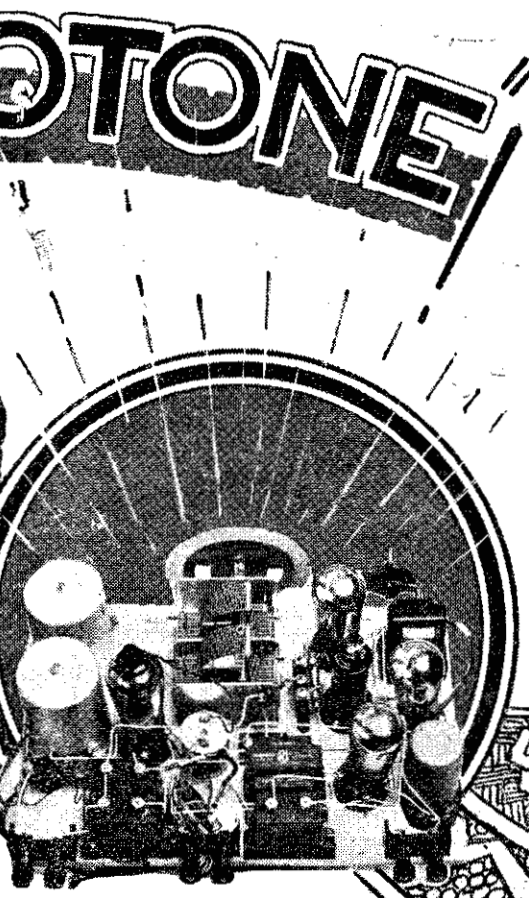
Received on the loud-speaker stren be given

Stations which were not st 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.

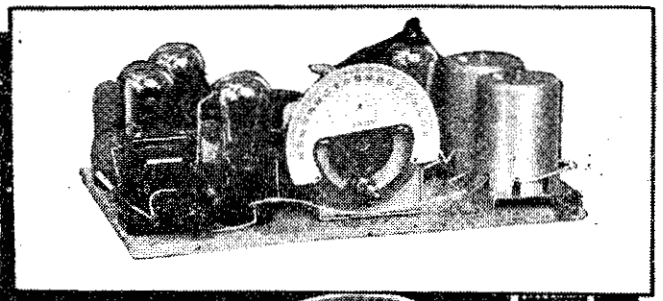
H.T. terminal of transformer to the left-hand terminal of 2 mfd. condenser.

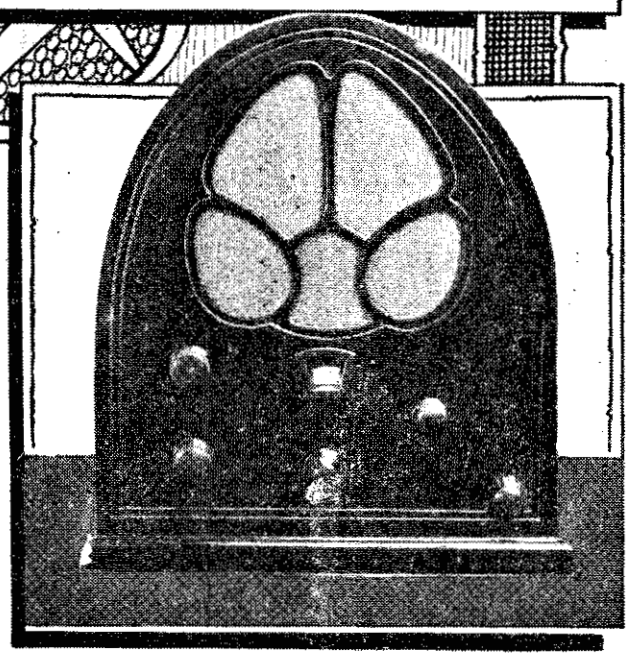
Attach the 10,000 ohms spaghetti to H.T. terminal of transformer, fixing the other end to H.T. 2 terminal of Transfeeda.

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.

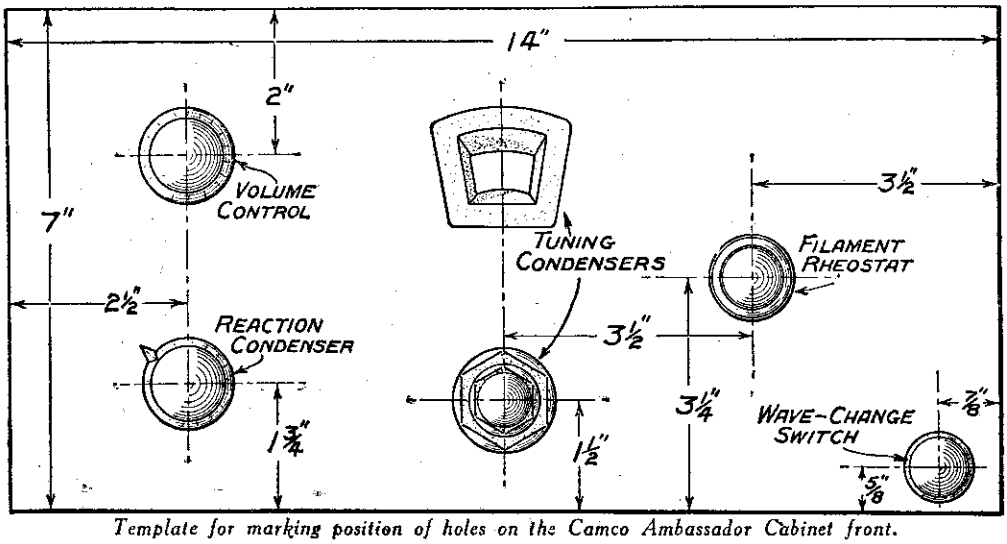
STATIONS

Sonotone at good gth. Full list will next week

ufficiently loud, or consistent o: 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 wood-screws. 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 pre-set 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.

