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Practical Wireless

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THE SELECTONE THREE

by FRANK PRESTON.

READERS' QUERIES PROMPTLY and ACCURATELY ANSWERED !

Building The Selectone—A Super Set! See page 766

ROUND *the* WORLD *of* WIRELESS

British Empire Broadcasting from Daventry

G5SW, the short-wave transmitter at Chelmsford, closed down on December 17th. On December 19th, the British Empire Broadcasting Station at Daventry took over a regular service to the British Dominions and Colonies overseas. The transmissions are made daily (Sundays included) at the following times: GSD, 25.53 m. (11,750 kc/s), to the Australian Zone, from G.M.T. 9.30 to 11.30 a.m.; GSE, 25.3 m. (11,865 kc/s), to the Indian Zone, from 2.30 to 4.30 p.m.; GSA, 49.6m. (6,050 kc/s) to the African Zone from 6 to 8 p.m.; to West African Zone, from 8.30 to 10.30 p.m., and to Canada, from 1 to 3 a.m. Simultaneous broadcasts of each transmission are also made through GSC, on 31.3 m. (9,505 kc/s).

Site for the 100 kW. B.B.C. Station

THE new 100 kilowatter, which is to replace the present Daventry National and Midland Regional transmitters, will probably be erected at Wychbold, near Droitwich. The site is about forty miles west of Daventry. It is not expected to bring the station into operation before 1934.

Radio Safeguards for Colliery Workers

EXPERIMENTS with wireless installations are being carried out at several pits in the Yorkshire coalfields, with a view to establishing connection between the workers underground and the engineering staff at the top of the shaft. During the tests made it was found possible to transmit messages to various points of the mine and to broadcast warnings by loudspeakers. Attempts will now be made to establish a two-way communication.

Relays of the Austrian Programmes

THE Vienna broadcasts are relayed by an experimental station operating on 1,250 metres (240 kc/s) every Monday, Wednesday and Friday, from 6 p.m. G.M.T. onwards. On Tuesdays and Thursdays, between 1.30 and 9 p.m. G.M.T.; these programmes are also broadcast through the short-wave station UOR2, on 49.4 metres (6,070 kc/s).

New Station in Hungary

ONE of the three recently constructed relay stations to take the Budapest programmes is now on the air; it is that of Nyireghaza, which, with a power of 6 kilowatts, broadcasts daily on 267.6 metres (1,120.9 kc/s).

China Calling!

THE Nanking 75 kilowatt transmitter, erected by the Telefunken Company, was formally opened on November 12th. Records of a speech made by the Chinese Ambassador to Germany were made in Berlin and sent to Nanking for re-broadcast at the inaugurating ceremony. The station transmits on 440 metres, and reception of its signals has already been reported by listeners in the British Isles.

Radio Traps for Mosquitoes

THE United States Sanitary Authorities, according to a report, have invented a radio trap for the destruction of malarial mosquitoes. Experiments were carried out by the Engineers of the General Electric Company's transmitter at Lynn (Mass.). The insects were attracted by a high-pitched buzzer tone produced by an oscillatory circuit, the exact note of a mosquito in flight being produced by careful tuning. When swarms of insects had thus been collected they were destroyed by heat derived from an electric furnace. A description of this peculiar trap was given recently over the National Broadcasting Network.

Centenary of the Builder of the Eiffel Tower

RADIO-PARIS recently celebrated the centenary of the birth of Eiffel, the French engineer who erected the tower as a special attraction for the Paris International Exhibition in 1889. As the life of the structure was not guaranteed for more than twenty-five years it had been decided to dismantle it in 1914. The advent of the Great War, however, induced the Military Authorities to take it over as an official wireless station.

Wireless *versus* Pianos

FROM statistics established by the German musical industries, it is demonstrated that since the advent of broadcasting in that country, of two hundred makers of pianos only ten are in existence to-day. Where six thousand artisans found employment, only three hundred are now in regular work.

In Competition with the British Empire Broadcaster

THE French authorities are studying a proposal to transmit special concerts and news bulletins through the Radio-Colonial short-wave station, between midnight and 3 or 4 a.m. G.M.T. daily, for the benefit of French Canadians resident in the Montreal-Quebec districts.

Special Radio Theatre in Italy

ONE of the principal theatres at Turin has been taken over by the E.I.A.R. (Italian Broadcasting system), to be used as a studio for the broadcast of the majority of entertainments comprised in the Milan, Turin, Trieste, Genoa, and Florence programmes.

France to Build Another High-Power Station

ACCORDING to an official statement, a site has been found at Tramoyes, near Lyons, for the 100 kilowatt transmitter which the French P.T.T. propose to erect in replacement of the present Lyons (La Doua) broadcasting station.

Illustrating Bolshevist Industrialism

THE Leningrad and Moscow high-power stations have chosen, as an interval signal, the beat of a heavy hammer on an anvil, to symbolise the feverish activity of the Five Year Plan. The beats are timed to one per second, and at the end of each full minute the letter G (– – .) in morse is transmitted.

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

Securing Quality

I AM often asked how improvements can be made to a set which does not give good frequency response. The question is a difficult one because the fault—if one may justly call it by that name—might be traced to the speaker itself, the L.F. couplings, the use of incorrect H.T. and G.B. voltages or even to the tuning circuits. If the speaker is of a fairly old pattern, especially if of the horn type, one can assume fairly safely that it will not do justice to the lower notes. When the speaker is known to be good, one should tackle the intervalve low-frequency couplings. Where L.F. transformers are employed they should be fairly massive or otherwise they should be connected on the resistance-feed system. In regard to the high-tension voltage, this should be as high as convenient and the grid-bias voltage should carefully be adjusted to suit it. If a sharply-tuned single circuit (as opposed to band pass) tuner is employed a certain amount of high-note loss is inevitable and in that case it is necessary either to change the tuner or to apply some form of tone correction in the L.F. stages.

"Boomy" L.S. Reproduction

WHEN reproduction is "boomy" due to accentuation of the bass it is often possible to effect quite a noticeable improvement merely by reducing the capacity of one or more of the coupling condensers used in the L.F. stages. If choke-capacity feed is used for the loud-speaker the usual 2 or 4mfd. output condenser should be replaced by one of lower capacity, down to .25 mfd. or so.

Better "Attack"

THE lower capacity also improves the "attack" in many cases. I might be excused for explaining to non-musical listeners that this latter expression is used to denote the simultaneous reproduction of the same or corresponding note by every instrument in an orchestra. With many sets and speakers, the notes of the higher-pitched instruments, violins for instance, can be heard a fraction of a second before those of instruments of lower pitch such as the double bass. The result is that a certain amount of "blurring" occurs.

Another Cause of Poor Attack

POOR attack can frequently be traced to the use of a moving-coil speaker with an insufficiently powerful receiver. The coil and diaphragm in even the best speaker have a certain amount of inertia, and since they have to move through a greater distance for low notes there is a certain minimum input below which they cannot vibrate; even before that minimum is reached they do not readily respond to low notes. On the other hand, the diaphragm movement is quite small (though more rapid) when higher notes are being dealt with and consequently the notes are reproduced more easily even though the input to the speaker may be below the proper level. The above rather sketchy explanation shows why reproduction is "thin" and high pitched when a loud-speaker is being run from a small set which is lacking in "pep."

INTERESTING and TOPICAL PARAGRAPHS

POCKET RADIO FOR THE POLICE

Picture of the special transmitting station erected on the roof of the Brighton police headquarters, from whence messages will be sent out and picked up by the policemen whilst on their beats. The pocket apparatus is now in operation at Brighton, which is the first town in the country to be equipped with the pocket radio.

Ultra S.-W. Television

WE hear that the B.B.C. have already carried out a few television transmission tests from their 7.75 metre station situated on the roof of Broadcasting House. These tests, under the Baird television system, have been well received by the B.B.C. engineers on their experimental receivers at Nightingale Lane, and it is anticipated that regular television transmissions will soon take place during broadcasting hours.

Russian Stations

HAVE listeners noticed that Radio Stalino (Russian) is interfering with Toulouse, whilst Uraspol, another Russian station, has taken up a position about midway between London Regional and Mühlacker. As a matter of fact, a number of Russian stations appear to be butting in on all parts of the wavelength scale. A newcomer called Tartu has squeezed in between Vienna and Brussels, and Ivanor-Vosneszensk (what's in a name ?) has actually taken up a position right on the North Regional's wavelength.

Broadcasting House

I HAVE just scanned the new B.B.C. book entitled "A Technical Description of Broadcasting House." It is an excellent publication, written in interesting language, and beautifully illustrated. It gives fairly detailed descriptions of all the rooms and equipment in Broadcasting House, and no end of staggering statistics. A good five shillings' worth that would make a splendid present to a wireless enthusiast.

Frequency Response

DID you listen to the frequency tests which were given by the B.B.C. some time ago ? If you did you were probably struck by the poor response of your set and speaker. For the benefit of those who did not listen I would explain that a pure musical note which varied in pitch from 50 to 6,000 cycles per second was transmitted. All through the frequency range, the note was maintained at the same intensity at the transmitting station. When reproduced by the average loud-speaker the portions below about 150 and above 3,500 cycles were scarcely heard at all. At the time of the transmission in question, I happened to be listening with a new set of the Stenode type, fitted with tone control. By adjusting the resistance on the tone-control transformer, I was able to find a setting at which quite good response could be obtained over the whole range of transmitted frequencies. As a matter of fact, the only part of the range which was noticeably weak was that above 5,000 cycles. Even so, the note was quite audible at 6,000 cycles.

—JACE.

SOLVE THIS!

Problem No. 16

Ferguson had built a three-valve set which had worked for some weeks. One day it refused to give any signals, and he accordingly tested the anode circuits of each valve with a milliammeter. The normal reading was obtained in each valve circuit, but no signals could be tuned in. Grid Bias was normal; the loud-speaker was in order, and on test every connection was intact and correctly made. Tuning coils were changed and also tuning condensers, but still no signals could be heard. What was causing the trouble ? Three books will be awarded for the first three correct solutions opened. Mark envelopes Problem No. 16, and send to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8–11, Southampton Street, London, W.C.2, to reach us not later than January 10th.

SOLUTION TO PROBLEM No. 15

Owing to the low resistance of the speech winding, Jones was virtually short-circuiting his output choke. He should have used a step-down transformer, and joined this to the two anodes through fixed condensers.

The following three readers received books in connection with Problem No. 14

F. Bird, Esq., Bury House, Town Green, Wymondham, Norfolk; H. Foster, 19, Regent Street, Dunstable, Beds.; J. F. Spore, 1, Pallas Terrace, Eltham, S.E.9.

Turn to pages 766 to 768 for details of Frank Preston's Selectone.

Fitting New Plates in an Accumulator

An Instructive Article on Dismantling and Renewing the Plates of a Low-tension Accumulator, Together with Several Points on Upkeep

By GILBERT E. TWINING

Fig. 3.—Using a small blow-lamp to finish off the pouring in of the composition.

THE life of a low-tension 2-volt accumulator is naturally governed by the manner in which it is treated, taking into consideration, of course, that its capacity was sufficiently large for the output necessary for the set when it was first installed. If a battery is overloaded its life will be considerably shortened and, if the discharge of a battery is too great, the paste will be driven out of the grids of the plates, and it will need to be recharged more frequently. Therefore, it must be emphasized, from the point of view of economy, to choose one of ample capacity whenever purchasing a new low-tension battery. The writer wishes to point out that if the accumulator case is made of celluloid, and in any way cracked or damaged, it will not be worth while fitting it with new plates, for it will not repay the time spent on it. Patching up with odd pieces of celluloid, and securing them with celluloid cement seldom makes a satisfactory job. This article deals principally with batteries having transparent glass containers. The obvious advantage of this type is that they do not discolour and it is always possible to see the condition of the plates and to keep the level of the electrolyte up to that marked on the outside of the case.

The plates may be obtained from authorized agents, and first-class garages, where they cater for the wireless trade. The name and index or type number of the accumulator should be quoted when ordering replacements. The following is a list of only one of the well-known manufacturer's prices, and these can be taken as representing the average prices in use to-day :—

Type.	*Plates.*	*Maximum list price.*
0.25	Positive Group	1s. 6d. each
,,	Negative ,,	1s. 6d. ,,
0.50	Positive ,,	2s. 6d. ,,
,,	Negative ,,	2s. 6d. ,,
0.75	Positive ,,	4s. 0d. ,,
,,	Negative ,,	4s. 0d. ,,

The prices of the glass jars are as follows, for if an accumulator jar is smashed the plates can quite well be placed in a new container :—

Type.	*Container Price.*
0.25	1s. 2d. each.
0.50	1s. 9d. ,,
0.75	2s. 9d. ,,

Removing the Plates

The two terminal knobs and the filler plug should be first removed from the top of the accumulator, and all the electrolyte emptied away. It will be assumed that the accumulator is at least two years old, in which case the top will be filled in with a composition which has first to be removed. Now if the reader has a gas fire handy the accumulator can be placed in front of it on its side upon a block of wood ; the wood is for raising it up level with the fire.

A tin tray—an old cigarette tin will do—is placed underneath the accumulator so that the heat from the fire will melt the composition and cause it to run into the container below it ; any small quantity which is left in the top may be scraped out with a screwdriver whilst still warm. Fig. 1 shows the accumulator on its side in position before the fire. If no fire is available, however, the composition must be chipped out, or the battery placed in a warm oven, and on removal the pitch dug out and scraped away ; chipping takes rather longer than the melting process.

When all the composition is removed from the accumulator the plates can be lifted clear of the glass container, together with the flat piece of composition board which holds the plates in position, and at the same time forms the bottom of the tray into which the composition was originally poured, thus preventing it from running into the interior of the battery. Fig. 2 is a section of the battery, and it clearly shows the board in position. The positive and negative blocks can now be withdrawn from the above-mentioned board, being replaced with the new plates, taking care to put these in the same holes from which the old ones were taken, so that they will correspond—when the battery is reassembled—with the positive and negative markings on the outside of the case. Any sediment at the bottom of the glass container must be washed away and the container rinsed out with clean water.

Inserting the New Plates

The new plates with the board can now be inserted into the case ; make sure to push the board right down on to the glass stops on the inside of the container, for this board prevents the plates from any upward movement and so stops rattling. The plug collar, which is threaded on the inside to take the screwed filler cap, is then placed in position over the hole in the board, and the composition heated in a tin over a gas ring. When this is in a molten state, it may be poured into the top of the accumulator.

(*Continued on page 758.*)

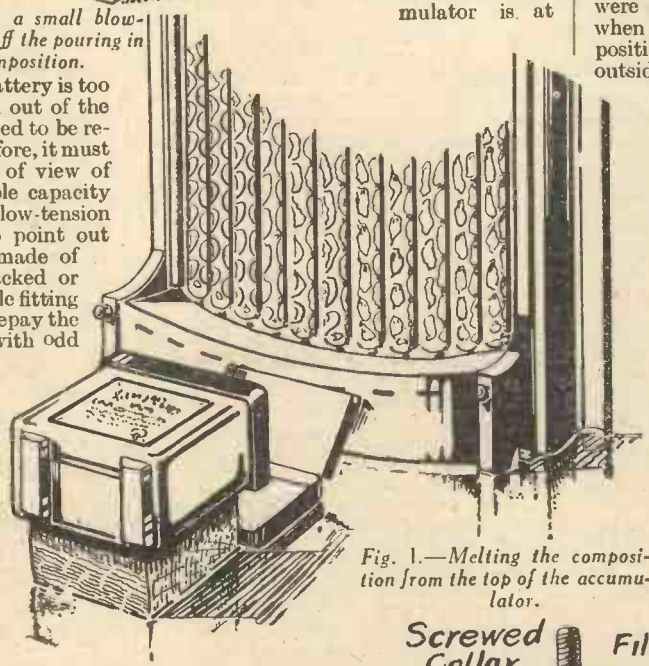


Fig. 1.—Melting the composition from the top of the accumulator.

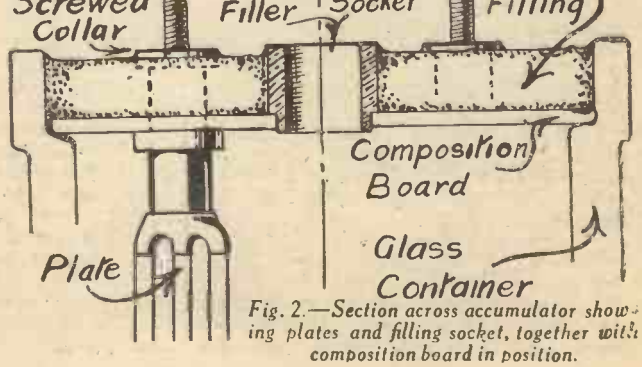


Fig. 2.—Section across accumulator showing plates and filling socket, together with composition board in position.

REJUVENATING

This Article by Frank Preston, F.R.A., Tells

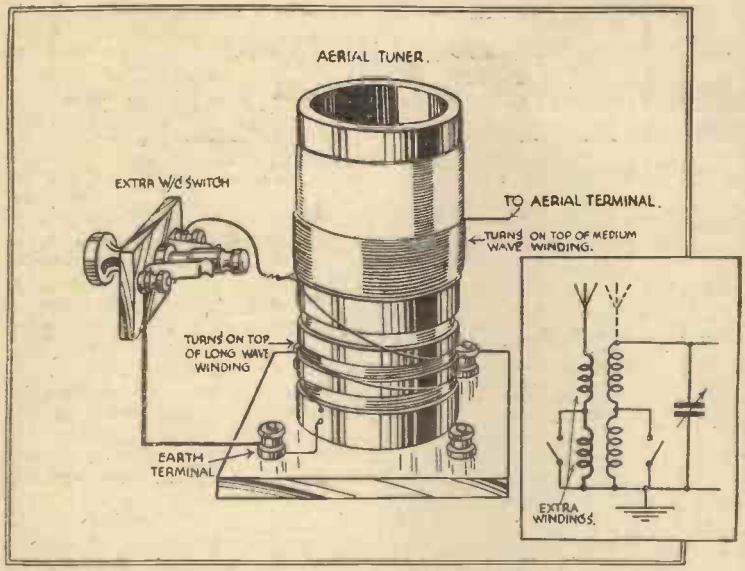


Fig. 1.—Improving selectivity by adding an aperiodic aerial winding.

A NUMBER of readers who are in possession of a set made some years ago have written to express their regret at being unable to build one of the many fine receivers described in PRACTICAL WIRELESS, due to the difficulty in producing the necessary cash. For financial reasons they are obliged to keep the old set, despite its many disadvantages. At the same time they would be quite prepared to spend a few shillings here and there in bringing the old set up to date if they knew just how to tackle the job, and what alterations should be made. The same difficulty must have occurred to hundreds of readers who have not yet written to us, for there is no doubt that times are distinctly hard, and money scarce. It is for the benefit of readers who are in the position of those just referred to that the following suggestions are principally intended, but it is hoped that they might also prove of assistance to others of an experimental turn of mind. None of the alterations I shall suggest will be of such a radical nature that the set will need to be entirely rebuilt, so it must be assumed that it is already in "working order," and simply out of date.

Although receiver design has undergone many changes during the past few years (principally due to improvements in broadcasting technique), I do not hesitate to say that any set made during the last three or four years, provided it was of modern design when made, can certainly be modified to make it satisfactory for present and future use. The first point to consider is what parts of the old set shall be retained, and which shall be scrapped. To enable you to decide on this point, we will trace through the stages of an average set and consider what improvements are desirable, and how they can best be made. I would say at the outset that I do not propose to pay so much attention to the super set as to the average types which I know to be in regular use. By the "average types" I mean the 3-valvers having either one screened-grid valve, followed by a detector and low-frequency amplifier, or a detector and two L.F. stages.

Selectivity

Whatever the type of set, selectivity is of paramount importance, especially when reception conditions are so good as they are this winter. If the set is unselective it is not unlikely that even the local station will be interfered with by a powerful foreigner. The methods of increasing selectivity which were popular a year ago, namely, inserting a small condenser in the aerial lead or reducing the length of the aerial, though still useful, are seldom sufficient. Probably the cheapest way to obtain real selectivity with an old set is to change to band-pass tuning. This can be done by buying a new tuner, of course, but a less expensive way is to fit a band-pass adaptor like that described on page 537 of PRACTICAL WIRELESS No. 11. If you object to a separate unit, and you will if the set is neatly housed in a large cabinet, the adaptor can be built into the set by mounting the necessary components at the "aerial" end of the baseboard. In that case, it is essential that the two coils should be screened. If the coils themselves are not fitted with screening cans a vertical sheet of aluminium should be erected between them, and connected to earth.

Band-pass tuning is open to the objection that it entails the use of two variable condensers. When two similar coils are employed a gang condenser would serve, but that would involve additional expense. If this is your objection, you can get any amount of selectivity by altering your aerial tuner, as shown in Fig. 1. A winding consisting of about twenty-five turns of 24's gauge d.c.c. wire is put on top of the medium-wave coil, and one of fifty turns (equally divided over the slots) on the long-wave coil. Both new windings are connected in series, and the turns must go in the *opposite* direction to those of the tuner. The aerial is taken from its usual terminal, and connected to the end of the new winding, whilst the other end of this winding is joined to the earth terminal of the tuner. A switch will be required to short-circuit the long-wave portion, and will be connected as shown. If desired, operation can be simplified by replacing the previous two-spring wavechange switch by one of the three-spring type; in that case, the junction of the new windings will be connected to the third terminal, the other two functioning in the same way as with the previous switch. The three-spring switch will operate simultaneously on both (old and new) sets of windings.

The latter method of improving selectivity is open to two objections; it will cause a reduction in volume and *might* reduce slightly the response of the set to the higher musical notes. The second objection will not apply if a pentode valve is employed or if it is proposed to fit a tone control transformer.

"Break-through"

A difficulty rather apart from the question of selectivity is that caused by "break-through" of the medium-wave local station at the bottom of the long-wave band. Occasionally an improvement in selectivity will reduce the interference, though this does not always follow. But break-through can be cured quite easily by inserting a suitable choke in series with the aerial lead. A choke specially designed for the purpose is made by Messrs. Lissen and connections for it are shown in Fig. 2. It will be noticed that a switch must be fitted to short-circuit the choke for medium-wave reception, but this can sometimes be combined with the normal wave-change switch by replacing the latter by one of the double-pole-double-throw type, such as the Bulgin type "S.29" or Wearite type "L.22."

Changing to Variable-Mu

Having settled the selectivity question, we can pass along to the S.G. valve (when used). If the set is so far away from the nearest transmitter that no overloading of the first valve occurs (generally distinguishable from the fact that signals become weaker when the set is tuned exactly to

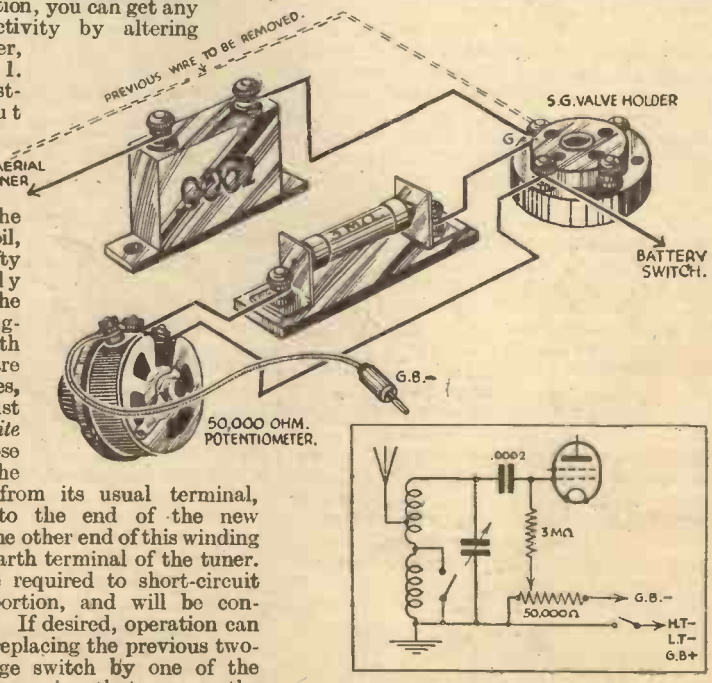


Fig. 3.—Adding a potentiometer for the employment of a variable-mu valve.

THE OLD SET

You How to Bring Your Old Set Up to Date

the station, and louder on each side of the proper tuning position), no alteration need be made, but if overloading does occur, it will be worth while to replace the present valve by one of the variable-mu type. The V.-M. valve will also provide an excellent and convenient volume control which can be used on any station.

A number of ways of fitting the necessary potentiometer for a V.-M. have been given in previous issues of PRACTICAL WIRELESS so I will mention only one here. This is shown in Fig. 3, from which it will be seen that a small fixed condenser (.0001 mfd. upwards) is inserted in the lead from the grid terminal to the tuning coil and a 3 megohm (approximately) grid leak is connected from the former point to the centre terminal of a 50,000 ohm. potentiometer. One of the outside terminals of the potentiometer is connected to G.B. negative by means of a flex and wander plug whilst the other is joined to that terminal of the valve holder which is connected to H.T.—, L.T.— and G.B.+ through the switch. By connecting the potentiometer in this way it is automatically disconnected from the G.B. battery when the set is switched off. In cases where the battery is housed inside the set care should be taken that its positive end is connected to the high tension negative terminal and not directly to the filament terminal of a valve holder. The method shown is not quite the best but is most convenient.

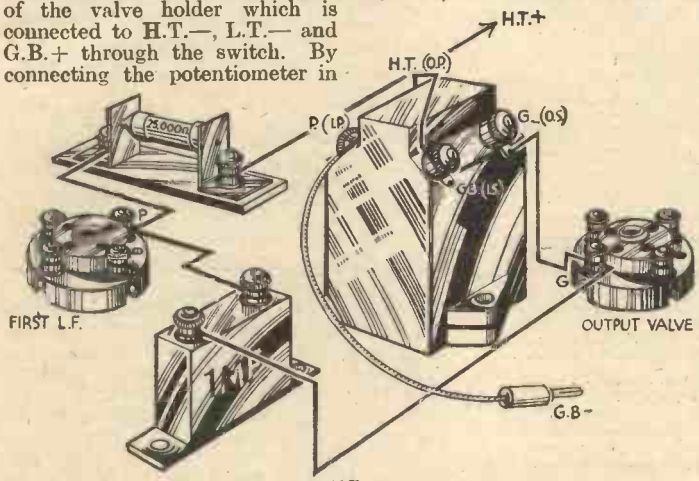


Fig. 3.—Reducing the amplification by altering the ratio of the transformer.

The Detector Valve

Now we pass on to the detector valve. No alteration will be required in its grid circuit but several improvements might be possible in the anode circuit. A number of H.F. chokes which were on the market a few years ago had so low an inductance that they were useless on the long waveband. This does not mean that the set would not work on long waves, but that reaction control would be unsteady or insufficient to produce oscillation. If your set suffers in this way, buy a good modern choke; get one of well-known make and pay about three and sixpence, it will be worth it. If reaction control is unsteady on both wavebands, it is unlikely that the H.F. choke is the cause of trouble. Try the effect of a .0002 mfd. or .0003 mfd. fixed condenser joined between the anode terminal of the detector valve-holder and H.T.—. (See Fig. 4.)

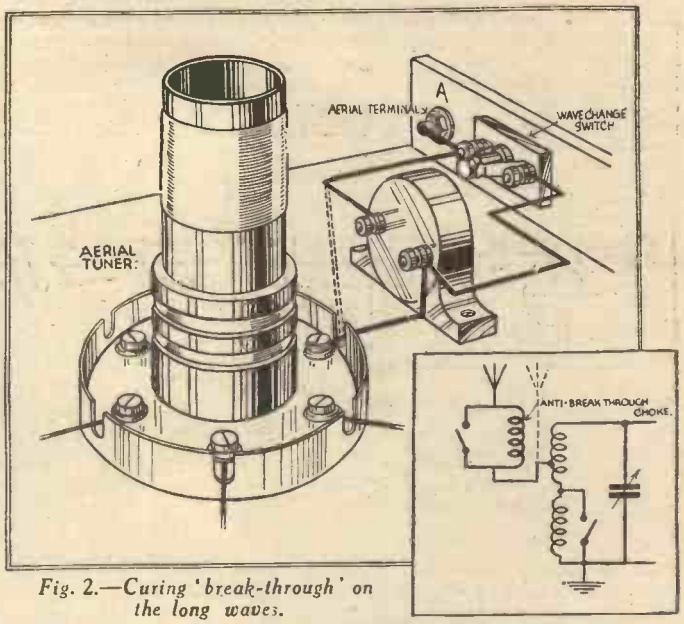
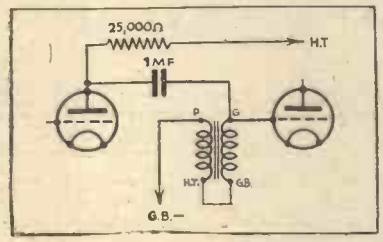


Fig. 2.—Curing 'break-through' on the long waves.



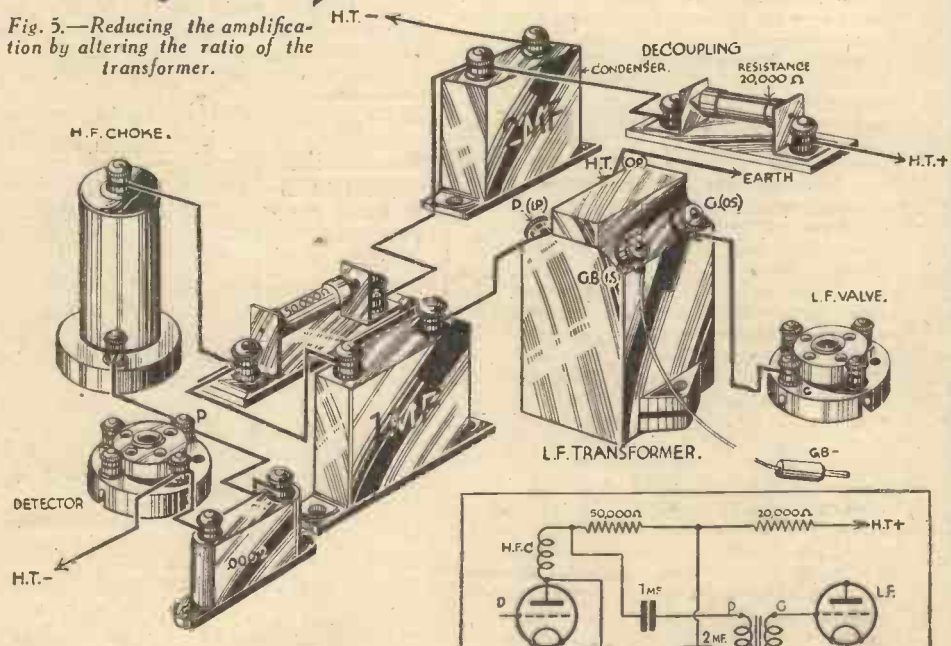


Fig. 4.—Improving the anode circuit of the detector stage.

Resistance Feed

The L.F. transformer will most likely be connected directly in the anode circuit of the detector valve. Unless it is of a large and fairly expensive type, it will probably cause a loss of low-note amplification so that reproduction will be lacking in bass. This can be overcome by connecting the transformer on the resistance-feed system as shown in Fig. 4. A fixed non-inductive resistance (metallised for instance) is connected in place of the transformer primary terminals and one of the latter is connected to the "anode" end of the resistance through a 1 mfd. condenser. The other primary terminal is joined to earth and the secondary connections remain as before. As the terminals of some of the older transformers are marked differently from those of the present-day ones, both kinds of lettering are given in Fig. 4. The resistance-feed method of connecting the transformer, besides improving bass response, will often cure distortion due to overloading.

Decoupling

The idea of decoupling the anode circuit of the detector valve has been advocated so often in these pages tha?

I feel I ought not to refer to it again. But it is so important that I cannot restrain myself. Decoupling prevents various kinds of instability besides prolonging the useful life of the H.T. battery, so you really must make provision for it if you have not already done so. The only components required are a fixed resistance of from 20,000 ohms. upwards and a condenser of 1 or 2 mfd., and they are connected between H.T. positive and the L.F. transformer or feed resistance as indicated in Fig. 4.

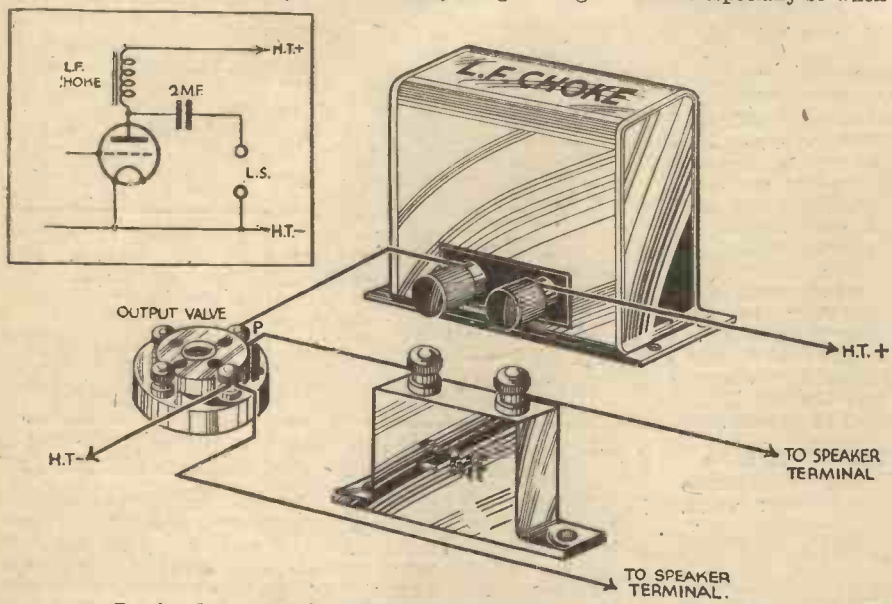


Fig. 6.—Improving the output arrangements by adding a filter circuit.

Preventing Overloading

When two transformer-coupled L.F. stages are employed it often happens that overloading occurs when using modern valves due to the overall amplification being too high. This is especially so when both transformers have ratios greater than about 3 : 1. The latter difficulty can easily be overcome by connecting the second transformer as shown in Fig. 5. When connected in this way the effective ratio is only 1 : 1 regardless of the transformer's rated step-up ratio. In any case the transformer should be resistance fed so you can try the connections of Fig. 4 as well as those of Fig. 5, and adopt the one which proves superior. The value of the feed resistance is given as 25,000 ohms. because this is a good average ; actually it should be equal to twice the impedance of the preceding (first L.F.) valve.

The Output Stage

We have now arrived at the last valve. When only a single L.F. stage is used this should be a small power valve of the high amplification type such as a Cossor 220 P.A., but if two L.F. stages are employed a "larger" valve of lower amplification such as the Cossor 220 P. or even the 230 X.P. will be far more satisfactory. If you have bought a moving-coil loud-speaker, it will be fitted with a suitable transformer and no other output device will be necessary. On the other hand, if you are still using a "cone" speaker it will be much better to employ a choke output filter when a P. or X.P. valve is used in the last stage. For this you will require an L.F. choke and 2 mfd. condenser ; they should be connected as shown in Fig. 6.

Use Ample H.T.

Remember that none of the alterations described above can produce the best results unless you give the set plenty of high-tension voltage, certainly not less than 100 volts, and carefully adjust G.B. tappings to their best positions. Besides, if the set is very old, an hour or so will be well spent in testing the components, as explained in the article "Test Your Components Before You Build," published on page 446 of PRACTICAL WIRELESS, No. 9.

Simple Tone Correction

By E. JOHNSON

SOME method of compensation for the restoration of the higher musical frequencies is becoming increasingly popular in modern receivers. It is a well-known fact that there is a decided tendency for high notes to be lost by reason of sharply-tuned circuits with their consequent side-band cutting. Moreover, unintentional stray capacities in the circuit have the same effect. In such cases the replacement of a triode output valve by a pentode will often put matters right. There are many little snags, however, which confound the tyro if he is tempted to banish his triode, and he may well be doomed to disappointment unless he be willing to experiment ; pentodes are very touchy to slight changes in the output impedance and require careful matching to assure good results.

Tone Compensation in Triode Circuits

Most methods now in vogue necessitate either a special tone-compensation transformer or an extra stage of amplification. This means additional expense. The scheme in use by the writer needs only a suitable L.F. choke. Fig. 1 shows the familiar resistance-capacity-fed transformer. The voltage amplification of the valve depends on the external impedance, which usually is a pure resistance ; other things being equal, therefore, the magnification remains sensibly constant over the musical scale. If, however, our external impedance is partially inductive, the impedance will rise with the frequency. Therefore increased amplification will result on the higher frequencies. In order to prevent excessive compensation we retain our usual coupling resistance ; the larger this is, or the smaller the choke, the less the degree of compensation.

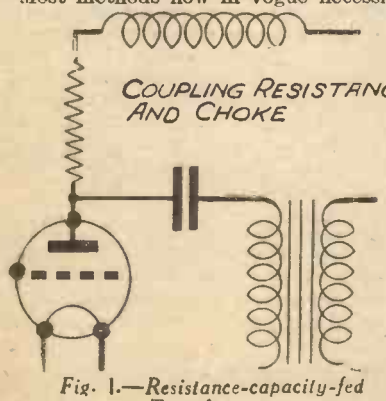


Fig. 1.—Resistance-capacity-fed Transformer.

One must not lose sight of the fact that the choke with its inherent self-capacity will resonate at some definite frequency which should be well removed from the musical scale, and in most cases will be above audibility. Fig. 2 will show this clearly, although it should be borne in mind that the ordinates are purely arbitrary. A bad choke of high self-capacity will cause a very nasty resonance in the audible spectrum, especially if we aim at a high degree of compensation by using a small resistance. In practice, a resistance equal to about half the impedance of the preceding valve will be suitable, in conjunction with a .5H. choke.

Voltage amplification =

$$\frac{I_E}{I_V + I_E}\mu$$

I_E = external impedance
I_V = valve impedance
μ = amplification factor

$$= \frac{R + 2\pi fL}{I_V + (R + 2\pi fL)}\mu$$

R = resistance in ohms,
f = frequency,
L = inductance in henries

The result in each case to be multiplied by the transformer ratio.

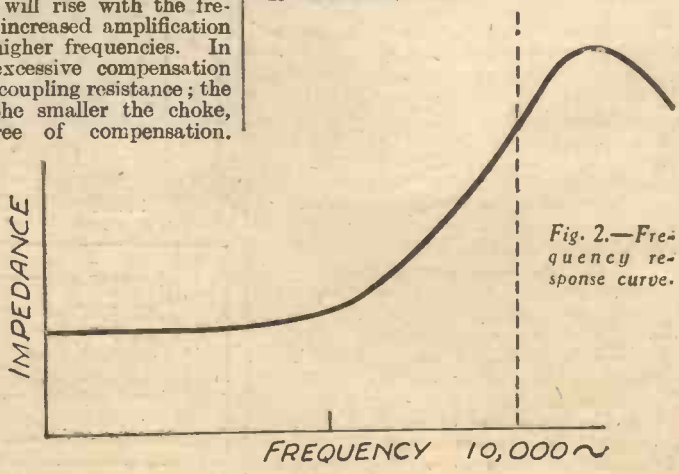


Fig. 2.—Frequency response curve.

WHAT *is* TELEVISION?—(5)

A Short Series Explaining the Fundamental Principles.

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

I THINK the appetite of the reader should by now have been whetted sufficiently to make him desire to know how those one or two quite simple components described in last week's article can be assembled together so as to produce in the television receiver an image which is identical with the scene transmitted from the studio except for the greatly reduced size. Taking the items in turn, we must mount the motor on a bracket, which in turn is held generally on a baseboard having four feet, one at each corner. The height of the centre of the motor spindle from the table on which the apparatus rests will depend on the disc diameter, it being necessary to allow a clearance of, say, 1in. to permit easy running of the disc.

Fig. 1.—Showing the complete assembly of the various components used in a Baird disc model machine.

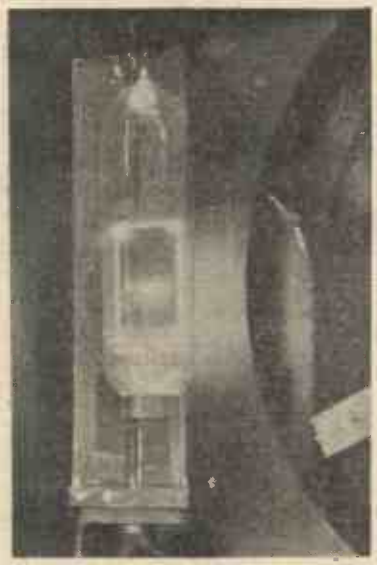


Fig. 2.—Showing how the flat plate neon lamp is scanned by holes near the outer edge of the disc, the magnifying lens being behind.

Now a slot must be cut in the baseboard to allow the disc to revolve, this being shown in the photograph, Fig. 1, which illustrates the assembled apparatus in the case of a Baird disc model machine, the disc projecting below the baseboard a matter of about 4in. With the disc held to the motor shaft by a screw passing through the boss and gripping the spindle, the neon lamp can now be positioned. To suit the type of television transmission now being sent out by the B.B.C., the disc must rotate in an anti-clockwise direction and when facing the front of the apparatus the single turn spiral of holes is in a clockwise direction. It is essential, therefore, to see that the disc is the right way round on the shaft, otherwise the resultant image seen will be reproduced so that all horizontal movement is reversed. The neon lamp is mounted in its bayonet holder so that it is on the extreme right of the disc immediately behind the spiral of holes.

Fig. 3.—A composite picture built up from elemental squares to give some idea of how the resultant television image is formed.

The centre of the glowing neon plate (assuming one of the flat plate variety is being employed) must be on the same horizontal line as the centre of the motor shaft. The illustration (Fig. 2) gives a fair idea of how the glowing neon lamp plate is scanned, this picture having been taken from the back so that the lamp is not obscured by the disc. Then in front of both our disc and lamp is placed the lens or lenses complete with their own particular type of mount. As a general rule it is wise to have interposed between the disc and the lenses a mask having a shaped area cut out to conform to the shape of the resultant light area revealed by the rotating disc. In this way any section of the light which is not required during the process of image reconstruction will be blacked out.

Still neglecting for the moment our synchronizing mechanism, as I intend to deal with that fully in next week's article, (the mechanism itself can be seen at the front of the motor in the illustration, Fig. 1), the only additional control we need mention is the variable resistance used for adjusting the speed of the motor. This, by the way, should have no "off" position, otherwise the individual working the apparatus is liable to move the contact arm to this position when the hand is on the control, but the eyes are on the image. The motor speed will at once start to drop and it becomes imperative to begin resolving the picture into an intelligible image all over again. This resistance is seen on the left of Fig. 1.

Fig. 4.—A cathode ray television receiver which has been demonstrated in Germany.

Working the Apparatus

Having now built up our imaginary television apparatus, three distinct forms (using a disc for scanning) of which are shown side by side on the stand of Fernseh A.G. at an exhibition held a year or two ago in Berlin, in Fig. 5, let us now see the method which must be employed to make it work. Tune in the wireless set to be used for the reception of the television signals so that it receives the London National station. If the television signal is heard on the loud-speaker, and this policy is always recommended to start with, the sound which will be listened to is of a rather peculiar rhythmic character, something like a high-pitched, steady note, with another high-pitched chirrup superimposed upon it.

Then disconnect the loud-speaker leads and join the neon lamp to the set's output terminals. Actually, the method of connection will vary according to the type of output used in the receiver, that is, whether direct, transformer or choke, but this item is really beside the point for the moment. Often a subsidiary source of high tension voltage is required in order to "strike" the neon lamp and make it glow, even when no incoming signals are passed through to it. When this is done, switch on the motor so that it drives round the perforated disc in front of the glowing neon lamp.

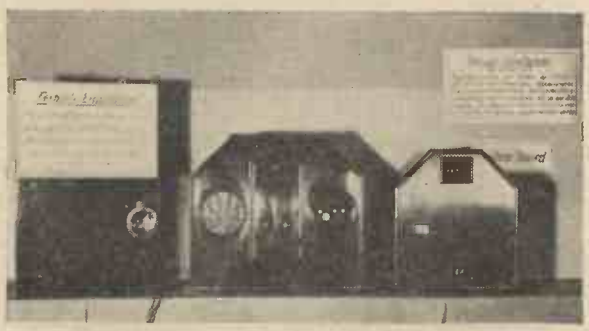


Fig. 5.—Television receivers at the Fernseh A.G. Exhibition stand in Berlin, 1929.