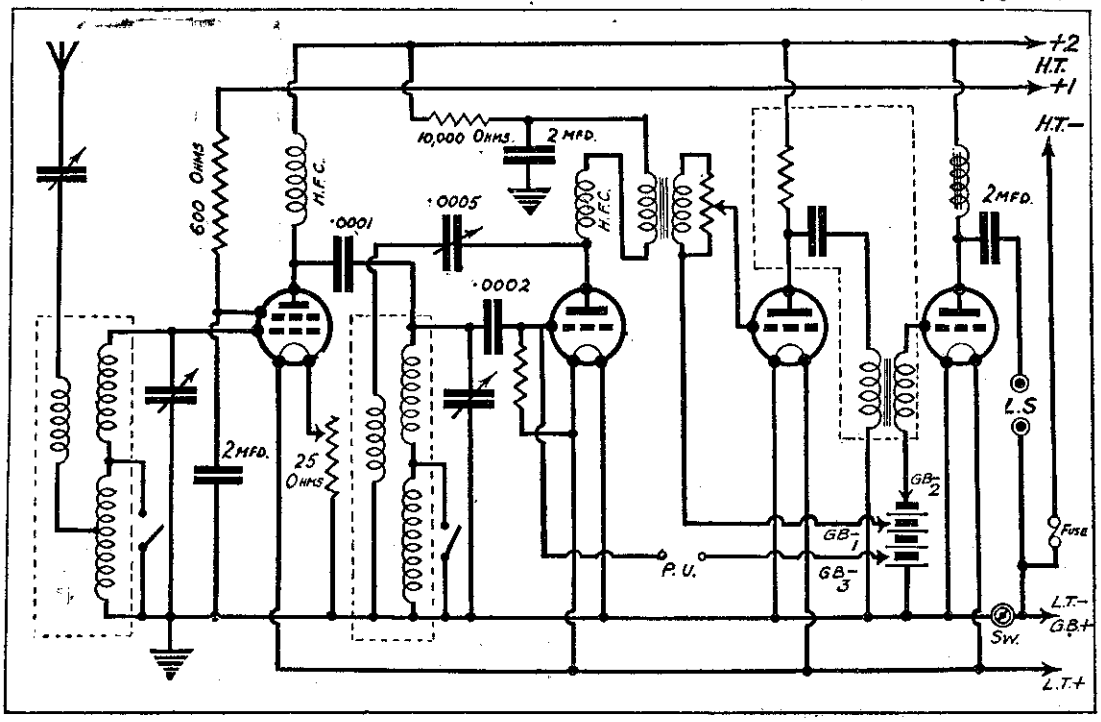
VALVEHOLDERS
Four Lotus 4-pin.

VALVES
Mazda SG.215; HL.210 (Metallised) L.2 and P.220A.

VOLUME CONTROL
Sovereign 500,000 ohms.

FUSE
Microfuse 100 m/A.

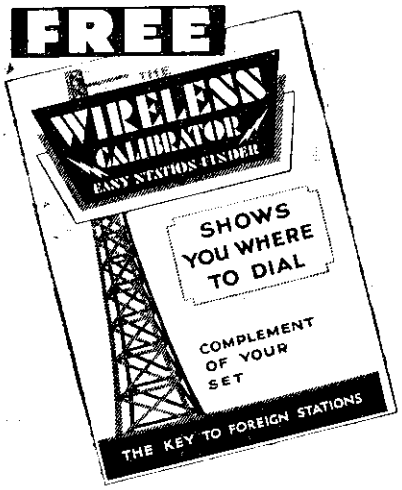
ACCESSORIES
Three Belling Lee Terminal Blocks.
Six Belling Lee terminals—Aerial, Earth, L.S.—, L.S. +, and two Pick-up.
Five-way Belling Lee Battery Cords.
Two coils Glazite connecting wire.
Short length of flex.
Four Wander plugs — G.B.+, G.B.1, G.B.2 and G.B.3.
One Tin of Filt.
Pertrix Batteries, 120 volt and 9 volt.
Camco Ambassador Cabinet.
Igranic D.9 Speaker.
One two-volt Accumulator.



The theoretical circuit of the Sonotone.

Direct Radio

159 BORO HIGH STREET LONDON BRIDGE



GREAT FREE GIFT *with the* 'SONOTONE' FOUR CALIBRATOR

Easy Stations Finder

Every "Practical Wireless" enthusiast must have a Calibrator, the new gadget that identifies Foreign Stations by name. Amazingly simple to use, it trebles the entertainment value of any Receiver. No set is complete without it.

THAT IS WHY WE GIVE ONE ABSOLUTELY FREE WITH EVERY DIRECT RADIO KIT

The Press says:

"Indispensable to Ether Searchers. Enables all stations to be found and identified immediately . . . . Decide what station you want and—hey presto—there it is! No more guessing!"

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Make a point of visiting our Showrooms at 159, Borough High Street, for interesting demonstration of all new Kit Sets and Loud Speakers.

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We specialise in Radio for Export. Goods to your exact specification are very carefully packed and insured, all charges forward. Terms: Cash with order, or deposit one-third with order. Balance C.O.D.