Now the mere fact that television signal pulses are being fed to the neon lamp will make the light intensity of its illumination change in accordance with the signal strength. Furthermore, the changes occur with the same rapidity as that which generated them at the transmitting end, this being due to the neon lamp's inherent properties which I referred to earlier in this series. It will therefore be possible to watch these fluctuating light changes through the small holes in the disc and an image will be built up for the following reasons:

First of all, to simplify the explanation, let it be imagined that the disc at the receiving end is running in perfect synchronism (see how that important point keeps cropping up) with the transmitting apparatus, that is to say, it is revolving at the same speed of 750 revolutions per minute and in the same phase relationship, or what is commonly called in step. When this happens, at any one instant, a hole in the disc of the receiving apparatus will reveal a tiny square area of the neon lamp glow. If, for example, we imagine the exposed area in the centre of the image, then it must be realized that at that identical instant there is a corresponding position in the centre of the scene or object at the transmitting end, which is being explored by the moving light spot.

Building Up the Television Image

The intensity of the tiny neon glow area shown must therefore be in direct proportion to the light reflected and picked up by the photo-electric cells at the transmitting end. This is because of the proportional changes it has passed through from end to end, the "links" in the chain of events being reflected light to photo electric current, amplification, passed to wireless aerial and broadcast, received on the home wireless set, again amplified and finally handed on to the neon lamp to modulate or regulate its glow intensity.

In effect, therefore, we are reproducing in terms of light the conditions prevailing at the transmitting end at that one instant, and this goes on spot by spot from the bottom to the top of the glowing lamp area, recreating a strip of incandescence which shows in miniature all the corresponding light and shade which has been transmitted electrically as a television signal. When one hole has finished its prescribed motion, then the next hole takes charge and performs an identical function by creating another light strip of varying intensity immediately next to its predecessor.

It is in this way that, strip by strip, lying side by side, the complete television image is built up, the various degrees of light and shade intermingling to bring about an intelligible and clearly recognizable image. A reference to the illustration shown as Fig. 3 will no doubt help still more to make this explanation better understood. Here a composite image of the head and shoulders of a young woman is built up from tiny elemental areas all correctly positioned one with the other. In actual practice the square pattern shown will of course not be noticed, as the image is built up from strip formation, but, what is more important, owing to the phenomenon known popularly as visual persistence, or persistence of vision, the eye lag makes the image appear as a whole. A certain amount of flicker is perceptible, but with the twelve and a half pictures per second now used with the transmissions from the B.B.C., the process is rapid enough to prevent the eye dwelling too intimately on the mechanics of the process.

In this way, therefore, it is possible to show in miniature a good proportion of the light, shade, contour and movement of the artist or subject performing before the photo electric cells in the television studio, or in other words, produce "vision at a distance" in the home. Of course, there are various ways of building up the apparatus in order to produce the image, and it is interesting, therefore, to see the illustration of Fig. 4, for there is shown a cathode ray television receiver which from the description underneath obviously emanates from Germany. Although a lot has been said concerning cathode ray apparatus, nothing has yet appeared beyond the laboratory stage, while the life of the tube is a very doubtful factor.

The next points that I want to deal with concern synchronism, the operation of the vision apparatus, and one or two peculiar effects which are often observed and also one or two items directly associated with the wireless set used for receiving the television signals. These, however, must be left over until next week's article.

The composition will probably require to be heated several times, and even then it will be impossible to get an even flow over the surface. If it is possible to obtain a small mouth blow-lamp, and just blow over the surface, it will smooth off the composition and make it settle down to a uniform surface, but take care not to apply too much heat to it, otherwise it will burn and char. The method of using a small blow-lamp is shown in Fig. 3.

Preparing the Accumulator for Charging

When the operation of running in of the composition is finished, the accumulator may be filled with electrolyte of the correct specific gravity stated by the makers on the outside of the case. The electrolyte can be obtained from a charging station or any first-class electrician. The battery is now ready to be charged, and it is advisable to work the battery only for about one half of its normal period after this first charge, the second charge will then place the accumulator in really good condition.

Points on Maintenance

To keep the accumulator up to standard,

FITTING NEW PLATES IN AN ACCUMULATOR

(Continued from page 753.)

it should be kept as fully charged as possible, and charged at regular intervals, a full charge being indicated by both plates gassing fairly freely, the voltage rising to approximately 2.5 volts. A battery should never be completely discharged or left for any length of time with a low voltage, for this tends to cause buckling and sulphation of the plates.

Sulphation

Sulphation appears on the plates in the form of a white deposit of lead sulphate. slight traces may be removed by a prolonged charge at a reduced rate, but if not checked immediately the battery will be ruined.

Level of the Electrolyte

Never let the electrolyte fall below the top of the plates; keep it up to the level marked on the outside of the case. The loss is caused by evaporation of the water only, sulphuric acid does not evaporate, therefore, it is only necessary to keep the level constant by the addition of distilled water.

Corrosion

When purchasing a new accumulator see that it is fitted with large non-corrosive and non-interchangeable terminals of the bright red and black top variety. Even if terminals which are said to be non-corrosive are left in a very dirty condition they will corrode, and the best cure is to clean all traces of acid away, and scrape the corroded parts bright with a pocket-knife, afterwards wiping over with ammonia, and then smearing freely with vaseline.

Testing the Battery

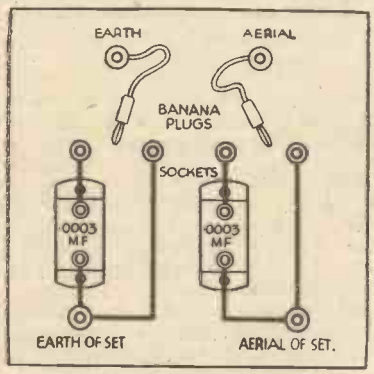
Testing the condition of a battery with a voltmeter should always be done under load, that is to say, when the set is working, otherwise a false reading will be given. A hydrometer should be used in conjunction with the voltmeter, for this will enable the specific gravity of the electrolyte to be kept up to the correct standard.

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

Simple Selectivity Gadget

I HAVE noticed that in order to obtain requisite selectivity a fixed condenser answers perfectly in the aerial circuit, while sometimes it is better in the earth

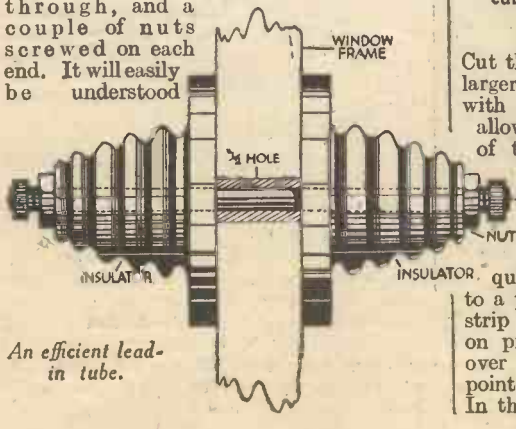


A simple selectivity device.

lead, while, when Continentals are extra strong, both are necessary. When both condensers are in circuit the selectivity is excellent. Therefore, I have made a very simple little gadget consisting of two .0003 mfd. fixed condensers, a piece of ebonite, four terminals, two "banana" plugs, and four sockets. These are arranged as shown in the accompanying sketch. Alternatively, the unit may be incorporated in the set with the plugs, and sockets at the back. Thus the "switching in" of the condensers is a simple matter of changing plugs. Another way is to use push-pull switches for "shorting out" the condenser or condensers not required. The "aerial" condenser may be variable.—R. S. MENZIES (Scarborough).

A Well-Insulated Lead-in Tube

EXPERIMENTERS who are not satisfied with the efficiency of the usual ebonite lead-in tube can make a very good one by using two porcelain stand-off insulators, as shown in the illustration. The bolts and nuts are removed from the insulators and after drilling a half-inch hole in the window-frame, one insulator is placed on each side. A piece of threaded 2BA brass rod is run through, and a couple of nuts screwed on each end. It will easily be understood



An efficient lead-in tube.

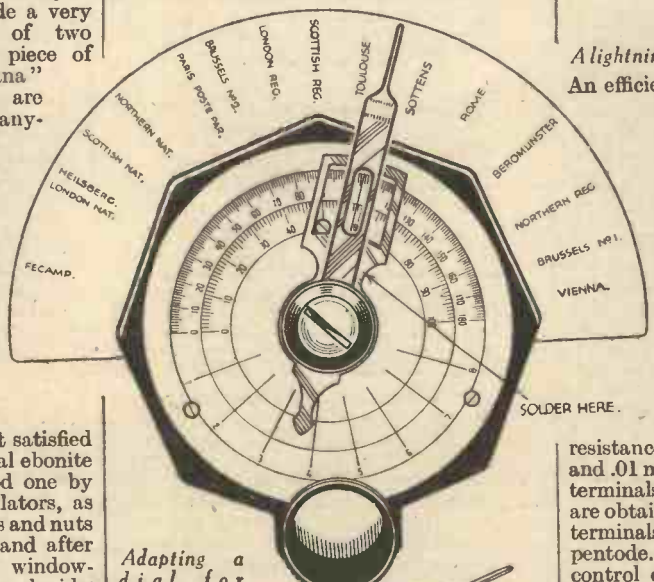
THAT DODGE OF YOURS!

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

that the insulation of this tube is very high. —V. H. BLARE (Edinburgh).

A Station-locating Dial

HERE is a simple method for enabling listeners to find stations again (after first identifying and marking them on the chart) in a second, and also giving slower motion. A piece of stiff white paper and strip of thin brass are the only additional parts necessary. Exact measurements are not given as all slow motion dials vary in size.

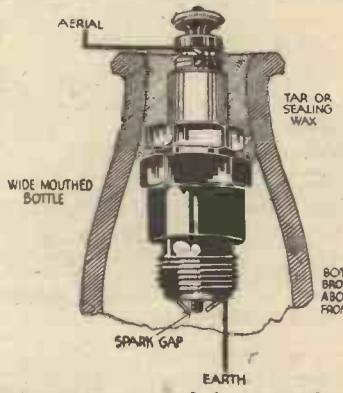


Adapting a dial for station indicating.

Cut the paper in a semicircle 1in. or 1½in. larger than the circumference of the dial with a piece cut out at the bottom for allowing the paper to slip past lock-nut of the condenser. Slip this behind the dial, making sure that it is perfectly straight. I find the pressure of the dial against the panel quite sufficient to hold it in place. The strip of brass can be quite thin. Cut the strip (¼in. wide) to a point at one end. The length of the strip must be just long enough to solder on present indicator and to bend round over the ebonite of the dial itself. The point should now rest lightly on the paper. In the centre of the brass strip a window is cut so that the degrees on the dial can be correctly registered. As the stations are identified the name of the station can be neatly printed on the paper disc, as depicted in the accompanying sketch.—F. SPINK (Peckham).

A Novel Lightning Arrester

WHEN lightning is about, one usually feels a trifle safer when the receiver is protected by some form of lightning arrester.

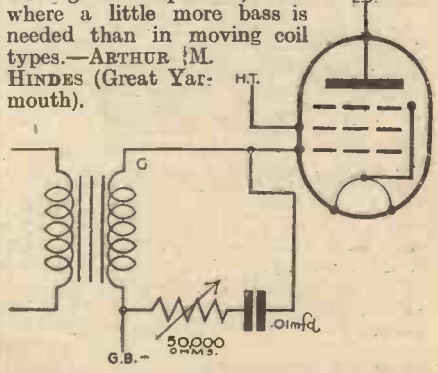


A lightning arrester made from a sparking plug.

An efficient arrester can be made as shown in the accompanying sketch. The parts required are a wide-necked bottle, an old sparking plug, and some sealing wax. The neck of the bottle is broken off, the sparking plug inserted in it, and the space filled in with sealing wax. The top of the plug is attached to the aerial, and the bottom to earth.—C. TAYLOR (Cardiff).

Tone Control

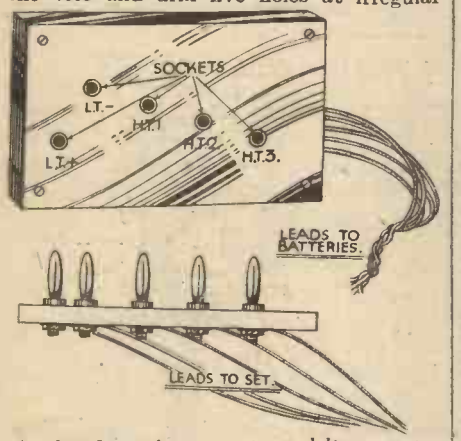
AFTER experimenting with several forms of tone control to be used with a pentode, I find that instead of fixing a resistance-condenser (50,000 ohms var. and .01 mfd.) control across the loud-speaker terminals as recommended, better results are obtained by fixing it across the secondary terminals of the transformer before the pentode. The resulting tone, and the control of tone itself is very much better than the former method and well worth trying, especially to constructors who use moving iron speakers, and where a little more bass is needed than in moving coil types.—ARTHUR M. HINDES (Great Yarmouth).



A simple method of tone control.

A "Safety-first" Gadget

WIRELESS experimenters are fully aware of the nuisance of having to disconnect all leads from the batteries before working on a set and then having to connect up again for testing. This trouble can be eliminated entirely if the gadget herewith described is made use of, as the leads can be connected or disconnected in half-a-second. The requirements are: Two pieces of ebonite about 3½in. by 2in., and five Clix coil pins and sockets. Put the two pieces of ebonite together in the vice and drill five holes at irregular

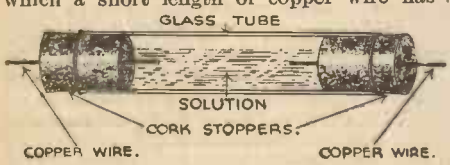


A safety device for connecting and disconnecting battery leads.

intervals right through. The drill used should be of a size to suit the coil pins (about 6 B.A. clearance). Fit the pins into position with one nut on each. The holes in the other piece of ebonite are now opened out to suit the sockets (about 2 B.A. clearance) and the latter secured with nuts. It will now be seen that the pins will fit snugly into their sockets. The leads from the H.T. and L.T. batteries are taken to the sockets and well secured. This unit is fastened to the wall or bench behind the set, and short pieces of coloured flex are then fastened to the pins, fitted with terminals at the other end for connecting to set. Only one negative lead need be taken to each pin and socket, as the two negatives (H.T. — and L.T. —) are usually connected in the set. To connect the set to the batteries it will be seen that all that is required is to "plug in," and to withdraw them when disconnecting. The diagram will make the scheme quite clear. —EDGAR WILLIAMS (Llanelly).

An Easily-made Pole Finder

HERE is a useful and inexpensive pole finder. A short piece of glass tubing about ¼in. in diameter is fitted with a cork (or rubber) stopper at each end through which a short length of copper wire has

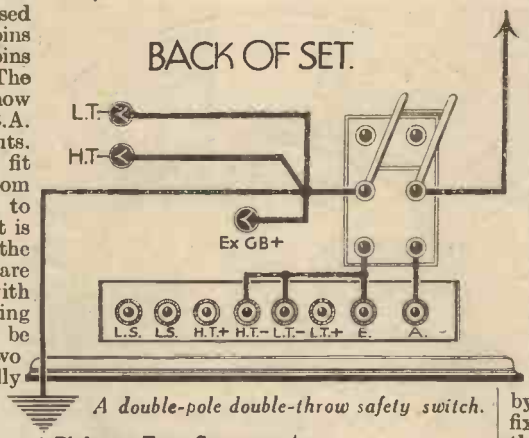


An easily-made pole finder.

been forced before fitting in the tube. The tube is half filled with a solution made up of phenolphthalein 10 grains (about a pennyworth), sulphate of soda (Glauber Salts) ½oz., and about 2oz. of water. Shake the solution before filling the glass tube as only a small proportion of the phenolphthalein dissolves in the water. A resistance should be placed in series when used on a source of H.T., but voltages up to six may be applied directly across the pole finder. The negative pole will turn the solution around that particular wire a red colour, which will disappear when the solution is shaken. —J. W. D. (Cork).

A Safety Switch

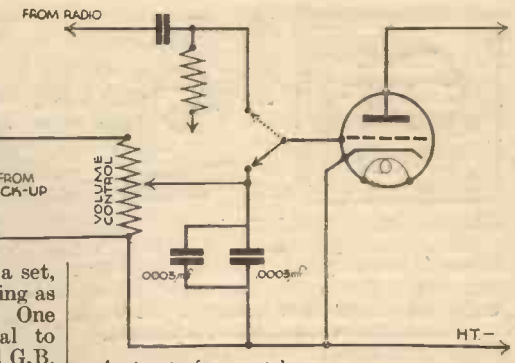
A DOUBLE-POLE double-throw switch, fastened to the back of a set, can be made to do some useful switching as shown in the accompanying sketch. One switching either connects the aerial to earth and cuts off the H.T., L.T., and G.B. batteries from the set, or disconnects aerial from earth and switches on the programme. No separate aerial-earth switch is needed, neither is any other switch required for switching the set off. Furthermore, when the set has been switched off there are no complete circuits to produce "shorts." Note that the two upper terminal points of the switch must be joined together with wire for the aerial to have a direct path to earth. The G.B. positive lead from the grid-bias battery plug is brought out through a small hole drilled in the cabinet and joined on to the same place as the H.T., L.T., and earth. Fit a terminal on each side of the switch, as shown in the sketch, so that connections can be made easily. These terminals, of course, must be wired to the switch.—E. ROBERTS (Croydon).



A double-pole double-throw safety switch.

Pick-up Tone Compensator

WHEN using a standard type pick-up on a home-constructed all-mains set, results are often disappointing, due to a hissing sound on high tones and loud passages, along with accentuated needle scratch. The cause of this would at first appear to be due to overloading of one of the valves, but, on reducing the input by means of the volume control, it will be found that this objectionable sound is still present. The condition is most prevalent in resistance-capacity coupled amplifiers, and is due to reasons other than overloading. The trouble is, however, satisfactorily overcome by the method illustrated. Connect a condenser of .0006 mfd. capacity between the grid leak on the volume control and the cathode or negative high tension. The required capacity will be best made up of two .0003 standard fixed condensers in parallel. This



A circuit for a pick-up tone compensator.

modification will result in reproduction of a rich and mellow quality, without serious loss of volume.—H. B. ROCHESTER (Manchester).

Making a H.F. Choke

A VERY useful H.F. choke for use on the short wavelengths from about 12 to 100 metres may easily be constructed from the oddments usually found in the possession of an amateur. The former on which the wire is wound is made from a piece of old ebonite, ¼in. or ⅛in. thick. This should first be cut into two pieces 2½in. long by 1in. wide, and the edges over which the wire is wound may with advantage be rounded with a file. Next make a mark on each piece 1¼in. from the end, which will give the centre position, and with a hack saw make two cuts from one end to the centre, the distance between the cuts being equal to the thickness of the ebonite. Next remove this centre portion by drilling several small holes; it may then be broken off and filed smooth. Providing the removing of the centre has been done carefully, the two pieces will now fit firmly together as shown in the sketch. Before fitting together, two holes should be drilled, as shown in Fig. 1, to take terminals. The wire for use on this choke should be of a gauge about 36 or 40; in the writer's case the wire from an old car coil was used. Connect one end of the wire to terminal B and then wind on 175 turns and connect the other end to terminal C. The choke may be mounted by a small brass or aluminium bracket, and fixed as shown in the sketch. Fig. 2 shows the completed choke, which has given splendid results on the wavelengths mentioned.—F. N. P. (Ruislip).

Next week's Data Sheet is entitled "Wire and Wire Gauges."

Fig. 2. Detail sketches showing of an H.F.

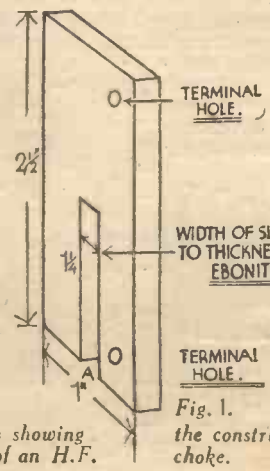


Fig. 1. the construction choke.

OUTDOOR AERIALS

Their Method of Construction and Erection, and How to Deal with Cases of Mishap.

By R. A. HARRIS

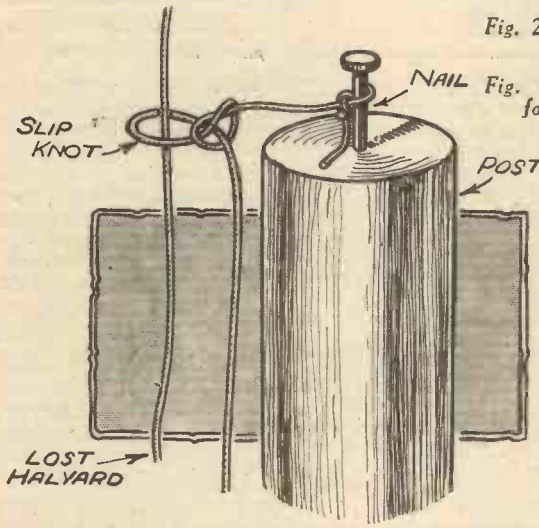
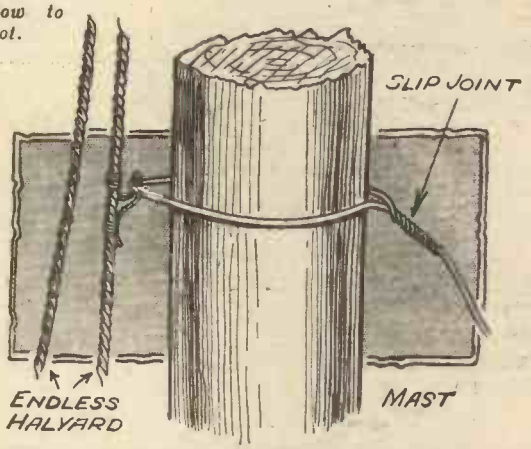


Fig. 2 (right). — Forming the slip joint.

Fig. 3 (left). — How to form the slip knot.



The Erection of a Mast

TO many, this means only the digging of a hole, inserting the mast and ramming the soil home. But, with a little forethought and extra labour at the initial erection, considerable time and labour can be saved when the need for renewals or repairs arises. A rusted pulley, broken aerial wire or dirty insulators all require either renewal or cleaning. Furthermore, a careful wireless enthusiast will wish to keep his mast in a good state of preservation, and this necessitates periodical repainting or re-creosoting.

To remove a mast from its foundation is no easy matter, and to obviate this trouble, the following mode of erection, which embodies the facilities necessary for the lowering of the mast will, no doubt, appeal to many readers. Assuming that the mast is from 20ft. to 35ft. in length and of average diameter, purchase from the wood merchant two lengths of wood 6ft. by 4in. by 3in., one length of 1ft. 6in. by 7in. by 3in., and one block 5in. by 4in. by 3in. From the ironmonger, obtain some long screws, and two bolts 12in. long with nuts to fit. For masts of greater length proportionally larger pieces of wood are required.

Firstly, take the 1ft. 6in. piece "A" (see Fig. 1), cut out a slot 4in. wide by 1in. deep, in and at the centre of each of the two 3in. faces. Place the vertical piece. "B.1." and "B.2." at right angles, so that the ends fit into the slots. With long screws (with nut and bolt, if preferred), fix firmly together. Now, take the spacing piece "C" (Fig. 1), fit this between the two verticals so that the top of the former is 3ft. from the top of the latter. Fasten firmly with screws. (A bolt can be used if preferred.) When this is done, take the mast and slide the bottom end between the verticals (if the mast is too wide, shave down to a width of 5in.) so that the base of the mast is 3in. above the top of the spacing piece. Bind temporarily but securely, with wire or cord.

Next, drill holes through the two verticals and the mast at point X (Fig. 1) 6in. from the top of the verticals and point Y 1ft. 9in. below point X. These holes are to receive the bolts, and it is advisable to insert the latter to ensure that the holes are correctly drilled. If everything is so far satisfactory, the mast can now be removed, and the now completed bearer should be creosoted or tarred. If desired, the bottom half can be charred for the purpose of preservation.

Fixing the Mast Bearer

The time is now opportune for the digging of the hole at the selected spot where the mast is to be erected. This hole should be 3ft. deep and sufficiently long to receive the bearer, but no more soil than is necessary should be excavated. The bearer can now be placed in the hole, but it must be ascertained that the base of the mast, when in position, will be above the ground level.

If the bearer is upright and facing the correct direction, the hole can be filled in with rubble, hardcore, and soil. Water well when ramming down to prevent subsequent subsiding. If time permits, it is advisable to leave the final fixing of the mast until the lapse of a few days, to allow things to settle down to normal. The next stage is the fitting of the pulley, aerial wire, and necessary stays. When this is done, it is only necessary to raise the mast and fix. This should be done as follows: Place the mast between the verticals, insert the top bolt, fit nut, and tighten up until the mast is just sufficiently loose to be rotatable. The mast can now be raised to the vertical position and the second bolt inserted. Now tighten up both bolts firmly. The completed job will give sufficient satisfaction to recompense the owner for the extra time and labour entailed.

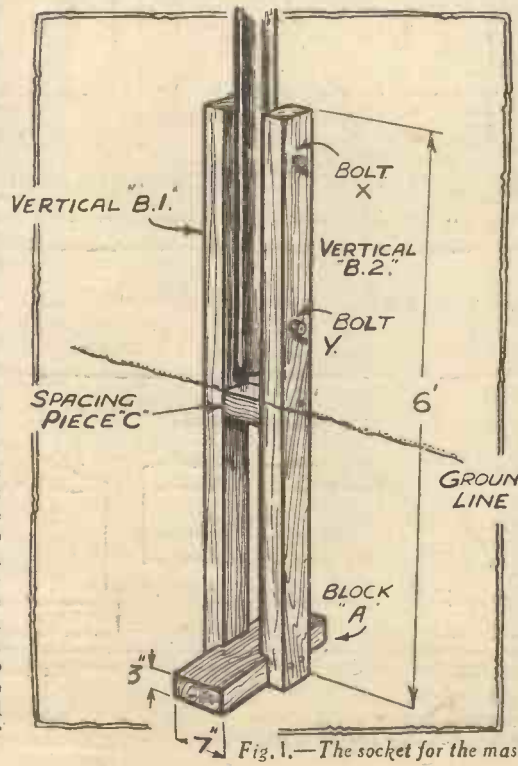


Fig. 1.—The socket for the mast.

Stay Wires

It is often found necessary to fit stays to an existing pole, and if the latter is embedded in the ground, considerable difficulties may be encountered before the operation is ultimately completed. In a case where a continuous halyard is in use, the following method of fixing is worthy of note:—

Take the mast end of the stay wire, loop round the base of the mast, and twist round to form a slip joint (Fig. 2). Bend a small piece of wire to form a hook, and fasten with string to the mast side of the halyard. Support the wire loop by the hook, and gently pull the halyard upwards at the same time relieving the weight of the wire by an upward pressure of the latter. When the required height is attained, a sudden downward and outward pull on the wire

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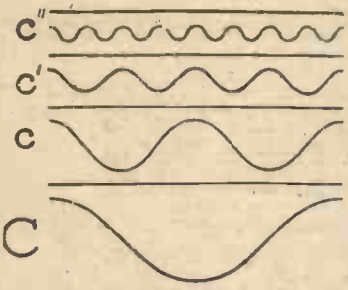

Fig. 1.—The curves of the musical note C and its octaves.

TONE CONTROL

An Important and Informative Article on a Subject Which Will Interest All Who Are Interested in Reproduction Problems

By F. W. LANCHESTER, LL.D., F.R.S.

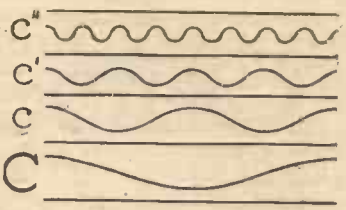

Fig. 2.—The curves of the gramophone record of C and its octaves.

THERE is nothing actually new about tone control, but recently it has come very much to the front. Tone control has been exercised by broadcasting stations for many years, but the tone control which is of interest to the owners of receiving sets means something different; it is the same principle applied to the set itself.

Broadly stated, tone control consists in a means of varying the "centre of gravity," and distribution of the acoustic spectrum, and it commonly involves the provision of a special circuit whose function is to give more amplification to the bass or treble, as called for. That is one way of expressing it, but it would be more true to say that it is a means of giving *less* amplification to the treble or bass, as the case may be, because the introduction of a tone control circuit can only act by *diminishing* the gain or amplification of the upper or lower frequencies. Consequently, tone-control cannot be made use of with any success, unless the set or amplifier has a great deal in hand which we can afford to throw away. Ordinarily, to justify the adoption of tone control in a set which gives *just* sufficient volume without, it is necessary to supply an additional L.F. stage.

For the Gramophone Amplifier

The subject is best approached by a simple example rather than by a generalisation. It is well understood that in the ordinary gramophone record, the bass, say, from about middle C downward (c′ = 256 frequency), is not recorded at full amplitude, and the lower the tone the more inadequate the amplitude; the result is that with the ordinary mechanical gramophone the reproduction is always deficient in bass; a characteristic imparting to music what is currently termed "gramophone quality." This may be regarded as a defect in recording, but it affects all kinds of recording, and it is a *necessary defect*: the reason being that in making a record the spiral spacing of the needle track cannot be varied to suit changes of pitch in the music; it is necessarily constant and is dependent upon the recording apparatus; it has to be such as will give the required length of run (about four minutes for a 12in. record). Thus, the pitch commonly adopted is approximately 1/100 of an inch; it varies a trifle with different records and different makes of record. If the track "band" (measured radially) on a record is 3½in., then the record will run for 350 turns, and dividing this by 80 (the speed of the turn-table) we find the run to be a little less than 4½ minutes. So we appreciate that the spiral pitch of the track must be strictly limited, and since fully half of this is taken up by the needle point, the maximum amplitude of movement permissible is certainly not more than .005 of an inch. Fig. 1 represents enlarged the amplitude for c′ (middle C)* and the two octaves c and C below, *as it should be for equal energy output*, and Fig. 2 the amplitude restricted by considerations of recording; c″ (an octave above middle c′) is given in both figures. Actually, for realism, the energy in the extreme bass should be many times that of the middle frequencies, as every organ-blower knows to his cost, but we are not considering that at present. So we have the problem of tone-control for the gramophone amplifier defined; it involves a relatively great amplification of the bass, or more accurately expressed (as has been pointed out), an *actual* attenuation of the higher acoustical frequencies. Referring in greater detail to Figs. 1 and 2, it is an established fact that for equal power (watts) the *amplitude* × *frequency* is constant; and c′ is shown with the full amplitude permissible, that is to say, occupying the whole of the available track width. Now comparing Fig. 2 to Fig. 1, the C one octave below has an amplitude only half what it should be, and for the C two octaves below (the C string of a 'cello 66—), the track width is only one-quarter of what it should be. In Fig. 1, the amplitudes shown for the 3 C's are those of equal energy.

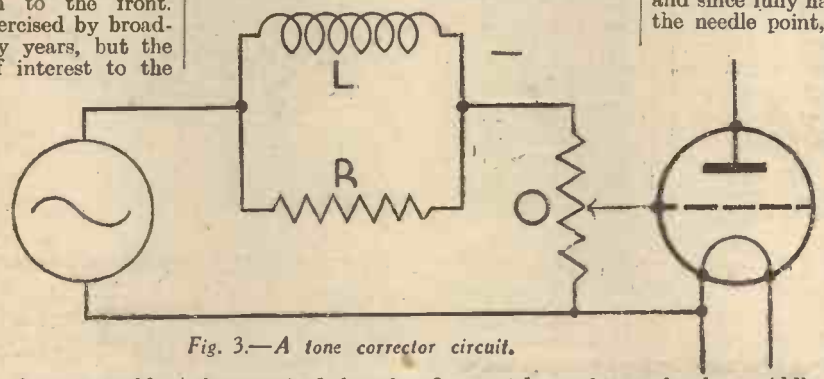

Fig. 3.—A tone corrector circuit.

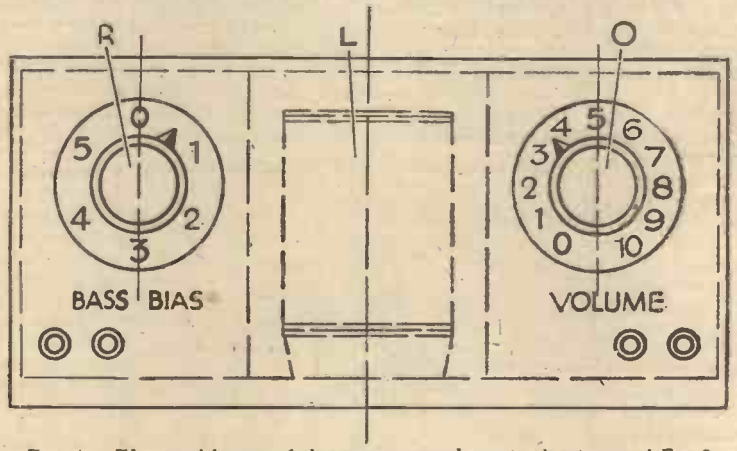

Fig. 4.—The panel layout of the components shown in the circuit of Fig. 3.

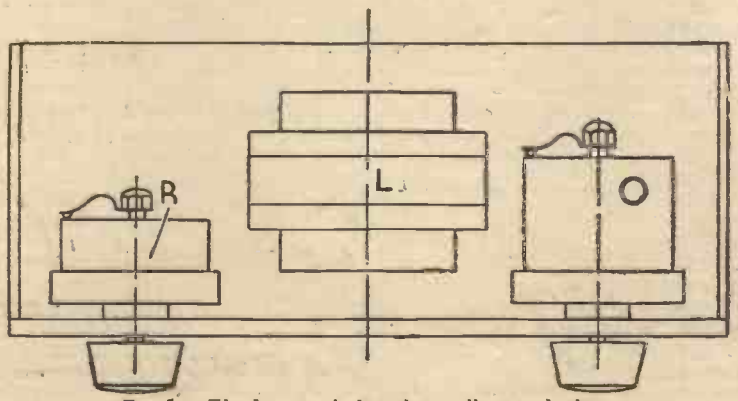

Fig. 5.—The layout of the scheme illustrated above.

Tone Control for High-Power Amplifier

In an amplifier used to illuminate a lecture given by the author of the present article, in the Town Hall, Birmingham, in January, 1929, gramophone records were used exclusively, there being too much interference from trams, etc., to make use of broadcast; a tone-control circuit was devised,

* The notation used is that of Helmholtz, C, c, c′ and c″; c′ is middle C.

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Tone Control

(Continued from page 762.)

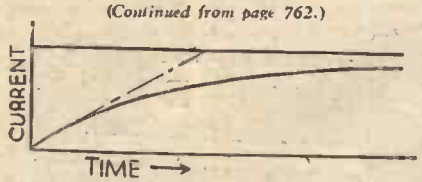
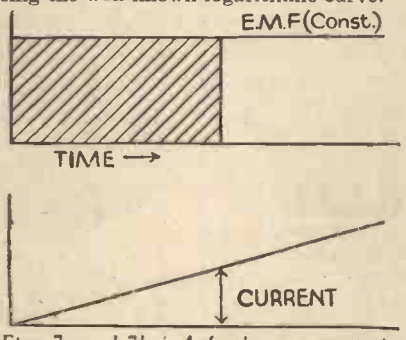


Fig. 6.—A diagram illustrating time and current.

following the pick-up, controlled by a rheostat which, by attenuating the upper frequencies gave various degrees of "bass-bias." In order to permit of the (relative) augmentation of the bass, which meant throwing away the upper frequencies wholesale, a four-stage amplifier was specially designed, having an over-all amplification of 100,000, or thereabouts. The H.T. E.M.F. was supplied by an Exide battery of 450 volts, and the power "galaxy" consisted of eight B.12 valves (B.T.H.), 4 and 4 in push-pull, with a maximum undistorted output (calculated), about 12 or 14 watts.

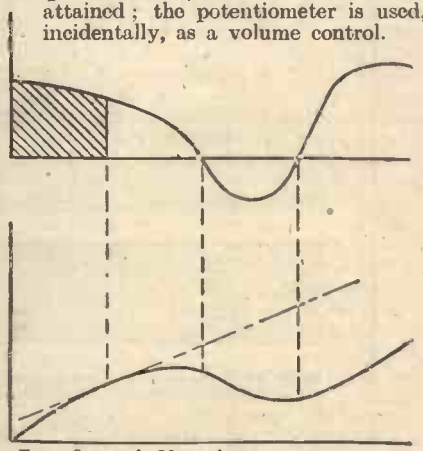
The extent of "bass-bias" required to restore organ music to its true majesty is far greater than that necessary for equality of energy, the bass needs many times the watts of the higher frequencies. We succeeded in reproducing the organ music with such power and realism that the bass shook the seats throughout the vast auditorium; many people, as they entered the hall and took their seats, were under the impression that the Town Hall organ was responsible. Fig. 3 is a diagram of the tone-control circuit employed. It comprised a choke or inductance *L* of about 50 henries (Ferranti, B.1), a potentiometer *O* of 2,500 ohms, and a variable resistance, *R* (rheostat) max. 500,000 ohms. Fig. 4 is a front elevation of the embodiment of the circuit, and Fig. 5 a plan view; the same reference letters are employed. The essentials of the circuit are the inductance and the potentiometer. The function of the rheostat is to by-pass the "bass-bias" circuit to diminish its influence; the rheostat knob is the means of tone control, and acts by varying the extent to which the higher frequencies are allowed to come through direct.

In considering the function of the circuit as a means of bass-bias, we assume the resistance *R* to be infinite, non-existent in fact. Then, when E.M.F. (in this case supplied by the pick-up) is applied to inductance *L*, the current rises in proportion to time; at first, strictly so, and later, at a less and less rate tending to a maximum (which is dependent upon the applied E.M.F. and the resistance in circuit), when the current becomes constant. The resistance in the present case is made up of the pick-up winding, the potentiometer resistance, and the ohmic resistance of the choke A. The rise of current with time, and its gradual approach to its maximum value, is shown in Fig. 6, the form of the graph being the well-known logarithmic curve.



Figs. 7a and 7b.—A further representation of Fig. 6.

The inductance of the choke *L* is sufficiently high in relation to the circuit resistance to ensure that the current never approaches its limiting value, and that the portion of the graph in Fig. 6 which is utilised can be regarded as the initial inclined line (without serious error), so that the current is proportional to the time of application of the constant E.M.F, and we have two graphs, namely, that of the applied E.M.F., which is constant (Fig. 7*a*), and the current which grows with time (Fig. 7*b*). It is now necessary to use terms which denote the relation of these graphs. In Fig. 7 graph *b* is said to be the *integration* of *a*, and conversely *a* is the *differentiation* of *b*, these are terms used in the calculus; the editor informs me that I may not presume that *all* his readers are mathematicians, so I will proceed to explain. In Fig. 7*b* the ordinate which represents current is the measure of the corresponding area in Fig. 7*a*, and the ordinate which represents E.M.F. in Fig. 7*a* is a measure of the slope in Fig. 7*b*, so that a constant value of E.M.F. Fig. 7*a*, when *integrated*, gives a constant slope or rate of increase in Fig. 7*b*. Conversely, a graph of constant slope in Fig. 7*b*, which represents a constant rate of increase, when *differentiated*, gives a constant value of E.M.F. The particular example is just a simple case illustrating the more general principle of graphic calculus. Thus, in Fig. 8 we have an arbitrary varying E.M.F. 8*a* applied to an inductance. The graph 8*b* representing current is derived from 8*a* by measuring areas such as that shown shaded (by means of a planimeter), and laying them off to a suitable scale to give the current at any instant as in Fig. 8*b*, and, conversely, if the graph of the current be given the corresponding E.M.F. value is derived by laying off ordinates (Fig. 8*a*) proportional to the slope (tan. angle) of the graph in Fig. 8*b*. So that we have learnt to regard the circuit of Fig. 3 as an *integrating* circuit, the *current* is an integration of the applied E.M.F. But we want a new *E.M.F.* which is the integration of the input E.M.F. By passing the current through a resistance (the potentiometer) the desired result is attained; the potentiometer is used, incidentally, as a volume control.



Figs. 8a and 8b.—A current variation plotted in accordance with this article.

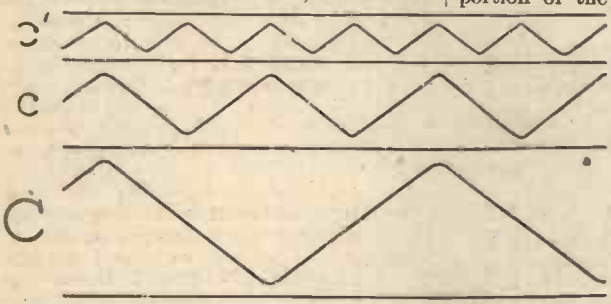


Fig. 9.—The record trace to give correct reproduction of C and its octaves.

TABLE I.

Frequency=f ..	64	310	1,600
$P=2\pi f$	400	2,000	10,000
R=infinite Imp.=	20,000	100,000	500,000
R=100,000 Imp.=	19,600	70,000	98,000
R=20,000 Imp.=	14,100	19,600	20,000

TABLE II.

Frequency=f ..	64	310	1,600
R=infinite	×6	×26	×126
R=100,000	×5.1	×18.5	×25
R=20,000	×4.5	×5.1	×6
R=0 *	×1	×1	×1

* Tone control cut-out.

The Action of an Integrating Circuit

Let us now see in what manner this integrating circuit acts in interpreting the gramophone record. Let Fig. 9 represent the trace required to give equal energy for middle c' and the c one and two octaves below respectively; we have seen that these cannot be properly recorded. For reasons that will be supplied later, in Fig. 9 a zig-zag has been substituted for the more conventional sine curve. Now, if we differentiate these zig-zags which (representing equal energy or power) are all of the same slope, we get a new set of three curves (Fig. 10) whose ordinates are all equal, for as explained, in differentiating, the ordinate is drawn proportional to the slope of the parent curve. We see at once that these differentiated curves fit into the recording scheme, *they represent equal energy for*

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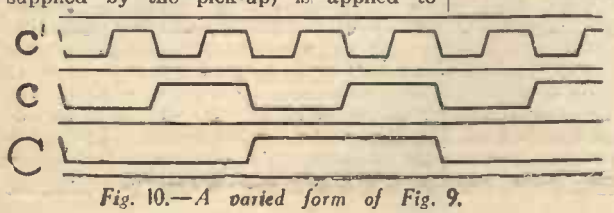


Fig. 10.—A varied form of Fig. 9.

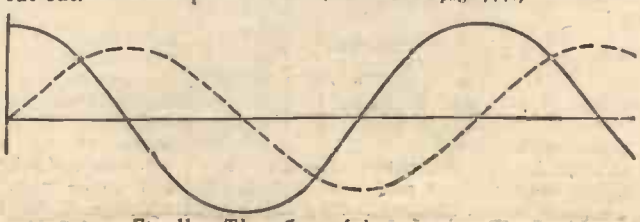


Fig. 11.—The effect of harmonics.

Receivers and their Records

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

WHEN so many makers are devoting their activities to the production of mains operated receivers it is pleasant to know that there exist some reliable battery sets on the market which, offered at a reasonable figure, fulfil the requirements of the man whose house is not equipped with electric current. The "*Aerodyne*" *Screen Grid* "3", is one of the most popular models of the range of receivers made by Hustler Simpson and Webb, at their Walthamstow (London, E.17) works. It is, in effect, a highly sensitive instrument embodying a variable-mu screen-grid valve of the latest type, power grid detector and super-power output valve feeding a permanent magnet moving-coil loud-speaker. (Although the receiver is primarily designed for battery operation, it will function equally well if current is supplied by a high tension eliminator.) The receiver is housed in a cabinet of neat appearance; its design is strictly modern, and the general finish leaves nothing to be desired.

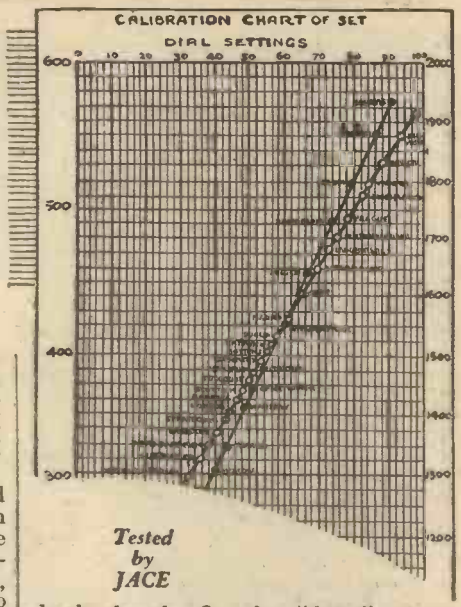
All the necessary controls—four in number—have been symmetrically grouped on the front of the cabinet below the loud-speaker grille. The main tuning knob which works the ganged condensers is also incorporated with a separate trimming device which acts as an auxiliary condenser and is of the utmost importance to fine tuning. By this means it is possible to increase the strength of weak signals in conjunction with the reaction and volume controls. The trimmer or compensator is on a spindle concentric with the main tuner knob. Underneath it will be found the combined "on" and "off" and wave-change switch giving three positions—namely, "shortwave" (250-500m.) to the left, "longwave" (1,000-2,000m.) to the right; and "off" when the point thus marked is uppermost. On the extreme left is the control which provides a variable volume. This is obtained by means of a 25,000 ohm potentiometer working on the bias to the screened-grid high-frequency valve. Finally, the right-hand knob represents "reaction"; it works smoothly and no difficulty was encountered in obtaining good sensitivity whilst keeping the valves just below oscillation point. There is a knack in tuning a receiver which the beginner must set himself to acquire at the outset, if satisfactory results are to be obtained. This principle applies to all receivers. A search for a transmission is facilitated if the volume control is first set at its maximum position. Tuning is then carried out by means of the main condenser knob or dial, in conjunction with the reaction control. When signals are heard they should be brought up to the required volume by means of this main tuner, and a finer reading on the scale secured by the concentric trimmer. Reaction must be kept as low as possible; if the mark is over-stepped the set will burst into oscillation and signals are blurred and distorted. If they are too loud, reaction may be further reduced by the appropriate control knob. When dealing with transmissions on neighbouring wavelengths, which require separation, it is better to reduce volume, to re-tune carefully, in particular with the trimmer or compensator, and to increase reaction within reasonable limits. Controls of all receivers, irrespective of their make and design, should be turned slowly if full advantage is to be taken of the selective properties of a circuit.

"AERODYNE" SCREEN GRID "3"

On test the "*Aerodyne*" *Screen Grid* "3" gave a very good performance and a number of British and foreign broadcasts were

The "Aerodyne" Screen Grid "3."

received at good loud-speaker strength. For the purpose, both outdoor and indoor aerials were used; in the latter case local transmissions provided good signals, but except under the best conditions, foreign stations were below useful strength. There are two aerial sockets at the back of the cabinet—namely, A1 and A2; the latter provided a higher degree of selectivity than the former, and proved its utility when dealing with severe interference. During daylight hours it was found possible, when coupled to an outdoor aerial, to hear Daventry, Radio-Paris, Eiffel Tower, London Regional and National programmes; during the evening, in addition to these transmitters, many others were successfully logged. The circuit showed a good degree of selectivity in permitting the separation of London National from Trieste, and again from Heilsberg; with better adjustment of the controls Turin was



Tested by JACE

clearly heard. On the "long" waves, such stations as Motala, Eiffel Tower, Daventry and Huizen could be tuned in easily, but Königs Wusterhausen was not clear of its neighbours. On the lower portion of the coil there appeared to be a break-through of the London transmission, but this occurred only over a small portion of the scale and did not interfere with the above-mentioned broadcasts.

The dial is very clearly marked in degrees, a principle which many makers might adopt, as, against readings in actual wavelengths, unless perfectly calibrated, such markings are liable to puzzle the beginner, because if any discrepancy occurs it makes identification of the transmitter a difficult matter.

The "*Aerodyne*" *Screen Grid* "3" may also be used for the electrical reproduction of gramophone records. The pick-up sockets are located at the back of the cabinet and it is only necessary to plug in the pick-up leads to obtain the desired result. To avoid, however, the superimposing of radio on gramophone signals, it is advisable to detune the instrument—namely, to make sure that the dial reading does not tally with the wavelength of a powerful local transmission. If volume of reproduction is too great, an external potentiometer control may be adopted. Generally speaking, the *Aerodyne* passed its tests very satisfactorily. It has been built with care and forethought and the construction shows a good standard of workmanship. The components have been carefully grouped on the metal chassis, and to ensure efficiency, all wiring is carried out under the base plate. The moving-coil loud-speaker gives an excellent quality of reproduction, with a very even response throughout the scale. Speech was crisp and clear, and tone remained natural so long as volume was not injudiciously forced.

The "*Aerodyne*" *Screen Grid* "3" (Battery) may be strongly recommended as an all-round efficient receiver which, although listed at the reduced price of £9 9s., is capable of giving the listener the choice of a number of British and foreign programmes. The makers, in order to assist beginners in wireless, have issued clear and concise instructions in the booklet supplied with the set, and to facilitate matters, have labelled every single lead in the cabinet which an unskilled person may be called upon to handle.

Introducing

THE SEL

AN ULTRA-EFFIC

Wonderful Receiver; Novel in Principle,

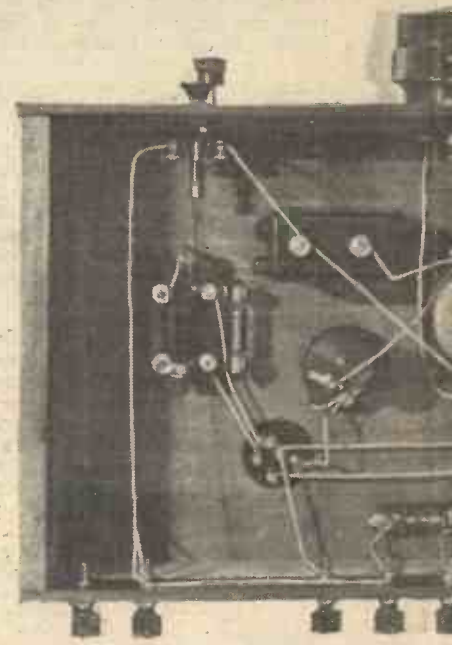
By FRANK

Mr. Preston, the designer of this interesting receiver

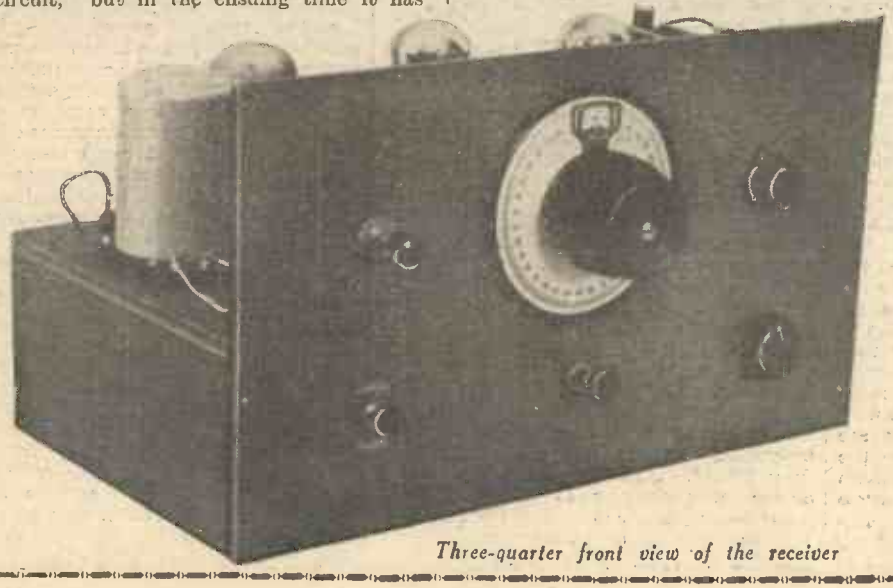
IN the first issue of PRACTICAL WIRELESS the Editor kindly invited me, along with my colleagues, to describe my favourite circuit. Since the time of publication numerous queries have been addressed to me (c/o the Editor) asking for further details and practical data in regard to the construction of a set employing the circuit I described. In each case I have been compelled by reason of our rules to ask those querists to wait for a little while, because (I did not tell them this) I was experimenting on a greatly improved version of my original idea. All readers of PRACTICAL WIRELESS are by now well aware of the fact that we absolutely refuse to supply constructional details of any set which has not been made and subjected to the strictest and most rigorous tests in our own laboratories. In no other way can we give an absolute guarantee of the set's performance. The Selectone, which I am going to describe, started its life on the test bench several months ago as a practical example of "My Favourite Circuit," but in the ensuing time it has grown to full maturity. It has passed through many experimental stages, and even six weeks ago it was a set of which I was proud. But that was not enough; I was determined that before I would present the design to readers of PRACTICAL WIRELESS the set must not only be good, but it must be as near perfection as possible. I should not have prepared this article now were I not confident that the Selectone is better than any other contemporary receiver in its class, and also that it represents a very definite step forward in design and technique.

Perfect Tone Control.

Before telling you just what the Selectone will do let me give an outline of its special features. In the first place the circuit is on the Stenode principle, which means that tuning is so dead sharp as actually to cut off a portion of the sidebands. For this reason the tuner is purposely designed to weaken the higher musical notes, *but* by using a variable tone control, which can be operated at will by the listener those notes can be restored to any desired extent. The full significance of this feature must be experienced to be fully appreciated, but it ensures that any desired tone from "shrill" to "boomy" bass can be obtained as desired. More than this, however, it makes possible in mild



The underside of the baseboa



Three-quarter front view of the receiver

LIST OF COMPONENTS

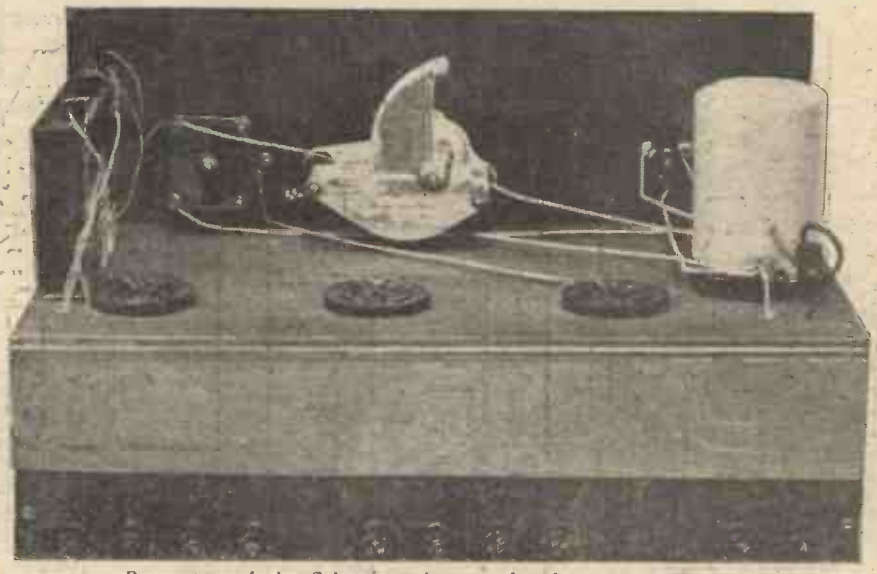
1 Vibranti plywood panel 14in. by 8in.
1 Utility Standard .0005 mfd. condenser.
1 Utility type W. 181 micro-dial.
1 Lissen .00015 mfd. differential condenser.
1 Colvern type "T.D." coil.
1 Lissen 3-point wavechange switch.
1 Telsen on-off battery switch.
1 Wearite type "G.C.O." radio-gram switch.
1 Lissen 5,000 ohm. potentiometer.
3 Eddystone chassis mounting valve-holders.
1 T.C.C. .0002 mfd. fixed condenser.
1 Dubilier 3 megohm grid leak.
1 Dubilier grid leak holder.
1 Telsen Standard H.F. choke.
1 Benjamin Transfeeda.
1 T.C.C. 2-mfd. condenser.
1 Varley Rectatone transformer.
1 Belling Lee baseboard fuseholder with 60 m.a. fuse.
10 Belling Lee "Junior" terminals; 1 each marked A, B, L.T.+, L.T.—, H.T.—,

ECTONE

ENT BATTERY SET

in Conception, in Design and in Performance

RESTON, F.R.A



Rear view of the Selectone, showing the clean appearance

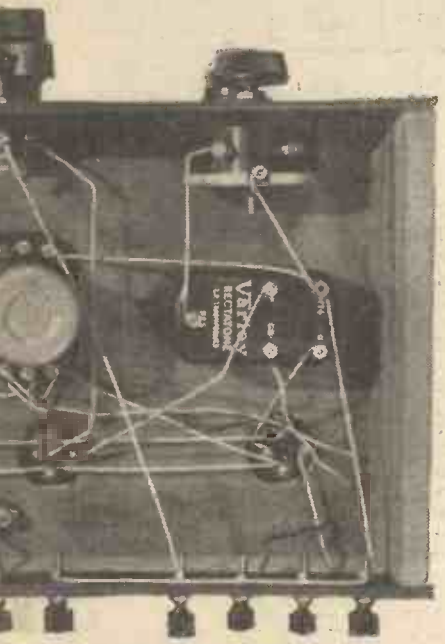
cases the complete elimination of heterodyne whistles created by stations working on adjacent wavelengths. This latter is impossible with any ordinary receiver unless fitted with a special whistle filter.

Variable Selectivity

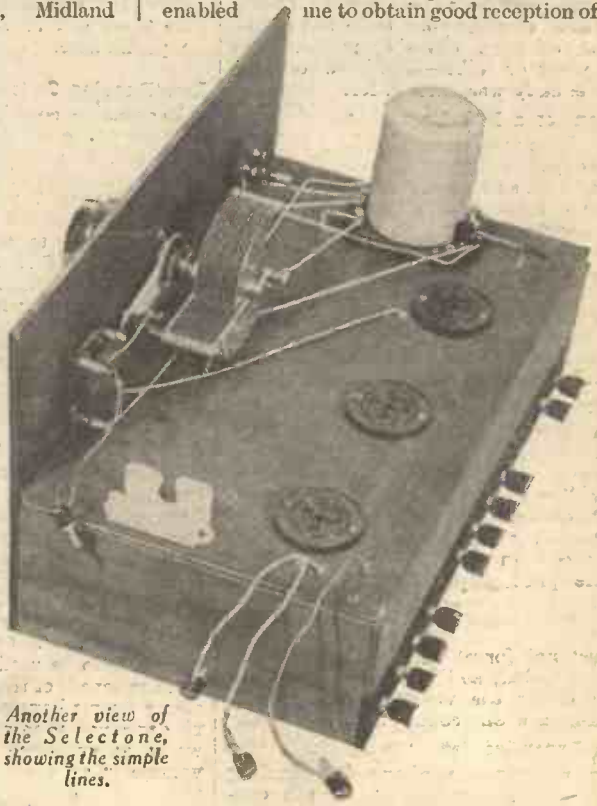
Tuning is perfectly sharp, so that no station (even if it is situated a few miles from your aerial) will occupy more than two or three degrees on the special micrometer tuning dial. The Selectone is not merely highly selective, however, but the degree of selectivity is under full control, and can be altered to suit any and every set of conditions. The extreme selectivity ensures a silent background and real enjoyment of the programme being received. On the long waves, Daventry, Zeesen and Radio Paris can all be received separately, even though the frequency separation of the two former stations is only 4 kilocycles, or insufficient to permit of their separation with a band pass tuner. Such stations as North Regional—Langenberg, Midland Regional — Bucharest and North National—Hilversum on the medium waves can be separated with ease, whilst even Mühlacker and London Regional can be received clear of each other by a slight sacrifice of the higher frequencies.

Sensitivity

Most highly selective receivers, except those using a large number of valves, are not particularly sensitive, but that cannot be said of the set under review. During the first test of the final model (at least four others were made during the experimental period) forty-two stations were well received at good speaker strength when using an outside aerial of 70ft. overall length. Reducing the length to 40ft. had very little effect, and even when the set was transferred to a poor indoor aerial running round the picture rail of a downstairs room, no fewer than twenty-five stations could be brought in at good programme strength. As the tuner covers a range of from under 200 to just over 500 metres in the medium-wave position, and from about 850 to 2,000 metres on the long waves, practically every worth-while European and American station is covered. It will be of interest to would-be constructors to learn that a few hours after completion the Selectone brought in two American medium-wave stations, KDKA on 306 metres and WGY on 379.5 metres, at fair speaker strength, even though the time (Greenwich) was only 1 a.m. Such popular Continentals as Fécamp, Bucharest, Hilversum, Rome, Mühlacker, Moscow and Radio Paris can always be relied upon to provide really good loud-speaker signals at any time of day or night. As a matter of fact a short test during the afternoon enabled me to obtain good reception of



ard showing the simple wiring



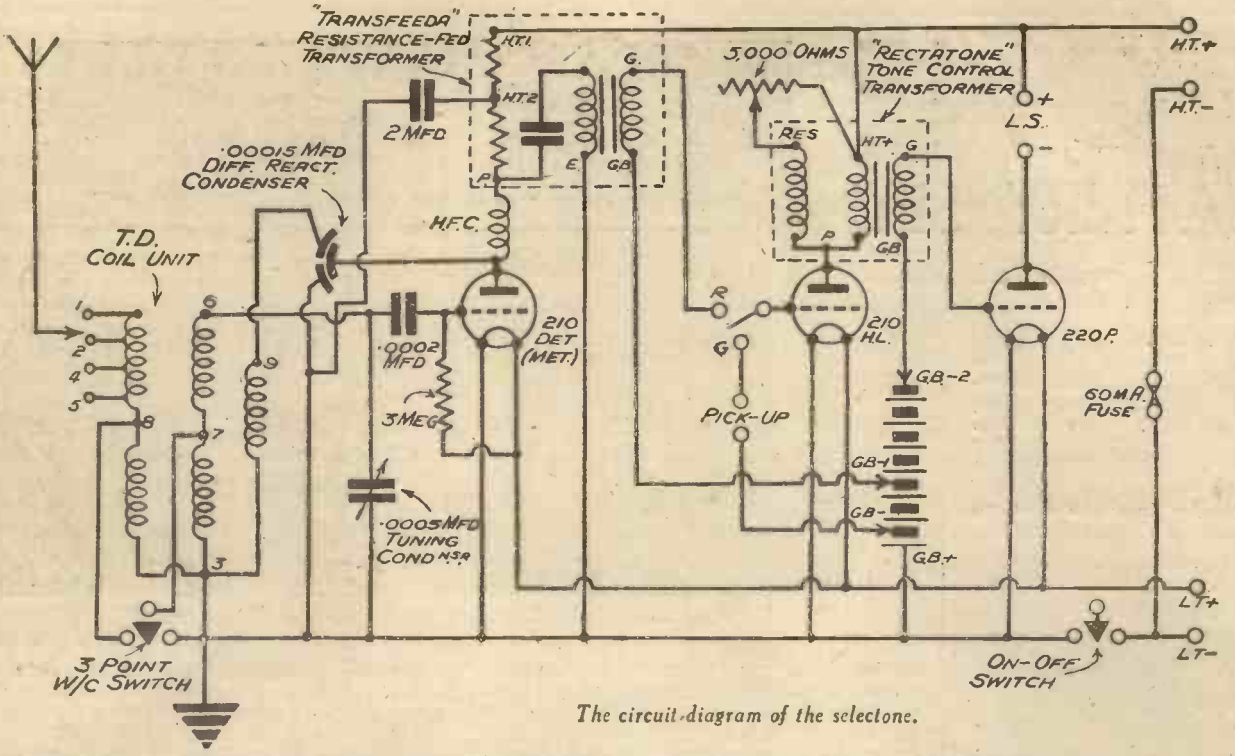
Another view of the Selectone, showing the simple lines.

FOR THE SELECTONE

H.T.+, L.S.—, L.S.+, and 2 marked Pick-Up.
6 Belling Lee wander plugs; marked G.B.+, G.B.—, G.B.—1, G.B.—2, H.T.+, H.T.—.
1 Strip Becol ebonite, 14in. by 1½in.
1 Bulgin G.B. battery.
1 Coil Glazite connecting wire.
1 short length flex.
1 5-ply baseboard, 14in. by 8in.
2 pieces hard wood, 14in. by 3½in. by ½in.
1 piece 3-ply, 14in. by 2in.
Approximate total cost — £4 10s. 0d.

Accessories.

1 Camco "Excelsior" or "Aston Senior" cabinet.
3 Cossor valves; 1 type 210 Det. (metallized), 1 210H.L. and 1 220P.
1 Ediswan 9v. G.B. battery.
1 Ediswan 105v. super capacity H.T. battery.
1 Ediswan 2v. 40 a.h. accumulator.
1 Celestion Soundex permanent magnet moving-coil loud-speaker.



The circuit diagram of the selectone.

a dozen foreigners. I will say no more at this juncture about the actual stations received, but will leave that matter for a later article in which I will give a more complete log and figures in relation to dial readings.

Loud Speaker Quality

The quality of reproduction will meet with the approval of the most fastidious of music lovers, whilst the fact that the actual tone can be varied will be keenly appreciated, whether your taste lies in the direction of jazz, chamber music, brass bands, plays or talks—high-brow or low-brow is equally well catered for.

Provision for a Pick-Up

Yes, I have made provision for a pick-up, and the quality of gramophone reproduction is just as good as that of radio programmes. The tone control is also operative on gramophone music and, in addition to its normal function, it can be employed as a scratch filter, so making it possible to eliminate needle scratch. The pick-up is brought into circuit by the action of a switch mounted on the front panel, so there is no need to probe about inside the set to effect the change-over.

Appearance

Both from inside and out the Selectone looks as good as it is. The clean layout and use of a box-form chassis make the interior "look good," whilst the Cameo cabinet, designed specially for this set, is of particularly handsome and attractive appearance; in fact, I can honestly say that the photographs do not do justice to it.

Safety

I must not forget to add that a safety fuse is provided, so that it is impossible to damage either the valves or components by making a wrong connection.

Not an Expensive Set

After reading the above introductory remarks you may have drawn the conclusion that the Selectone is going to cost rather a lot to build. I would not go so far as to say it is a "cheap" set, but it is definitely not expensive. Considering that it gives results equal to most super-heterodynes, and better than many of them, its cost is distinctly reasonable. You will see from the list of components that the price of the bare set is approximately £4 10s. 0d., in spite of the fact that really high-grade and modern components are specified. If you add to this the cost of the cabinet, valves, batteries and speaker you will find that there will be some change out of a ten-pound note.

Low Running Costs

Reasonable cost is not confined to the building of the set though, because running costs are, in proportion, even lower still. The consumption of high-tension current is no more than 7 milliamps when using a 108-volt H.T. battery, or 10 milliamps with 120 volts high tension. Filament current consumption is .4 amp., and so the 30 ampere-hour accumulator will give about 75 hours' running per charge. If you have a H.T. eliminator, even of the smallest type, it will be quite suitable for this set, because adequate decoupling is provided, and only a single H.T. positive tapping is required.

Ample Loud Speaker Output

When using the valves specified, in conjunction with a 108-volt high-tension battery, the Selectone has a maximum undistorted output of about 110 milliwatts, or with a 120-volt battery the output is 140 milliwatts. If desired the undistorted output can be brought up to 170 milliwatts by increasing the H.T. voltage to 150, but this will not be necessary unless the set is to be used in a very large room. For the benefit of those readers to whom the above figures have no significance it should be explained that an output of 100 milliwatts is sufficient to give really good volume in an average sized drawing-room when using a sensitive moving-coil speaker of the type specified.

For "Old Hands"

The Selectone will have a particularly strong appeal to "old hands" who are tired of reading descriptions of so many "new" sets which are obviously mere modifications of those they have been building for years. The new principles, up-to-date constructional methods, *de-luxe* features, really sensible and easily-calibrated tuning dial and businesslike appearance are just a few of the things that will at once be recognized. In addition they will be pleased to have a set with which the number of stations receivable varies in proportion to the skill of the operator. By skilful use of the reaction control the range of reception is truly unlimited.

—And Beginners

But the beginner will also find the set just to his liking. Its method of construction, combined with the complete wiring charts, sketches and photographs to be given next week, will be found so simple and straightforward that the veriest tyro need not hesitate to build the Selectone with full confidence of success. Although as pointed out in the last paragraph, the results vary in relation to the skill of the operator, I have proved that a person without any experience of receiver operation can bring in a goodly number of stations by the mere process of revolving the tuning knob. As a matter of fact, I recently asked an oldish lady to see what she could do with the Selectone, after I had connected the batteries. The test was made during the evening on an 80-foot aerial situated some twenty miles from the North Region transmitters. She did not attempt to use the reaction control at all, and yet was able to bring in eleven stations on the medium waves and four on the long. The tuning of each of the Northern stations spread over less than four degrees, and neither station could be heard *in the slightest degree* when the set was switched over to long waves. That, I think, is wonderful proof of the Selectone's capabilities!

CAN YOU READ A GRAPH?

FRANK PRESTON, F.R.A., here explains in straightforward language the advantages and use of graphs of the types frequently employed for wireless purposes.

AS you have observed, graphs are employed very frequently in wireless work and provide a simple means of supplying a large amount of data in what might be called tabloid form. Immediately you open a valve carton you find inside a graph showing the characteristics of the valve; when buying a transformer you are often supplied with a graph which shows its response to various frequencies; every week in PRACTICAL WIRELESS you will find on the page devoted to "Receivers and their Records" a graph showing the condenser settings for the various wavelengths; in a recent issue of PRACTICAL WIRELESS I gave some graphs from which one can find the ratio of an output transformer suitable for various combinations of loud-speakers and valves. But I need give no more examples—you know the kind of diagram I refer to.

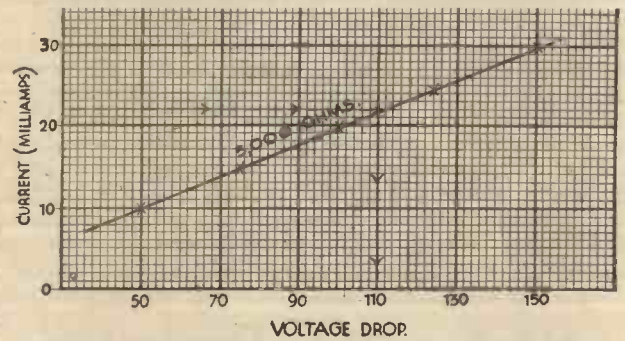


Fig. 1.—This graph shows the relationship between voltage drop and current for a 5,000 ohm resistance.

What do all these graphs mean to you; can you understand them and use them to the best advantage? I know perfectly well that many readers fight shy of graphical diagrams because they look uninteresting and perhaps rather "highbrow," if I may use that much overworked word. Believe me, they are neither, if you will spend about half an hour in considering them. A graph is a much easier thing to understand than is a bowling analysis or a bridge score card, once the basic principles have been grasped.

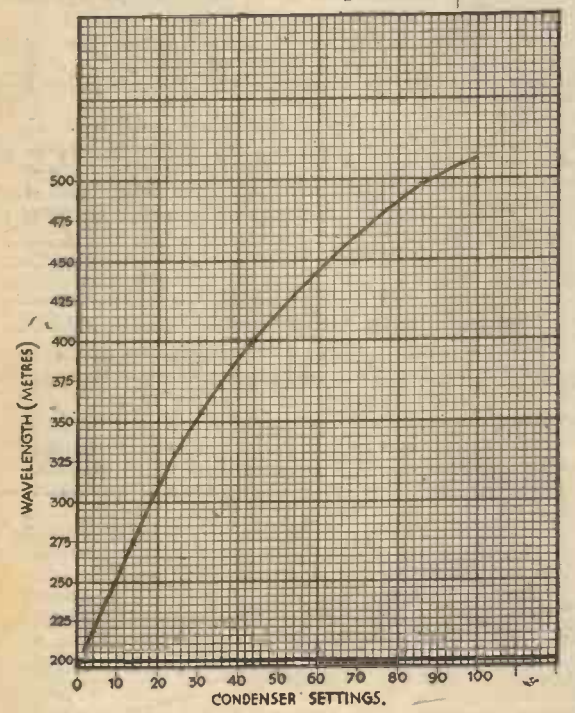


Fig. 2.—A typical tuning curve.

What a Graph Is

Stated briefly, a graph is a diagram used to show how one factor varies in relation to another. Thus we could, and often do, prepare a graph to show how the temperature changes from day to day or how the value of the pound fluctuates. A graph could also be used as a ready reckoner, so that corresponding values of two variable quantities can be read off at a glance. As an example of this I would ask you to compare the following table with the graph of Fig. 1.

Current. m.a.	Voltage Drop. volts.
5	25
10	50
15	75
20	100
25	125
30	150

Both the table and the graph show the voltage drop across a 5,000 ohm resistance when passing various values of current. But whereas the table only gives the voltage drop at a few specified current ratings, the graph is applicable to any current. For instance, we could not find from the table the voltage drop at, say, 22 milliamps, but by using our graph it is immediately apparent that the required figure is 110 volts. The result is obtained by finding 22 milliamps on the vertical scale and taking a horizontal line across to the graph; where it cuts the latter we take a vertical line down to the lower scale and read off the answer. By working in the reverse manner we could find the current necessary to produce any required voltage drop.

Curves

The graph of Fig. 1 is of the simplest kind, where the two variable factors, voltage and current, are in simple proportion. It is because of the latter fact that the graph is represented by a straight line. But it is more usual to find the relationship expressed by a curved line, such as that of Fig. 2, which is a typical tuning graph for a receiver.

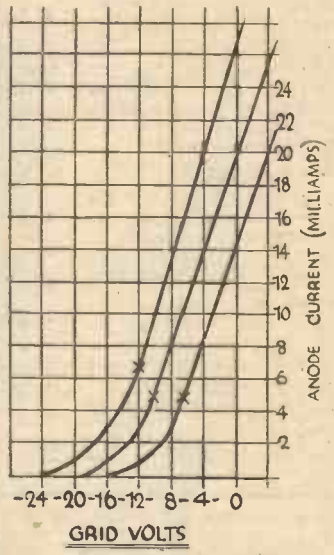


Fig. 3.—A "grid volts—anode current" curve of power valve.

Tuning Curve

The curve has been drawn by plotting various condenser settings against the corresponding wavelengths. Actually the curve was prepared by tuning in a few stations of known wavelength at different parts of the condenser dial and marking with a small cross the wavelength appropriate to each setting. Having obtained a few positions a smooth curve was drawn through them. When the curve is drawn it can be used to find the wavelength of the set at any position of the condenser or, conversely, to find the condenser setting required to tune the set to any desired wavelength.

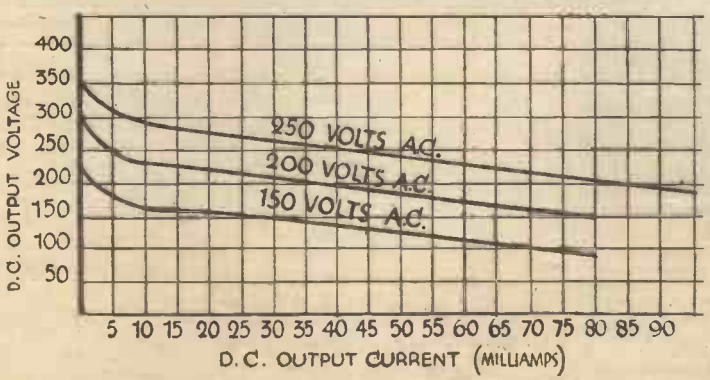
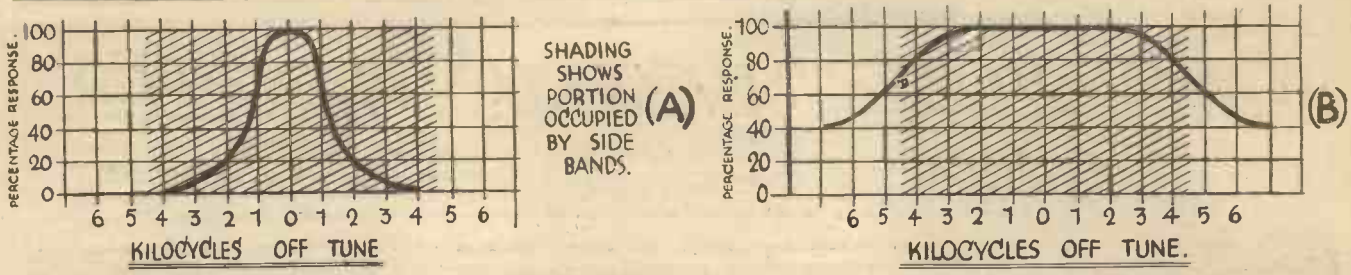


Fig. 4.—Load current for a half-wave rectifier.

"Anode Current—Grid Voltage" Curves

A similar kind of curve can be drawn to show how the anode current of a valve



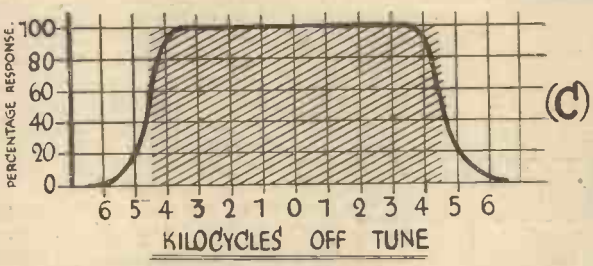


Fig. 5 A. B. and C.—Response curves for different kinds of tuned circuits.

varies with the grid bias voltage. The graph of Fig. 3 is that supplied by the makers in relation to a typical small power valve.] In this case three curves are drawn on the same graph to represent the conditions existing at three different anode voltages. Besides showing how much anode current the valve will consume, the graph can be employed to find the correct grid bias voltage for different anode voltages and also the power handling capacity of the valve. Space does not permit of my entering into the theory of valves here, but it can be explained that to produce distortionless amplification and to prevent overloading, the valve should always be worked on the part of the "curve" just above the lower bend. Thus when 100 volts H.T. is used the correct G.B. voltage is approximately 7.5 and at these voltages the anode current consumption will be about 4 milliamps. In the same way it will be seen that when 150 volts high tension is used, the correct grid bias voltage is about 12 and the anode current rather more than 6 milliamps.

Rectifier Output

Another use for a graph is to show the voltage output of a rectifier under varying conditions of current load. Fig. 4 shows the "load curves" for a half-wave rectifying valve when fed from three different transformer voltages. It will be seen that when 200 volts A.C. is applied to the rectifier the output voltage is 250 with a load of 10 milliamps, or 170 volts with a load of 75 milliamps (the maximum for this valve). The graph enables us to see at a glance what the output voltage would be at any particular current load. This information is invaluable when designing an eliminator or mains receiver because it enables us to calculate with certainty the correct values for the various H.T. fed resistances.

Curve Shape

Quite apart from obtaining accurate numerical data a good deal of information can often be gained merely by studying the *shape* of the curve. As an example of this I would ask you to examine the graph of Fig. 5 (*A*) which shows the response of a tuning circuit to different frequencies. The zero position on the horizontal scale represents the frequency of the carrier wave of a station and the figures on each side refer to the frequency of the side bands or musical notes impressed on the carrier wave. It will be seen that although full response is given to notes of low frequency, the response to high frequencies falls off very rapidly. The curve tells us that the circuit under review tunes very sharply and cuts off, or gives little response to, the higher musical frequencies. In consequence, it will provide excellent selectivity, but must be followed by some kind of tone-correction device if good reproduction is required. Now compare the graph of Fig. 5 (*A*) with that of 5 (*B*). The latter obviously represents a flatly-tuned circuit which would be unselective but would give practically an even response to all musical notes.

Fig. 5 (*C*) is the response curve of an ideal band-pass tuner; equal response is given to all musical frequencies up to 4½ kilocycles (the highest permissible under the present scheme of 9 kilocycle separation between stations), but higher frequencies are given a sharp cut-off. Thus the circuit represented will be very selective, even though giving full response to all musical frequencies. The curve will explain the reason for the term "square-peak" as applied to a certain band-pass tuner.

Voltage Amplification

Another kind of graph, of which the shape of the curve is most instructive, is that which is used to show the percentage amplification afforded by a low frequency transformer at various musical frequencies. Fig. 6 is a typical example of a percentage amplification-frequency curve, and shows us that the transformer represented gives practically uniform amplification to all frequencies from about 150 cycles per second to just over 2,000 cycles. Below 150 cycles the amplification falls off rapidly, whilst the same thing occurs above some 5,000 cycles. There is a "peak" at 4,000 cycles, and therefore notes round about this frequency will be emphasised to a certain extent. The curve is fairly representative of an average low-priced L.F. transformer.

It will be noticed that the scale of frequencies is graduated so that the lower frequencies are more "spread out" than the higher ones; this arrangement is generally employed in connection with musical notes since it gives a better representation of performance at the frequencies most commonly employed.

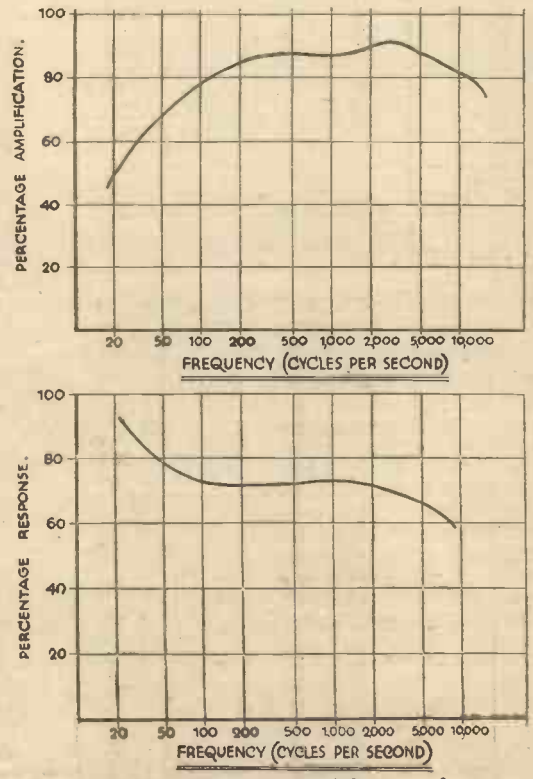


Fig. 6 (above).—Percentage amplification—frequency curve for an L.F. transformer.

Fig. 7 (below).—Response curve for an up-to-date pick-up.

Pick-Up Response

And now it will be interesting to compare Fig. 6 with Fig. 7. The latter is the response curve for a good up-to-date gramophone pick-up. The response to frequencies between about 100 and 2,000 cycles is more or less uniform, but the curve *rises* below 100 cycles and falls gradually above 2,000 cycles. A pick-up with characteristics such as these would make it possible to obtain an almost equal (loud-speaker) volume from all sound frequencies because the lower frequencies are of necessity attenuated (reduced in intensity) by the process of recording.

For the Practical Man

It would be impossible in a short article such as this to refer to every kind of graph, but it is hoped that sufficient has been said to enable every reader to give a correct interpretation to all those in common use. Remember that, although graphs are often prepared by the technician and theorist, they are intended for use by the *practical* man, and it is he who benefits most by them.

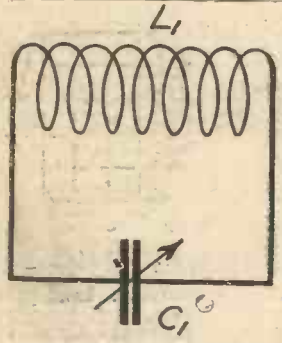


Fig. 1.—A closed circuit as used in the absorption wavemeter.

THE SIMPLEST WAVEMETER

A Practical Article on the Construction and Use of an Absorption Type Wavemeter. By K. E. BRIAN JAY

WAVEMETERS, or frequency meters as we ought to call them in these days, are of two kinds, heterodyne and absorption. The difference between them is this: the heterodyne type puts a signal of known wavelength into the receiver, while the absorption type takes power out of the receiver at a known wavelength. The first kind will obviously be elaborate, since it must contain the means of generating a signal; older types used a buzzer for this purpose, but were not very accurate; the modern instrument, the true heterodyne type, employs a valve which, acting as an oscillator, generates a signal that sets up a beat note in the receiver. Heterodyne wavemeters can be very accurate, but are unnecessarily complicated and expensive, for such purposes as the ordinary listener requires them.

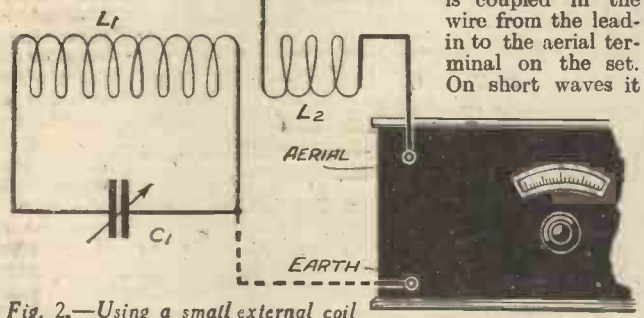


Fig. 2.—Using a small external coil for coupling the meter.

Absorption Type Wavemeter

The absorption type, on the other hand, combines reasonable accuracy with cheapness, and a simplicity that is unusual in radio apparatus. It consists merely of a coil and variable condenser loosely coupled to the receiver so that it absorbs a little power from the receiver when it is tuned to the same wavelength; this results in the signals heard decreasing in strength, or if the receiver is oscillating it will go out of oscillation. Fig. 1 shows the theoretical circuit of an absorption wavemeter, L_1 being the coil, and C_1 a variable condenser. The meter can be made up by mounting C_1 on a small panel fixed to a baseboard upon which the coil rests. If hand capacity effects are noticeable, connect the moving vanes of the condenser to earth; in cases where hand capacity is very bad, or should the constructor be ambitious for extreme accuracy, the meter can be mounted in a screened box. A good slow-motion dial with easily-read divisions and a fine indicating line must be fitted.

In use the meter is loosely coupled to the receiver, the simplest method being to place the coil in line with the receiver-coil and within an inch or so of it. On rotating the meter dial one point will be found where the signal strength of the station being received falls away considerably; the meter is then said to be in resonance with the incoming signal, *i.e.*, tuned to the same wavelength. In general, however, it is not possible to get the meter coil near enough to the receiver coil, especially if the latter is screened or the receiver is in a cabinet. To overcome this difficulty the meter coil is coupled in the wire from the lead-in to the aerial terminal on the set. On short waves it will be sufficient merely to loop this wire once round the meter coil, but on the broadcast band this is not enough. A few turns of wire should therefore be put on the former of the meter coil and connected as L_2 in Fig. 2.

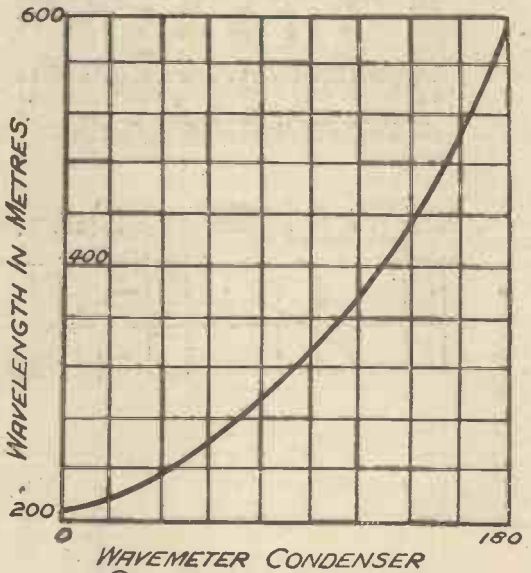


Fig. 3.—The tuning graph for calibration.

Constructional Details

With regard to constructional details, for C_1 any good variable condenser of .0005 or .0003 mfd. capacity will be satisfactory. The size of L_1 is not particularly critical: as a guide to making it at home, 65 turns of 28 D.S.C. S.W.G. wire wound on a cardboard tube of 2¾ins. diameter were found to tune from 239 metres at 49 degrees on a .0005 mfd. condenser, to 480 metres at 118 degrees. Corresponding readings of 72 degrees and 170 degrees were obtained with a .0003 mfd. condenser, which would therefore require a larger coil to cover fully the medium waveband; probably 70 to 75 turns would suffice for most purposes, any gauge of wire between 24 and 30 being suitable for either coil. A commercial unscreened dual-range coil would do quite well, and cover the long waves in addition. Whichever type of coil is used, however, it will be necessary to put on L_2 oneself. On the medium broadcast band about 8 turns wound close to one end of the coil should do, but on the long waveband more may be needed. This is a matter for individual experiment, the aim being to obtain as marked a reduction of signal strength as is possible, compatible with sharp tuning on the meter. To find out whether the coil L_1 is of the right size, if it is home-made, tune the receiver to a station as near the bottom of the waveband as possible, and adjust the wavemeter to resonance; the wavemeter dial reading should be near zero, say, 20 to 30 degrees for Fécamp on 223 metres. Do the same for a station, such as the North Regional, near the top of the band; in this case the meter reading must be around 160 degrees. As long as the whole waveband is within the wavemeter dial all is well. If the shorter wave station is at, say, 70 degrees, however, the coil will probably be too small; if no resonance point at all can be found for it, and the longer wave station is around 100 degrees, the coil is too big.