Those Elusive Foreigners *DIRECT RADIO'S* 'SONOTONE' FOUR *gets them* DEFINITELY

	£	s.	d.
1 Lissen 2-gang shielded coil with combined filament switch ..		17	6
1 Utility .0005-mfd. 2-gang variable condenser type W 312 ..		19	6
1 Ready Radio .0005-mfd. reaction condenser		2	6
1 Sovereign .0005-mfd. pre-set condenser ..		1	6
1 T.C.C. 3 terminal type .0002-mfd. fixed condenser		2	4
1 T.C.C. .0001-mfd. fixed condenser type "S"		1	3
3 T.C.C. 2-mfd. fixed condensers		11	6
1 Ready Radio Standard H.F. Choke		1	6
1 Kinva Screened H.F. Choke		2	9
1 Ready Radio L.F. Transformer ratio 3-1		8	6
1 Benjamin Transfeeda		11	6
4 4-pin valve holders ..		2	0
1 R.I. Audirad Output Choke		8	9
1 Lewcos 600 ohms spaghetti fixed resistance			9
1 Lewcos 10,000 ohms spaghetti fixed resistance		1	0
1 Colvern 25-ohms filament resistance FR		3	6
1 Sovereign 500,000 ohms volume control ..		4	6
1 100 m.a. fuse & holder		1	0
3 Belling Lee terminal blocks		2	0
6 Belling Lee terminals (aerial, earth, L.S.—L.S.X. and 2 pick-ups		1	3
1 Belling Lee 5-way battery cord		2	0
2 Coils Glazite			8
1 Permcol panel 14in. x 7in. drilled to specification		4	0
1 Baseboard 14in.x10in.			9
4 Mullard Valves: PM 12, HL 2, PM 1 LF, PM 2	1	19	0
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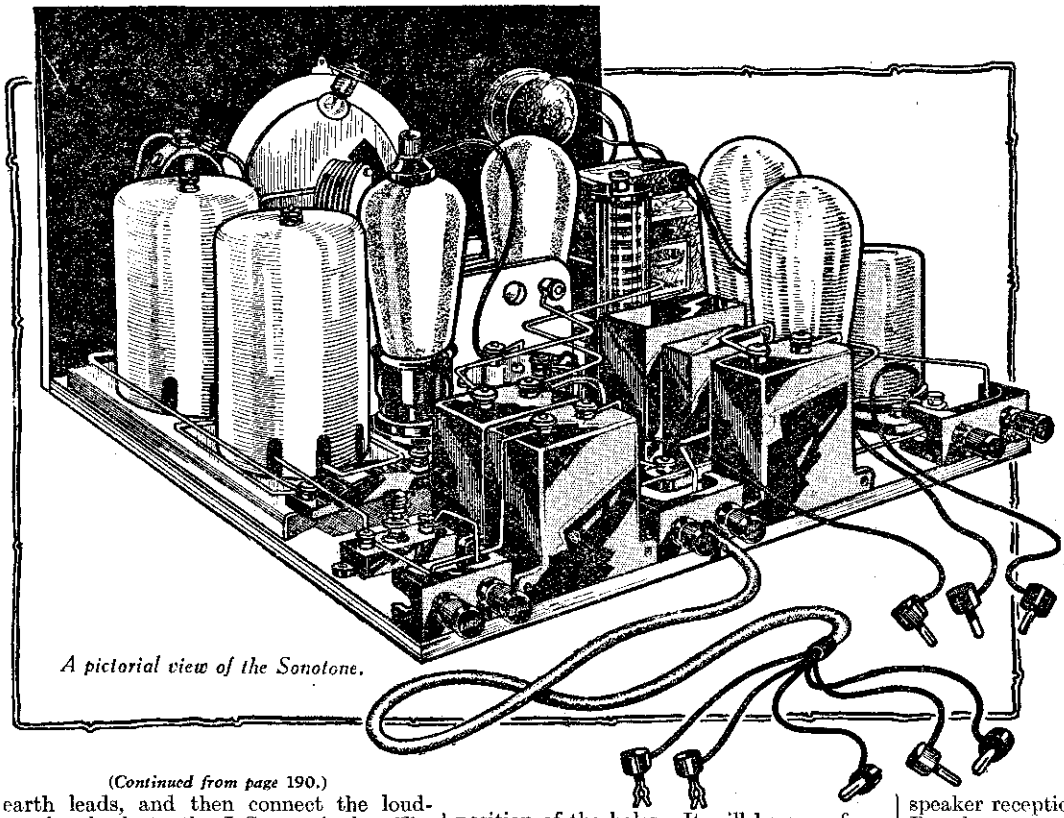


A pictorial view of the Sonotone.

(*Continued from page* 190.)

earth leads, and then connect the loudspeaker 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.

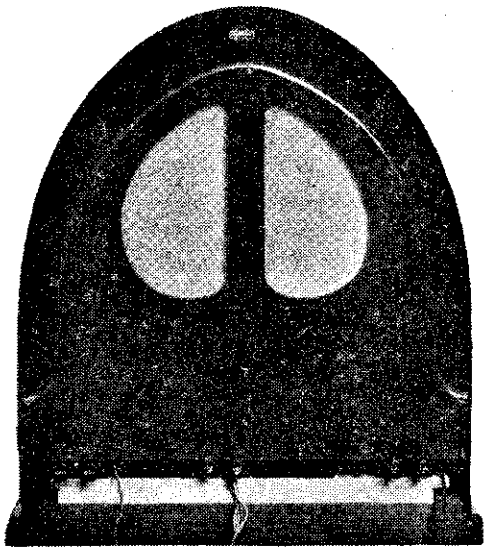
If desired, the set can be completely wired up outside the cabinet by screwing to the front of the baseboard a thin three-ply panel marked out in accordance with the special dimensioned panel layout diagram given on page 190. As mentioned before, this diagram is intended as a template for drilling the 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.

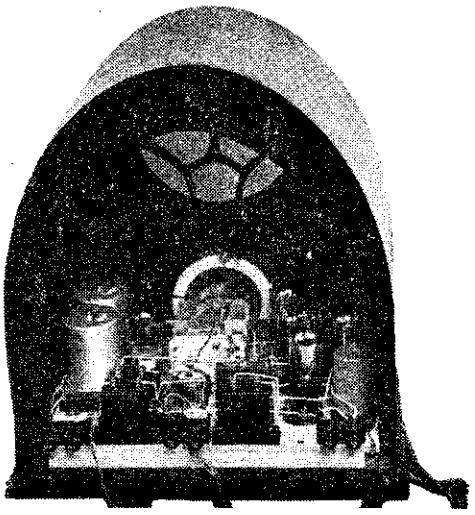
It will be found necessary to screw two battens to the underneath side of the baseboard to raise the wave-change switch to a sufficient height. These battens need to be about ⅜in. thick. If, however, the reader decides to use a dummy three-ply panel for erecting the controls (and this is, perhaps, the 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 loudspeaker 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.

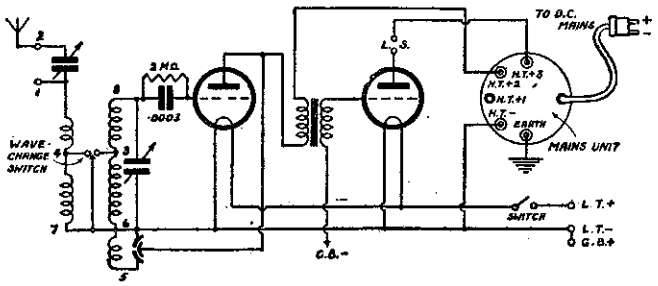


Fig. 1.—The circuit of the battery set before conversion.

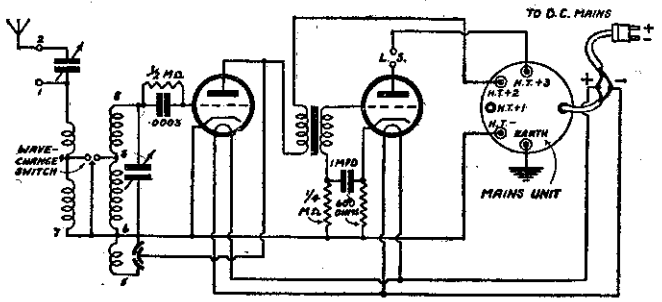


Fig. 2.—The circuit shown by Fig. 1 modified to suit the new Universal full mains voltage valves.

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.)

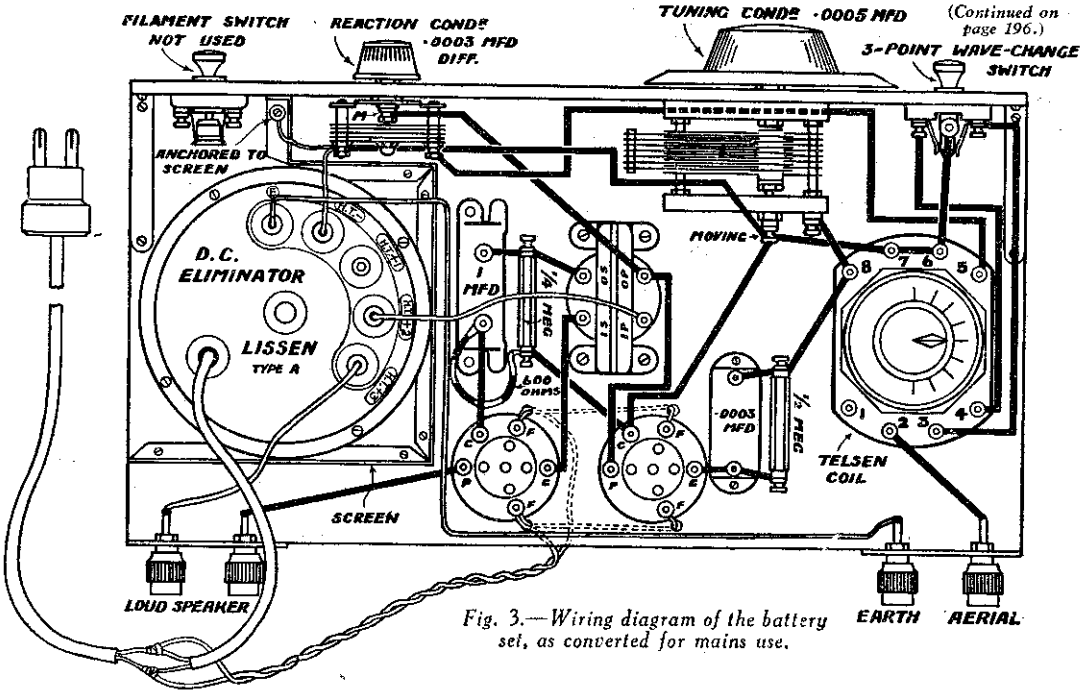


Fig. 3.—Wiring diagram of the battery set, as converted for mains use.