Calibrating the Instrument

We have now to calibrate our instrument, by no means a difficult operation despite its great importance. All that has to be done is to tune in as many reliable broadcasting stations of known wavelength as possible, tune the wavemeter accurately to resonance with each, and note its dial reading and the wavelength of the station. The

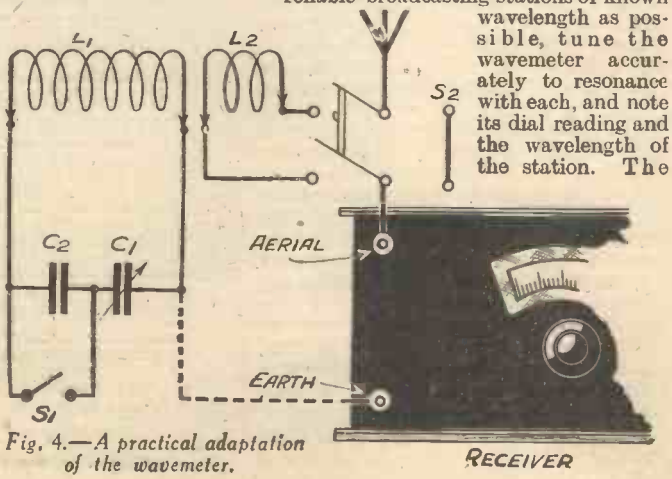


Fig. 4.—A practical adaptation of the wavemeter.

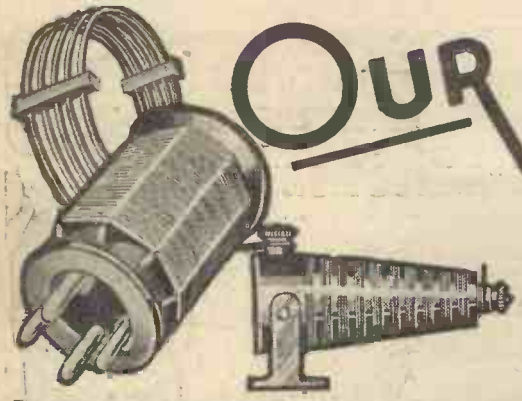
B.B.C. stations will give a useful nucleus of points, and there are several high-power foreigners who will be audible on most sets. A graph is then plotted on squared paper as in Fig. 3, wavemeter dial readings being marked along the bottom and wavelengths up the left-hand side.

The wavemeter can then be used to assist in identifying an unknown station. Suppose such a station is heard: the meter is coupled up to the receiver, and the knob turned until the signal strength is suddenly reduced. The condenser setting of the meter is then compared with the graph, and the wavelength read off. From one of the published lists of broadcasting stations the transmission nearest to this wavelength is found, and the station identified quite easily. If it is desired to search for a certain station the meter is set to the appropriate wavelength, and the receiver tuned until there is a sudden falling off in background noise: the meter is then de-tuned.

This type of wavemeter is particularly useful on short waves, but in this case a rather smaller variable condenser is desirable. For example, a .0003 mfd. condenser, together with a coil of 5 turns of 22 S.W.G. enamelled wire wound on a 2½in. former, will tune from 18 metres at 30 degrees to 50 metres at 180 degrees, and this is as wide a range as is comfortable. The same range is covered in less than 90 degrees with the same coil and a .0005 mfd. condenser, resulting in very cramped tuning; hence the smaller condenser is to be preferred. Coupling to the receiver is by a single turn of wire in the aerial lead. The most definite indication of resonance is obtained with the set just oscillating; at the resonant point it will stop oscillating with a click, and the coupling between meter and set should be such that the receiver stops and re-starts oscillating at practically the same point on the meter.

An "All-Wave" Meter

We have seen that a .0005 mfd. condenser, as used for tuning on the broadcast band, is too big for short waves, but in spite of this the wavemeter can be arranged to cover both long and short waves quite easily, by connecting a fixed condenser in series with the variable condenser, and so reducing its capacity to a value suitable for short waves. Fig. 4 shows such an "all-wave" meter. C_1 is the .0005 variable, and C_2 a .0005 mfd. fixed condenser: the total capacity of the combination is .00025 mfd., which will do for short waves. L_1 and L_2 are wound on the same former and arranged to plug in; ordinary six-pin formers could be used if they are available. Should it be felt that with .00025 mfd. tuning will still be unduly cramped on short waves, and there is no objection to using two or three coils, the effective capacity of C_1 can be reduced still further to about .00017 mfd. by making C_2 .0002 mfd. This will make the meter easier to tune, but several coils will be necessary. With the switch S1 closed C_2 is shorted out, and the whole .0005 mfd. becomes available for use on the broadcast band. Great care must be taken to keep the wiring of the meter, especially to S_1, quite rigid, or the calibration will not hold properly. On either waveband the meter may be left permanently in circuit. Deadspots can be avoided by de-tuning the meter or else cutting it out of circuit by a switch such as S_2, arranged as in Fig. 4.



OUR SHORT-WAVE SECTION

IT has nearly always been the writer's experience to hear the new-comer to short-wave reception express his disappointment at lack of results. Now, there is nothing fundamentally different in the construction of a short-wave set from one designed for normal broadcast use—in fact, from the detector onwards there is no need to make the slightest alteration in design. The tuning system is the heart of any set, and it is in this part of the receiver that the tyro so often errs. With this point in mind it will repay to investigate the matter at some length.

Nowadays it is customary for the tuning condenser in a normal broadcast receiver to have a capacity of .0005 mfd. In conjunction with a suitable coil the tuning range may often be from 200-600 metres; in terms of frequency this is 1,500-500 kc/s., or a band of 1,000 kc/s. width. Assuming we are using a 100 division tuning dial with a straight-line frequency condenser, each division will represent 10 kc/s. As probably most readers are aware, this is recognized as the width required by a simple broadcast transmission, although modern conditions have forced this separation down to 9 kc/s. It can be seen, therefore, that one station will occupy one division on our dial. Even tuning without a slow-motion dial presents no great difficulty. Let us now turn to our short-wave receiver and assume that we are using the same tuning condenser. With a suitable coil our tuning range very roughly may be 20-60 metres. Expressed in frequency this is 15,000-5,000 kc/s., or a width of no less than 10,000 kc/s., space enough for 1,000 stations spaced at 10 kc/s. intervals. Under these conditions there is room for ten stations to work comfortably in one division of the dial! Quite obviously a slow-motion dial is essential. Even then it is a tedious business searching. It is quite easy to see that the novice may very easily miss everything on tuning such a set, whilst in effect the dial may be alive with stations. An experienced amateur, thoroughly at home with a short-wave set, would not dream of tuning under such a handicap. Small wonder, therefore, that the tyro is beaten.

Small-capacity Tuning Condenser Necessary

The most obvious way of overcoming this difficulty is to use a tuning condenser of much smaller capacity. One often sees a .00025 mfd. specified. The writer, however, would never think of using anything larger than .0001 mfd. The great ease of tuning easily offsets the objection of limited tuning range, which in the case in point will be roughly from 20-27 metres. For those ultra-short-wave enthusiasts who like to delve into the mysteries of 5 and 10 metres, anything larger than .00005 mfd. (*four* 0's) is definitely taboo.

SHORT-WAVE TUNING

By E. JOHNSON

There is no basic reason why the normal broadcast receiver should not be used for short waves if provision is made for reducing tuning capacity. In passing it need hardly be said that careful attention must be paid to wiring and lay-out. Long straggling leads which pass muster on broadcast waves definitely will not do on short waves. Short and direct well-soldered connections are the way to success. Fortunately it is very simple to reduce our tuning capacity. All we need is a .0002 fixed condenser in series with our main tuning condenser. If the latter is the conventional .0005 mfd. our resultant tuning capacity is actually .00014 mfd., a value sufficiently near the one recommended above. Of course, a shorting switch must be fitted to cut out the fixed condenser when normal broadcast wave reception is desired. Fig. 1 will make this quite clear.

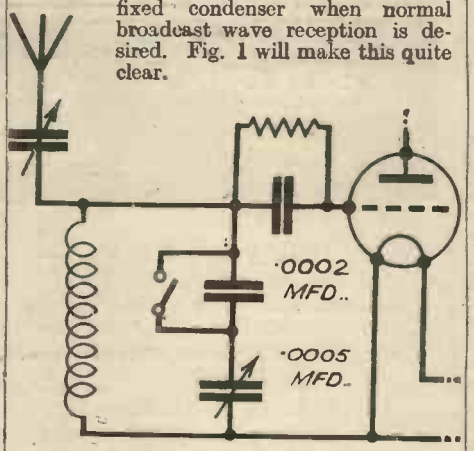


Fig. 1.—Method of switching to reduce value of tuning condenser.

The above method is very popular, but in the writer's opinion has rather a serious objection, viz., the switch. The ideal switch should have a negligible resistance in the closed position, a virtue seldom realized in practice. In any case switching in high-frequency circuits (especially *ultra*-high frequencies), is always a seat of loss. There is yet another drawback. Many short-wave sets are prone to body capacity effects, *i.e.*, the approach of the hand to the tuning dial entirely upsets tuning. Where the tuning capacity is small, especially at the lower dial readings, body-capacity troubles are usually noticeable because their extraneous capacity is a comparatively large proportion of the whole. A very simple way to overcome this, and one which has much to recommend it in another respect, seems at first sight contradictory to the first part of this article. In short, a .0005 mfd. tuning condenser is used with a .0001 mfd. in parallel. The large condenser is termed a band-setting condenser and is really not used for tuning-in at all. The procedure is as follows: Points are marked on the band-setting condenser corresponding to 20, 30, 40, 50, and 60 metres; the necessary stations must, of course, be tuned in for rough calibration. If we desire to search around 30 metres, therefore, all we have to do is to set our band-setting condenser to 30 metres and do the actual searching and tuning on the small condenser which will only have a tuning range of a few metres, thus making the handling of the set every bit as easy as on the broadcast waves. Another great advantage is that our body capacity is now a very small part of the main circuit capacity, and therefore has extremely little effect on the tuning.

Tuning coils need very little comment. Bare wire is the best, with as little dielectric as is compatible with mechanical strength. Regarding aerial coupling there is little doubt that a neutralizing condenser of low-minimum capacity in the lead to the receiver is the best solution, and simplifies matters by eliminating an extra coupling coil. Many new-comers worry because below 20 metres it is difficult to make the set oscillate without reducing aerial coupling to a very low value. Here and now it may be said that there is no need to be upset about this. On 10 metres the writer has known all the necessary aerial coupling to be obtained by merely dangling the aerial near the set. It seems that the lower one goes in wavelength the less necessary an aerial is, and, in fact, it seems quite likely that when these new micro waves are fully explored, aerials may be entirely dispensed with. After all, light is only a form of radio wave of extremely short length, and it would certainly seem ludicrous to find our street lamps complete with aerials to ensure proper illumination. This is certainly a case of *reductio ad absurdum*, but it illustrates the point.

MAKING IT OSCILLATE

By B. K. COOPER

OSCILLATION, the bane of the broadcast listener, is the short-wave enthusiast's necessity. Owing to the very small input of energy from the aerial to the grid of a short-wave detector, the valve must always work at maximum sensitivity, on the threshold of oscillation, in fact.

Probably the first effect noticed by the new-comer to the short waves on trying out his receiver is that the reaction control is

ineffective at certain settings of the tuning dial. Even with the condenser at maximum, no oscillation can be produced, and the set seems dead, except, perhaps, for faint murmurs from the very high-powered telegraphy stations. These "dead spots" are most likely to be encountered in sets of the simple detector and low-frequency type. Those employing a screen-grid high-frequency stage are usually free from them.

Aerial Damping

The dead spots arise from the "damping" effect of the aerial, and this is brought about in two ways. Firstly, there is the damping of a long aerial. This very often manifests itself by the set refusing to oscillate at all on the really short waves, say, from twenty metres downwards. It is often in evidence, too, at the top end of the condenser scale with certain coils, when higher reaction settings woud have to be used in any case.

To make an aerial effectively shorter, hence to reduce its damping, it is only necessary to couple it more loosely to the set. Most short-wave receivers include a very small variable condenser for this purpose in series with the aerial. Alternatively, the lead from the aerial terminal to the aerial coil is flexible, and provided with a tapping clip so that it can be connected to any portion of the coil found to give sufficiently loose coupling. Quite often both these schemes are employed, and it may be found that to make the set oscillate right down to fifteen metres or so, it is necessary to tap the aerial on to the coil at a point only half a turn away from the earthed end, and at the same time to reduce the setting of the series condenser slightly from its maximum.

It should be remembered that the more loosely the aerial is coupled to the set, the less volume will be given on all stations. You may find a very loose coupling that lets the set oscillate on every wavelength within its range, but do not leave it at that. Always work with as tight a coupling as you can, and do not grudge the little trouble you may have to take in finding the tightest practicable coupling you can employ on every station. Remember, tightest coupling and greatest volume, provided the set can be made to oscillate, are given with the aerial series condenser "all in," and the tapping clip at that end of the coil which is connected to the grid of the detector.

Eliminating "Dead Spots"

Even a short aerial will cause damping effects when its natural wavelength, or a harmonic thereof, coincides with the wavelength to which the set is tuned. "Dead spots" arising from this effect only extend over a few degrees on the dial, and conditions are normal on both sides of them. They can be shifted by making the aerial effectively longer, a proceeding that does not reduce volume. Try connecting a coil of thirty turns or so, wound on a former in series, with the aerial. Even a rather longer wire between the lead-in terminal and the set will sometimes be effective.

Damping may also be caused by long or carelessly-arranged leads in the wiring of the set. Every wire in the detector stage should be as short as possible. The coil holder, valve-holder, and grid-condenser should be spaced so that there is the smallest possible distance between those of their terminals that have to be connected to one another. Keep the leads to the variable condensers short as well, and see that they are well spaced.

TONE CONTROL!

(*Continued from page 764.*)

equal amplitude. And the fact that the recording instrument does actually reduce the amplitude below middle C to a constant, means that, in effect, the recording instrument does differentiate the "graph" for these low frequencies when engraving the wax. The differentiated record when interpreted by the ordinary gramophone sound-box as we know, does not sound right, *the differentiated record must be restored by integration*, this means that the graph of Fig. 10 is converted into Fig. 9 by the tone-control circuit, and the bass is *restored*, giving equality of energy.

Since the upper acoustic frequencies—above middle C—are recorded direct, and not differentiated, it would not be satisfactory to integrate everything that comes over; the object of the Resistance R (Figs. 2, 3, and 4) is to by-pass some of the E.M.F. from the pick-up, so that the signal received by the grid of the first valve, through the potentiometer, is in part integrated and in part direct.

A Question of Harmonics

There are several little points that require explanation. The reason the zig-zag has been chosen for illustration is in order that the parent and differentiated graphs should be different in appearance. If a sine curve be differentiated the result is another sine curve, out of phase with the first; the differentiation reduces sine curves of different frequency, but of the same energy value to the same amplitude, as with the zig-zag. This is shown in Fig. 11, but the contrast is not so striking. The zig-zag is justified by the fact that it is the type of trace made by a violin or other bowed instrument, such a graph including the *odd* harmonics only. But the bowed instrument does give forth *some* even harmonics of low intensity, and the zig-zag has rounded angles, as shown in Fig. 11. If it were not for this the differentiated curve would be absolutely square at its corners, and the needle could not follow the track.

To anyone not versed in acoustical theory the differentiated curve of Fig. 10 differs so strikingly from the parent zig-zag, Fig. 9, that it might be a matter for wonder how the record sounds as true as it does when used with the ordinary gramophone without integration. The answer is that it is not the shape of the graph that is important, except so far as the shape does define the harmonic composition of the note recorded; the same combination of harmonics (related pure tones) differently phased may, when recorded, make graphs of totally different appearance, but they all sound the same. Now the graphs in Figs. 9 and 10 both contain the same harmonics, but they are present in different proportions, and differently phased. The differentiation has, as we know, reduced the intensity of the bass relatively to the upper frequencies, and the shrill character of the ordinary gramophone rendering of the record is evidence of this fact, but the ear recognizes that the proper harmonics are there, and does not feel outraged, as it would were the harmonic combination changed.

It is of importance to examine the action of the integrating tone-control circuit quantitively. The inductance will be taken as 50 henries. The by-pass or tone-control resistance R will be taken at three different settings, namely: R = infinity, R = 100,000, and R = 20,000. We shall calculate the impedance of the circuit for these different settings at frequencies = 64, 310, and 1,600 cycles per second, the equation is:—

$$\text{Impedance} \quad \frac{1}{\sqrt{\frac{1}{P^2L^2} + \frac{1}{R^2}}}. \quad \text{Where } P = 2\pi f.$$

The results are given in Table I.

The potentiometer resistance (2,500 ohms) plus the resistance of the pick-up winding we shall denote by the symbol R_2; the value of this may be taken = 4,000 ohms. This is in series with, and therefore has to be added to, the impedances given in Table I. Since R_2 is the resistance or impedance which the pick-up has to overcome if the resistance R be made zero, there will be an attenuation = $\frac{R + R_2}{R_2}$ the additional magnification required to restore the signal to its full strength, that is, to make good the loss due to tone-control. Values for this are given in Table II.

We are able to see from these figures that the statement made at the outset, that tone-control, to be effective, requires an additional L.F. stage, is fully justified.

OUTDOOR AERIALS

(*Continued from page 761.*)

will tighten it to the mast. The mast side of the halyard can now be pulled down to release the hook when the stay wire can be permanently fixed to the stay block.

Doubtless, quite a number of our readers still make use of the single non-continuous halyard, although it is less convenient than the continuous type. During mending or cleaning operations, the reader may accidentally allow the first mentioned type to slip through the fingers, when it will usually fly up the mast, well out of reach. Should this happen, proceed as follows: Procure a length or lengths of pole (ordinary clothes props bound together will suffice) of sufficient length to reach the end of the wire or rope. Drive a nail into the end of the pole, obtain a length of cord, tie one end of the latter to the nail and make a slip-knot in the cord. (See Fig. 3.) The loop may be strengthened with the aid of a piece of small gauge wire.

With the loop standing out horizontally, raise the pole. On reaching the end of the halyard, guide the loop over the end and work up as far as possible. Now pull the cord, which will tighten the knot, to firmly grip the wire. The pole can now be lowered to regain possession of the wire.

A ladder is not always handy, when it is desired to fix a supporting wire to a chimney stack. Under such circumstances an alternative method, such as the following, might appeal to some readers.

Procure a ball of twine and holding one end, throw the ball over the roof near the stack, round which it is proposed to fasten the wire. Fix one end of the supporting wire to the near end of the twine, and from the other side of the house, pull over the wire, having first secured the other end of the wire. Wind up the string again, and return over the roof on the reverse side of the stack. From an upstair window (nearest to the stack) the next operation can be carried out. Either bind the two ends of the wire together and fasten on the insulator, or, fastening a small metal ring to one end of the wire, pass through the other end, and pull on the free end.

Interference from Electrical Apparatus

ONCE more I see the problem of interference of electrical apparatus with wireless sets has cropped up, and it appears that the number of complaints being received by the Post Office or the B.B.C. are increasing in volume daily. Over 10,000 cases per annum are dealt with by the Post Office and there is a growing opinion that the whole subject should be ventilated publicly. It is evident that with the increase in the purchasing of electrical apparatus more and more interference will be caused, and as machinery of an electrical nature is being bought by persons of a decidedly non-technical class in increasing numbers the difficulties will be considerable. Because of this it is felt that the onus should be thrown on the manufacturer of electrical plant and machinery, and that some sort of legislative powers be obtained to compel all apparatus likely to cause radio interference to be adequately protected. As the matter is at present, users of interfering apparatus usually fit smoothing devices as an act of good-will, and while the proportion of refusals is not high, some tramway companies have definitely refused to do anything to cure their interfering systems. I see the English Electric Co., Ltd., are marketing a pair of choke coils weighing some 34 lbs. for use on trolley buses which do much to stop interference from this type of vehicle. Most tramway systems with overhead collectors can be adequately filled with only one coil, as where lines are used the earth return is through these. In trolley buses, however, the return is made through a further overhead wire, so that for these vehicles the anti-interference device has to be duplicated.

Resistance-less Metal

JUST as the greater proportion of the power expended in moving any self-propelled vehicle is spent in overcoming wind-resistance, so is the larger part of electrical energy in any circuit used in overcoming resistance. Of course, in our radio sets we deliberately fit certain resistances for purposes peculiar to the circuits, but it is obvious that a resistance in series with any current supply is wasteful, and, strangely enough, the less resistance we insert in the flow of current the more will be available to overcome the resistance of the work to be done on the job, whether it be the heating up of a valve filament or in driving an electric motor. Some years ago—toward the end of the last century—a method was found of super-cooling certain gases to such extremely low temperatures as to cause them to liquefy. By using these liquefied gases various objects and metals were cooled far below zero, and among these was mercury, which, as you may know, becomes solid at low temperatures. A famous scientist—Dewar, I believe—tried the effect of passing a current through the mercury at varying low temperatures, and

JOTTINGS FROM MY NOTEBOOK.
By "DETECTOR"

found that the lower the temperature the less the resistance of the metal to the current passing. It was thus reasoned that if an absolute zero could be obtained a metal in this state would possess no resistance at all. Conflicting opinions arose and many great minds expressed the opinion that a resistance-less metal even at low temperatures was only a dream about on a par with perpetual motion. I see, however, in the pages of one of our scientific reviews that the subject has been worked upon by a noted British professor, who has been engaged upon a series of experiments dealing with the supra-conductivity of metals, as it is called. Metals have been cooled by means of liquid air, hydrogen, and helium, and the scientist has found that at temperatures around absolute zero —273° Cent.—mercury offers no measurable resistance to a current. A ring of metal was made, super-cooled by liquid gas, and a current was started in the ring. It was found that the current would flow indefinitely as long as the supply of liquid gas lasted, and a demonstration of this experiment was made before the Royal Institution during the past summer. This ring was immersed in liquid helium and was carried in an aeroplane several hundred miles. When the current in the ring was measured before the Institution some six hours later it was found that the original current of 200 amperes was still flowing undiminished. Power supply engineers and all engaged in the distribution of electrical energy in any form or other have watched the experiments with interest, as it can be imagined the possibility of carrying heavy currents over quite fine wires is attractive, to say the least of it. Further developments may be expected along these lines, as methods of making the system commercially possible are being explored as far as practicable.

Interference from a Neighbouring Set

A LITTLE while ago I came across a genuine case of interference between sets belonging to two neighbours. I had often read of such instances, but had never come across one myself, with the result that while I appreciated such a position might be possible, I do not think I realized just how serious such interference might be. In this case it certainly was serious, for at times one set seemed to blank out everything for the one next door, and only when both sets were tuned to the local station, or the long-wave Daventry, could reception be said to be worth listening to. Luckily the neighbours were quite good fellows, and were both open to reason, which was just as well, as for either of them anything approaching distance work was impossible when the other set was working. Anyway, we settled the problem by persuading the man with the most powerful set to use an indoor aerial until radical alterations could be effected to both of their outdoor aerials, which, incidentally, ran parallel to each other at about only seven feet apart. If you are troubled in this way it is a good plan to first of all try altering your earthing system. If the other fellow uses a water-pipe earth, try a natural or buried earth, or *vice versa*. If this does not make sufficient difference, pay attention to your aerial, and try and arrange yours or, preferably, his as well so that they are as far apart as possible, and not running both in the same direction. Again, it is a good plan to try an indoor aerial on your set. Selectivity is sure to improve, and volume does not always fall off to the extent that is often expected, especially as more often than not with a modern set much of the latter can be sacrificed without much loss. An indoor aerial can be placed around the picture-rail, it being assumed, of course, that good insulated wire be used; or you could stretch one of the spring type aerials sold for the purpose across the room from corner to corner. This might be considered unsightly, but during the festive season, at any rate, paper decorations could be hung from it without impairing reception to any great extent; in fact, for party purposes, or for operating radio sets in village halls and the like, this is an ideal way of disguising a makeshift aerial slung up. The ideal indoor aerial would be a vertical wire, and while this is not always a mechanical possibility, I have seen aerials taken up to an attic by means of the staircase well, the wire being neatly attached to the banisters; and once I saw such an aerial taken up a lift shaft. With the latter, however, the steel framing of the lift and the building shielded to a great extent the incoming signals.

Possibilities of the Quartz Crystal

IT is encouraging to remember that constantly a band of scientists are working to improve the lot of the radio amateur. I refer again to the work being done at the National Physical Laboratory in collaboration with the Radio Research Board, which, of late, has been on the lines of research into interference problems. The study of the behaviour of the quartz crystal used in a resonant circuit has been occupying the time of several of these workers, and it is believed that a new principle of "ultra-sharp" reception will be developed with the view of separating near-by transmissions. That there is a need for such a principle is self-evident, as you have only to touch the knobs of any valve receiver to find this out for yourself, and the problem of station interference is the greatest we have yet had to face.

Electrical Energy in Fruit

AN American chemist has found out that fruit possesses a small amount of electrical energy. He found that by inserting the two prongs of a very sensitive milliammeter into an apple that a small current was registered, this result denoting the acidity of the fruit. Different fruits gave different readings, and, as consequence, he assumed he had fallen across a new way of measuring the acidity of different fruits. Those of you who experimented with a potato as a detector in your crystal days may now scratch your heads, but please note I am aware that a potato is not a fruit—or is it ?

Public Address System

MANY of the large stores in London and other cities are now appreciating the possibilities of a public address system, and the Marconiphone Co. are busy fitting up several such department stores with an amplifier installation. S O S calls can be put through, and advice relating to the control of traffic through the stores given out without choking the telephone system with internal calls to the detriment of outside callers. Attention can be called to special bargains, and applications too numerous to mention can be thought of. Marconi-Reisz microphones are used, and a special amplifier has been designed by the Marconiphone Special Products Branch.

Useful Experiments at the N.P.L.

I MENTIONED, some time ago, the effect of different types of soil formation on wireless earths, and the N.P.L. have been recently carrying out a series of experiments for measuring the efficiency of different soils as earths in wireless reception and transmission. The importance of accurate knowledge of the electrical properties at radio frequency of the material of the earth's surface has been intensified by the development of ultra-short wavelengths of but a few centimetres, and the subject is being examined by laboratory methods. Samples of soil have been contained in a condenser, and from the measurements of the effective capacity and resistance of the condenser the specific conductivity and dielectric constant of different soils can be determined. It is proposed to measure soils falling into well defined classes from different localities, and the results will be tabulated and placed upon a definite quantitative basis. In this way a standard set of measurements will be available, and each kind of soil will have a certain number of units of efficiency. This is good work, and will enable us to form some idea as to the best locality for transmission and reception. Also the results will enable you to roughly judge the efficiency of the earth in the district where you live, and should, at the same time, indicate the best type of "earth" for your locality.

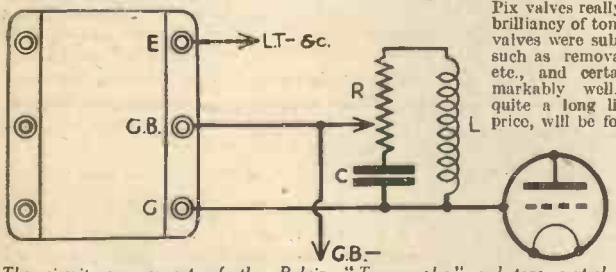
Faraday's Diary

VOLUMES I and II of Faraday's Diary have just been made available to the public, and it is doubtful if more absorbing reading can be obtained. The diary was bequeathed to the Royal Institution, and the work of editing and tabulating it has been going on for some time. In a foreword to Volume I, Sir W. H. Bragg refers to the section of Faraday's entries, where he tells of his experiments in which he induced a current in a wire by moving it in the neighbourhood of a magnet. By this Faraday detected the possibilities of electro-magnetic induction, and laid the foundation of all subsequent electrical experiments, experiments which led to the development of practically every kind of electrical apparatus we use to-day, and without which radio communication would be impossible. The whole of the work will be published at intervals, and when complete will consist of seven volumes, the total cost of which will be twelve guineas.

What we Found..

BULGIN "TRANSCOUPLER" AND TONE CONTROL

THE Bulgin "Transcoupler" gives even amplification under average working conditions, from below 50 cycles to well over 8,000 cycles, the top cut-off figure being largely determined by the capacity existing between the grid and cathode of the valve which succeeds it. In practice it is often found that for various reasons, certain frequencies are predominant, and although the "Transcoupler" will faithfully amplify all that is given to it, it will not in itself make any form of correction for unbalanced amplification due to other causes in the set or amplifier. If these causes are unremediable, *e.g.*, if the loud-speaker is incapable of balanced response, and has predominant resonances (so many of them have I) or if sidebands have to be cut in the interests of selectivity, some form of tone control must be used. The circuit arrangement above, shown additional to the "Transcoupler," enables everyone using it to tune matters to their liking. Turning the knob of the 250,000 ohm. volume-control-type resistance so that the amount of resistance towards the condenser is reduced, the treble will be reduced. Turn the other way, and the bass is progressively cut.



The circuit arrangement of the Bulgin "Transcoupler" and tone control. R=Potentiometer, 250,000Ω. L=250,000 μH. C=.001 to .01.

It will be seen that intermediate between the two extreme positions of the rotor-arm just the balance of reproduction the reader desires can be obtained.

The value of the condenser C governs the ultimate proportion of treble cut at the one extreme position of the resistance, R, and the value of the choke L governs the proportion of bass cut at the other extreme of rotation. Increase the value of the condenser if it is desired to cut more treble, and decrease the value of the choke, if it is desired to cut more bass.

The values given are, however, suited to most people's requirements.

The central position of the rotor-arm of the resistance will give substantially normal results such as the "Transcoupler" gives without the tone control circuit connected at all.

MAKING SHORT-WAVE CHOKES

WITH reference to the article on "Making Efficient Short-wave Chokes," on page 661 of our issue dated December 17th, 1932, Messrs. A. F. Bulgin and Co., Ltd., point out that this is similar to their choke, Type H.F. 3, appearing on page 30 of their catalogue.

PIX VALVES

THE British Pix Company are marketing a very extensive range of valves which are fitted with a special triple-coated neodymium filament. It is claimed that this gives a much greater emission than normal filaments, and that the tone is much improved by its use. On test, these claims would certainly seem to be substantiated.

An ordinary three-valve broadcast receiver was employed, and different makes of valve plugged into the valve-holders. With certain combinations of the Pix valves really fine results were obtained, with a brilliancy of tone which was quite marked. The valves were subjected to some rough treatment, such as removal of grid bias, severe shocks, etc., and certainly stood up to these tests remarkably well. They would appear to have quite a long life, and in view of the very low price, will be found very useful to the constructor who wishes to make up a cheap receiver employing a number of valves. The normal 2-volt series costs 4s. 6d.; the 2-volt power valves costing 6s. 6d. or 8s. 6d., according to class. The S.G. valve is 11s. 6d. For mains use, a range of indirectly-heated valves is obtainable for 11s. 6d., the mains screen-grid being 4s. extra. In addition to the types mentioned, full-wave rectifiers may be obtained for 8s. 6d. or 12s. 6d.

JACKSON "D" TYPE CONDENSER

THERE is a feeling of satisfaction when operating a condenser which rotates with a smooth, velvety movement. The condenser illustrated below is certainly a luxury instrument from more than one point of view. The finish and workmanship is of a very high order, the framework being highly nickel-plated, and the vanes of brass. Connection to the rotor plates is made by a plaited pig-tail connection which is firmly clamped at each end and provides a perfectly silent connection. Substantial terminals are provided for external connection. The slow-motion drive is effected by an elaborate epicyclic gear which is enclosed in a small box at the base of the spindle. The latter is drilled through and a small spindle runs through this and projects at the upper end. This may be clearly seen in the photograph. The operating knob is divided into two sections, the larger one clamping on to the spindle proper, and the smaller section fitting on the inner spindle. It is thus simple to obtain a direct or reduced drive by simply operating the appropriate dial. The reduction gear is of the order of 35 to 1, so that tuning of weak stations is rendered very simple, and the condenser is a high-class article which can be thoroughly recommended. The price of the .0005 capacity condenser is 14s.

The Utility bakelite condenser and disc drive. The hair-line escutcheon window may clearly be seen.

The "D" type slow-motion condenser, showing the double spindle employed for operating the direct and slow-motion drive.

WEARITE HETERODYNE FILTER

IT has already been stated in our pages that the trouble of heterodyne whistles, due to two stations working on very nearly the same wavelength, can only be overcome by employing some form of filter to remove frequencies of a high order. This naturally results in a top-note cut off and tends to spoil musical reproduction unless the cut-off apparatus is scientifically designed. The Wearite heterodyne filter is a piece of apparatus which may be usefully employed for the purpose in question, and it is made in two types, one cutting off at 3,500 and the other at 5,000 cycles. The cost of the instrument is 10s. 6d., but this will be found a very good investment, and in some localities will be essential if good reception is desired.

UTILITY BAKELITE CONDENSERS

FOR portable or other compact receivers it is often necessary to fit tuning condensers of the solid dielectric type in order to reduce the overall weight and size. This type of condenser normally has rather large absorption losses and is not advisable where the very best results are required. Messrs. Wilkins & Wright have, however, developed the condenser shown in the illustration, and this is quite suitable for tuning where really strong signals are obtained and losses do not matter very much. The condenser is very compact, and only the best bakelite is employed in the construction. The overall dimensions are roughly 2in. square by ¼in. thick for a capacity of .0005 mfds. The condenser costs 2s., and where it is desired to employ it for tuning, it may be obtained complete with the slow-motion dial and mounting bracket as shown. This dial is of standard size and pattern, and the escutcheon window enables the dial to be illuminated if so desired. The complete assembly costs 4s. 6d., in either .0003 or .0005 mfd.

NEW ETA VALVE

ONE of the new valves produced by the Electrical Trading Association, Ltd., has been received for test. This is the DW 4011, and is of the 4-volt indirectly-heated type. This valve has an impedance of 11,000 ohms with an amplification of 40. The slope is 3.6 ma/V. This is an ideal valve to employ for power grid rectification in mains receivers, and also makes a very good valve to insert in the first stage of a gramophone amplifier. The output from this is sufficient to warrant the inclusion of two super-power valves in push-pull immediately following it, with a transformer of only 3.5 to 1. The results are certainly admirable, and this valve costs 11s.

IMPORTANT NOTE

ON page 673 of the issue dated December 24th, in the advertisement of Jackson Bros., Ltd., the Figure 1 unfortunately became obliterated during printing. The price of the .0005 mfd. condenser should, of course, have read 18s. 6d., and not 8s. 6d.

Practical Letters from Readers.

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

Reports Wanted of Reception from Athlone Station

SIR,—I would be very glad to receive reports from any of your readers who may have heard the transmissions from the new Irish Free State High-Power Station at Athlone. The station works on a wavelength of 413 metres and will ultimately use a power of some 80 kilowatts. It would be interesting to hear of the reception experiences of listeners living in various parts of the country. The test transmissions usually take place after the ordinary programme at 10.30 p.m. each night.—JAMES KITCHEN (179, Pearse Street, Dublin).

Don't Use Milk Bottles

SIR,—Upon page 547 of the current issue of your journal, PRACTICAL WIRELESS, I observe that you publish an illustration of an accumulator Topping Apparatus as furnished by one of your readers, which involves the utilizing of an ordinary milk bottle. May I be permitted to respectfully point out that it is dangerous and illegal to put any harmful liquid into milk bottles, and the usage of such bottles for the purpose your reader suggests is most strongly deprecated by the Dairy Trade.—For and on Behalf of Milk Vessels Recovery, Ltd.—J. GILLARD STAPLETON (Secretary).

A "Practical Wireless" Club?

SIR,—As a wireless amateur since broadcasting began, and a radio-service mechanic by profession, I wish to congratulate you on publishing such a fine radio journal as PRACTICAL WIRELESS. Let us have plenty of "How to Make" articles, like some of the excellent articles that have appeared on making dual coils, etc.

I agree with Francis S. Coley, in his letter published in a recent issue, that PRACTICAL WIRELESS is written and illustrated so admirably that it is quite a pleasure to read it.

I would like to suggest that you give the short-wave side of radio more prominence, as this is definitely the thing of the future. Also, how about a "P.W." Radio Club, after the style of the Practical Wireless League. This, I think, would serve to make a greater success of PRACTICAL WIRELESS, and I, for one, would be pleased to try and form a local club. Perhaps you will put this suggestion before your readers. I would also suggest a Sale and Exchange page, where readers could advertise their unwanted components and sets at a cheap rate.

Wishing you every success.—ROBERT W. STEWART (West Hartlepool).

Station Chart Wanted

SIR,—In my opinion, what is needed is a chart giving the Continental stations, wavelength and call characteristics. Thus, Mühlacker would be 366.9 m., 60 kW; Call, three notes on tubular bells. These Continental announcers rattle off their call-signal at such speed and at such long intervals apart, it is very hard to find out what they are, especially the Swedish and Norwegian stations.—THOS. H. WEBSTER (Sydenham).

A Portable for 'Phones Only

SIR,—Every week I read letters published in PRACTICAL WIRELESS loading you with praise for the excellent value of your paper, and as a regular reader I would like to add my mite of satisfaction. I have "fooled about" with wireless for a few years now, but I think I have really learnt something during the past two months. After reading the issue of December 3rd I want to endorse the plea of Edward Logue (Glasgow), but I vote for a two or three-valve set with a frame aerial—in other words—an efficient battery Portable for 'phones only. If one must not wake the baby—or if others don't want the loud-speaker on—well, let us have a set which will give the National, all the Regionals and the main foreign stations at good 'phone strength. The frame aerial should be selective and directional and the S.G. H.F. valve could be cut out for the locals. Let PRACTICAL WIRELESS give us a set so that we may enjoy our programmes in solitary silence. Wishing the paper every success.—THOS. J. HITCHCOCK (Harrow).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—That the natural wavelength of an aerial is roughly four times its length.

—That a 75 or 100 plug-in coil makes a very good H.F. choke for short-wave work.

—That the response characteristics of a moving coil or other cone loud-speaker may be modified by scraping the paper thin at different points.

—That a remote control device costs practically nothing to operate, consuming only minute fractions of an amp. from a dry battery.

—That the highest wavelength used for broadcasting is 1935 metres, used by the Lithuanian station Kaunas.

—That a delay switch in the eliminator is a valuable safeguard when employing indirectly heated rectifying valves.

—That Eureka resistance wire has a resistance nearly thirty times as great as ordinary copper wire.

—That Tungsten has the highest, and Potassium the lowest melting point of the elements.

NOTICE

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

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

Circuits Wanted for Plug-in Coils

SIR,—I am an enthusiastic constructor, and have purchased your paper since its inception, and have studied all your circuits. These are, however, all based on modern components, coils, etc., and to build these it means the purchase of expensive items. There must be a large number of your readers, like myself, who possess a large junk box of good and serviceable components, and would like to experiment with these instead of leaving them idle. For instance, I have a complete set of plug-in coils of well-known make, including short-wave coils; also enough fixed and variable condensers, transformers, etc., to make up several sets. Could you not give us wiring diagrams for building two, three, and four-valve sets using plug-in coils, both for ordinary wavelengths (200–2,000) and for short-waves (10–100). I am confident this would be much appreciated by a large number of your readers.—W. COLLINS (Birmingham).

Entertainment Literature Not Wanted

SIR,—The first part of PRACTICAL WIRELESS that I turn to each week is the portion devoted to readers' letters, and after reading the issue for December 17th, I feel compelled to write in reply to the letter published from "WILL EVANS" (Paddington). This gentleman seems to be under the impression that when one reads PRACTICAL WIRELESS one must of necessity "fiddle with the set," to use his own words. Is this necessary? Cannot one read his favourite wireless paper without starting altering the radio set? I consider that the paper should keep to its name, and be practical. No true radio fan wants his practical literature interspaced with notes on gramophone records, broadcast artists, etc. Other papers can be bought that deal particularly with these subjects. Wishing success to the future of PRACTICAL WIRELESS.—J. SUTCLIFFE (Huddersfield).

Practical Letters from Readers

(Continued from page 781.)

A Satisfied Scottish Reader

SIR,—I have never before "written to the papers about it," but I feel that I would be lacking in gratitude if I did not add my great appreciation of PRACTICAL WIRELESS to that of your very many highly satisfied readers. After reading the first few numbers, I was highly delighted to realize that, at last, I was able to get a wireless paper that really got down to "brass tacks" with regard to broadcast receiver construction, operation and maintenance. However, although I was very well pleased with your paper and, indeed, recommended it to my fellow amateurs, I had a feeling that it was incomplete. There were few articles on the design of broadcast receivers nor were there any on television and television receivers. Since then you have started a series of articles on television which will, I hope, continue through to the construction, operation and maintenance of television receivers, and I am hoping that you will soon commence a series of articles on the design of receivers. Your gifts of data sheets which you recently started are the "very thing." Truly, PRACTICAL WIRELESS is a masterpiece in wireless publications and every day in every way it gets better and better. Please do not spoil it by inserting articles of ordinary wireless news relating to broadcast programmes, radio stars, studios, etc., as suggested by some of your correspondents. That would, indeed, be a retrograde step. I do not think it is necessary for me to wish you every success because you have already succeeded, in my opinion. I do, however, most heartily tender my best wishes for the good work which you are carrying out so efficiently and, without misgiving, promise you my unstinted support for, I hope, many years to come.—ENTHUSIASTIC AMATEUR (Aberdeen).

A Reader's Thanks : and a Suggestion

SIR,—I enjoy your paper very much, as it is the only paper I have had that is really constructional. When I buy a paper I don't want to know what colour the B.B.C.'s pianos are! I hope you will keep this high standard up, because I am sure you will be blessed by many thousands of readers! I suggest that you publish an article on smoothing chokes, mains and L.F., on the same lines as the article on "Designing Your Own Mains Transformer." Wishing you success with your really fine *constructional* paper.—R. J. CANAWAY (Havant).

Set Wanted with Old Type Plug-in Coils

SIR,—With reference to a reader's letter—(A. Bedding, Clapham)—in the issue for December 10, and your remarks at the foot thereof, may I be permitted to back this reader up in his very practical suggestion. I should also like to add an idea of my own; may the proposed set be *an all-wave model*, with a screen-grid valve and thoroughly decoupled for work with an electric mains unit. I have to thank you for the many happy hours your most excellent paper has given me. It is the best of its kind.—W. ROBINSON (Welling).

Making a Mains Transformer : a Correction

One or two readers have pointed out a printers' error that occurred in respect to the article entitled "Making a Mains Transformer," which was published in our December 3rd issue. All those dimensions given in Table No. 1, under the heading "C" should be as follows: For size 5 stampings, ¾in., for sizes 4, 4A, 30 and 30A, 1¼in.; for size 28, 1½in., and for size 29, 1⅞in. We hope that this correction will put the matter right.

A Canadian Reader's Appreciation

SIR,—Your magazine, up to the present, is much better than I ever thought it could be. Your various articles are very thorough in their explanation, and the editor and contributors deserve to be congratulated on their efficient service. I would very much like to see the "Short Wave Section" expand, and also receive the combined efforts of the research staff in order to advance the efficiency of such sets. I would also like to see articles on A.C. short-wave sets operating on 110v. 60 cycle—CHAS. F. COVELL (Toronto, Canada).

A Bouquet from Aberdeen

SIR,—I have perused reader's opinions from No. 1 onwards, and as an Aberdonian I always like value for my money (so they say), and by purchasing your valuable paper I am certainly getting real value for money. There are many ideas on how to run your paper, some are good, others bad, and some indifferent. I think you are about 100 per cent in keeping with the heading of your paper. I hope you will stick to it. If you go into all details of what your readers want you will perhaps land with a publication thicker than the family Bible. I myself am more than pleased, and cannot suggest any further improvement you could make at the price; everything you give is simple arithmetic. I am particularly interested in the articles by Frank Preston, F.R.A., which are highly interesting. He explains everything so clearly that one cannot fail to understand. At the same time I do not belittle other contributors. They are all that can be desired. Carry on with the good work and give us plenty of practical hints of what can be efficiently made at home at a reasonable price. Good luck for 1933 and onwards.—ALFRED RAMIE (Aberdeen.)