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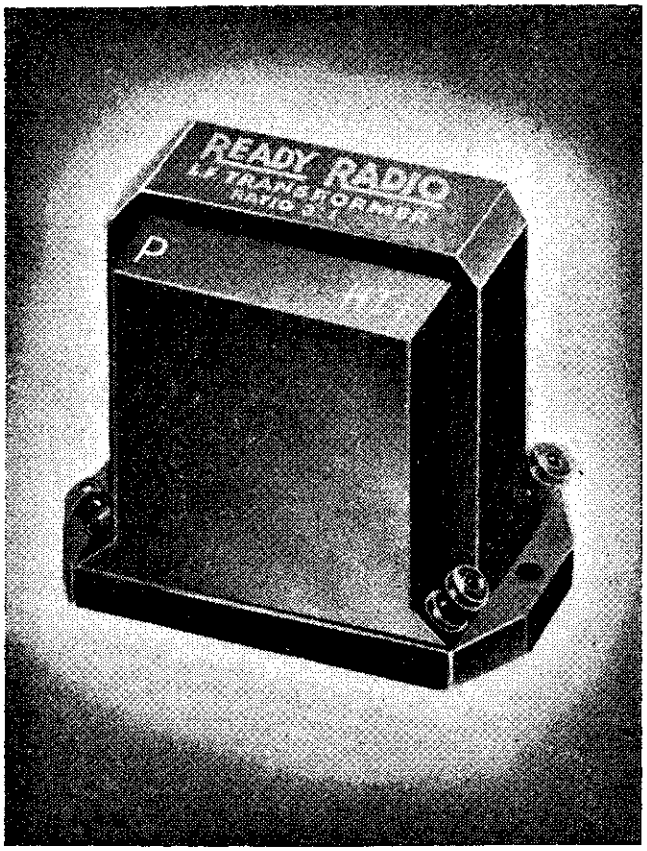

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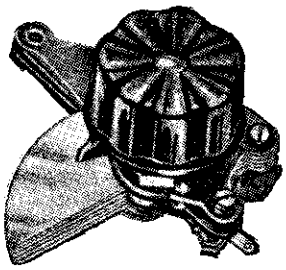

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(continued from page 194.)

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 ½ 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.

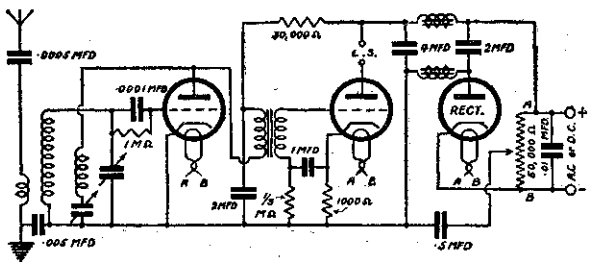


Fig. 4.—Circuit diagram of the Ostar Universal two-valve receiver.

List of Components Used in the Two-Valver Illustrated on p. 194.

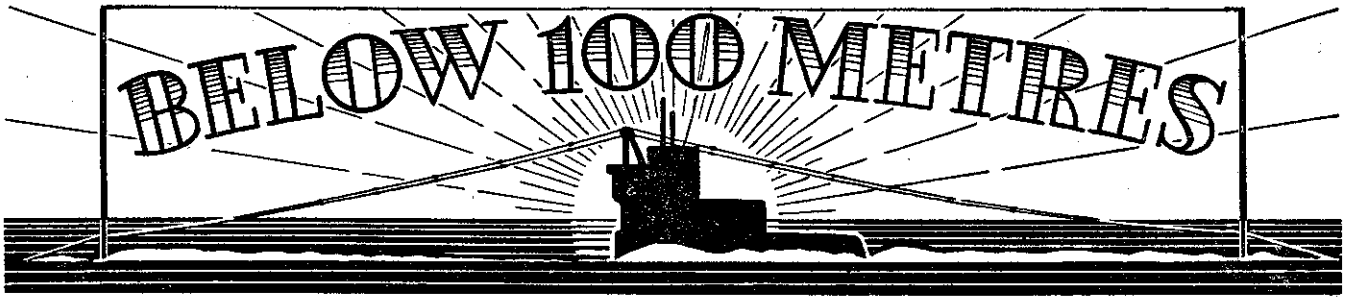
1—.0005mfd. tuning condenser, Stones.
1—.0003mfd. reaction condenser, Lotus.
1—Telsen dual-range tuning coil.
1—L.F. transformer, ratio 3 : 1, Lissen.
1—.0003mfd. fixed condenser, T.C.C.
1—1mfd. fixed condenser, T.C.C.
1—½ megohm grid leak, Lissen.
1—¼ megohm grid leak, Lissen.
1—Spaghetti resistance, 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 U020 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

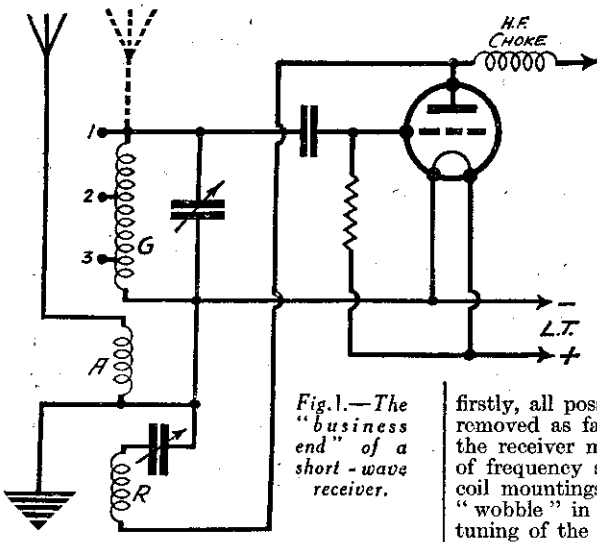


Fig. 1.—The "business end" of a short-wave receiver.

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.

"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

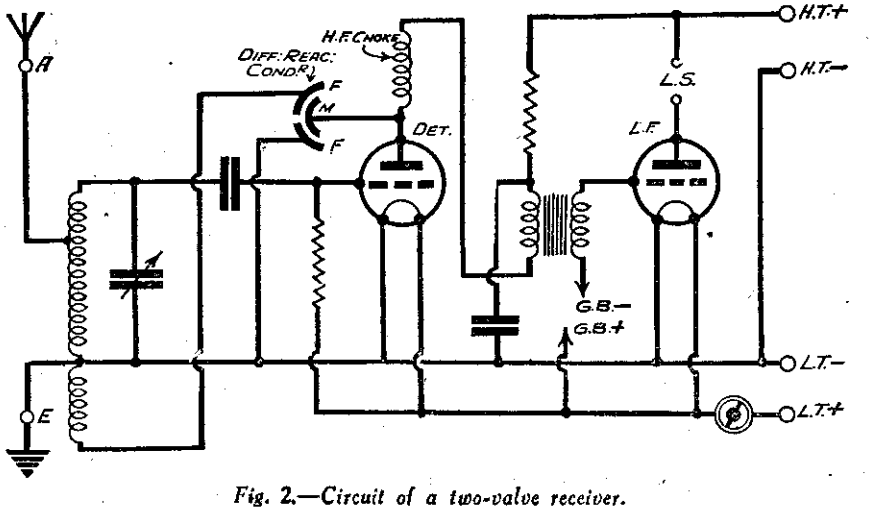


Fig. 2.—Circuit of a two-valve receiver.

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.

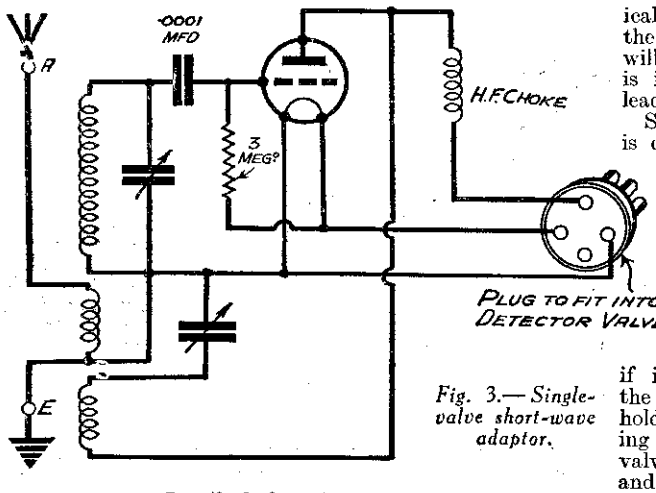


Fig. 3.—Single-valve short-wave adaptor.

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.

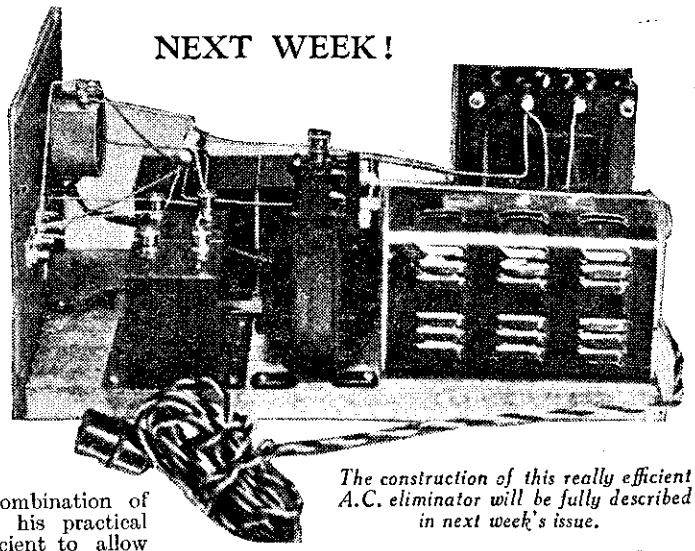
CHOOSING RESISTANCES

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."



NEXT WEEK!

The construction of this really efficient A.C. eliminator will be fully described in next week's issue.

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.

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 8s. 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.