A Complaint : and a Practical Hint

SIR,—I have read each number of your excellent paper from end to end, including the advertisements, and allow me to congratulate you on its superb contents. I have read a number of the letters published, and they are evidently from young men. I joined the Institution of Electrical Engineers in 1892, in which year I dabbled in wireless under Professor Sylvanus Thompson, and I am still dabbling. A complaint I have against electrical apparatus is in the modern "block" type accumulator. I have two different makes in use, also one of the old multi-plate ones in. When freshly charged, my total output in milliamps reads 9 with the latter and 6 with the former. This I attribute to internal resistance of the block type accumulator. I have found, from past experience, they are costly because they soon lose the paste, not due to heavy discharge, but to the accumulator manufacturer's friend, the local wireless man who charges or, should I say, ruins them. Now for a little practical hint on another matter. It may interest your readers to wind a "cage" aerial with three separate windings and tune them with a three-gang condenser, bringing one common wire from all three condensers to the aerial terminal of their set, and then tune the set. They will not need outside aerials, or complain of selectivity or volume.—V. DELEBECQUE (Hornsey).

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

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

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

SPECIAL NOTE.

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

(1) supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.

REMOVING REACTION

"I have a fairly good detector and two L.F. receiver, and am getting a really high-class quality from the receiver. It appears to me to be quite as good as I can expect from such a set, but after reading that reaction spoils quality, I should like to remove this part of the circuit from my receiver. I employ the normal condenser-fed arrangement, and should like to know whether I will spoil things if I simply short-circuit the reaction coil—to avoid dead-end losses—and disconnect the reaction condenser. If there is anything wrong with this perhaps you will suggest the best way to remove the part of the circuit referred to."—(R. Y., Broxbourne.)

The idea is quite practicable, but there is one point you must watch. Usually a small by-pass condenser is required from the anode to earth in the detector circuit, and this may already be provided in your receiver by part of a differential reaction condenser. By disconnecting the condenser entirely you may remove this by-pass condenser and by so doing affect the rectification properties of the detector. Beyond this, there is nothing wrong with your idea.

NEW VALVES

"I recently bought a completely new set of valves for my receiver, as I had read that modern valves were much more efficient than the old ones. Frankly, I am disappointed. The set is unstable, oscillates at the least provocation, and quality is terrible. What can I do? It was because I read in your book that the new valves were better that I wasted my money. I should be glad if you could tell me what to do, as I am extremely disappointed."—(Y. B., Hammersmith.)

The statements which you make in your letter prove that our remarks were correct. The modern valves are more efficient, and it is because of this fact that your old receiver is now unstable. Apparently you had taken liberties with the wiring of the old set, and there were faults in wiring, etc., which were not apparent owing to the comparative inefficiency of the old valves. If now you go over the wiring, and see that this is carried out efficiently (and possibly you will have to slightly modify the layout), you will find that the new valves will more than repay you for the money you have spent on them. The distortion is no doubt due to overloading of the output valve, due to the large signal being now passed on from the earlier stages. You must increase the H.T. applied to this output stage, and also see to the grid bias. Keep to the valve-makers' recommendations with regard to the applied voltages.

A TELEVISION POINT

"I have built up the Televisor described in your hand-book, and purchased a disc instead of making it. On trying it out I got a horrible series of patterns which were nothing like a picture. I read the article again and found I had got to get the speed right. The motor was not equipped with any form of control and I am not sure whether there is any method of getting the speed constant without fitting the special synchronising apparatus. Have you any little wrinkle which would suffice to enable me to see an image so that I may obtain sufficient interest to warrant the expenditure on a motor fitted with synchronising gear?"—(F. N. T., Blackpool.)

There is a perfectly simple way of getting the speed right, and that is by pressing the finger tips on the centre of the disc. By careful adjustment the disc may be kept at the right speed for the whole of the transmission. A more satisfactory way is to fit a small lever attachment with a screw adjustment so that the pressure may be adjusted and then left. Of course, any method such as this will not be so satisfactory as the synchronising gear wheel, but it will serve as a makeshift, for temporary reception.

MICROPHONIC VALVE

"I am puzzled by the behaviour of my receiver and should be glad if you could enlighten me on the peculiarity. When I tune in to a station there is a peculiar ringing sound, and as soon as the station is dead on tune the music is accompanied by a peculiar high-pitched singing sound. This seems to be some fault of the receiver and I should like to know how to cure it."—(T. G. B., Manchester.)

The trouble is due to what is known as a microphonic valve, that is one in which the electrodes are not very securely supported, or are perched at the end of long, thin supports. The result of this is that they take up all vibration and transmit it to the speaker. When you tune in to a station the sound waves impinge on the glass bulb and so add to the trouble. The remedy is to encase the valve in a sound-proof case, such as a cardboard box packed with cotton-wool, or to otherwise protect the valve from vibration. Sometimes an anti-microphonic valveholder will cure the trouble, although in some extreme cases it only aggravates it. You can try the effect of sticking lumps of plasticine or similar substance on the glass for the same purpose.

DATA SHEET No. 16

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

GERMAN SILVER RESISTANCE WIRE

S.W.G.	Resistance per yard	Yards per lb.	Current capacity
18	.117	51	3.5
20	.315	90	2.5
22	.520	147	1.5
24	.844	238	1.0
26	1.26	349	.5
28	1.85	527	.25
30	2.65	750	.2
32	3.50	984	.15
34	4.82	1360	.1
36	7.06	2000	.05

DEFECTIVE CONDENSER

"I have altered one of the low frequency stages in my set to employ the resistance-capacity principle. The values of the parts are as recommended in many books, but I get nothing but horrible distortion. The grid bias is correct for the valve; the preceding valve is getting its correct H.T., which has been compensated to allow for the voltage drop through the anode resistance, and in fact everything I can think of has been done. Where can this distortion be coming from? Your help would relieve me of a great worry, as I am now at a loss."—(D. S. C., Ayr.)

There is a simple solution to your trouble, and that is the coupling condenser in the R.C. stage. This is no doubt defective and is permitting the H.T. positive potential of the preceding anode circuit to be applied to the grid. This is neutralising the applied negative bias and is producing the distortion. If you replace the condenser we think you will find that the trouble will be definitely removed.

THE CHEAPEST SET

"I want to build up a cheap set to give as a present early in the new year. I want it to work a speaker, and the recipient is living quite close to a B.B.C. station. What circuit arrangement would you recommend? I do not want a poor set, but something which will be worth giving to a friend. Your advice on this problem would be greatly appreciated."—(F. H. J., Barnsley.)

We would suggest a two-valver employing a Pentode output stage. This would give sufficiently loud signals for good loud-speaker reproduction, and in conjunction with a good selective dual-range aerial coil will make up quite a good, and at the same time cheap, set. Use a 5 to 1 L.F. transformer for coupling purposes.

TRANSFORMER RATIOS

"Upon looking through a catalogue in order to choose a transformer for my three-valve set, I see that there are several different ratios obtainable. The catalogue does not state what the different types are for, and I should like some information to enable me to decide which ratio to get for the set. The circuit is the usual detector valve with two subsequent stages of transformer coupled valves."—(C. V. G., Dublin.)

As you are situated near to a main broadcasting station you will have to be careful that your output valve does not overload. Therefore the stage gain must be kept fairly low and we would suggest that the first transformer has a ratio of 3 to 1, and the second a ratio of 4 or 5 to 1. If, of course, you want to listen more to distant stations the ratio may be greater, but then you would have to arrange to cut out the first L.F. valve so as to avoid overloading.

DIAL LIGHT

"Having rebuilt my set, I should like the refinement of a light on the panel to see more clearly the tuning dial scale. I should like this light to be coupled up to the set in some manner so that when the set is switched on the light will also come on, and so provide an indication that the set is alive. Can this be easily carried out without complicated switching?"—(A. H. G., Belsize Park.)

The arrangement is quite simple, and consists only of joining the leads from the indicating light to the two filament terminals of one of the valve-holders. In this way, switching on the filaments also switches on the lamp. Do not be tempted to use an ordinary flashlamp bulb, as this has a rather high consumption. Special low consumption bulbs are obtainable at good wireless shops, and these only consume a very small current, and will make no difference to your accumulator charges.

EBONITE PANEL

"Some time ago it was the rule, rather than the exception, to employ ebonite for panels. In these later days one does not see so much employed, and I am keen to know whether the idea that it was a good insulator has now been exploded or whether there is some other explanation for its absence on many modern commercial receivers."—(F. B., Oxford.)

There is really no need to use ebonite for panels on many modern receivers, simply because the components which are now mounted on the panel are all at earth potential. Ebonite still holds its place as an insulator, but in these days the layout of a receiver has been modified so that the controls are connected to earth, and therefore there is no need to provide an insulated path between them. In certain cases, however, it is still necessary to see that there is no risk of coupling between certain parts, and therefore you should adhere to instructions given in periodicals which describe the construction of a receiver.

FREE ADVICE BUREAU

COUPON

This coupon is available until Jan. 14th, 1933, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 7/1/33.

CATALOGUES RECEIVED

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

BULGIN COMPONENTS

A USEFUL range of high-class components, covering everything the constructor is likely to require, is given in the latest catalogue issued by A. F. Bulgin and Co., Ltd. Included in the list are the new Bulgin Transcoupler "Quickwyre" for facilitating rapid and neat wiring, and a fine assortment of mains and battery switches. As usual, in the back part of the catalogue, there is a useful illustrated technical manual giving instructive information and showing how various Bulgin components are connected in different circuits.

ORMOND CONDENSERS

AMONG the new components shown in the latest Ormond list is a precision condenser, with friction control and slow-motion movement with a ratio of 55 to 1. Another new component listed is a logging drum dial with illuminated surface and a bakelite escutcheon plate and control knob. A slow-motion device is incorporated and condensers can be attached on either side.

HEAYBERD MAINS APPARATUS

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

UTILITY COMPONENTS

A FINE range of "Utility" steel ganged condensers is shown in the new season's catalogue issued by Wilkins and Wright, Ltd. The chassis is built of heavy gauge steel; and the spindles run in ball bearings of ample size which ensure smooth action. All ganged condensers are matched to less than one-half per cent. For super-het. sets a model is supplied which incorporates a specially-designed section for tuning the oscillator circuit. These condensers are obtainable in the two, three or four-gang type. Other high-class components shown in the list include a new straight-line dial, anti-capacity switches, drum dials, and the "Utility" Micro-Dial with a ratio of 100 to 1. This dial, with its fine vernier adjustment and smooth action is specially suitable for short-wave tuning.

Broadcast Query Corner.

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

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

SKY PILOT (Somerset): Beromuenster (Switzerland) relaying Stuttgart programme. PERPLEXED (Darwen): WJZ, Boundbrook (N.J.), National Broadcasting Company on 394.5 m. SEARCHER (Leeds): Dublin; new 80 kW. transmitter (at Moydrum), testing on 413 m. NAT (Bideford): According to your details and difference in time, the broadcast would appear to emanate from China, and possibly from the new 75 kW. Nanking station, but we cannot confirm, as this transmitter was advertised to work on 440 m.; the wavelength may have been changed. SHORTWAVE (Torquay): On December 11th, LSX, Hurlingham, Buenos Aires, 28.98 m., relayed a running commentary on the visit of the President of Uruguay to the capital of the Argentine Republic; possibly also re-broadcast by EAQ, Aranjuez-Madrid, on 30.43 m., but it was not advertised in published programmes for the latter station. SUPERHET (Bala): This was Leningrad on 835.4 m. TIRED (Ramsgate): (1) WBZ, Boston (Mass.), on 302.8 m. or KDKA, East Pittsburgh (Pa.), on 305.9 m.; (2) WABC, New York, on 348.6 m.

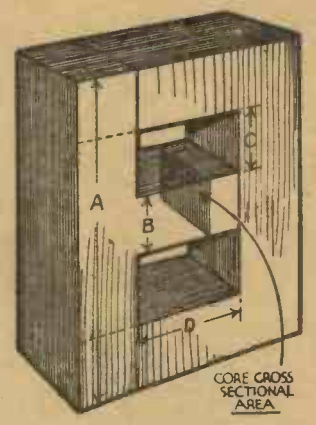
ADVERTISEMENT INDEX

P.W. Gift Stamp No. 15

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

"PRACTICAL WIRELESS" DATA SHEET No. 4

Mains Transformers



The assembled core of a Mains Transformer.

FINDING THE NUMBER OF TURNS.

The formula for ascertaining the number of turns of wire for Mains Transformers is :—

$$\frac{V}{T} = \frac{A\,B\,n}{3.49 \times 10^8}$$

where $\frac{V}{T}$ = Volts per turn in both the Primary and Secondary.

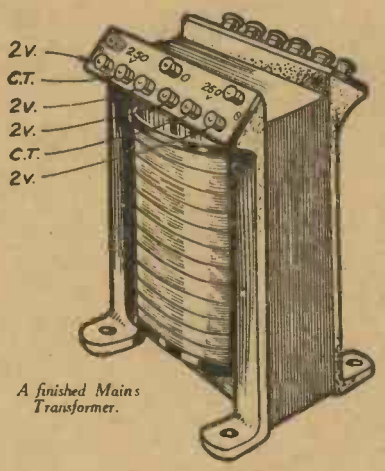
A = Cross sectional area of the core in sq. ins.

B = Flux in the core in lines per sq. cm.

n = Frequency of the supply in cycles per second.

The usual flux density varies between 6,000 and 8,000 lines.

The method of building up the laminations for the core of a mains transformer. The principal dimensions are referred to in the tables. The central bar is the most important part of the assembly, as it is principally upon the cross-sectional area of this that the number of turns of wire depends. The size of the winding area also enters into the calculations, but by purchasing standard sizes of stampings the calculations are greatly facilitated.



A finished Mains Transformer.

How to assemble the completed transformer, with a strip of ebonite to carry the various terminals. It is safest to take all the secondary windings to one strip situated on one side of the transformer, and the primary (or mains input) terminals to a strip on the opposite side. This prevents accidentally touching or shorting the mains. The feet and supports, as well as clamping bolts, should be of brass and not steel. If found more convenient aluminium may be used.

FINDING THE RATING.

The total rating of a mains transformer is obtained by adding together the wattage of each separate winding and then adding 20 per cent. to the resultant figure. The cost of operating a mains receiver can therefore be easily worked out.

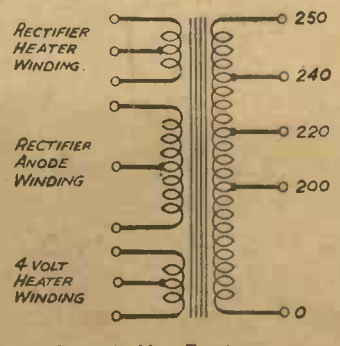
CORE PROPORTIONS.

Size of Stalloy Stampings.	Dimensions (ins.) A.	B.	C.	D.	Number of Stampings	Watts (approx.)	Turns per volt.
5	3¼	⅝	1⅜	1⅜	6 doz.	25	15
4	3⅛	1¼	1⅛	2⅛	6 doz.	50	8
4 A	3⅛	1¼	1⅛	1⅛	6 doz.	40	8
30	3⅛	1¼	1⅛	1⅛	6 doz.	40	8
30 A	3⅛	1¼	1⅛	1¼	6 doz.	35	8
28	5	1½	2½	3	6 doz.	100	6
29	6¼	2	2½	3¾	6 doz.	250	4

TESTING.

Before connecting a home-made mains transformer in circuit all windings should be tested for breaks, short-circuits and insulation. A high voltage dry battery may be used, in conjunction with a meter, and there should be no readings between different windings, nor from windings to core.

Theoretical circuit of a small mains transformer, showing how the primary winding is tapped to suit mains inputs of different values, and the manner in which all heater windings are centre-tapped. The Rectifier valve heater winding forms the positive lead of the H.T. supply, and the centre tap of the Anode winding is the negative lead. Where it is preferred the remaining heater windings may be provided with an adjustable centre tap by means of an external potentiometer instead of the wired point.



Circuit of a Mains Transformer.

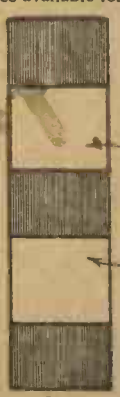
WIRE FOR TRANSFORMERS.

In the table below the number of turns per sq. in. makes no allowance for the end cheeks of the winding bobbins. This must therefore be taken into consideration. The Safe Current should also be regarded as the absolute maximum value, and if possible the next largest size of wire should be employed, especially for heater windings where large currents are to be handled. When using enamelled wire care must be exercised that the covering does not crack during winding. This wire takes up less room but greater care must be taken in the winding.

WIRE DATA.

Standard Wire Gauge.	Safe Current (amps.)	Turns per sq. inch. Enamelled.	Turns per sq. inch. D.C.C.	Yards per Pound. Enamelled.	Yards per Pound. D.C.C.
18	3.7	392	297	46.9	45.4
20	4.0	685	472	83.3	79.4
24	1.5	1,770	977	221	203
28	0.7	3,760	1,630	488	422
30	0.5	5,370	1,990	694	587
32	0.4	6,890	2,550	915	755
34	0.25	9,610	3,020	1,202	1,024
36	0.18	13,500	4,100	1,840	1,477
38	0.1	20,400	5,100	2,810	2,287
40	0.07	32,500	—	4,576	—
42	0.05	44,300	—	6,576	—

Section through the core showing the winding area in which all the windings have to be disposed. It is most efficient to arrange the windings on bobbins placed side by side as indicated, with heater windings disposed between the input and H.T. windings. This forms a screen and helps to prevent induced hum. This illustration should be studied in conjunction with the diagram in the upper left-hand corner of this sheet. The actual space available for winding has also to accommodate the formers of the windings, and this should be remembered when measuring the space available.



Section through core.

Practical Wireless, January 14th, 1933

FREE INSIDE: DATA SHEET No. 5. "WIRE & WIRE GAUGES"

Practical Wireless

3D

Published every Wednesday by
GEORGE NEWNES LTD.
Vol. 1—No. 17
JANUARY 14th, 1933
Registered at the G.P.O. as a Newspaper.

MAKING YOUR OWN COMPONENTS

DETAILS INSIDE

When the higher notes are missing RECTATONE restores them . . . . .

YOU NEED IT *NOW*

Rectatone—the Varley component that restores to their true value the all-important higher notes.
It is by deliberately cutting off these higher notes that to-day's Superhets and ultra-sharp tuned circuits achieve their selectivity. Now comes Rectatone to put them back again . . . **and millions know they need it.**

RECTATONE

1. Has a rising response curve from 1,000 to 4,500 cycles.
2. Balances any form of sound reproduction.
3. Restores a weakened treble to its correct value.
4. Gives a variable compensation and, therefore, complete control of tone correction.
5. Gives the required tone correction without an extra L.F. stage.
6. Becomes at will and instantly a normal straight-line transformer.
7. The ideal L.F. coupling for selective sets.
8. Particularly useful where the same L.F. amplifier is used for radio and gramophone reproduction.

Ratio 7-1
List No. D.P. 33

VARIABLE COMPENSATION

The degree of compensation may be suited to the particular tuned circuits in use or employed to correct deficiencies due to the loud-speaker or to the acoustics of the room.

Compensation is controlled by a variable resistance of about 5,000 ohms connected externally between the terminals H.T. + and RES.

With a pentode output valve a 2,000-ohm fixed resistance may be connected in series with the variable resistance in order to prevent excessive amplification of high frequencies with consequent liability to self-oscillation.

15/-

When Bass and Treble are correctly present, Rectatone preserves them . . . When the higher notes are missing, Rectatone restores them.

Varley

SPECIFIED IN THE "*Practical Wireless*" SELECTONE

FOR EVERY SET — *there's a*

PILOT AUTHOR KIT

CASH — C.O.D — or H.P.

EVERYTHING RADIO

CARRIAGE PAID TO YOUR DOOR

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

EPOCH "20 C" PERMANENT MAGNET MOVING-COIL SPEAKER. (New Edition). With 5-ratio input transformer. Cash Price £1/15/0. Carriage Paid. Balance in 5 monthly payments of 6/6. — Send 6/6 only

BLUE SPOT UNIT AND CHASSIS, Type 99 P.M. Including matched transformer. Cash Price £2/19/6. Balance in 11 monthly payments of 5/6. — Send 5/6 only

ROLA PERMANENT MAGNET MOVING-COIL SPEAKER F.6. With universal tapped input transformer. Cash Price £2/9/6. Carriage Paid. Balance in 11 monthly payments of 4/6. — Send 4/6 only

R & A "VICTOR" PERMANENT MAGNET MOVING-COIL SPEAKER DE LUXE. With 6-ratio input transformer and protecting grille. Cash Price £3/10/0. Carriage Paid. Balance in 11 monthly payments of 6/5. — Send 6/5 only

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LISSEN "SKYSCRAPER" S.G.3

COMPLETE WITH VALVES

CHASSIS KIT with (Lissen) S.G., Detector and Pentode Valves. Cash Price, Carriage Paid, £4/9/6. Delivered, carriage paid, on first payment of .. .. 8/3 *Balance in 11 monthly payments of 8/3.*

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ATLAS ELIMINATOR. Type A.C.244. Three tappings: S.G., Detector and Power. Output: 120 volts at 20 m/A. Cash Price £2/19/6. Carriage Paid. Balance in 11 monthly payments of 5/6. — Send 5/6 only

HEAYBERD HOME BATTERY-CHARGER Model A.0.3. for A.C. Mains only. Charges 2, 4, or 6v. accumulators at 1 amp. Cash or C.O.D. Carriage Paid. £2/2/6. Balance in 8 monthly payments of 5/3. — Send 5/3 only

GARRARD INDUCTION GRAMOPHONE MOTOR. For A.C. mains. Model 202. Mounted on 12-inch nickel motor plate with fully automatic electric starting and stopping switch. Cash Price £2/10/0. Carriage Paid. Balance in 11 monthly payments of 4/7. — Send 4/7 only

PETO-SCOTT 1933 ADAPTAGRAM. Beautifully constructed of solid walnut with contrasting Walnut Veneers. Ready to take your set and gramophone motor. Cash or C.O.D. £3/3/0. *Carriage 3/6 extra.* Balance in 11 monthly payments of 5/9. — Send 8/3 only

W.B. PERMANENT MAGNET MOVING-COIL SPEAKER, Type PM4. Complete with transformer. Cash Price £2/2/0. Carriage Paid. Balance in 7 monthly payments of 5/9. — Send 5/9 only

SELECTONE Described this week

KIT-BITS

Selected C.O.D. lines—You pay the postman—We pay post charges on orders over 10/-.

	£	s.	d.
1 PETO-SCOTT Oak-faced plywood panel, 14in. by 8in., *ready drilled*; Peto-Scott 5-ply baseboard, 14in. by 8in., *ready drilled* ebonite strip, 14in. by 1½in.; connecting wire, screws, and wood as specified		8	0
1 UTILITY Standard .0005 mfd. Condenser with UTILITY type W.181 Microdial		16	0
1 COLVERN type "T.D." Coil		8	6
1 BENJAMIN Transfeeda		11	6
1 VARLEY Rectatone Transformer		15	0
3 Specified Valves	1	2	9
1 CAMCO Excelsior Oak Cabinet as specified..	1	2	6

KIT "A"

CASH OR C.O.D. *Carriage Paid.*

Author's Kit of specified parts, including *ready drilled panel*, but less valves and cabinet.

£4-8-0

or 12 monthly payments of 8/-

KIT "B"

As Kit "A" but with valves, less cabinet. CASH or C.O.D. Carriage Paid.

£5 - 10 - 9

or 12 monthly payments of 10/2.

KIT "C"

As Kit "A" but with valves and cabinet, CASH or C.O.D. Carriage Paid.

£6 - 13 - 3

or 12 monthly payments of 12/3.

SOLO KNOB 3

KIT "A" specified parts, *drilled panel*, and cabinet. Carriage paid.

Author's Kit of including *ready* but less valves CASH or C.O.D.

£3 - 0 - 0

or 12 monthly payments of 5/6.

Specified Valves £1-2-9. *Cabinet* 15/-.

Recommended for the Selectone

PETO-SCOTT WALNUT CABINET MOVING-COIL SPEAKER

In handsome Walnut Cabinet with Contrasting inlaid Walnut Veneer.

CASH OR C.O.D. CARR. PAID **47/6**

Send **4/6** Only

Balance in 11 monthly payments of **4/6**

A wonderful Permanent Magnet Moving-Coil Speaker that reproduces with amazing realism. Sensitive to very small inputs and is therefore entirely satisfactory for battery-operated sets, as well as all mains sets, and can be used with normal or Pentode valves.

Recommended for the Selectone

BUILD YOUR "PRACTICAL WIRELESS" SET INTO THE PETO-SCOTT WALNUT CONSOLE

Constructed in Walnut with contrasting inlaid Walnut Veneers.

Comes to you with vignetted front, as illustrated, ready to take your own set. No skill or expensive tools are required to transform your radio into a beautiful Console instrument, presenting the professionally finished appearance of the most luxurious Radio Receiver money can buy. Cash or C.O.D. Or 12 monthly payments of 5/8. **62/-**

Carriage and Packing 2/6 extra England and Wales.

Baffle Board ready Drilled 3/6 extra.

Dimensions: 36in. high; 21½in. wide; 15½in. deep. Panel 18in. by 8in. Baseboard, 14in. deep.

1933 KELSEY SHORT-WAVE ADAPTOR

Tune-in the Short-Wave Stations on your present set. Plug the Kelsey Short-wave Adaptor—it fits without any alteration. No extra valve required, no extra-apparatus. Ready for immediate use and sold complete with Dial Calibration Chart and simple Tuning Notes by our Short-Wave Expert

45/-

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IMPORTANT. Parts, Kits, Miscellaneous Components, Finished Receivers or Accessories for CASH, C.O.D., or H.P. on our own system of Easy Payments. Send us a list of your wants — we will quote you by return. C.O.D. orders value over 10/- sent carriage and post charges paid.

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for which I enclose £.....s.....d. CASH/H.P. Deposit.

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ADDRESS .....

..... Pr.W. 14/1/33

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Next Week's Free Data Sheet is entitled "HIGH- AND LOW-FREQUENCY CHOKES"

ROUND *the* WORLD *of* WIRELESS

New High-power Station for Algeria

AS complaints have been received from French residents in Algeria that broadcasts from Radio Alger cannot be picked up at Oran, the French Government has decided to erect a 20-kilowatt transmitter at Sainte Barbe du Tiela, near that city.

Listeners Choose Their Own Studio Announcers

IF a French station wishes to engage an announcer a number of candidates are put up for election, and each one in turn announces certain items in the programme. Except for the fact that he is given a number, or appears under a *nom-de-guerre* before the microphone, he remains anonymous to the listeners, who are requested to vote for the voice which best pleases them.

The Race for Power

BELGIUM, apparently, although a small country, is dissatisfied with the size of its two 15-kilowatt Brussels broadcasting stations. In the course of 1933, the Velthem transmitters are to be reconstructed in order to secure an output approaching 75 kilowatts in the aerial.

Paying for the Dutch Broadcast Programmes

THE A.V.R.O., a non-political wireless association which provides the bulk of the entertainments at the Hilversum station in Holland, boasts of over 175,000 members. As no licence is collected from listeners, the expense of running the studio is defrayed privately. The sum contributed annually by the A.V.R.O. supporters amounts to £88,000.

Jugoslavia Comes to the Front

WORK on the new 15-kilowatt Belgrade transmitter is so far advanced that tests may be carried out in the course of a few days. The Zagreb station, built in 1925, and now one of the smallest in Europe, will also be replaced by a bigger plant. Its successor will be erected at Otok on the bank of the River Save, and will be of a power equal to that of the new capital transmitter.

Do You Hear Radio-Toulouse?

ALTHOUGH no official permit has yet been obtained, the 60-kilowatt station at St. Agnan (near Toulouse) is carrying out tests nightly from 11 p.m. onwards; its wavelength is 385 m.

Results of the Madrid Convention

SOME little gain has been made for radio telephony, inasmuch as on the long waves the band comprised between 1,250 and 1,875 metres has been entirely released for broadcasting stations. On the medium waveband, the limits were not extended and remain from 200—546 metres. The power of transmitters, however, was restricted to 150 kilowatts for those stations working on wavelengths above 1,000 metres, and to 100 kilowatts if on channels in the lower broadcasting band. Exceptions appear to have been made for certain stations, either already in operation or under construction. These are Prague, Vienna, Budapest, Toulouse, Rennes, and Leipzig, which may increase their power to 120 kilowatts.

Sunday Broadcasts by the League of Nations

THE weekly talks given through the Prangins (Switzerland) short-wave station on the work done by the League of Nations are now broadcast at 10 p.m. G.M.T., simultaneously on 31.3 and 38.7 metres.

Don't Confuse Them

THERE are two broadcasting stations in Europe which make announcements in both French and German, namely, Radio Strasbourg (345.2 metres) and Luxembourg, which, at present, is testing on wavelengths varying between 1,186 and 1,250 metres. The former can be identified easily by the fact that as an interval signal it uses a deep buzzing note.

Vienna's Super Station

IT had been hoped to get the 120-kilowatt transmitter ready in time for the Christmas broadcasts, but this was found impossible. It is now definitely stated that this "giant" will be brought into action towards the end of February, and that its official opening ceremony will take place at Easter.

A Further Addition to the German Net

A SITE has been found at Billerbrok, near Hamburg, for the seventh of the high-power German regional stations. This 60-kilowatter, when installed on the banks of the Alster, should be well heard in Great Britain.

France Follows Suit

UP to the present, in view of its low power and close proximity in wavelength to London National, broadcasts from Radio Lille (PTT Nord) can only be picked up with difficulty by listeners on this side of the "ditch." In the course of a few months, however, Lille should appear in our daily logs, as work on the 60-kilowatt station to be erected at Camphin has already begun.

Radio Greetings to the Polar Regions

ON Christmas and New Year's Day, in exchange for a small fee, the Danish broadcasting authorities allowed listeners to send through the Kalundborg high-power transmitter personal messages and greetings to their friends and relatives in Greenland. During the winter months a similar service is carried out by some of the American stations for residents in Alaska and the "Frozen North."

Broadcast of the Australian Test Matches

THE B.B.C. will transmit through the Regional stations eye-witness accounts at the close of play of the test matches in Australia. With the exception of the match starting at Adelaide on January 13th, they will all be heard in the British Isles at 8.5 a.m. G.M.T.

The Radio Synthetic Kiss

FOLLOWING a series of experiments, the Radio-Paris studio has adopted a new method for imitating the sound of a

IN THIS ISSUE

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

kiss where required in a broadcast play. Tests showed that the real thing did not convey the right noise to the listener. By gently rubbing a cork previously powdered with resin against a small glass plate which, in its turn, has been covered with fine emery powder, the radio engineers have found that the illusion is almost complete. But then many males in France still wear beards!

Boycotting State Transmitters

SINCE the Reichsfunk took over the German broadcasting system the character of the programmes has undergone considerable change. As a protest against the political aspect of the entertainments and talks, local associations requested their members to show their dissatisfaction by a refusal to pay the listening tax. As a result, it was publicly stated in a recent debate at the Reichstag that during the period July 1st—December 1st over 486,000 listeners had omitted to renew their broadcasting licences. On the other hand, recent official statistics tend to prove that 80,000 new licences were taken out in November last.

Testing Commercial Receivers

EXPERIMENTAL work is still going on for the testing of the efficiency of commercial receivers, and new apparatus is being developed in this connection. This is probably the most popular contribution to radio technique yet made, and is of undoubted benefit to manufacturer and customer. By its use, receivers can be tested as regards selectivity, sensitivity, and for audio-frequency fidelity, and buyers of radio apparatus will at once have a means of direct comparison of the performance of different sets. We, as radio men, owe a lot to the N.P.L., and it seems as if our debt is to be increased rather than otherwise.

New Transmitter for Experimental Work

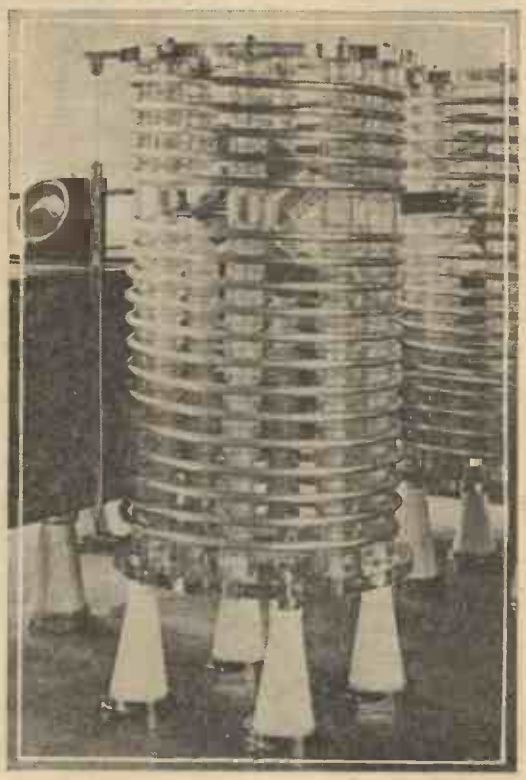
STILL further experiments are going on with the object of studying the transmission of wireless waves through the ionized range of the atmosphere, and for some time a series of transmissions have been sent out from N.P.L. of which the frequency has been variable in a regular manner through a definite range of frequencies. As it is considered these transmissions are doing good work, and will be required for several years to come, another transmitter is being erected. The new transmitter is to be of increased power, and will send out short period pulse transmissions, in order that the fullest investigation of the Heavyside layer may be made, and the maximum electron density of the upper atmosphere determined. The new installation will take an input of 2 kW., and can transmit on a range of wavelengths ranging from 30 metres to 1,000 metres. The change in wavelength or frequency is to follow a pre-determined schedule, and is automatically operated by a synchronous alternating current motor by means of which the frequency change device is accurately timed.

Athlone At Last

IT is some time since I mentioned that the new 80 kW. Athlone station would be "on the air" very soon, but there has been a good deal of unexpected delay, and the station is not yet in operation as I write these notes. Test transmissions have been taking place for some time at 10.30 p.m., and it is now understood that the Free State giant will definitely commence a regular service in a very few days. You will probably have heard it before reading this issue—unless there have been further delays.

INTERESTING and TOPICAL PARAGRAPHS

PRAGUE'S NEW 200 KW. RADIO STATION.



The new radio station is situated in the geographical centre of Europe, some 35 kilometres east of Prague, in the vicinity of the small town of Cesky-Brod. This new high-power broadcasting station is rated at 200 kilowatts (C.C.I.R.), and is the most powerful broadcaster operating in the medium wave broadcast band. The illustration shows a close-up view of inter-stage tuning coils at the new Prague broadcasting station.

Empire Broadcasting

A LARGE number of favourable reports have already been received by the B.B.C. in regard to the short-wave Empire Broadcasting station. Apparently the only zone from which reports are unsatisfactory is that which includes Canada. I believe that a different wavelength will shortly be tried for this zone, because it seems evident that the present one is unsuitable.

Prangins, or by its other name, Radio Nations, the broadcasting station run by the League of Nations, has been doing some excellent long-distance work of late. Good reception has been reported from Japan and Western America, so the engineers are no doubt very proud of their station. A number of broadcasts have been given by prominent statesmen connected with the League, and it is hoped that Prangins will afford good publicity for the League of Nations movement. If you want to try for this station you will find it on 31.3 metres from 10 p.m. to 10.45 p.m. on Sundays.

Licence Figures in the North

LICENCE figures are still rising rapidly in the North of England, and especially in Yorkshire. Whether or not this is coincidence or has some bearing on the recent rumours that the Post Office "plain vans" were in the vicinity I cannot say. Being in sympathy with the North, I should vote for coincidence.

The New Munich Transmitter

HAVE you heard the new 60 kW. Munich broadcasting station yet? It recently commenced operations on 533 metres and comes in rather well. If you cannot tune up to 533 metres in the ordinary way, put a .0001 mfd. fixed condenser in parallel with each tuning condenser; this should increase the wavelength range to 550 metres or so and you might also bring in Budapest which is a fairly strong signal just now.

Ultra S.W. Television

AS I forecast a couple of months ago, the B.B.C. Ultra S.W. transmitter installed on top of Broadcasting House is now being used for television tests by the Baird System. A wavelength of 7.3 metres is used and transmissions take place from 3 p.m. to 5 p.m. on Wednesdays and Fridays. I gather that before long experiments will be conducted with images having from 100 to 200 lines instead of thirty as at present. Those readers who have been following our "Television" articles will understand that if these tests are successful they will mark a definite advance in the progress of the new science.

(*Continued on page 798.*)

SOLVE THIS!

Problem No. 17

Having built a simple three-valver, Rogerson decided that perhaps a parallel-fed transformer arrangement would sound better than the direct fed method he was using. He accordingly bought a 10,000 ohms spaghetti resistance and inserted this in the anode lead in place of the primary of the transformer. The anode was then joined to earth, via the primary, but signals proved to be very weak, and within a day the H.T. battery had run out. Where had Rogerson gone wrong in this arrangement? Three books will be awarded for the first three correct solutions opened. Mark envelopes, Problem No. 17, and send to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8/11, Southampton Street, Strand, London, W.C.2, to reach us not later than January 16th.

SOLUTION TO PROBLEM No. 16

The tests revealed that an Anode component was being short-circuited. Actually the H.F. choke was at fault, owing to the enamelled insulation having been cracked, and the leading-in and leading-out leads were touching, and so were short-circuiting the whole choke.

The following three readers received books in connection with Problem No. 15:—

Mr. C. Bonnett, 196, Farebrother Street, Grimsby; Mr. W. Harris, 19, Connis Street, Openshaw, Manchester; Mr. B. C. Watson, 150, Hilderthorpe Road, Bridlington.

PRACTICAL HINTS ON WIRELESS RECEIVER DESIGN

Important Facts Concerning Lay-out and Construction

By JACE

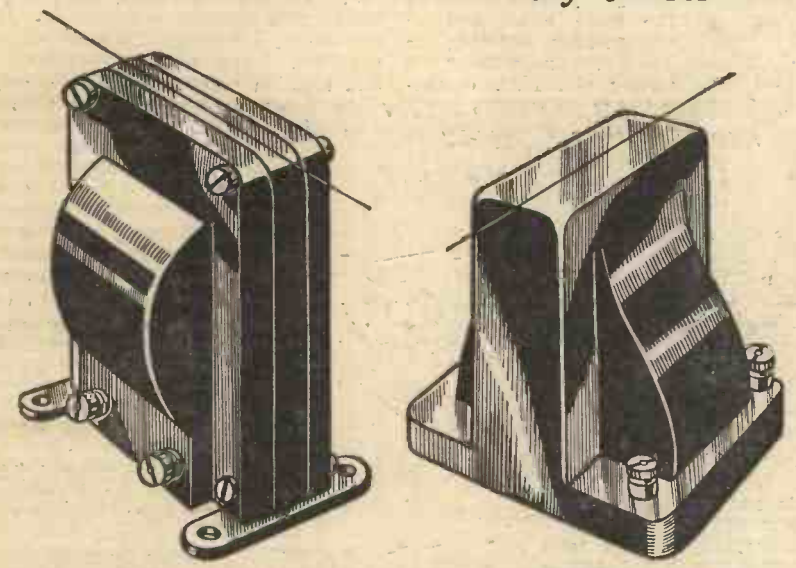


Fig. 1.—Arrange L.F. chokes and transformers with their cores at right-angles to each other.

THERE used to be a prevalent idea that the performance of a wireless set was purely and simply dependent upon the circuit employed, and I am afraid that even to-day the idea is not quite dead. It is time it was because as a matter of actual fact the working out of the circuit diagram is only a small part of receiver design. If a dozen constructors were all supplied with the same circuit diagram and asked to interpret it, or to build a set using it, I dare wager that each one would obtain entirely different results. Why? Because they would arrange the parts in various different ways with a result that many of them would be unable to operate in the manner intended by the designer of the circuit. In consequence, the set's performance would in all probability be a good deal below the standard anticipated. Of course it would be impossible, in the course of a short article, to deal fully with the whole subject of receiver design, so rather than attempt to do that I propose to discuss some of the most important points which arise in connection with the building of a set of any kind, and to point out a few of the problems which occur. I shall assume throughout that a circuit has been decided on, and that the question which remains is how it can best be "translated" into practical form.

Important Features of Design

Let us first consider what are the most important features. Generally speaking they resolve themselves into the following order of importance:—

1. The components must be so placed that stray capacities, and inductive couplings are reduced to a minimum.

2. Consistent with condition (1) the set should be as compact and as easy to wire up as possible.

3. The tuning and reaction controls should be so placed that they come readily to hand.

4. The panel lay-out must be as neat and symmetrical as possible consistent with conditions (1), (2) and (3).

The Chassis

Before proceeding further we must decide on the type of chassis to be employed. With a simple one or two valve set it is probable that the rather old-fashioned horizontal baseboard with vertical panel will prove most satisfactory, but in most other cases a chassis consisting of an inverted box will be better. The latter gives more space for components without increasing the overall dimensions of the set. It also allows most of the wiring to be carried out below the baseboard and so gives a neater and more businesslike appearance. Shall the chassis be of wood or aluminium? This is rather a debatable point and depends largely upon the facilities of the constructor. If he is fond of metal-working he will probably choose aluminium, but, on the other hand, if he is not in possession of the necessary metalworking tools he will no doubt favour wood. If aluminium is used it will form a very desirable and convenient screen, but the same result can be obtained by covering the wooden chassis with metal foil, or with some of that excellent aluminium-sprayed paper now on the market. In any case the metal screening will be of use not only for its nominal purpose, but also for making numerous earth connections. Since the screen will of necessity be connected to earth, wiring can be simplified and many wires reduced in length by connecting them to the screen by means of screws fitted with washers. Screening, as such, is not always necessary in a simple set, but in case of

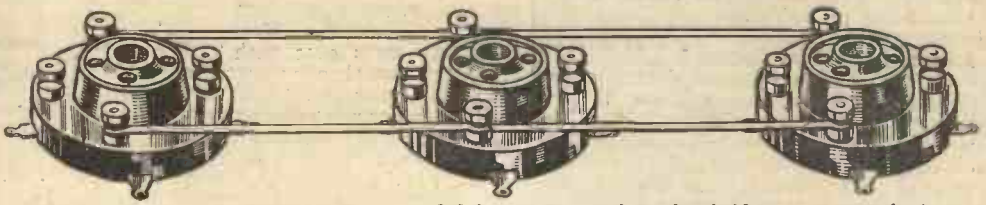


Fig 2.—Wiring of L.T. circuits is simplified by arranging the valve holders in a straight line.

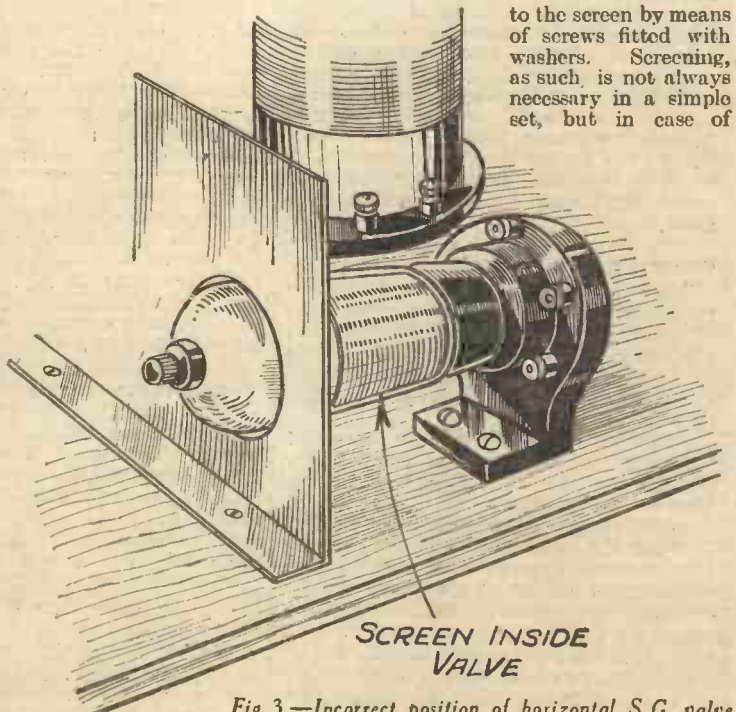
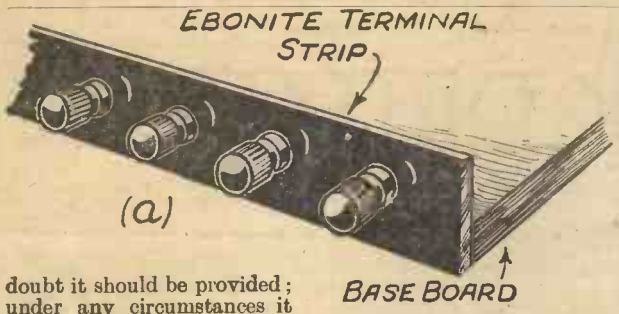


Fig. 3.—Incorrect position of horizontal S.G. valve holder in respect to the screen.



doubt it should be provided; under any circumstances it can do no harm even if it is not actually beneficial.

Before leaving the question of the chassis we had better give a little thought to the position created when the set is an all-mains one. Shall we build both receiver and power supply unit on the same chassis, and, if so, what screening should be necessary? Again, the question is debatable, and one upon which the individual must decide. If the set is not of a very powerful type, it is improbable that it will suffer very much from the close proximity of mains transformers, chokes, etc., but if it has two or more L.F. stages there is a danger that any slight interaction between it and the power supply might result in serious mains hum. Whenever convenient it is advisable to play for safety by building the mains equipment as a separate unit which can be kept some little distance away from the set (a matter of inches is generally sufficient) if necessary. This method offers a further advantage in so far as the supply unit can be used on another set when the time comes to dismantle the present one.

Iron or Aluminium Screens?

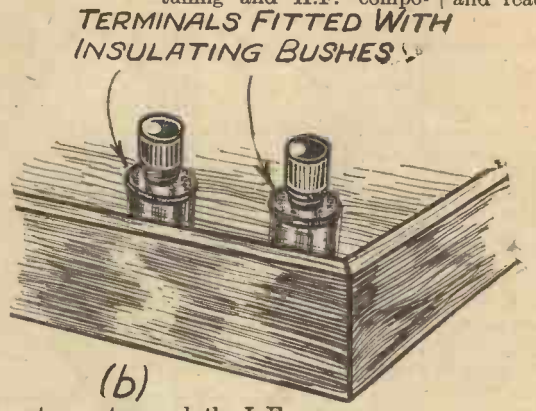
A number of amateurs, and even a few designers who ought to know better, "screen" the mains equipment in the same way as they screen the set—with aluminium or copper. I purposely put the word "screen" in inverted commas because non-ferrous metal does not screen components such as transformers and chokes operating at low frequencies—iron must be used for that purpose. Non-ferrous metals can act as electrostatic screens, but not as electromagnetic ones. On the other hand, iron should not be placed near to components in the high-frequency circuits because it will cause definite loss of energy due to the formation of eddy currents in it. This is another argument in favour of separating the set from the mains equipment.

Component Arrangement

After deciding on the type of chassis to be used, the next step is to arrange the components in the most suitable positions. For some reason or other this task gives me a peculiar fascination, and it is the part of the constructional work I always look forward to.

And what are the rules to be observed? They are not very numerous, nor are they difficult to remember; stated briefly, they are as follows:—

1. Allow as much separation as possible between the parts in the high-frequency circuits and those comprising the low frequency amplifier. This can generally be accomplished most satisfactorily by mounting the S.G. and detector valves at one end of the baseboard (it doesn't matter which) and the L.F. valves at the other end. A better way when the width, from front to back, of the chassis or baseboard is of no consequence is to keep the components forming the H.F. circuits just behind the panel and to place the L.F. amplifier at the back of the chassis. The latter arrangement has the advantage of allowing very short and direct wires to be used for the tuning circuits. When a fairly deep (from 3 to 4 inches) chassis is employed the same effect can be obtained by screening the baseboard and putting the tuning and H.F. components on top and the L.F. ones underneath.



2. Carefully arrange each component so that its terminals are in such a position that they can be connected to other components by direct wires, and without wires having to cross over each other any more than is absolutely essential. To comply with this rule the constructor must first commit the circuit to memory and attempt to visualize the connections. In regard to the arrangement of components it should be remembered that most attention should be paid to the S.G. and detector valve holders, coils, tuning and reaction condensers, grid condenser and leak, H.F. choke, and any wires associated with the high-frequency circuits. Wires between the latter components should be as short as possible, but this is not nearly so important in respect to L.F. transformers, chokes, feed resistances, etc.

L.F. transformers and chokes must not be placed too near together, and they should be arranged so that their cores are at right angles to each other, as shown in Fig. 1. Neglect of this simple precaution will probably result in L.F. instability, with consequent distortion and howling. When possible, it is a good idea to arrange the valve holders in a straight line, as shown in Fig. 2, with the anode terminals all pointing in the same direction. This simplifies the wiring and allows two straight wires to be employed to carry the filament supply. The wiring will also be simplified fairly considerably if most of the components are arranged in positions corresponding approximately to those they occupy in the circuit diagram, and in most cases this will also contribute towards general efficiency.

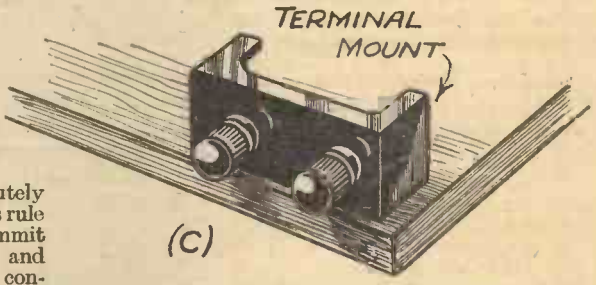
3. Make quite sure that the coils are either properly screened or are arranged with their axes at right angles. The same rule applies to H.F. chokes; if unscreened, their axes should be at right angles to each other and also to those of the nearest coils.

4. If the S.G. valve is not of the metallized type it should be fitted with a screening box, or mounted in a horizontal holder so that it can pass through a 1½in.-diameter hole in the screen used between the tuning circuits. The position of the valve holder should be adjusted so that the screen inside the valve (it can be seen as a metal band just above the cap) is in line with the external screen. See Fig. 3.

5. As mentioned before, the panel controls should be arranged symmetrically and in such positions that they can easily be operated. Most important are the tuning and reaction knobs, and these should be fairly well apart so that they can be operated simultaneously when necessary. In arranging the panel components do not forget to allow for the diameter of the tuning dial, or you might find that one of the knobs comes very close to, or even touches it.

When a single-tuning dial is employed it is well to try to arrange it in the very centre of the panel and to space the other knobs around it. If two separate tuning controls are required, they can generally be fitted at equal distances from each end of the panel.

6. Next one must decide on the method of connecting the battery leads; shall terminals be employed, or shall the flexible wires be joined directly to the components? The former system is perhaps a little neater and more professional, but the latter is very convenient, especially if batteries are to be housed in the same cabinet as the set. If terminals are preferred, there are three ways of mounting them, as shown at (a), (b), and (c) in Fig. 4. Method (a) is the well-known one where a 1½in. strip of ebonite is screwed to the baseboard or chassis; in method (b) terminals fitted with insulating bushes are attached directly to the baseboard, which should not be more than about ⅜in. thick; method (c) consists of using a set of ready-made terminal mounts.



Figs. 4 (a, b, and c).—Three methods of mounting terminals.

When direct battery leads are to be used care should be taken that they cannot be pulled off the terminals by accident. This can be ensured either by knotting them and passing them through the baseboard or side of the chassis, or by bunching them together and securing them to the baseboard by means of a small brass "bridge."

(To be continued)

THE GRID-LEAK DETECTOR

An Explanation of the Manner in Which the Valve Rectifies a Signal

By S. J. GARRATT

TO understand the action of "leaky grid" detection the reader must, of course, be familiar with the principles on which the ordinary three-electrode valve works. Excellent articles dealing with this subject have already appeared in PRACTICAL WIRELESS, so a brief *résumé* is all that is now necessary.

Fig. 1 illustrates the usual connections for a grid-leak detector. The filament emits a flow of electrons when heated, and these electrons—which are really minute charges of negative electricity—are attracted by the positively charged anode, the charge on the anode being maintained by a high-tension battery. This flow of electrons constitutes the electric current of the high-tension circuit. Now by altering the potential of the grid, this flow of electrons is interfered with; if the grid is made more positive the flow of electrons will be increased (this being the same thing as an increase in anode current), while if the grid is made more negative the flow of electrons will be reduced, with a consequent decrease in the anode current. But the electrons are attracted by a positive charge, so when the grid is positive, a few electrons (about 1 in every 1,000) will be attracted to the grid, or, in other words, a small grid current will flow, completing a circuit through the grid-leak back to the filament. When the grid is negatively charged, however, the electrons will be repelled from it, and there will be no grid current. This grid current is extremely minute, being only a few millionths of an amp., or about a thousandth part of the anode current, but upon this tiny current depends the detector action of the valve.

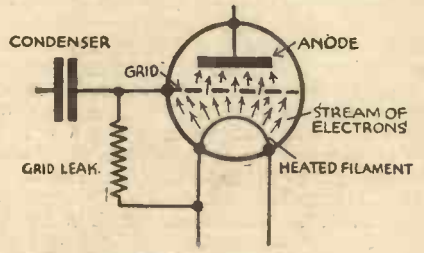


Fig. 1.—Connections for grid-leak detector.

The left-hand side of the condenser in Fig. 1 is connected either to the aerial tuning system or to the output of the last H.F. valve, as the case may be, with the result that radio-frequency impulses appear on the left side of the condenser as an alternating charge. This charge successively attracts and repels the electrons on the right-hand half, causing them to surge to and from the grid to the condenser and *vice versa*. It will be seen that this high-frequency input causes no change in the total quantity of electrons on the grid system, but only causes the grid of the valve to become negative at the expense of the condenser, and *vice versa*.

Electron Flow

But we have not yet taken the grid current into account. When a steady series of radio-frequency waves (such as is graphically represented at the left of Fig. 2) appears on the grid, each positive half of the wave will attract a number of electrons to the grid. These electrons cannot get away from the grid system, except comparatively slowly through the grid-leak, so that at every positive impulse more electrons arrive on the grid, and the potential of the grid will therefore become more and more negative, thus attracting fewer electrons, until the rate at which electrons arrive on the grid equals the rate at which they escape *via* the grid-leak. The *mean* grid potential will then remain at a steady negative value, as shown to the right of Fig. 2. The high-frequency variations are still present and of the same value, but owing to the effect of the grid current they fluctuate about a more negative *mean* value than they would do if there were no grid current. The mean anode current is therefore steady, and the radio-frequency impulses having no effect, no sound will be heard from the speaker. This is, of course, all in order, for a wave like Fig. 2 would mean that there was silence in the broadcasting studio.

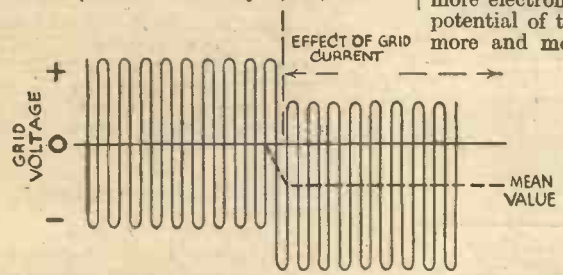


Fig. 2.—Showing the effect of grid current on the mean grid potential.

Now suppose the band begins to play so that modulated waves, after the style of Fig. 3, arrive on our detector grid. These modulations are merely changes in amplitude (*i.e.*, vertical measurement in Figs. 2 and 3) of the original wave represented by Fig. 2. The modulations are controlled by the microphone in the transmitting studio, and are of course of audible frequency.

Fluctuations of Grid Potential

As in the case of a steady, unmodulated wave (Fig. 2), the positive half of each radio-frequency impulse will cause grid current to flow, and the greater the amplitude the more grid current there will be, causing a greater accumulation of electrons on the grid, which is the same thing as saying that the *mean* potential or voltage of the grid becomes more negative. The mean value of the grid potential therefore fluctuates, and the greater the amplitude of the modulated wave, the more negative the grid becomes. These negative fluctuations of grid-potential therefore follow the modulations of the wave (represented by Fig. 3) which are of audible frequency, and cause corresponding audible frequency variations in the anode current, which, after suitable amplification, are capable of working the loud-speaker.

If the reader has followed this explanation carefully he will see that it is not correct to say that the detector valve "cuts off one half of the modulated wave." This is the accepted explanation of the action of a crystal detector, but in the case of the valve detector, the complete wave appears on the grid, and therefore is reproduced in the anode circuit in its entirety, high frequency as well as low frequency. All that happens is that the *mean* value of the grid voltage is made to fluctuate at an audible frequency. Fig. 3 represents the modulated wave as it is received, and Fig. 4 shows what happens to the wave after it has been "detected."

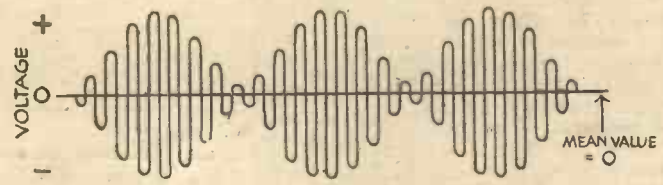


Fig. 3.—Modulated wave before being influenced by the detector valve.

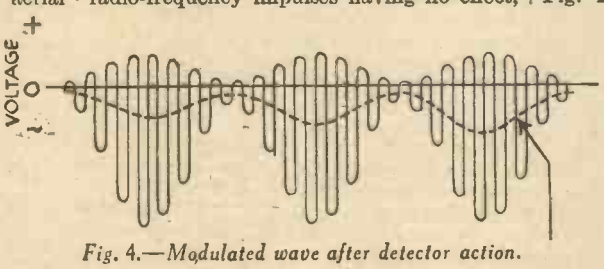


Fig. 4.—Modulated wave after detector action.

The Grid-leak's Function

Perhaps a reader will ask: "What does the grid-leak do?" If there were no grid-leak at all, the electrons which arrived on the grid inside the valve could not get away; they would accumulate on the grid and the right-hand side of the condenser (Fig. 1), making the grid system more and more negative until the valve ceased to work. On the other hand, if a piece of copper wire were used instead of the high-resistance leak, the electrons would escape as fast as they arrived, so that they could have no effect on the grid potential at all, and consequently there would be no detector action.

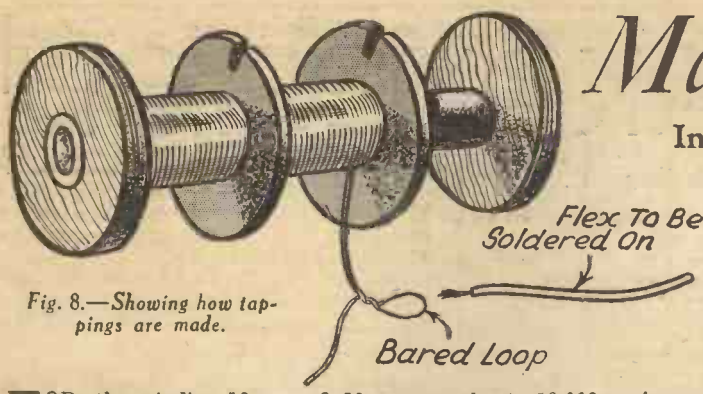


Fig. 8.—Showing how tappings are made.

Making Your Own

In This Article FRANK PRESTON, F.R.A., Simple Construction of

FOR the winding 10 oz. of 38 gauge enamelled wire will be suitable. This choke will have a D.C. resistance of approximately 1,450 ohms and will be very satisfactory for use in practically any medium-power set or eliminator.

A Low-frequency Transformer

Due to the somewhat enormous number of turns required, the construction of an L.F. transformer is inclined to be rather a tedious business. This is especially so when the windings are of about 44 gauge wire such as is generally employed for commercially-made instruments. However, a hedgehog transformer can be made in a fairly simple manner by employing the same general form of construction as that adopted for the chokes described above. The bobbin should be of the size shown in Fig. 9 and both (primary and secondary) windings are in 40 gauge enamelled wire. The primary, for which 3½ oz. are required, is wound in the middle section. To reduce the capacity to some extent a layer of oiled silk or waxed paper insulation is inserted half-way through the winding. The secondary is divided into two halves which are placed in the end sections of the bobbin. Each half is exactly like the primary, and after winding they are connected in series; the soldered joint between them must be carefully insulated to prevent it from making contact with the core.

The winding process can be simplified very considerably if a lathe is available because the bobbin can be rotated by gripping the dowel rod in the lathe chuck. A reel holder will still be desirable and might be held in the tool carrier. As the wire is very delicate it must be handled with care and the lathe should be set to a very low speed or even turned by hand. If a counter is available it will be rather useful; the number of turns in each section should be about 10,000. As a substitute for a lathe a large hand-drill can be held in a vice and the bobbin rotated with this. The core consists of a ½in. bundle of soft iron wires 9 or 10in. long and is fitted in exactly the same manner as described in respect to the chokes. A system of mounting like that shown in Fig. 5 will be suitable when the terminals are fitted one on each corner of the baseboard. The latter should be marked with small labels to correspond with the connections shown in Fig. 9.

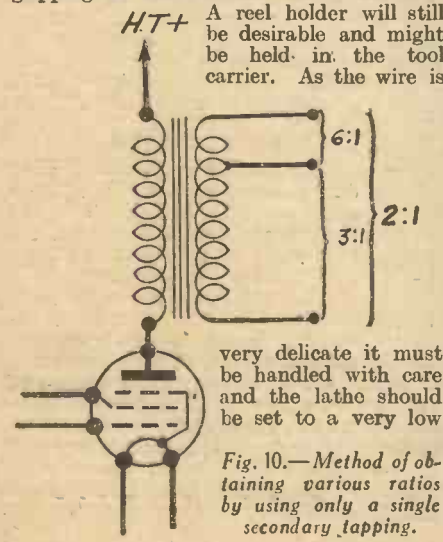


Fig. 10.—Method of obtaining various ratios by using only a single secondary tapping.

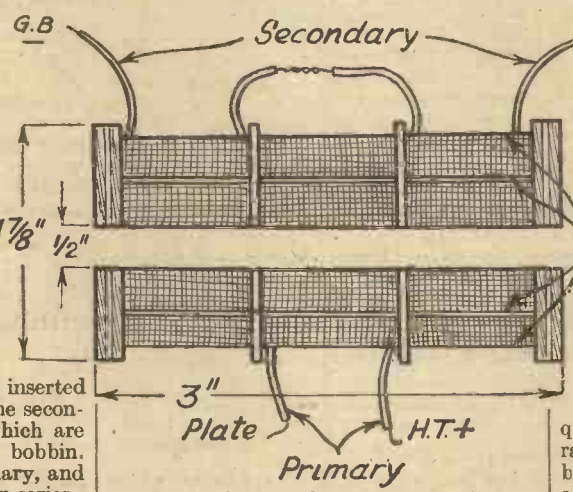


Fig. 9.—Section through bobbin of the hedgehog transformer described.

The transformer described will only have a ratio of 2 : 1, but will nevertheless give splendid results. A higher ratio could be obtained by using a greater number of turns of finer wire (42 or 44) for the secondary, but that would make the winding process much more difficult. The transformer will give good low-note response when passing any value of primary current up to 4 milliamps and will be appreciably more efficient than the average medium-priced commercial instrument.

A Loud-speaker Output Transformer

The L.F. transformer just described can be employed very satisfactorily as a 2 : 1 step-down output transformer with either a pentode or power valve by reversing the primary and secondary connections, or in other words, by using the secondary as primary, and *vice versa*. The transformer so used would be very suitable for feeding a "cone" speaker of average impedance from any battery-operated output valve. Higher step-down ratios could be obtained by taking tappings from the winding serving as secondary. For example, if a single tapping were made after winding one-third of the turns, ratios of 2 : 1, 3 : 1 and 6 : 1 would be obtained by connecting the speaker across the whole winding, between the tapping and one end or between the tapping and the other end, as shown in Fig. 10. In the same way any other ratios could be provided by making one or more tappings at other points. If it is remembered that the ratio is always equivalent to the proportion of the number of primary turns to the number of secondary turns in circuit, there should be no difficulty in deciding on the correct tapping position for any required ratio.

The output transformer just mentioned would be suitable only when the primary current (anode current consumption of the last valve) is not more than 20 milliamps. If a transformer were required for higher primary currents a larger core and bobbin, like those prescribed for the smoothing choke, would be desirable. The latter should be wound with 40 gauge wire, using about 6 oz. for the primary, and for the secondary the quantity required to produce the required ratio. A transformer of this type could be used with any primary current up to about 40 milliamps.

High-frequency Chokes

A number of high-frequency chokes have been described at various times, but in almost every case the writer concerned has specified a turned ebonite rod. Of course, that is

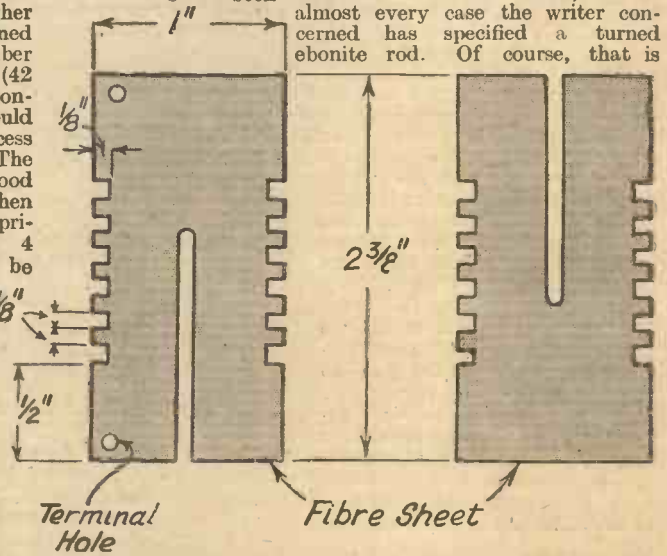


Fig. 11 (b).—The former for the choke or resistance shown in Fig. 11 (a).

Components (2)

Continues to Instruct You in the Chokes, Condensers, etc.

all very well if a lathe is available, but I think I shall be correct in assuming that not one in every hundred readers of PRACTICAL WIRELESS has such a tool. The choke illustrated in Fig. 11 will therefore be of interest. It can be made by the use of only a saw, drill and file, but is, in fact, more efficient than most of those made on an ebonite bobbin, since the windings have an air core and, in consequence, a very low capacity indeed. Having a natural wavelength of 5,000 metres or more it will be suitable for use in practically any radio-frequency circuit. The former is built up from two pieces of fibre measuring 2⅜in. by 1in., and these are fastened together at right angles by making a slot half way down each and of width equal to the thickness of fibre. This slot can be made most easily by sawing down the strip and cutting off at the end with a sharp knife. Six equidistant slots are made down the edges of the fibre by means of either a file or a sharp chisel. Two holes are made in one of the strips to take terminals, which should be fitted with soldering tags. A winding of approximately 1,000 turns in all of 38 gauge enamelled wire is put in the six slots and the ends are attached to the terminal soldering tags.

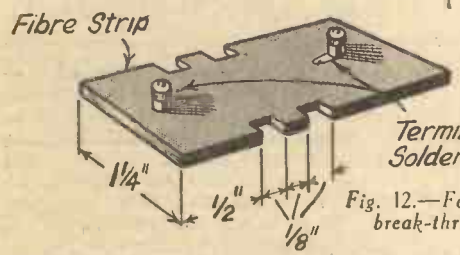


Fig. 12.—Former for anti-break-through choke.

An Anti-break-through Choke

A choke for preventing medium wave break-through when listening on long waves can be made quite easily as shown in Fig. 12. A single fibre strip with four slots is used as a former and the winding consists of 300 turns of 38 gauge enamelled wire. Two terminals should be attached to the strip and the ends of the winding connected as explained for the H.F. choke. Both of the chokes described will be attached to the set by means of their connecting wires,

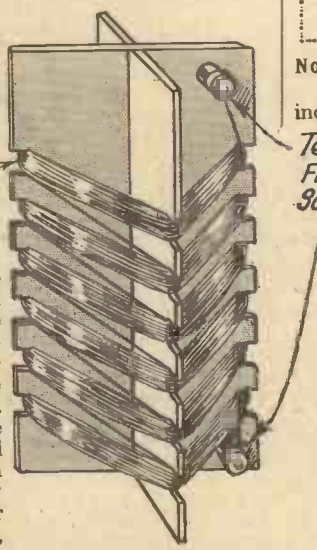


Fig. 11 (a).—Constructional details of an H.F. choke or wirewound resistance.

although they could be screwed to the baseboard if desired, by fitting small brass angle brackets.

Fixed Resistances

Various types of fixed wire-wound resistances can be made in precisely the same manner as that of the two chokes, but by using resistance wire in place of copper wire. The amount of wire necessary for any particular resistance value will depend upon the gauge employed and the current-carrying capacity required. To enable readers to make resistances for different purposes, the following table, which applies to Eureka resistance wire, is given. For resistances of the type under consideration either enamelled or silk-covered wire should, of course, be chosen.

Eureka Resistance Wire Table

S.w.g.	Resistance per 1,000 yards.	Max. Current (milliamps).	Approx. weight per 1,000 yards. (pounds).
32	7,350	500	1.1
36	14,840	250	.55
38	23,808	100	.35
40	37,184	150	.23
42	53,564	130	.17
44	83,664	100	.10

Non-inductive Resistances

Resistances wound as above will be inductive and therefore unsuitable for many purposes. They can be made to be practically non-inductive, however, by winding the wire in opposite directions in alternate slots; the inductance of one section will neutralise that of the next. Another way is to put on a double winding by using two reels of wire at the same time. The "beginning" ends of the wires from both reels are fastened together and the winding proceeded with in the normal manner. Connections are, of course, made to the two "finishing" ends. The resistance value will be equal to the sum of those of the two lengths of wire.

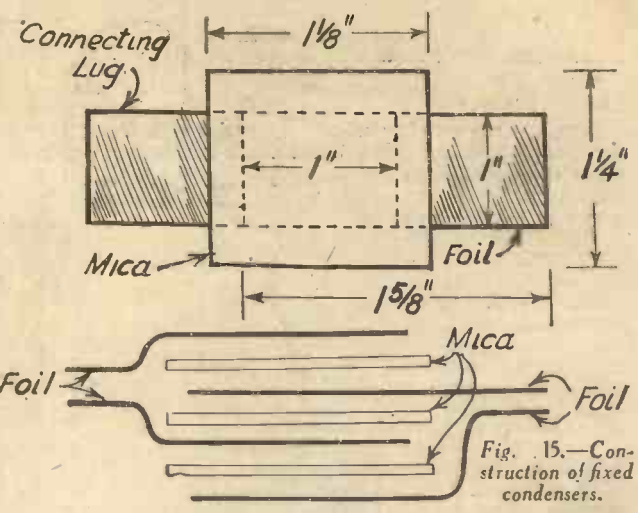


Fig. 15.—Construction of fixed condensers.

Power Resistances

When resistances are required for power purposes, that is when they have to carry a fairly heavy current, it is generally better to use bare wire so that the heat developed can be more easily dissipated. In such cases the wire has to be wound in a single layer and the turns can be insulated from each other by means of thread. The windings can be put on fibre and the winding is carried out as illustrated in Fig. 13 by putting on a length of resistance wire and one of thread at the same time. If the current is likely to exceed the figures given in the above table it will be best to wind without the thread and allow a small space between each turn of wire. The reason for this is that the wire will become fairly hot and might burn or char the thread. In any case the currents stated should not be exceeded by more than fifty per cent. or there will be danger of charring the fibre. If glass or asbestos material is used as winding core, the currents given can safely be increased by 100 per cent. without there being any fear of burning out the windings. There will be a certain amount of heat developed, so the resistance should be so placed that air can freely circulate around it.

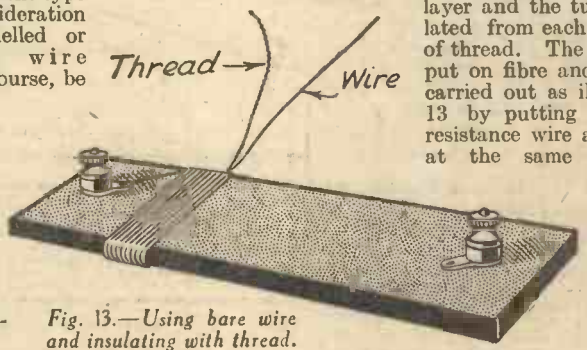


Fig. 13.—Using bare wire and insulating with thread.

Tappings

When bare wire is employed tappings can conveniently be taken at any point by means of a crocodile clip or by fitting a brass clip like that shown in Fig. 14. Thus a centre-tapped 50-ohms resistance for obtaining an "artificial" centre tapping from the 4-volt heater winding of a mains transformer could be made by using a winding of about 1½yd. of 40 gauge

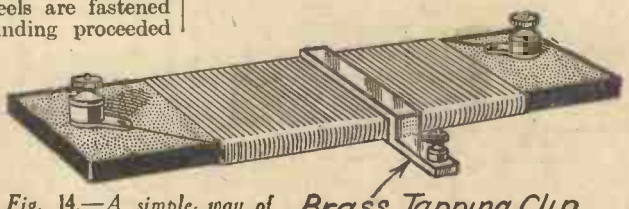


Fig. 14.—A simple way of tapping a fixed resistance.

Eureka wire. The tapping clip should be moved about until a minimum amount of mains hum can be heard.

Fixed Condensers

In view of the very low price of the ready-made articles it is scarcely worth while to make one's own fixed condensers, but in case any readers wish to make one or two for experimental purposes a few particulars will be useful. Fixed condensers are, of course, made by interleaving strips of metal foil (copper or tin) with small sheets of mica. The capacity is determined by (a) the area of overlap, (b) the number of metal plates, and (c) the thickness of the mica dielectric. To simplify matters we will keep to a standard of area of 1 sq. in. and a mica thickness of .002 in. (that most commonly employed). Using these values, the number of plates required for various capacities can be obtained from the following table :—

Approx. Capacity.	*Number of Plates.*
.0006 mfd.	2
.002 mfd.	4
.005 mfd.	10

Any smaller or larger capacities can be produced by reducing or enlarging the plate area in proportion to the capacity required. To obtain an overlap area of 1 sq. in. the plates should be cut to the sizes shown in Fig. 15. The strips of foil must be in perfect and uniform contact with the mica and this can best be ensured by *very lightly* smearing each piece of mica with thin shellac varnish. When assembled the condenser should be pressed perfectly flat and allowed to stand with a heavy weight on until the shellac sets. It will become quite solid, and can be mounted on an ebonite base by passing a terminal through each connecting lug.

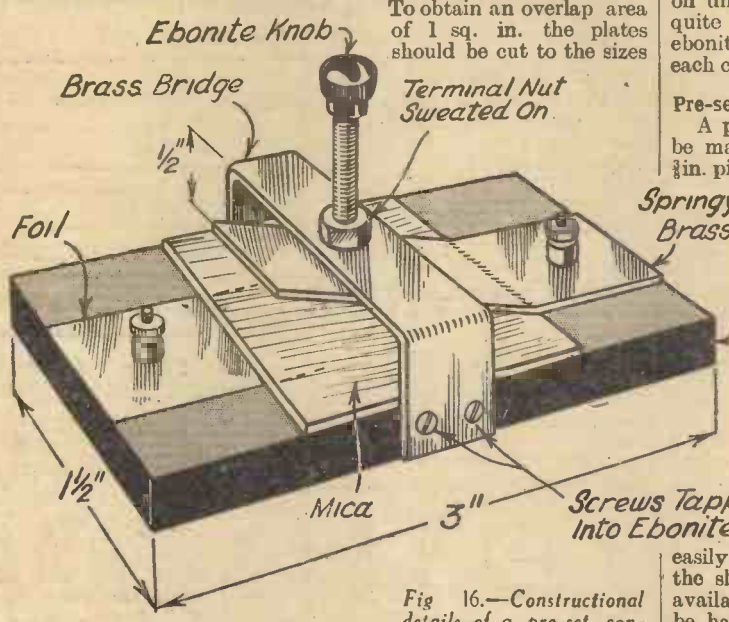


Fig 16.—Constructional details of a pre-set condenser.

Pre-set Condensers

A pre-set or semi-variable condenser can be made as shown in Fig. 16. A ¼in. or ⅜in. piece of ebonite serves as a base, and the condenser itself consists of two plates, one of foil and the other of springy brass. The foil is fastened to the underside of the mica dielectric and the brass is arranged to move towards, or away from, the mica. Movement is controlled by a small ebonite knob attached to the shank of a terminal. The nut of the latter is sweated on to a brass bridge fastened to the ebonite base by four 6 B.A. Whitworth screws tapped into the ebonite. No more need be said of the constructional details, for they will easily be followed by making reference to the sketch. If it is found that the brass available is not sufficiently springy, it should be hammered out on a flat surface, heated to redness, and allowed to cool slowly.

THE STENODE RADIOSTAT

By "RADIO ENGINEER"

MUCH research has been undertaken in the past two or three years in order to improve the selectivity of receiving sets without impairing the quality of their reproduction. Dr. J. Robinson has come forward with a circuit which he calls the "Stenode Radiostat," and which is undoubtedly the last word in extreme selectivity, for so sharp is the tuning that an interfering station whose carrier frequency is less than 1 kilocycle-sec. removed from the desired frequency can be eliminated without high note loss.

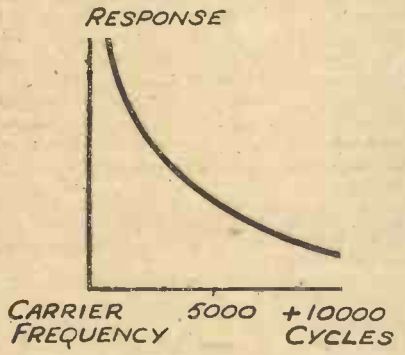


Fig. 1.—The response curve of a highly selective receiver.

Now it is well known that as selectivity is increased in an ordinary tuned high-frequency circuit so the higher frequencies are cut off and the reproduction becomes woolly owing to an excess of bass. Fig. 1 shows the response curve of a highly selective receiver.

The Principle Involved

The principle of the Stenode depends on the fact that although the response at 10,000 cycles may be very small and extremely distorted, it is only necessary to have a sufficiently sensitive device and they are detectable, after which all the frequencies can be restored to their normal value by a suitable tone corrector. Also, it must be remembered that the heterodyne whistle set up, due to the interaction of the high-frequency carrier-waves of two transmissions, has a different effect from the speech frequencies which are imposed on the wanted station's carrier-wave, and the Stenode makes use of this difference.

Tuned Circuit and Quartz Crystal

The tuned circuit used by Dr. Robinson employs a quartz piezo-electric crystal (Fig. 2). A quartz crystal, when properly ground, will vibrate at a very definite frequency, having a band width of only a few cycles either side of this fixed value; and again, as a sensitive device, it is at least a thousand times more effective than the ordinary tuned circuit.

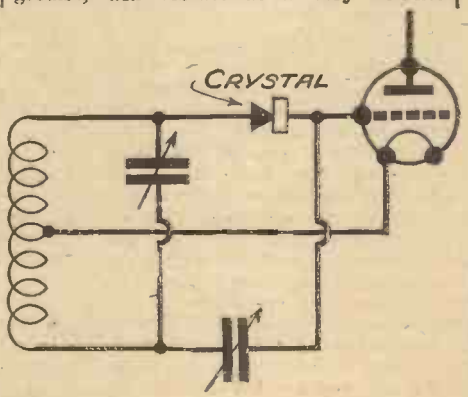


Fig. 2.—The fundamental arrangement of a quartz crystal circuit.

Thus we may use the super-het. principle and change the frequency of all incoming signals to that of the crystal. Then, after passing the crystal, the signals may be rectified in the ordinary manner, and finally passed through an L.F. amplifier whose amplification varies with the frequency (Fig. 3). As with an ordinary super-het., there are only two controls, one for tuning the aerial and the other for the frequency changer, to convert the signals to a fixed frequency of 100 kc/s.

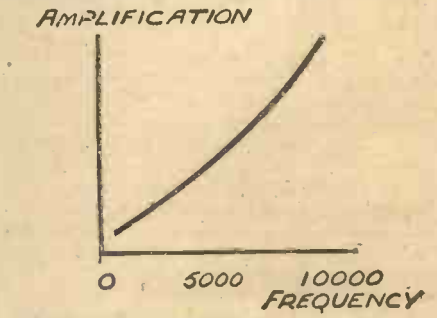


Fig. 3.—The amplification curve of the receiver.

It must be noted that the Stenode is so selective that unless the transmitting station is crystal-controlled so that its frequency is absolutely constant, a very slight variation will result in its going out of tune with the receiver. This method is certainly the extreme in ultra-selectivity, but with the ever-increasing number of stations and their powers, it seems that it will find more and more use as time goes on.

HOLDING THE FOREIGNERS

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

A Short Series of Articles Dealing With the Essentials for Consistent and Pleasurable Long Distance Reception and Touching Upon New Features of Set Design Which Will Undoubtedly Find a Prominent Place in Advanced Receivers of the Near Future.

THE three main obstacles to reliable and consistent results in long distance reception are first, the high degree of selectivity required if the elusive foreigner is to be clearly separated from his more powerful neighbours on the wavelength scale; second, the great sensitivity which the receiver must possess if the comparatively weak signals from distant stations are to be brought up to pleasurable volume; and third—fading. No very serious technical difficulties exist to hinder the provision of the first two desiderata, although every listener will realise that great sensitivity and selectivity can only be achieved by the installation of devices which, naturally, render the receiver somewhat more expensive than a set designed only for local station reception. But the screened grid valve, of which one or more may be employed as radio frequency amplifiers, can be depended upon to bring in, at reasonable strength, every worthwhile station. The additional tuned circuits incidental to the use of one or more radio frequency stages and also the advent of band-pass tuning, make adequate selectivity quite easy of attainment. Alternatively, the superheterodyne receiver, now enjoying a measure of return into popular favour, makes possible all that is necessary by way of sharp tuning and efficient amplification of incoming signals.

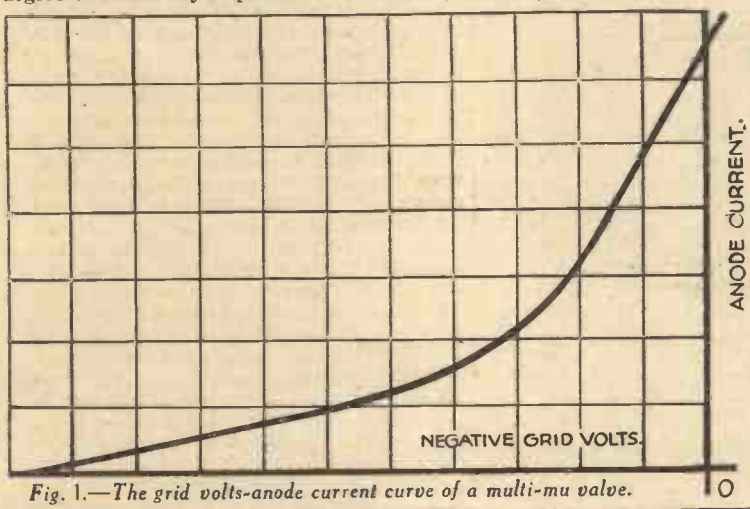


Fig. 1.—The grid volts-anode current curve of a multi-mu valve.

A Hard Nut to Crack

Unfortunately, the third drawback to successful foreign reception, that is, fading, has proved a much harder nut to crack. Until recently no really successful scheme for dealing with it had been devised, but arising out of the development of the multi-mu screened grid valve a scheme has been evolved which goes a considerable way towards a practical solution of the fading problem.

This device has been termed "automatic volume control," or more shortly "A.V.C." It was developed originally in America and has been adopted for a considerable number of commercially built sets with great success. As will appear later, the application of this device has been expedited in the U.S.A. owing to the development of new forms of detector valves which are not, at the present moment, available in this country, but British radio engineers have been working on the problem, and it is now certain that the up-to-date receiver of the future will embody some form of automatic volume control. It is therefore of interest to all listeners to learn something about the system, but before describing the principle upon which it operates and the practical method of application, it will be of service to rehearse the action of the multi-mu valve to which the control is applied.

It has been explained before in these columns that the use of screened grid valves enables weak signals, such as those emanating from distant stations, to be brought up to good strength before being passed to the detector valve. This is necessary for two reasons; first because foreign reception is not worth having unless a reasonable volume of sound is available, and second, because good and distortionless detection is only possible provided a signal of good strength is applied to the detector grid.

Overloading the H.F. Valve

But the provision of a large degree of radio frequency amplification brings another difficulty in its train, namely, that when the receiver is tuned to a powerful station such as the local transmitter, the screened grid valve, or at any rate the second of two screened grid valves, may be overloaded, that is to say, the signal applied to its grid may be too great for the valve to handle without distortion. Even if this does not occur, there is a risk that the amplified signals reaching the detector stage may cause overloading and distortion. In any case, if the set is powerful enough to give full volume with distant stations, the volume on the local station will be excessive.

The multi-mu valve was developed to furnish a more satisfactory method of adjusting the final volume of the receiver in accordance with the strength of the incoming signals. Ordinary methods of volume control on the audio-frequency side were not satisfactory in this case because the over loading and distortion usually occurred on the radio frequency side, and any restriction of output applied in the later stages was very much a case of locking the stable door after the horse had been stolen. By using one or more multi-mu valves instead of the conventional

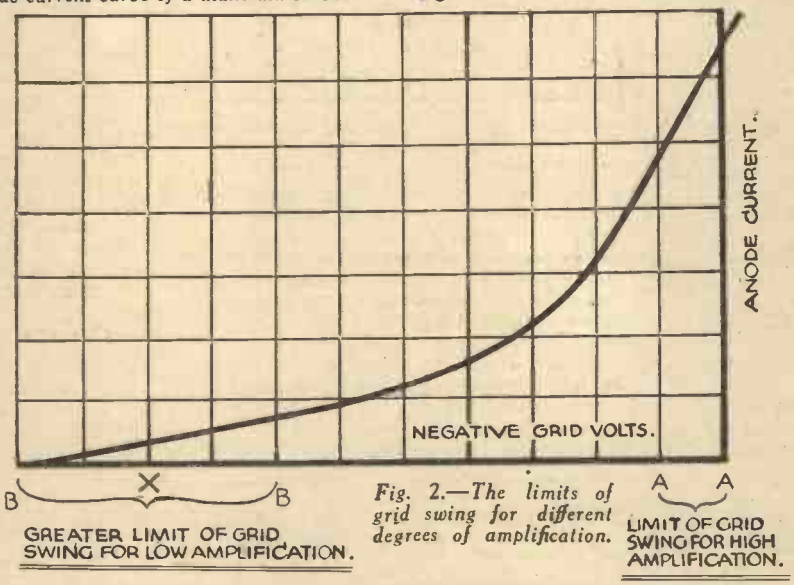


Fig. 2.—The limits of grid swing for different degrees of amplification.

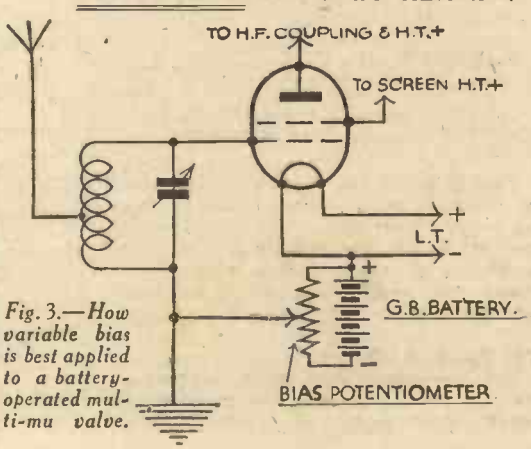


Fig. 3.—How variable bias is best applied to a battery-operated multi-mu valve.

screened grid valve, however, the amount of radio-frequency amplification can be easily controlled. Full amplification can be applied when weak signals are being received, and very little amplification can be used for powerful transmissions. How this is possible can be seen best from the diagram reproduced in Fig. 1, which shows the grid volts-anode current curve of a typical multi-mu screened grid valve. Towards the right hand end of the graph the curve is very steep, indicating a high value of mutual conductance, and therefore a high effective amplification. As we trace back the curve towards the left hand side of the diagram, however, the slope of the curve decreases gradually. If, therefore, additional negative bias is applied to the grid, the valve will operate on this low slope portion of its characteristic so that the effective amplification is considerably reduced.