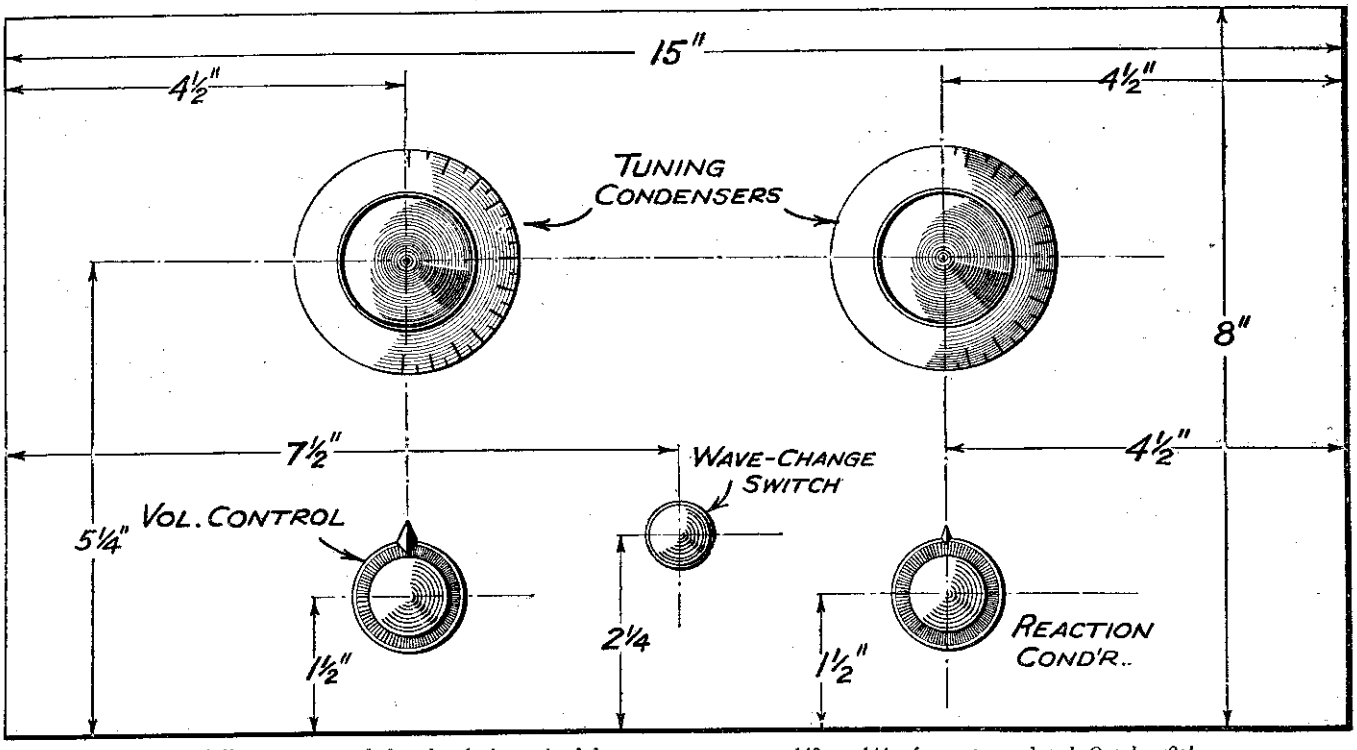
CONDENSER GANGING DEVICE

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.

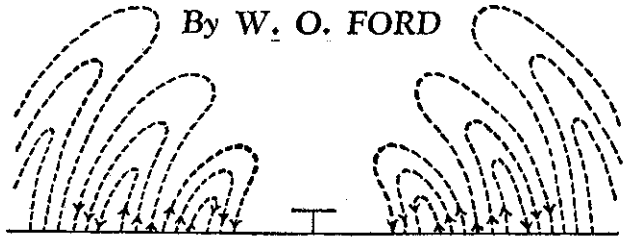


Fig. 1.—How the lines of stress radiate.

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.

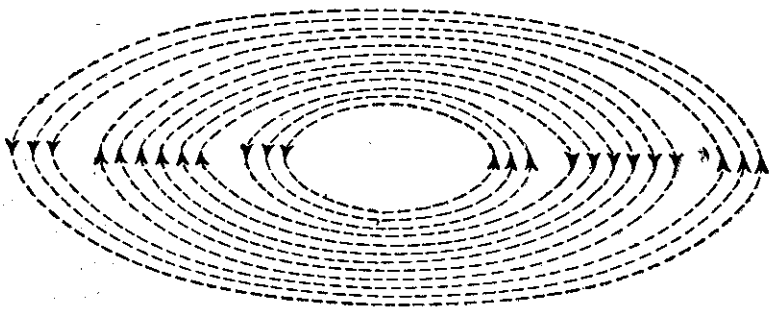


Fig. 2.—A diagram of the lines which accompany the above radiation.

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 exacting 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.

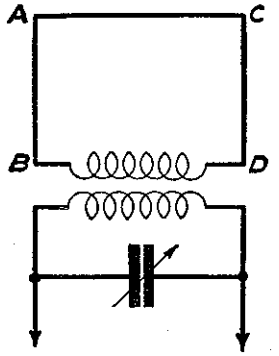


Fig. 3.—The frame aerial with its small coil coupled to the main tuning circuit.

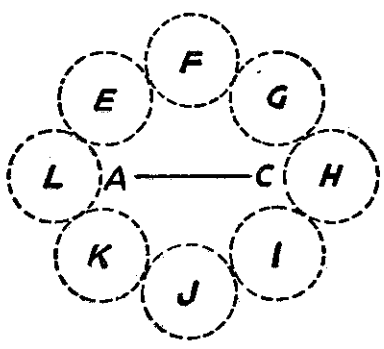


Fig. 4.—The wave-forms of different stations approaching the frame aerial A—C.

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.

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

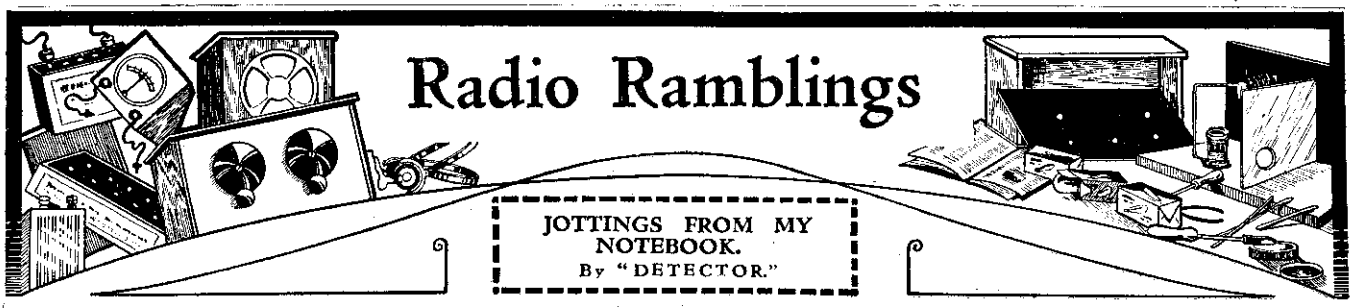
A treble-reading instrument of the kind just described will do the following things, then: Test the accumulator; the H.T. battery; record the total current consumption of the set, and so enable you to decide whether or not you are using the right kind of H.T. battery; test for overloading, and enable 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.

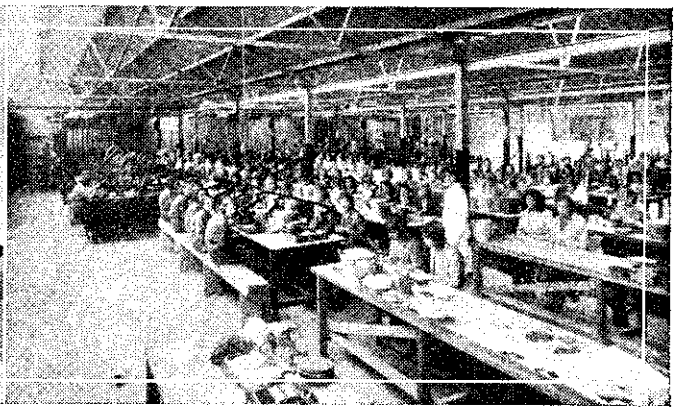
Bristol Radio Exhibition

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!

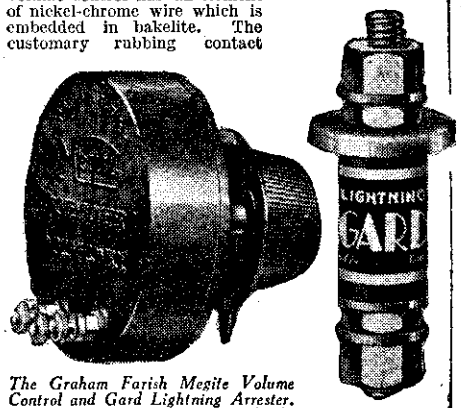
A New System of Tuning-coil Construction

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

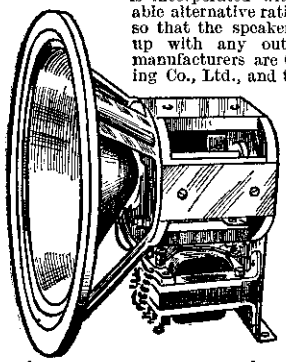
THESE two products, from the well-known firm of Graham Farish, are both interesting items. The volume control has an element of nickel-chrome wire which is embedded in bakelite. The customary rubbing contact has been dispensed with, and a slipper plate arrangement fitted, which permits of silent, frictionless 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

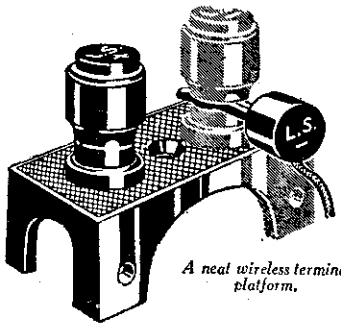
THE famous shielded coils produced by Messrs. Lissen have now made their appearance in a new form, the coils being mounted on a base plate in two or three gang units. Wiring is greatly facilitated by this method of construction, and the coils are designed to suit the particular requirements of the various 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

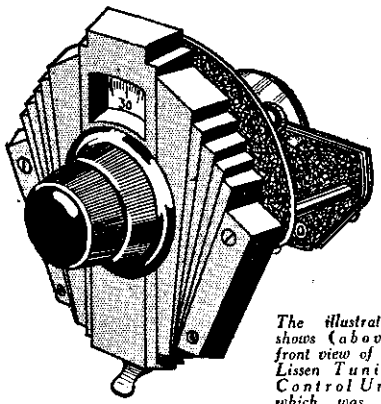
THE small terminal blocks manufactured by Messrs. Belling-Lee (illustrated below) are of great value to the home constructor. Each block accommodates two terminals, and the holes are recessed so that the large type of Belling-Lee terminal may easily be fitted. The blocks may be mounted in a vertical or horizontal position, and for the experimenter they will be found of great use. The price is 8d. each.

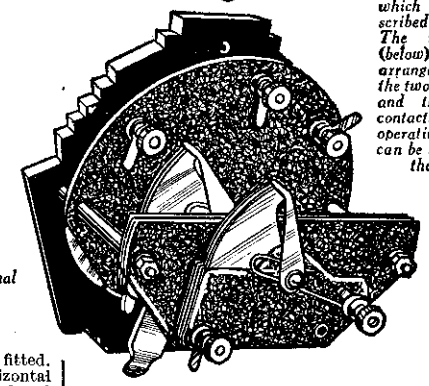


A neat wireless terminal platform.

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.

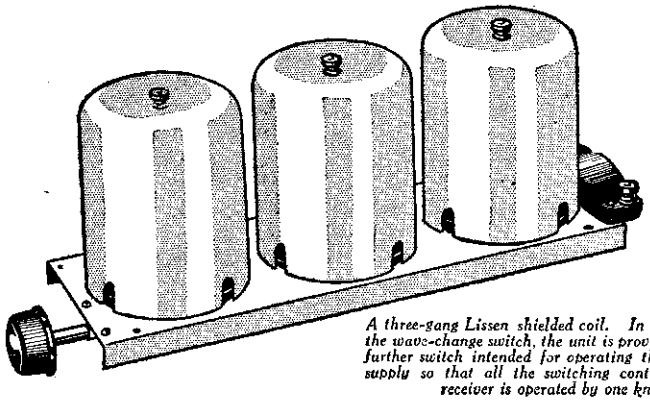




The illustration shows (above) front view of the Lissen Tuning Control Unit which was described last week. The rear view (below) shows the arrangement of the two condensers and the switch contacts. The operating lever can be seen below the dial.

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

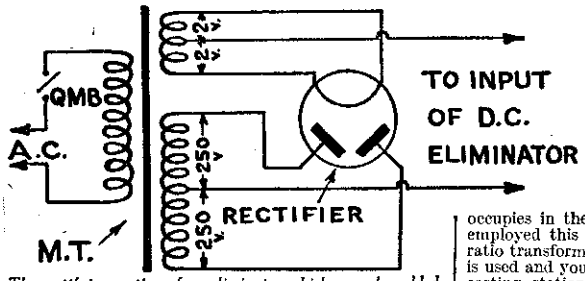
REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

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.

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