Valve Handling Capacity

An important point to be noted is that the rate of change of the slope is gradual, and that as the slope diminishes so the working grid base expands. Perhaps this needs a little explanation. You know, of course, that for distortionless amplification the working range of a valve, that is to say, the range of grid voltages covered by the incoming signal, must correspond to a substantially straight portion of the valve's characteristic. With the multi-mu valve, a signal applied to the grid at low values of grid bias must not be greater than as indicated at AA (Fig. 2). But if the valve is given additional bias, say to the point X, it will handle without distortion the much larger signal represented by BB. Thus, it comes about that not only can we vary the degree of amplification or effective sensitivity by increasing the negative bias applied to the multi-mu valve, but also, when operating at low sensitivity the valve will handle without distortion very much stronger signals. This is just what we want, because it is the strong signals which do not need much radio-frequency amplification that bring about all the trouble with overloading.

The principle of the multi-mu valve, then, is that it can be operated at low grid bias when it will amplify weak signals very greatly, or at bigger values of grid bias when it will handle strong signals without distortion, but will not give so much amplification. The adjustment of grid bias in the normal multi-mu circuit is quite a simple matter. In the case of a battery operated set a potentiometer of about 25,000 to 50,000 ohms resistance should be connected across the normal grid bias battery (which must be of 15 volts) and the slider of the potentiometer connected to the lower end of the grid coil as indicated in Fig. 3. With an A.C. all-mains set the variable grid bias is best applied by means of a variable resistance in the cathode circuit as shown in Fig. 4. No

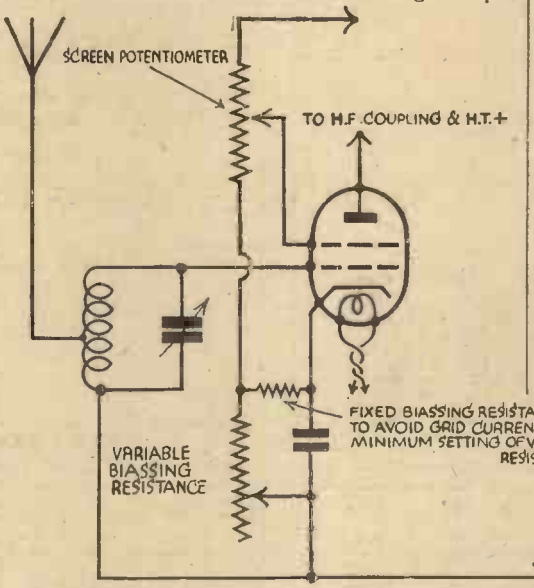


Fig. 4.—The best method of biasing a mains-operated multi-mu valve.

definite value can be assigned to the resistance as it depends upon the normal anode current taken by the valve and the amount of total bias to be applied—matters which are usually fully stated in the valve maker's catalogue. So far we have only summarised what is generally known about the action of the multi-mu valve, stating it, however, in a manner which should make it easier to understand the following explanation of automatic volume control.

Suiting Different Strengths

It is clear that if we tuned in a signal of moderate strength, we could, by adjusting the grid bias to the multi-mu valves, set the volume at a certain value. If, now, we retuned the set to a stronger signal, we should have to increase the bias in order to bring down the volume to the same level. Similarly, if we tuned in to a very weak station it would be necessary to decrease the bias if the volume is to be maintained at the same level as before.

Again, supposing that the medium power station was tuned in and the volume level adjusted to a comfortable strength, after which the signal began to fade. It could be brought up to full volume again by reducing the grid bias to the multi-mu valve. But it would be a wearisome process to be continually operating the control in order to maintain the volume at the desired level. Automatic volume control is simply a self-regulating device which automatically alters the amount of bias applied to the multi-mu stages in inverse proportion to the strength of the incoming signal, so that the volume level is maintained to all intents and purposes constant. When properly designed and adjusted, the circuit will keep the volume of sound practically unchanged whether the incoming signal is strong or weak, providing it is not unreasonably attenuated. The device will also take into consideration the changes in strength of a given station, and thus, to a very substantial degree, will counteract the effects of fading.

The principle on which automatic volume control operates is this: First of all some part of the circuit subsequent to the radio frequency stage is found at which a drop of potential occurs proportional to the signal strength. This voltage drop is then fed back to the grids of the multi-mu valves in such a way that increasing signals produce an increase in negative bias, and this, of course, is reflected as decreasing effective amplification. Moreover, it is possible to pre-set the volume level which the device is to maintain, and to vary this by hand control in addition to the automatic control.

Owing to lack of space I am prevented from giving a more detailed description in this issue, but in the next article in this series I shall describe various suitable methods of applying this form of control in different circuits.

ROUND *the* WORLD *of* WIRELESS

(*Continued from page 790*)

Gilbert and Sullivan Opera

ON the last day of the season at the Savoy Theatre, namely, January 21st, the B.B.C. will relay excerpts from the opera given on that evening, and listeners will hear some of the farewell speeches from the stage.

Radio Salonica

AS a result of experiments carried out by the Radio Club of Salonica (Greece), a 3 kilowatt station has been erected in that city. The transmitter operates on 270 metres and broadcasts daily from 11.45 to 12.45 a.m. and from 19.15 to 20.15 G.M.T. The call is *Empros etho Thessaloniki*. Radio entertainments are not encouraged by the Greek authorities, and the listening tax has been fixed at an equivalent of roughly 10s. per month!

Revival of Flecker's "Hassan"

THE B.B.C. has decided to re-broadcast a studio performance of James Elroy Flecker's masterpiece, *Hassan*, with music by Frederic Delius, as produced in November, 1926. Part I of the play will be transmitted through the National stations on February 7th, to be followed by Part II. on February 10th, on Regional wavelengths.

The New York Radio City

THE Temple of Entertainment, otherwise known as the Rockefeller Centre (New York), which is to become the hub of all broadcasting activities in that city, was formally opened on December 27th with a public music-hall performance to which some seven thousand spectators were invited. When completed, the centre will include several theatres, concert-halls, and all the necessary studios for the purpose of broadcast transmissions. It will become the house of the National Broadcasting Company of America.

Berlin Relays Egypt

FOR the first time in the history of broadcasting, listeners to the Berlin programme recently heard a transmission of Arab music emanating from Cairo. This was made possible by a relay through SUV and SUZ, Abu Zabal, on respectively 29.84 and 21.70 metres, in connection with the Nauen (Germany) station. The Reichsfunk proposes to carry out these experiments at regular intervals in addition to the New York broadcasts and test transmissions from Buenos Aires and Rio de Janeiro.

HOW THE SUPER-HET WORKS

An Article Explaining the Principle of Working of This Useful Circuit.

By E. G. ROWE, B.Sc., A.C.G.I.

THE demand for increased selectivity with unchanged tonal quality has caused the revival of an old circuit, popularly known as the "super-het." Its long name—the supersonic-heterodyne—has made it seem very highbrow to newcomers to radio, but I am going to try to explain how simple it really is.

Back in the early days of radio, experimenters found that, while high-frequency amplification was comparatively easy on the long wavelengths around 3,000 metres, as they got down to the shorter-waves so this amplification became increasingly difficult to obtain until at 300 metres it was practically impossible. Then an American, Dr. E. H. Armstrong, devised a frequency-changing method of reception, having an idea directly opposite to that of ordinary receivers. With the standard set, one tunes the high frequency amplifier to suit the wavelength of the incoming signal, changing the tuning for each station required.

With the super-het. though, one changes the wavelength of the incoming signal to that of the amplifier, which is designed to work at a fixed wavelength. By making this arbitrary wavelength about 3,000 metres, the valves and the coupling circuits are able to work at maximum efficiency.

Thus, older wireless enthusiasts will tell you how, for long-distance reception, they used super-hets. having regular banks of valves. Then the neutralised high-frequency amplifier came along, and was followed by the screened-grid valve, and, as the difficulty of high-frequency amplification was overcome, so the popularity of the expensive super-het. waned.

Comparatively recent work on this somewhat neglected circuit has shown its use as a means of separating stations and hence its return so that now practically every manufacturer of note has a model on the market.

Principle of Working

Most of us at some time or other have seen and heard two aeroplanes at once, and noticed that the notes of the engines have clashed and given rise to a rhythmic beat note which rises and falls in cadence. This idea illustrates the principle of the super-het.

Suppose a station sets up an e.m.f. which oscillates, say, twelve times in the period shown (Fig. 1a). Now if we have a local oscillator which puts out an e.m.f. oscillating at, say, ten times a second (Fig. 1b), then these will add together to give a current as in Fig. 1c, which, when rectified, gives us a beat-note (Fig. 1d). The transmitting station starts with a carrier wave, which is a regular oscillating current in its aerial. Then the currents which are set up by speaking into the microphone are imposed on this and we get a complex wave known as the "modulated wave." Putting this modulation in does not alter the frequency of the wave, it just varies the amplitude of the oscillations. This modulated wave is the one we receive in the aerial circuit of our receiver, and while we do not alter the modulation or the mean amplitude of the oscillations, we just vary the frequency of the original carrier wave. The usual super-het. arrangement is shown diagramatically in Fig. 2.

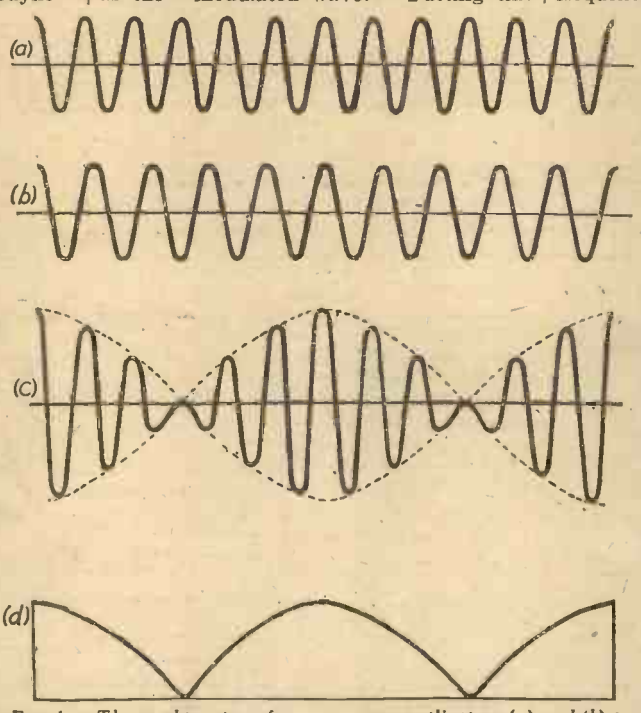


Fig. 1.—The combination of two separate oscillations (a) and (b) to provide the envelope shown at (c). At (d) is shown the rectified result of the combination.

Amplifying the Incoming Signal

The incoming signal is received on a frame aerial and is then mixed with a signal generated by a local oscillator to give an "intermediate frequency" which is usually 100 kc/s., that is, 3,000 metres. This is then amplified up, but we must remember that it is still high-frequency, and therefore needs a detector stage in order to reduce it to the audio frequencies.

Suppose we tune the aerial to 300 metres, that is a million cycles, and we have the local oscillator working at 900,000 cycles, then the resultant signal will be the difference between these, that is 100,000 cycles=3,000 metres. The super-het. has the big advantage of being far more selective than any two tuned circuits, and to prevent serious cut-off of the higher frequencies, it is usual to use either a band-pass filter or tone-correction. As was explained previously, the signal given to the low-frequency stages is at a constant wavelength of 3,000 metres. These stages are designed to work most efficiently at this wavelength.

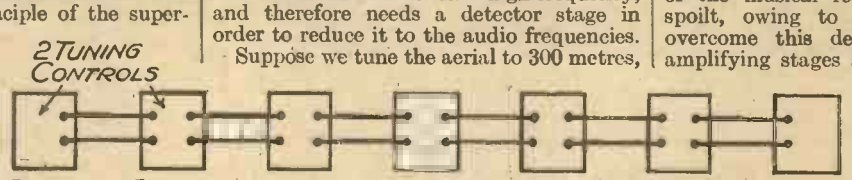


Fig. 2.—A diagrammatic representation of a Sup-het. receiver.

How Increased Selectivity is Obtained

I will now illustrate the reason why we get increased selectivity. Suppose we wish to receive a station at 1,000kc/s. and there is an interfering station at 1,010 kc/s., that is, 1 per cent. off tune. If our intermediate frequency amplifier is tuned to 100 kc/s., the frequency of the station we want will be changed to 100 kc/s., while the interference will be at 110 kc/s., which is now 10 per cent. off tune. This improvement must also be combined with the fact that we have removed the required signal from a crowded waveband into one where there is much less interference.

In conclusion, it may be stated that the super-het. presents no difficulties in operating—there are only two tuning controls, one to tune the frame aerial to give the maximum signal and the other to tune the frequency changer so that the resultant frequency is 100 kc/s.—and this circuit seems to have a big future ahead of it, both on the score of selectivity and of quality.

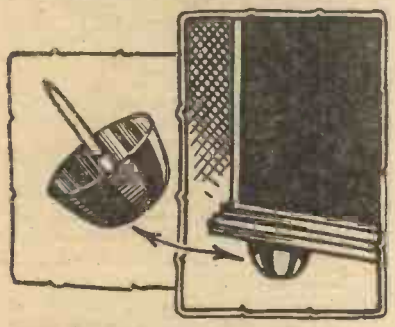
There are, of course, a number of commercial variations of the frequency-changing circuit, some of which employ a first detector followed by a separate oscillator, and some employing a combined arrangement. Whatever type is employed, the coils have to be very accurately made, and it is essential that they should be enclosed in metal screening cans. Another point of interest is that in some receivers the method of rectification in the first and second detectors is varied and employs both grid-leak and anode-bend detection. In one modern form of receiver the selectivity is of such a high degree that the tone of the musical reproduction is definitely spoilt, owing to high note cut-off. To overcome this defect the low-frequency amplifying stages are provided with tone-controlling devices, which while not requiring any adjustment are so arranged that the musical response is compensated and the reproduction sounds practically as good as on a simple receiver. It is now possible to purchase sets of super-het coils, and ganged condensers specially designed to work with them.

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

Ebonite Toes for Cabinets

HERE is a very economical method of making ebonite toes for speaker or receiver cabinets. The only tools required are a penknife, bradawl, eggcup, and an old



Neat toes for radio cabinets.

gramophone record. First heat the record in a stove or oven for a few minutes until quite soft. Then press firmly into base of upturned eggcup until the hollow is quite full. It can then be levelled off with penknife and, while soft, it should be pierced with a bradawl, resulting in a hole of sufficient size for a nail to fit neatly.—MONRO LLEWELLYN (Treherbert).

Uses for Old Valve-holders

DISCARDED anti-microphonic valve-holders, if provided with terminals, can be used in a variety of ways if adapted as in sketch. First, remove the centre piece containing the sockets. The remaining portion is sawn through at the dotted line (Fig. 1) and the result is two very handy terminal mounts as shown in Fig. 2. These may be used for L.S., H.T., etc., or as a relay to obviate the use of long flexible leads, such as from G.B. to first transformer. The terminal mount can be placed near to the G.B. battery and flexible leads taken to the terminals. If there are also soldering tags these can be used for connecting to the rigid leads from transformers, thus making quite a neat job. There are a variety of other uses which will no doubt suggest themselves to readers.—R. BARR (Broxburn).

Fig. 2.

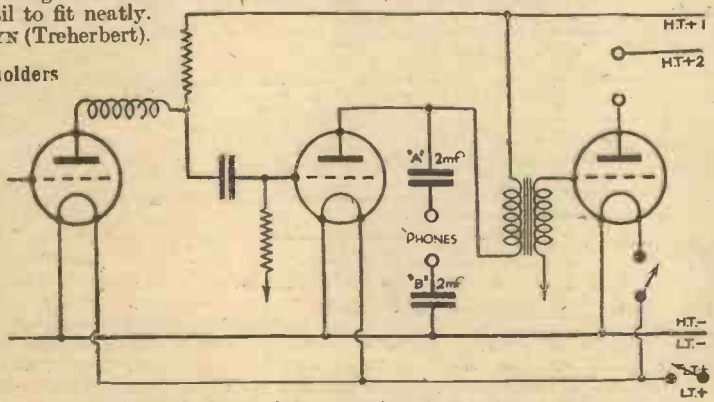
How discarded valve-holders can be put to good use.

THAT DODGE OF YOURS!

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

Using 'Phones with a Three-valver

AFTER being frequently requested to switch off the loudspeaker while a good programme was on, I decided to make the following addition to my set, and it has proved very satisfactory. The set, a three-valver, is too powerful for 'phones, and without a filter output is unsafe, as I take my H.T. from the mains. I had on hand two 2 mfd. condensers,



Method of using 'phones with a three-valve receiver.

and using the primary of the L.F. transformer as an L.F. choke, I joined condenser A to plate of second valve, other terminal to 'phones, from 'phones to condenser B, and other terminal to earth. A push-pull switch is inserted in the positive lead of the last valve. For a quick change-over I have a wander-plug in the positive lead of loudspeaker and terminal socket in the set. The 'phones can be used in conjunction with 'speaker for tuning in, with a slight decrease in L.S. strength. With A.C. you can do without condenser B, but there is a slight hum. I find that taking condenser B direct to earth gives louder volume than when joining it to L.T. negative.—W. E. THOMAS (Llanelly).

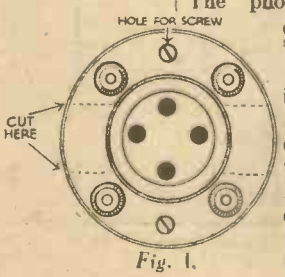
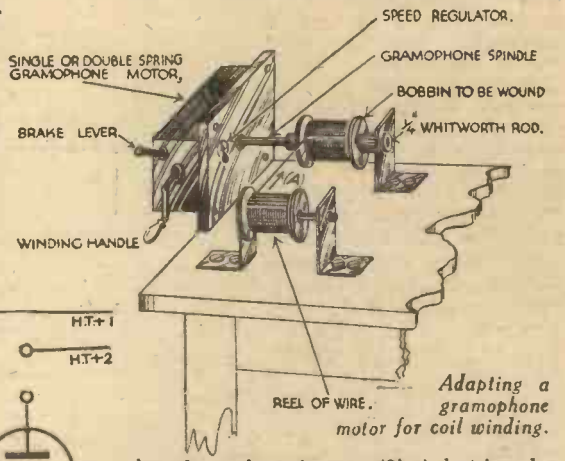


Fig. 1.

Using a Gramophone Motor for Coil Winding

THE accompanying illustration shows how a gramophone motor can be adapted for winding coils, chokes and transformers. The rod on which the bobbin is to be wound is ¼in. diameter, threaded at one end for screwing into a bush ½in. long. This bush in turn is fixed permanently to the spindle of the gramophone motor. After winding the bobbin it is an easy matter to unscrew the rod from the bush and remove the bobbin. The rod that the reel of wire runs on is the same

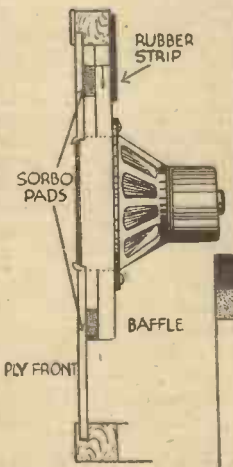


Adapting a gramophone motor for coil winding.

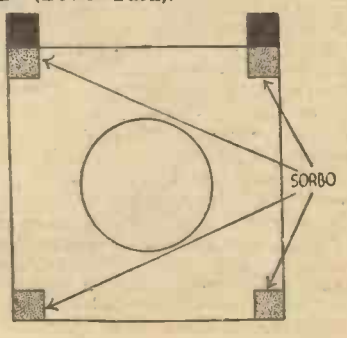
length as the other one (9in.), but is only threaded 1in. at either end. This is to allow two nuts to be screwed on after the wire and rod are placed between the two brackets. The arrow (A) indicates in which direction the motor is running. My gramophone motor is only a single spring one, obtained from my junk box.—EDWARD A. PORRIT (Forest Hill).

Eliminating Boom in a Loudspeaker

I HAVE recently constructed a radio-gram with a cabinet of plywood, but as a moving-coil speaker was used a good deal of boominess was noticeable. This was eliminated in the following simple manner. Between the baffle and the cabinet front four Sorbo rubber pads are placed, as shown in the accompanying sketch, while the baffle is held in position by a strip of rubber at each corner.—LESLIE AUSTIN (Bowes Park).

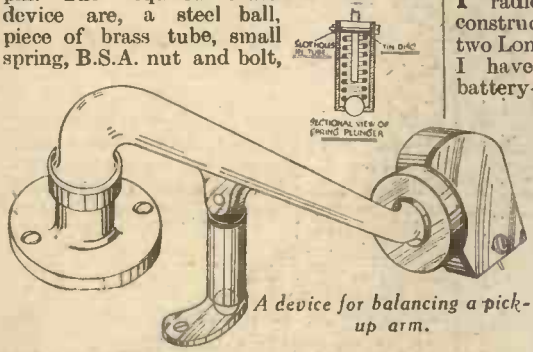


Using rubber pads for eliminating boom in a loudspeaker.



Balancing a Pick-up Arm

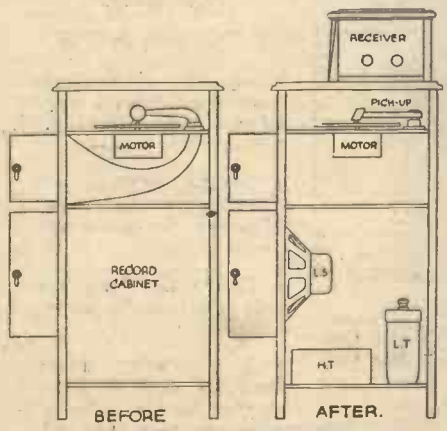
IN fixing a pick-up on some gramophone arms an extra load is placed upon the record, and to relieve this load a spring plunger can be fitted over the auto stop pin. The required materials for this device are, a steel ball, piece of brass tube, small spring, B.S.A. nut and bolt, and a small tin disc. Most of these items can be purchased from any bicycle dealer for a few pence. A slot hole will have to be made in each side of the brass tube to allow for the spring compression. One end of the brass tube must be hammered over to stop the steel ball falling out of place. The small brass sector plate acts as a base-run for the steel ball. See that the fixing screws for this sector plate are countersunk. This device will not interfere with the working of the auto-stop.—C. R. HODGSON (Gainsborough).



A device for balancing a pick-up arm.

Converting a Cabinet Gramophone.

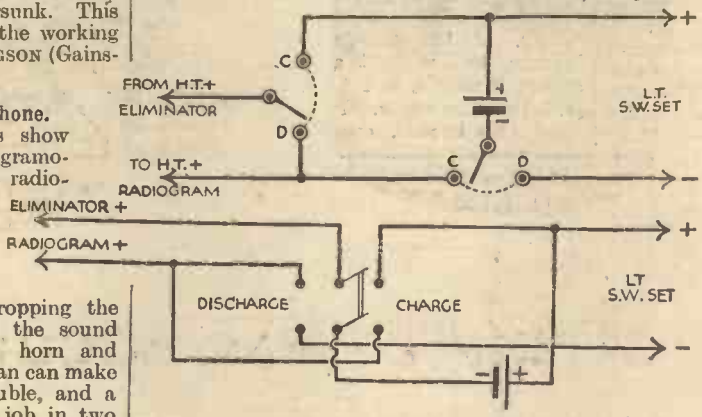
THE accompanying sketches show how easily an old cabinet gramophone can be converted into a radio-gram. I used my gramophone as a stand for a 4-valve set, but was unable to play records on account of lifting the lid every time. I then hit upon the idea of dropping the motor board to the level of the sound doors, scrapping the existing horn and using a pickup. Any handy man can make this conversion with little trouble, and a few tools. I, myself, did the job in two evenings. All I had to make was a new motor board, which I fixed in with screws from the back and sides, but brackets could have been used from the inside to support it. I next bought a well-known make of pick-up and mounted it according to instructions provided with it. I find this arrangement is quite satisfactory; in fact, I find that it is quite as easy to place records on the turntable and fit needles from the front through the doors, as it used to be to lift up the lid every time. The record cabinet provides ample space for the loud-speaker and batteries.—J. R. PLACK (Nottingham).



Showing how an ordinary gramophone can be converted to a radio-gramophone.

A Useful Battery-switching Device

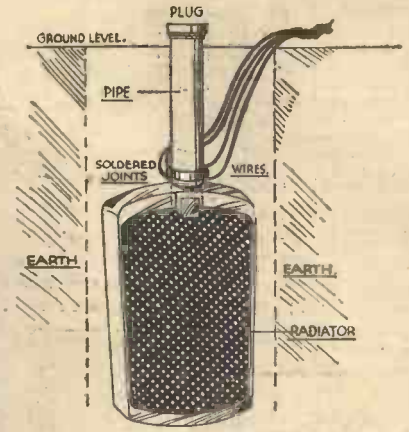
I AM using a powerful all-mains (A.C.) radio-gram of my own design and construction for quality reception of the two London stations. For short-wave work I have an entirely separate det.-L.F. battery-fed outfit. The only time I have to spare to indulge in short-wave reception is at week-ends, and naturally the accumulator I use for this set does not get much work. Rather than let it stand about for weeks in a gradually falling state of discharge, I thought out a circuit whereby I can keep the accumulator permanently wired to the radio-gram and the short-wave set, and by simple switching can either put it on trickle charge or connect it to the short-wave set when required. I append a schematic and wiring diagram of the arrangement, which is rather unique for its simplicity. It will be seen that I utilize the rather heavy current of the radio-gram to charge the accumulator. This current runs into some 45 to 50 mA., and I find that by using the battery at week-ends I can make good the current taken from it by keeping it on charge during the rest of the week whilst the radio-gram is being used. In addition to this the battery is entirely disconnected from the short-wave set when on charge, and the radio-gram can still be used in the normal way when the accumulator is switched over to the short-wave set. The arrangement is cheap, as the only extra components needed are a D.P.D.T. switch, two spades, and a few feet of rubber-covered wire. It is simple in use as the only operation necessary is to throw the switch to either the "charge" or "discharge" position as required. The only thing to remember is that the battery will need occasional "topping-up" with distilled water.—W. E. THOMPSON (Vange).



A wiring diagram of a useful battery-switching device.

A Reliable Earth

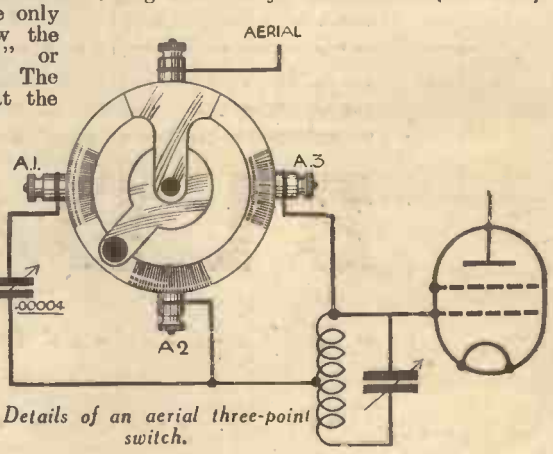
OBTAIN an old motor radiator, remove the water filler cap, and solder about four connections to the top of the radiator as shown in the sketch, using 7/22 aerial wire. Join the soldered wires together into one soldered connection about 3ft. long and cover the joints with motor grease and plenty of insulated tape. Bury the radiator 3ft. deep, and fix a length of piping into the hole at the top so that water can be poured into the radiator periodically. If the radiator leaks slightly, so much the better.—IRVINE FIRTH (Manchester).



An earth made from the radiator of a motor-car.

An Aerial Three-point Switch

IN my home-constructed S.G. det. and pentode receiver I had three alternative aerial connections at the back. This constant changing of the aerial connection caused me considerable annoyance till I devised the following switching arrangement. First of all I got an old variable panel-mounting rheostat and cut the resistance wire in two places, making three connections. Screws, with terminal heads, were fastened to each portion of the wire to facilitate wiring up, and a washer is put at each side of the wire to make good contact. The aerial wire now goes to the arm of the rheostat, and it will be seen from the accompanying sketch that when the arm is rotated it gives the three alternative aerial connections without the usual fiddling about at the back of the cabinet with plugs. When the switch arm is in the A1 position the aerial is connected to a .00004 condenser and the centre tap on the aerial coil. In the A2 position this .00004 is cut out, whilst in the A3 position both the .00004 *and* the centre tap are cut out, the aerial then being connected across the whole of the coil. This last connection is usually made use of on the long waves only.—J. PICKARD (Bradford).



Details of an aerial three-point switch.

Ring out the old: ring in the new

Triumph of *plate-less* accumulators

Nuisance of frequent re-charging overcome at last

THE familiar glass-box accumulator is a thing of the past. The new accumulator is a handsome cylinder (covered in bakelite) giving twice the ampere-hour capacity. Thus, though no bigger than your 40 amp.-hour accumulator and costing little more, it needs charging only half as often. It is also much more durable.

This revolution is owed to the work of John Fuller, Faraday's collaborator and a founder of the battery industry—work that his son and grandson perfected. The negative electrode, a pasted lead cylinder, itself acts as the battery container—a central core forms the positive. With no " grids " to interfere, you get complete effect throughout the active paste. Brings your wireless up to date—the saving on re-charging alone would repay you !

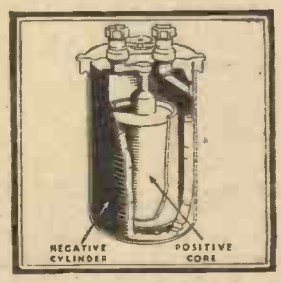


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plate-less accumulators

80 AMP HRS. 11/6

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BLOCK BATTERIES LTD, ABBEY ROAD, BARKING, ESSEX.

THE NEW ACCUMULATOR

1. Negative electrode is itself the battery's container—nearly all weight is thus active material.

2. Circular, gridless formation gives uninterrupted action throughout the paste.

3. Total result—Twice the amp. hour capacity per lb. weight.

4. No sulphation; Won't run down when inactive; No grid buckling; Extraordinarily long life; Almost unbreakable.

Receivers and their Records

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

IT is admittedly a difficult question for the prospective purchaser of a wireless receiver to make up his mind when the choice of models is such a wide one. It will be agreed that the circle is narrowed when the conditions of mains drive or battery feed is stated, and then comes the all important question of striking a good balance between the pocket and performance. For satisfying the last-named double requirement the new Wates Futura Six Receiver is well worth considering. It is a five-valve set A.C. mains fed, with a sixth valve acting as a double wave rectifier in the eliminator section.

As far as external appearance is concerned the table model, complete with speaker, is most prepossessing, the set being housed in a beautifully finished walnut cabinet, with the speaker grill located in the top part of the front panel according to modern practice. The centre control operates the ganged condenser for tuning, and as the three tuned circuits are accurately matched, no trimming device has been incorporated. There is a large scale graduated in wavelengths and stations, illuminated shadow tuning being provided for ease of logging. The other two controls are a combined wave change and gramo-radio switch on the left, and a combined volume control and on-off switch on the right.

Circuit and Construction

The circuit arrangement comprises two high frequency stages employing two MM4V Mullard variable mu valves, an anode bend detector stage, using a Mullard 354V valve, followed by two resistance capacity coupled low frequency stages, using a Mullard 354V valve in the first stage, and a Mullard AC044 valve in the output stage. An examination of the complete circuits reveals one or two interesting features. First of all there are two alternative aerial terminals to meet selectivity conditions in different places, and as the aerial coil is magnetically coupled to the tuned grid coil of the first H.F. stage, this enables accurate matching of the three tuned stages to be undertaken before the set leaves the works. This is irrespective of the type of aerial employed, the matching being maintained throughout the whole of the scale, and hence no trimming adjustment is required as mentioned earlier.

Since variable mu valves are incorporated in the pair of H.F. stages, it is natural that advantage should be taken of their inherent properties to control the volume by varying the applied grid bias. This is effected by a variable resistance in series with a limiting resistance in the common cathode lead. Automatic bias is provided for the three other valves, decoupling being included in the case of the output valve, which has a directly fed filament. The resistance capacity coupled stages follow normal practice, but adequate decoupling is included in the anode circuits. On the power side a very generous output has been arranged for the maximum rectified volts are over 300. Even after allowing for the drop of voltage in the smoothing circuit there is ample voltage remaining to ensure that the valves are operated at high efficiency.

All the coils are accommodated in separate rectangular screening boxes and judged as a whole the chassis is "clean," compact and well balanced, representing good workmanship and careful forethought in design, coupled with the utilization of really good-class material. The table model has a built-in moving coil loud-speaker, while provision is made for an extra loud-speaker as well as a gramophone pick-up.

Specification.

Receiver: Futura Six, A.C. mains driven, table model.

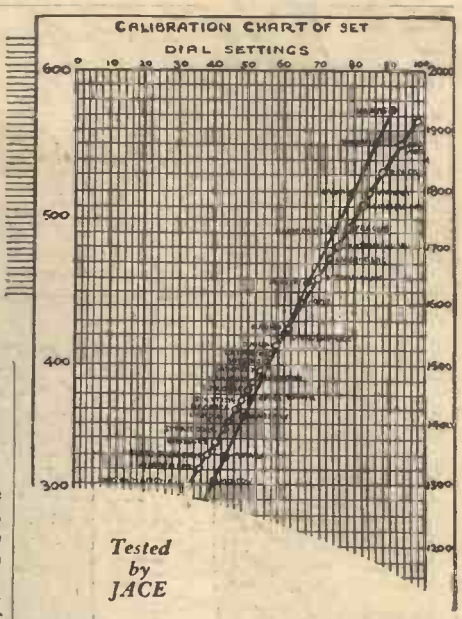
Makers: Wates Radio Ltd.

Specification: Five valves with a sixth double wave rectifier. Two as screened grid variable mu choke fed stages; anode bend detector and two stages R.C. coupling. Moving coil loud-speaker, with mains energized field winding. Triple tuned circuits all ganged without trimmer, large scale graduated in wavelengths and stations, illuminated shadow tuning. Three controls only.

Price: Twenty Guineas, in first-class walnut cabinet.

WATES' FUTURA SIX TABLE MODEL

The Futura Six.
An all-mains five-valve receiver.



Tested by JACE

Results on Test

The makers of this set recommend its use in conjunction with a standard outside aerial, but it was found that even with an inefficient "energy collector" the average users' requirements would be satisfied.

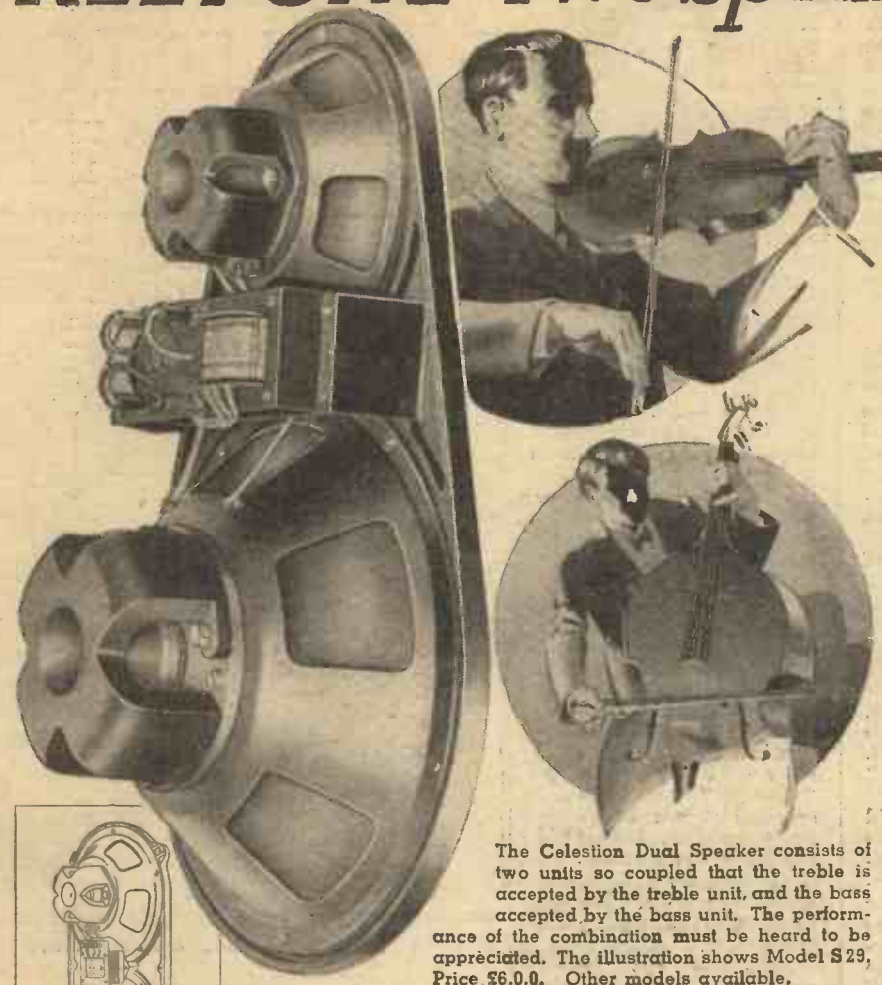
When connected up and switched on, the operation of the controls was acquired after a minute or two's practice, and the range of the set was found to be limited only by local interference. No attempt was made to keep a record of the stations heard at a strength sufficient to be listened to in comfort in a large room and absolutely clear of interference. It may be stated, however, that the number was exceedingly high, and yet the makers in their modesty have included only a few of the more powerful English and European stations on the dial itself. In our opinion the Futura Six has a performance which is outstandingly good, sensitivity and selectivity being of a high order, with station overlap very unnoticeable.

The set itself is in no way noisy, but a slight trace of mains hum is heard during the silent period of a programme. Reproduction from the loud-speaker is good, with a nice even response over the musical range, while the undistorted output exceeded 1½ watts. Operating the set is extremely simple, and for an all-round performance, including the most rigid demands on sensitivity, selectivity and quality, this Wates set meets the needs admirably.

CLUB NOTICES

THE EDITOR will be glad to receive reports of club meetings for publication in this journal. Club Secretaries should send their reports, not exceeding 200 words in length, to reach us not later than Tuesday of each week. Address to The Editor, *Practical Wireless*, 8-11, Southampton Street, Strand, London, W.C.2.

REETONE-Two Speakers as one



The Celestion Dual Speaker consists of two units so coupled that the treble is accepted by the treble unit, and the bass accepted by the bass unit. The performance of the combination must be heard to be appreciated. The illustration shows Model S29, Price £6.0.0. Other models available.

CELESTION "REETONE" MATCHED SPEAKER

Whereas the Dual Speaker has differently sized diaphragms, the Matched units are nearly similar in all respects, except that the mechanical resonances in the lower register are "staggered." This "staggering" eliminates the tendency to "boom" evidenced in all small moving coil speakers in which the bass has not been suppressed and generally augments the output below 150 cycles.

The following models are available:—

TYPE NO.	MATCHED	LIST PRICE
99	Two Perm. Magnets	£4.5
88	Two Energised	£4.5
98	One Perm. Magnet One Energised	£4.5

For the very first time — sound reproduced Naturally

When Celestion announce a new speaker the great listening public expects a definite advance in sound reproduction. In introducing the Reetone Range of Dual and Matched Speakers, Celestion are confident that nothing finer has ever been offered to discriminating listeners. Tonal quality far superior to anything previously imagined, yet alone heard; a rich beauty of reproduction never previously associated with anything but the actual performance. These are the qualities that stamp the Reetone Range of Speakers vastly superior instruments.

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— BUILDING —

THE SELECTONE

Here FRANK PRESTON, F.R.A., Desc[illegible]
Make This W[illegible]

BEFORE passing on the constructional details I would like to ask you to glance over the circuit diagram with me and to study it in conjunction with the sketches and photographs. If you cannot understand a circuit diagram please do not skip the next few paragraphs because I hope they might at least give you some idea of the usefulness of diagrams of this kind. We see that the aerial can be connected (by means of a wander plug) to a number of tappings on the untuned aerial coil; the lower the tapping is moved down the coil the greater is the degree of selectivity. The secondary winding is tuned by a .0005 mfd. condenser and the "top" end is connected to the grid of the detector valve through a .0002 mfd. fixed condenser. A 3 megohm grid-leak is employed, it being found that this higher value gives rather greater selectivity and smoother reaction control. Reaction is obtained by means of a differential condenser connected from the anode of the detector valve to a reaction winding on the tuner. A differential reaction condenser is employed so that tuning is not affected by reaction-control. The usual H. F. choke is wired in the plate circuit of the detector valve, and connects the latter to the resistance-fed transformer (a "Transfeeda" is its trade name). As the Cossor "210 Det." valve used for detector has an impedance of 13,000 ohms the 30,000 ohm portion of the "Transfeeda" resistance is sufficient for coupling purposes, and so the other part is used to decouple the anode circuit, by connecting a 2 mfd. condenser between the tapping "H.T.11" and earth.

A radio-gram switch is wired in the grid circuit of the second valve, and thus the two last valves can be used as a gramophone amplifier. A separate grid bias connection is provided for the pick-up, for whilst this is not strictly necessary it does enable one to make the very best of gramophone records. Signals are passed on to the power output valve through a special tone control transformer which is used in conjunction with a 5,000 ohm variable resistance to provide the required variations in tone. The "Rectatone" transformer is so designed that it gives proportionately less amplification to low notes than to high as the resistance value is reduced. As the tuner gives emphasis to the low notes it is possible to effect a "balance," or to exaggerate low or high notes at will. The last valve is not fitted with an output transformer since that is provided in the speaker itself.

Making the Chassis

And now to get to work. I assume that you have obtained all the components of which a list was given last week; in case you have not the list is given again on this page.

First of all the chassis must be made, and for this you will require an 8in. by 14in. plywood panel, a baseboard consisting of a 14in. by 8in. piece of 5-ply, two pieces of hardwood, each measuring 7¾ins. by 3ins., a 14in. by 2in. strip of 3-ply and a 14in. by 1½in. ebonite terminal strip. If you have bought a "Vibranti" panel as specified it will be already polished, but if you prefer to use a sheet of ordinary oak-faced plywood you will have to polish it before going any further.

Next set out the positions of the panel holes as shown in the sketch of Fig 2. This should be done on the back of the panel with a pencil. Having located all the holes run a small drill or bradawl through each centre, and then make the holes full size by means of a brace and centre bit. All holes excepting that for the tuning condenser

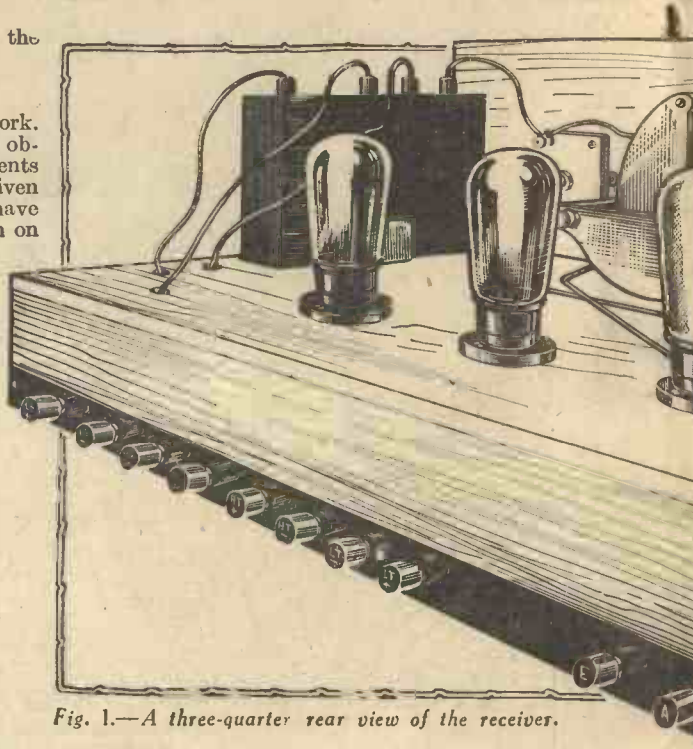


Fig. 1.—A three-quarter rear view of the receiver.

LIST OF COMPONENTS

1 Vibranti plywood panel 14in. by 8in.
1 Utility Standard .0005 mfd. condenser.
1 Utility type W. 181 micro-dial.
1 Lissen .00015 mfd. differential condenser.
1 Colvern type "T.D." coil.
1 Lissen 3-point wavechange switch.
1 Telsen on-off battery switch.
1 Wearite type "G.C.O." radio-gram switch.
1 Lissen 5,000 ohm potentiometer.
3 Eddystone chassis mounting valve-holders.
1 T.C.C. .0002 mfd. fixed condenser.
1 Dubilier 3 megohm grid leak.
1 Dubilier grid leak holder.
1 Telsen Standard H.F. choke.
1 Benjamin Transfeeda.
1 T.C.C. 2-mfd. condenser.
1 Varley Rectatone transformer.
1 Belling Lee baseboard fuseholder with 60 m.a. fuse.
10 Belling Lee "Junior" terminals; 1 each marked A, E, L.T.+, L.T.—, H.T.—, H.T.+, L.S.—, L.S.+ and 2 marked Pick-Up.

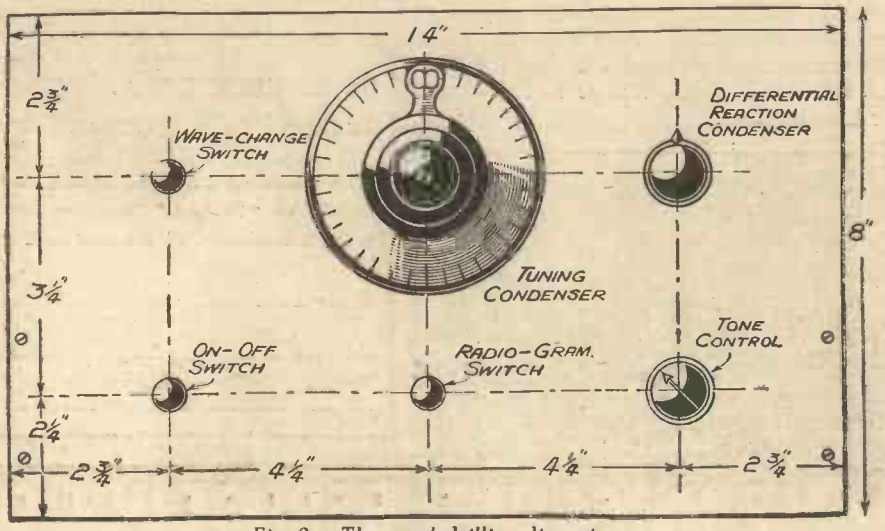


Fig. 2.—The panel drilling dimensions.

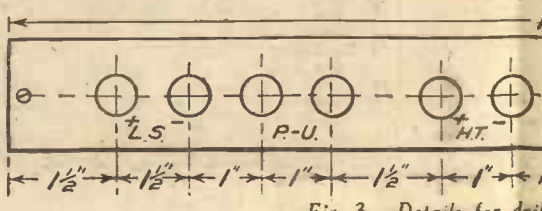
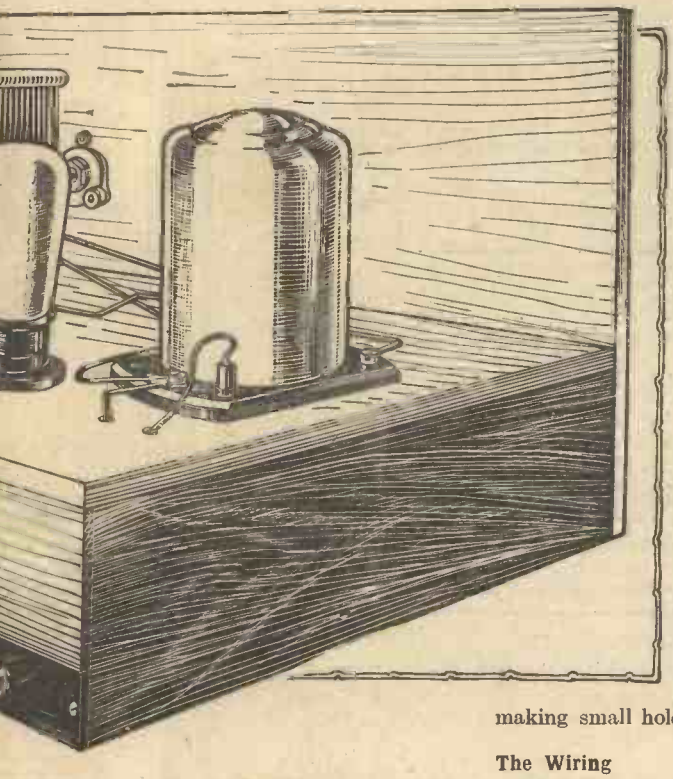


Fig. 3.—Details for dri[illegible]

BATTERY THREE

...es in Simple Language Exactly How to ...onderful Set.

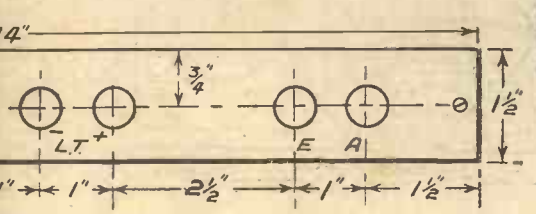


FOR THE SELECTONE

6 Belling Lee wander plugs; marked G.B.+, G.B.—, G.B.—1, G.B.—2, H.T.+, H.T.—.
1 Strip Becol ebonite, 14in. by 1½in.
1 Bulgin G.B. battery.
1 Coil Glazite connecting wire.
1 short length flex.
1 5-ply baseboard, 14in. by 8in.
2 pieces bard wood, 7¾in by 3in.
1 piece 3-ply, 14in. by 2in.
Approximate total cost—£4 10s. 0d.

Accessories.

1 Camco "Excelsior" or "Aston Senior" cabinet.
3 Cossor valves; 1 type 210 Det. (metallized), 1 210 H.L. and 1 220P.
1 Ediswan 9v. G.B. battery.
1 Ediswan 105v. super capacity H.T. battery.
1 Ediswan 2v. 40 a.h. accumulator.
1 Celestion Soundex permanent magnet moving-coil loud-speaker.



...ling the terminal strip.

are ⅜in. diameter whilst the latter is ¼in. The terminal strip can be marked out and drilled as shown in Fig. 3, making the holes 9-64 in. diameter with a twist drill. I need not explain how the chassis is assembled for that will be quite clear from Figs. 1 and 6. All joints butt together and ⅜in. screws are used for fixing purposes. After assembly, make the 1in. holes in the baseboard to receive the valve holders—for positions see Fig. 5.

And now all the components can be mounted in the positions shown in the wiring plans, taking care to duplicate the lay-out as accurately as possible. Round head brass screws size ⅜in. by 4 are most suitable for attaching the parts to the baseboard, and you will require about two dozen. If you find any difficulty in working on the under side of the baseboard, you can remove it whilst attaching the components. Personally I experienced no difficulty in this respect if the screws were given an easy start by first making small holes with a bradawl.

The Wiring

Everything is now ready for the wiring, and you will not find this a difficult task, even if you have never made a set before. Each wire is clearly shown in figures 4 and 5, whilst most of them can be traced in the photographs. Seven wires are taken through the baseboard and they have been numbered on the wiring plans so that you can follow them with ease. Be careful that you get the wires to the radio-gram switch on the proper terminals; to prevent any chance of error the switch terminals have been numbered on all the drawings. The switch itself is not numbered, but the terminal I have called number 2 is in the centre and the contact spring with which it is associated has a larger loop than have the other two. You will see that one terminal on the 5,000 ohm potentiometer is not required in this case and is left free.

Wiring Hints

For the benefit of the less experienced, a few hints in regard to the easiest way to wire up will not be out of place. I advise you to commence by doing as much wiring as possible on the panel and upper side of baseboard. Then put on as many wires as you can on the under side, leaving until last those wires which pass through the baseboard. To avoid possible confusion, tick off each wire on the wiring plan as you put it in place. I have not numbered all the wires because I think that would

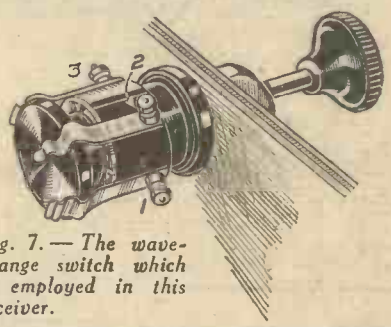


Fig. 7.—The wave-change switch which is employed in this receiver.

complicate, rather than simplify, matters. Most of the wiring is carried out in "Glazite" insulated conductor and as this is supplied in a coil it should be straightened out as required. After straightening fit it roughly into position, add about an inch and a quarter to the length actually required and cut off; this will leave five eighths of an inch at each end for making contact. The insulation can be removed very easily and neatly

(*Continued on page 825.*)

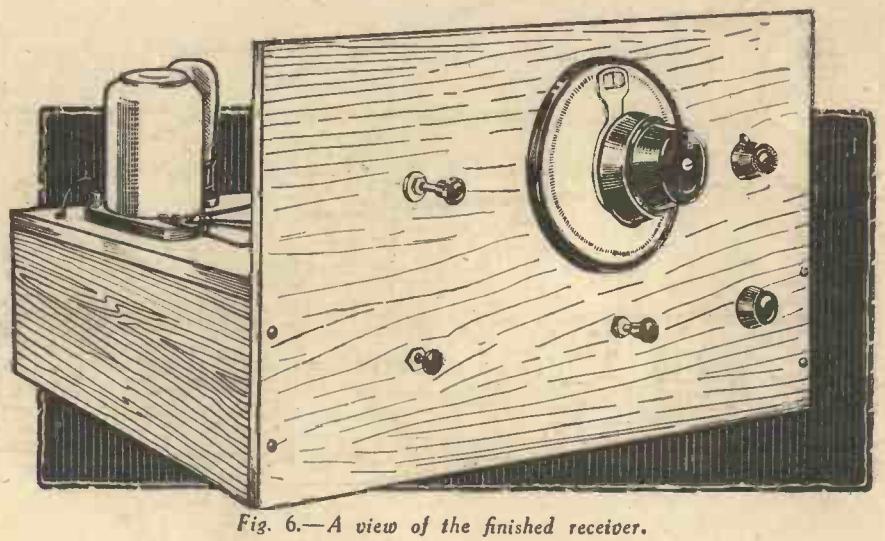
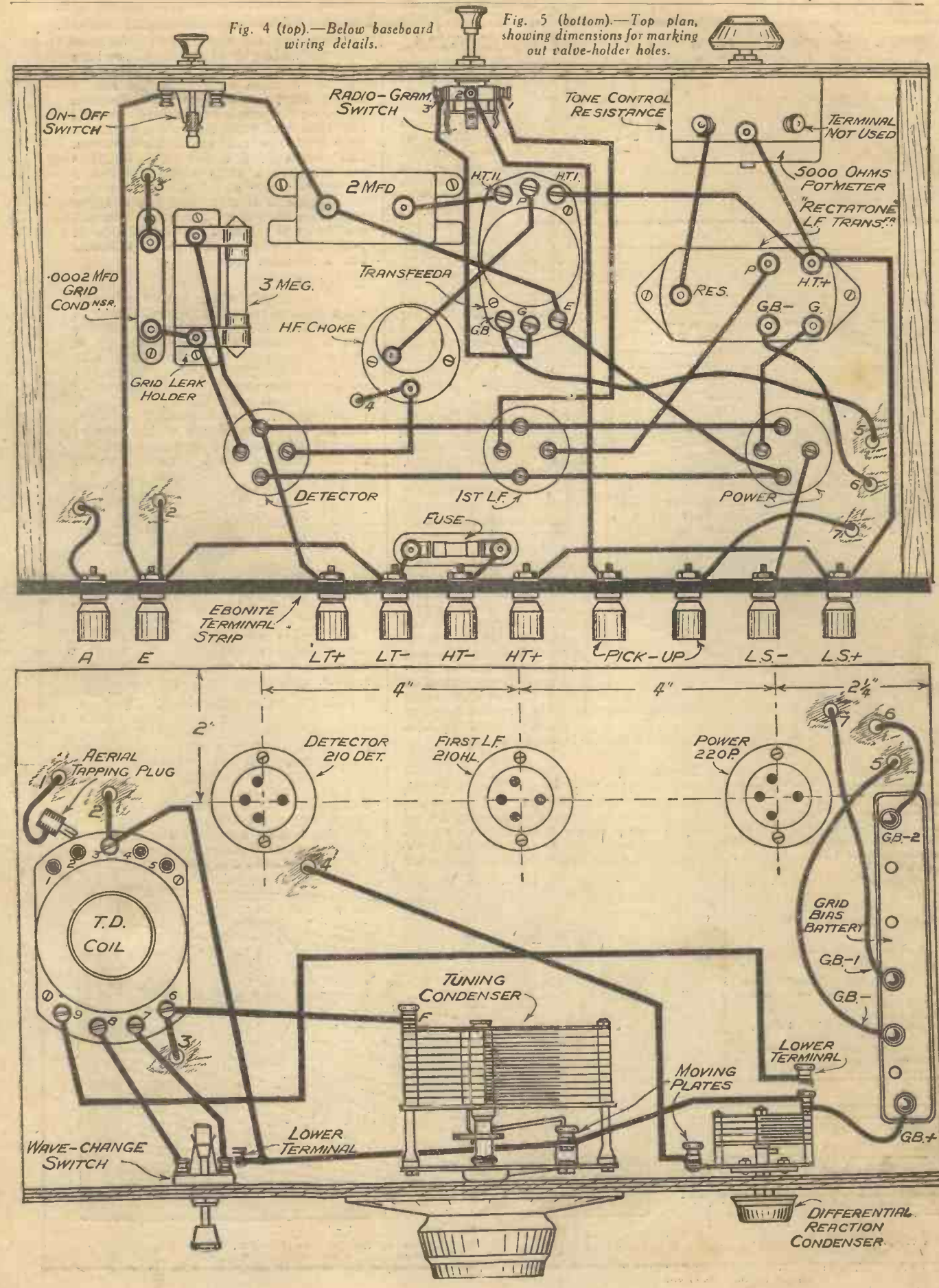


Fig. 6.—A view of the finished receiver.

Fig. 4 (top).—Below baseboard wiring details.

Fig. 5 (bottom).—Top plan, showing dimensions for marking out valve-holder holes.



A PRACTICAL TUNING HINT

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

MANY people still look upon tuning as a case of merely turning the condenser dials or other tuning knobs until the required station is heard on the loud-speaker, but this does not represent the whole truth of the matter. It is necessary to acquire a certain tuning touch or feel in order to get the best out of one's set. That being so, practice is necessary before any distant stations can be brought in properly without causing interference to one's neighbours, even with such a simple set as the straight Reinartz reaction (or capacity controlled reaction) detector, and one or two stages of low frequency coupling, where generally there is only one tuning dial and one reaction dial. If ordinary plain dials happen to be used, employ those of large diameter, for then the engraved scale has markings which are more "open" than is the case with smaller dials. This will enable better station logging to be undertaken, although of course where possible it is preferable to use some form of slow-motion dial, provided it is of reliable make.

Let us, for the sake of an example, take the case of a Reinartz reaction set complete with one tuning dial, and one reaction control. First of all, with the reaction dial set at zero, tune in the local station. Now increase the reaction condenser until the set is in its most sensitive condition, that is, just *off* the oscillation point. Then very carefully, degree by degree, rotate the tuning dial with one hand so as to receive stations above or below the local wavelength as desired. When increasing the wavelength, the reaction condenser can be increased slightly and progressively in capacity as we go up the tuning dial, the reverse process operating when tuning from the higher to the lower wavelengths. On hearing signals from a station, the reaction control will probably need a slight further adjustment to bring up the signals to the required loud speaker strength.

The Reinartz or capacity-controlled reaction has the distinct advantage that the setting of the reaction condenser has very little effect on the tuning of the grid or aerial circuit as the case may be. There is a slight effect, however, and it is as well to see how this operates. Referring to Fig. 1, where L_1 and C_1 represent the tuned circuit, we see that across the points A B—that is, the extremities of the tuning condenser—we have other capacities. First of all, there is the grid to filament capacity of the valve, valve-holder and associated leads, but this does not have any bearing on the point at issue and hence is not shown. Then we have three condensers or capacity effects in series, which together are in parallel with C_1. These are the real condenser C_2, the self capacity C_3 of the reaction coil L_2 and the plate-to-grid capacity C_4. If this valve is working as a detector with a grid leak and condenser, then there will be an additional series capacity introduced by this grid condenser, but to simplify matters this has also been omitted.

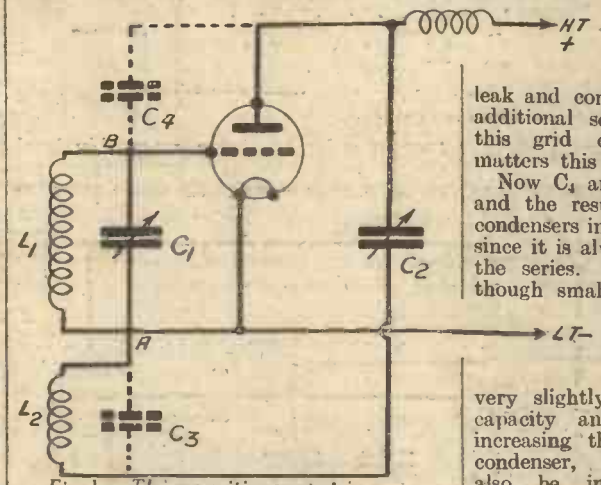


Fig. 1.—The capacities present in a valve detector circuit.

Now C_4 and C_3 should be quite small, and the resultant capacity of the three condensers in series will therefore be small, since it is always less than the smallest in the series. This capacity, however, although small, is actually across A B, or, in other words, in parallel with C_1. We can now see that any alteration in the reaction condenser C_2 will, very slightly, alter this added shunting capacity and affect the tuning. On increasing the capacity of the reaction condenser, the tuning capacity will also be increased slightly, and vice versa.

TONE CONTROL

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

THIS comparatively new idea in radio has developed out of the necessity for more and more selectivity, due to the increase both in number and power of broadcasting stations. With the increase in selectivity of any circuit, so is the high note cut-off more evident, and correcting devices are fitted to replace these frequencies in their correct proportions before they are reproduced in the loud-speaker.

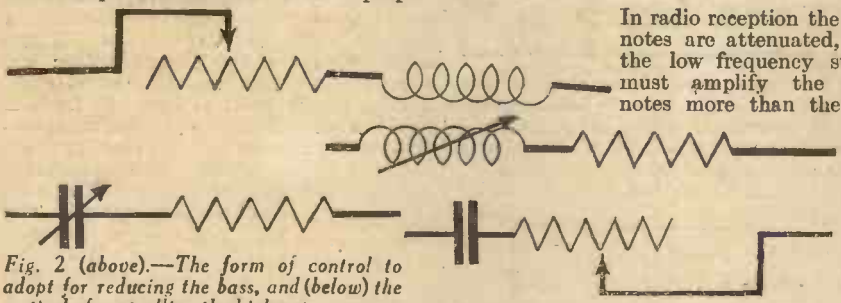


Fig. 2 (above).—The form of control to adopt for reducing the bass, and (below) the method of controlling the high note response.

A further development, however, has come from this. Every person has his own ideas on quality, and, what is even more important to him, pleasing reproduction. Tone Control enables the set to be adjusted so that the tone is just what suits the listener—if he likes plenty of bass he can have it, or if he is musically minded he can go in quest of those high notes which are said to make so much difference. Then, again, all sets have their faults. If it is necessary to push the reaction to its full in order to get a station, or if the set is ultra-selective, then the preponderance of low notes may be compensated for; if there is a noticeable shrillness from the pentode stage, then this may be eliminated; if there are speaker resonances these can be reduced, and so we may go on.

Necessary Components

These tone controls may be built up of chokes, condensers and resistances, using one or all of them, and it will prove worth while to the experimenter if he were to look over the contents of his junk-box and test out various combinations. The justification in using these controls lies in the fact that different stations have different tones depending upon their percentage modulation, while with a radiogram they are even more a logical necessity.

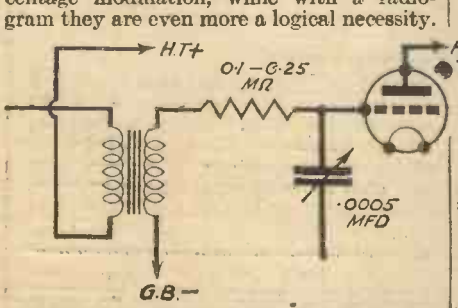


Fig. 4.—A simple tone controlling device for use in conjunction with an L.F. transformer.

In radio reception the high notes are attenuated, and the low frequency stages must amplify the high notes more than the low ones in order to give a reasonably level overall response. With gramophone records both the bass and the treble notes are reduced, and we have the added complication of keeping needle scratch down to a minimum.

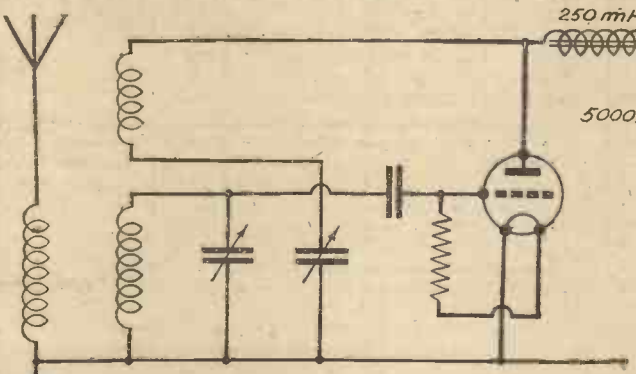


Fig. 1.—A simple tone control arrangement.

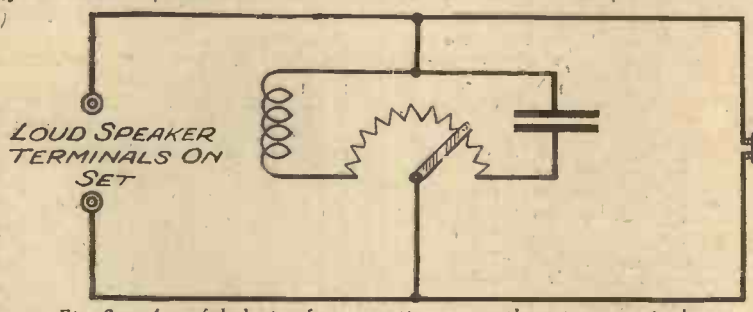


Fig. 3.—A useful device for connection across the output terminals of a receiver.

Tone at the Output

Perhaps the best position to fit a tone control is in one of the output stages, and Fig. 1 shows a suitable circuit. All one has to remember in experimenting is that condensers will reduce the high notes, and inductances will cut down the bass. Variable control may be on the condenser, resistance or inductance as desired. Fig. 3 shows a useful control to fit on the loud-speaker terminals. As R is varied from the condenser end to the choke end, so the reproduction will change from shrill to boomy. A simpler control is a variable condenser of about 0.1 mfd. put across the loud-speaker to cut down mush and needle scratch.

Figs. 4 and 5 show how to apply tone controls to transformer and resistance capacity coupling in order to by-pass the high notes. Probably the best way of all is by using a tone control transformer as an intervalve coupling, and by means of a potentiometer fitted across the transformer the tone can be varied at will over a very wide range.

Whilst dealing with tone control it is, perhaps, as well to point out that it is not possible to insert frequencies which are missing from the loud-speaker. Perhaps this statement should be made a little clearer. Suppose we are using a pentode valve and a moving iron type of loud-speaker. Unless special arrangements are made, the reproduction will sound high-pitched or squeaky, and there will be quite a noticeable lack of bass notes. Now there is nothing that can be done to introduce more bass into the reproduction, so that in order to get some form of balanced output, or an output which sounds as though both bass and treble are reproduced in the correct proportion, what we have to do is to cut off some of the treble or high notes, and this will produce the effect of strengthened bass. One of the circuit arrangements which have been given will serve to carry out this form of tone control.

Of course, it would be possible, no doubt, to introduce different forms of L.F. coupling into such a set to give a better bass response, and here some form of parallel-fed transformer would be suitable, with a coupling condenser of such a value that the circuit comprised by the condenser and transformer primary resonated to some particular low note and so gave a stronger low note output.

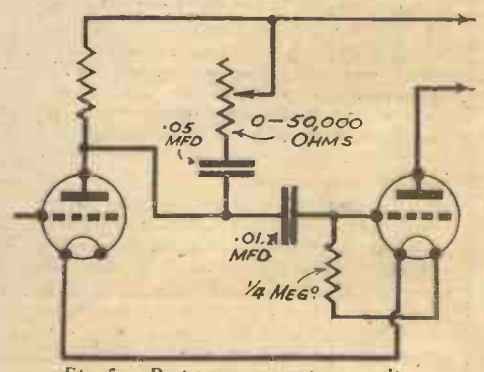
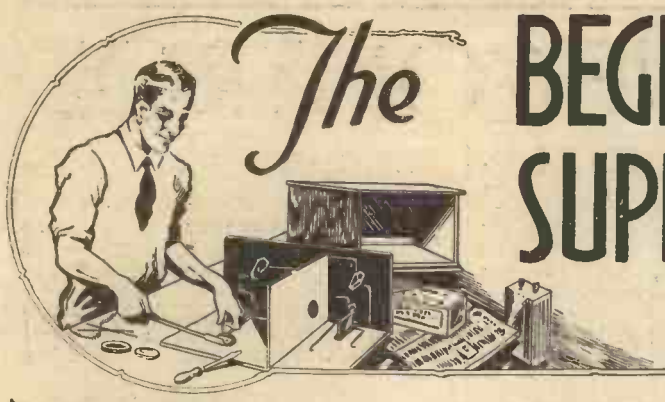


Fig. 5.—Resistance capacity coupling, combined with tone control.



The BEGINNER'S SUPPLEMENT

Conducted by
F. J. CAMM

Change-over Switch

A DEVICE for changing the flow of current from one circuit to another. Unlike a *reversing* switch it does not change the *direction* of flow of the current. It simply changes its path.

Fig. 1 shows what is known as a single-pole change-over switch. A common use for this type is as an earthing switch for the aerial of a receiver. The aerial is connected to the centre contact (the arm of the switch) while the other two are joined, one to the aerial terminal of the set and the other to "earth" (a metal plate or rod buried in the earth, or a water pipe). When the arm is thrown over one

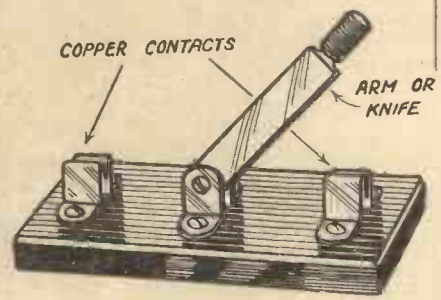


Fig. 1.—A typical changeover switch.

way it connects the aerial to the receiver but when it is "changed over" to the other contact it joins the aerial to earth. Connected thus the switch is used to safeguard the receiver against lightning. During a thunderstorm the arm of the switch is thrown over so as to "earth" the aerial. In this way any electric charges picked up by the aerial from the atmosphere are conducted straight to earth and do not pass through the set.

There are, of course, many other forms of change-over switch used in radio; there is, for instance, the double-pole type which is similar to two single-pole switches mounted side by side. The two arms are joined together with a cross piece so that they are operated as one. Then there are enclosed types which, although they perform the same operations as the knife type shown here, yet employ rather different mechanisms.

Characteristic Curve

A graphical representation of the change in characteristics, or in function, of a material or a piece of apparatus under varying conditions. A curve showing the rise in temperature of a wire as the current passing through it is increased would be an example of a characteristic curve. It might be called a temperature-current curve for that particular wire.

THE BEGINNER'S A B C OF WIRELESS TERMS (Contd.)

In wireless the term is usually confined to a graph or curve showing the performance of valves, crystals, etc. Fig. 2 shows a typical characteristic curve for a valve. It shows how the output current (called the anode current or plate current) varies as the input (grid) voltage is altered. By looking at the graph you can see immediately what change there is in anode current if you alter the voltage on the grid of the valve. In the particular example shown you will see that a change in grid voltage from 0 to + 5 would mean an increase in anode current from 2 milliamps to 3.5 milliamps. To arrive at this you follow the lines of the squared paper. If you follow up from "0" volts on the base line in a vertical direction as shown by the dotted line you will strike the curve at the point "X." You now follow from X horizontally until you meet the milliamps scale which you strike at "2." Thus at 0 volts there is a current of 2 milliamps flowing. In the same way if you follow up from 5 volts positive to the point "Y," and then across you will see that the current is now 3.5 milliamps.

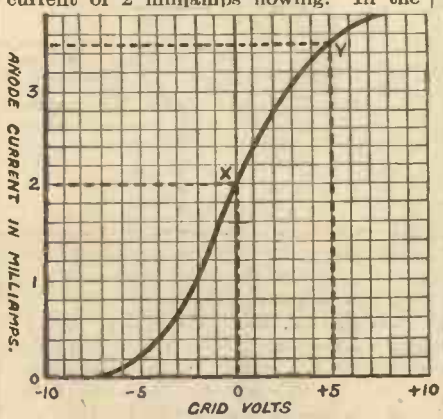


Fig. 2.—A characteristic curve.

Naturally there are other relations between the various voltages and currents of a valve from which characteristic curves may be drawn. However, the example given is one of the most useful. Makers usually include a copy of one or more of the characteristic curves on the leaflet supplied with their valves. These are very useful as a guide as to how a valve will work, and what conditions are necessary to obtain the best results.

Charge

When a body is in an electrified state it is said to contain a *charge* of electricity. According to the electron theory for a body to be charged with electricity implies an excess to deficit of *electrons* (negative particles of electricity). For instance, if there are more electrons present than normal the body is said to be charged *negatively*. If less, then it is said to have a *positive* charge. A simple experiment to show the presence of a charge of electricity is provided by rubbing a dry

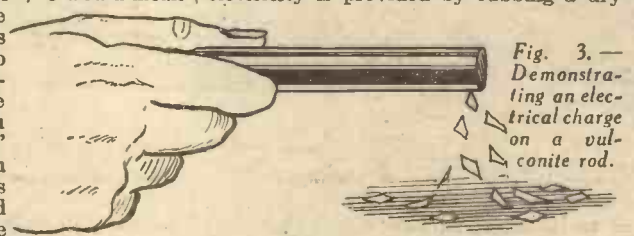


Fig. 3.—Demonstrating an electrical charge on a vulconite rod.

glass rod with a piece of silk or a stick of vulcanite with fur. If the glass or vulcanite is then held near light objects such as small pieces of tissue paper they are attracted and stick to the rod, as shown in Fig. 3.

In the case of a charged condenser there is an unequal distribution of electrons in the two sets of plates. On connecting the plates with a piece of wire the electrons adjust matters by flowing along the wire from one set of plates to the other. The flow of electrons constitutes an electric current, and after this has ceased the condenser is no longer charged. To give it another charge the connecting wire must be removed and the condenser must be momentarily joined to some source of electricity such as a battery. On removing it from the source of electricity it will be found to be charged again. See also "*Capacity*."

Charging Board

A form of switchboard used to control the charging of accumulators. It usually contains some form of resistance such as coils of resistance wire or a number of carbon filament lamps as a means of reducing the high voltage of the mains to a value suitable for charging one or more accumulators. It also contains the necessary switch gear for adjusting the number of coils or lamps included in the circuit and fuses to prevent damage to any of the apparatus in the event of a short

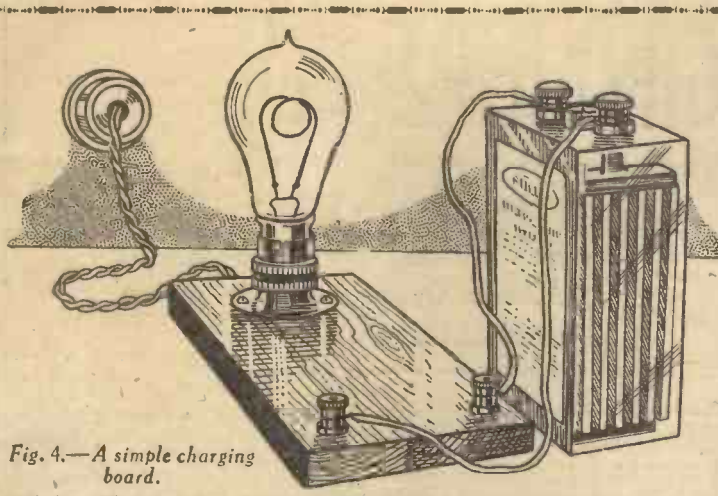


Fig. 4.—A simple charging board.

circuit. The charging board in Fig. 4 is a simple type such as might be used for charging wireless accumulators at home. It contains no switch, as the wall plug is used for switching on and off.

Chattertons Compound

A black insulating substance made in sticks like sealing wax. It is used in wireless for such purposes as filling up unwanted holes in ebonite panels. It can be employed for any job where a compound is needed for filling up crevices or for insulating wires. It is composed of Gutta-percha, Stockholm tar and resin, and is used by gently heating the stick. When it melts it can be run into the crack or hole, as depicted in Fig. 5. On cooling it sets hard again.

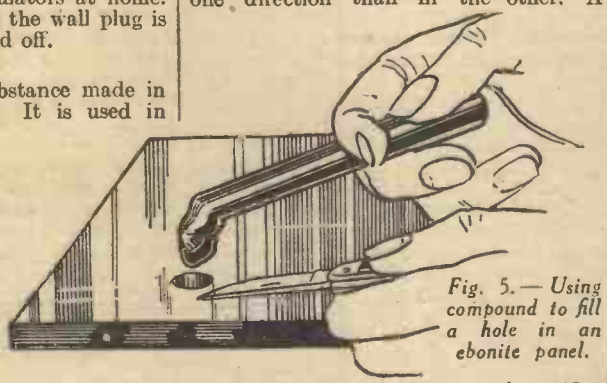


Fig. 5.—Using compound to fill a hole in an ebonite panel.

Chemical Rectifier

A device for changing alternating current into direct current. It usually consists of two metal electrodes placed in a jar containing a solution: in fact it is very much like a cell of the wet type. It depends for its action on the fact that an electric current will pass through it more easily in one direction than in the other. A very common form of chemical rectifier has a rod of aluminium in the centre with a sheet of lead round the inside wall of the jar as in Fig. 6. The solution which is poured in is ammonium phosphate dissolved in water. On connecting the rectifier to a source of alternating current it will flow easily from the lead to the aluminium but not *vice versa*. Thus the result is a fluctuating direct current. Chemical rectifiers are chiefly used for charging accumulators from alternating current mains. They convert the alternating current into the necessary direct current. See also "*Nodon valve*," "*Tantalum rectifier*," "*Rectifier*." There are other methods of rectifying A.C., and all of them are fully dealt with in "Accumulators," price 1/-, from the publishers of this journal.

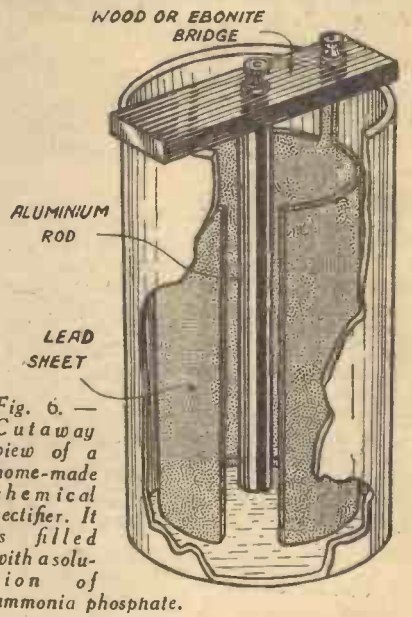


Fig. 6.—Cutaway view of a home-made chemical rectifier. It is filled with a solution of ammonia phosphate.

Volume Level

THE Mayor of Montlucon (France) has recently issued a decree to the effect that radio sets and gramophones must be so controlled that they do not give out any more sound than a piano. Unfortunately no particular kind of piano is specified, so it would appear that there is a good deal of permissible latitude.

Japanese Relays?

IT is rumoured that the German Rundfunk authorities are proposing to relay programmes from Japan in the near future. The relay would be effected by means of short-wave wireless links between the two countries.

Transmitting "Pirates"

THE idea of sponsored programmes (organized by commercial concerns for publicity purposes) is growing rapidly on the Continent. Most of the French stations devote a good deal of their time to sponsored programmes, and apparently they find it a paying game. Following the French example, two or three unlicensed Dutch stations have recently commenced to give publicity broadcasts. The ironical part of the business is that although the stations are giving publicity to various manufacturers' produce, they are very careful to hide their own identity. Two of these illicit transmitters have now been working for some time, and they have become so brazen as to send out a "Good Luck" message every night to the police who are trying to trace them.

The Prince's Latest

THE Prince of Wales's latest car is equipped with a very up-to-date wireless receiver and two loud-speakers. The set is provided with automatic volume control, so that weak signals are given increased amplification and strong ones toned down. As a result the volume remains constant irrespective of whether the car is passing through industrial areas, where screening occurs, or travelling on the open road, where conditions are particularly good. Will the Prince's lead be a means of popularizing automatic volume control in this country? I wonder.

Wise Legislation

LISBON Municipal Council has set a lead to the rest of the wireless world by forbidding the erection within the city area of any electric signs not fitted with suitable filters to prevent interference with radio reception. Not content with this, the Portuguese Radio Club is endeavouring to get the order extended to cover all other forms of electrical machinery.

How Many Valves?

THERE has been a good deal of bickering of late on the question of whether or not the rectifying valve of an A.C. set should be taken into account when specifying the number of valves. Many reasons have been advanced both for and against the inclusion of the rectifying valve in the specification, but I still consider the rectifier as part of the mains equipment and having nothing whatever to do with the receiver proper. Besides, many A.C. sets use a metal rectifier, and would therefore appear to the uninitiated set-buyer to be less powerful (according to the advertised specification) than those having a valve rectifier, if the latter were included in the designation. I think it is high time the manufacturers came to the decision that a set should be described according to its number of *receiving and amplifying valves*. If the rectifier must be included, it should be given under a separate heading.

Aeroplanes for Spotting Shoals of Fish

RADIO is rapidly becoming as indispensable to aircraft as it is to shipping, and the other day the Danish Broadcasting Corporation co-operated with the Department of Fisheries in the discovery of shoals of fish by aeroplane. Shoals can often be easily detected from the air and the location of these was communicated to the shore from the aircraft engaged by wireless telephone, from whence it was radiated by the D.B.C. stations. You will thus soon owe the presence of your morning kipper to Marconi!

Are You Getting

MOVING-COIL QUALITY?—1

By "DETECTOR"

Fig. 2.—When the speaker has feet fit a bracket to the baffle to take these.

THE advent of the moving-coil speaker set a new standard of reproduction, and "moving-coil quality" became the goal of every radio enthusiast. Unfortunately the impression was quickly gained that by purchasing a speaker of this type the last word in perfect reproduction was merely a matter of attaching the speaker to the output terminals of a wireless set, and that forthwith *all* the instruments in the band, from the piccolo to the big drum, could be heard in their correct position on the range of frequencies. This led to the almost accepted fact that the acquisition of a moving coil was the solution of all poor quality problems, whereas in actual practice the reverse was more often the case.

Quality of Reproduction

The first of the moving coils suffered from many defects, the chief of which, from the amateur's point of view, was that they needed considerably more low-tension current to energise their fields than was taken by the set itself, and until the use of a trickle charger operated from the mains became more general, this item of expense reacted unfavourably on the development of the type. With the production of a really satisfactorily designed permanent magnet, from material of efficient magnetic permeability, the future of the permanent-magnet moving-coil speaker became assured, and it made up in convenience what it lacked in sensitivity over the energised-field type. Even at the present time, however, where the combined requirements include perfect quality coupled with good sensitivity and ability to handle large outputs, the energised-field type speaker is still superior, and, where a good A.C. mains supply is available, represents a good proposition. Another serious fault with the early moving coils, energised or otherwise, was the very poor reproduction of speech. This was usually very "woolly" and any set adjustments made with a view to curing this too often resulted in a serious bass cut-off.

Permanent-Magnet Speakers

For all this the permanent-magnet speaker has come to stay, and its improvement has been such that only the most critical ear can now detect any discrepancy between its quality and that of the energised type. It is now possible to obtain such speakers built by reputable firms and capable of giving really excellent results at very low prices—prices made possible by large demands and by the utilisation of the most modern mass-production methods. In spite of the improvements in design, however, the impression is still abroad that the buying of a moving-coil speaker fulfils the purchaser's obligation as regards the search for quality, and as a result the new owner of one of these speakers is often disappointed with the results when connected to his own set. His disappointment is due to the fact that whereas his old cone or horn speaker conveniently smoothed out any minor defects or distortions in his set, the moving coil, with its vastly improved response, accentuates these defects.

Tests with Different Speakers

With all this in mind I decided to carry out certain tests with several makes of permanent-magnet moving-coil speakers, and to put the results before the readers of PRACTICAL WIRELESS in a non-technical manner, and from the view-point of the average amateur. I obtained stock models of several speakers falling in the medium-priced range of from 40s. to 50s., and after numerous tests, narrowed my field to two. These were both moderately priced permanent magnet speakers. Speaker "A" costs 42s., and speaker "B" 47s. 6d. —both inclusive of multi-ratio output transformers. Somewhat unfairly, perhaps, I wired these up together with a large energised-field speaker that I keep as a standard of reproduction and which cost nearly three times the price, the arrangement being that either of the speakers could be switched in alone or in combination with either or all of the others.

The first tests I made were with baffles, and I decided that whilst admitting the advantages to be gained with large-sized baffles it would not be policy to risk disturbing the domestic peacefulness of any home by asking the housewife to accept a baffle larger than 24in. square! I first used a wooden baffle on each speaker of 1in. thickness timber with quite good results, but later found that much better results can be obtained if one of the many types of composition boards be used. I used a brand known as "Ten-Test" myself and although it was only five-eighths of an inch thick, the entire absence of resonance made it an ideal material for the purpose. A hint or two may here be given with regard to fixing the speaker. If possible, use bolts passing right through the baffle and through the holes in the chassis of the speaker, and place ample size washers under the heads of the bolts, so that they can be tightened sufficiently without fear of the heads pulling through the material of the baffle. The hole in the baffle may be cut by drilling a starting hole on the circumference previously marked out, and by cutting round the circumferential line with a pad or fretsaw threaded through the starting hole. If the speaker has a base or feet for additional support, attach a bracket to the baffle to accommodate this, as by taking the weight in this way much strain is taken from the chassis and cone assembly. If resonance is felt through the baffle on large outputs a ring of felt (cut from a table or other mat obtained at any of the large stores) placed between the chassis and the baffle, can be used to advantage.

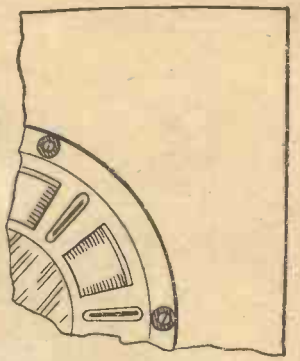


Fig. 1.—Use large washers under the heads of the screws when fixing your speaker to the baffle.

Results Obtained

Having dealt with the fixing arrangements I will now proceed to the results obtained. I found it impossible to make either of the speakers rattle before the energised one did so and then they all rattled in concert due to an overloaded output valve. This was on a four-valve all-mains set—S.G., det., 2 L.F. transformer-coupled—and the volume was sufficient to fill a small hall from either speaker. The bass response was adequate from speaker "A," but speaker "B" would have been better if fitted to a larger baffle. Both speakers had a crispness and brilliance of attack that surpassed that of the larger energised one, and speaker "B" gave the best reproduction of a pianoforte record that I have heard for a long time. The upper register in particular was especially fine, and the high notes had little of that "woodenness" usually associated with piano reproductions. On the other hand, a soprano from Daventry verged on the screechy side, while the mellowness of the "A" speaker did much to soften this.

Tone Control

Both speakers were too loud for the average room on this set and in preference to overmuch volume-controlling I now connected them to a straight two-valve set. The volume was adequate from the local station and most of the more powerful foreigners until I tried a L.F. tone-control fitment. The volume was immediately cut down by this and reaction had to be forced to a dangerous point—from a quality point of view—to regain the lost strength. From the local station, the volume was still ample, however, and the reproduction of the "B" speaker was much improved by a fair amount of top-note cut-off. The balance of the "A" speaker was apparently ideal for the size of the baffle used and very little top-note elimination was required; the bass response was pleasing and with the tone-control potentiometer right round there was rather too much bass for my taste. If you like plenty of bass, it is there to be had.

(To be continued)

Practical Experiments With Cone Diaphragms

How to Get Better Results from Balanced Armature Types of Loud-speakers.

—By "RADIOMAN"—

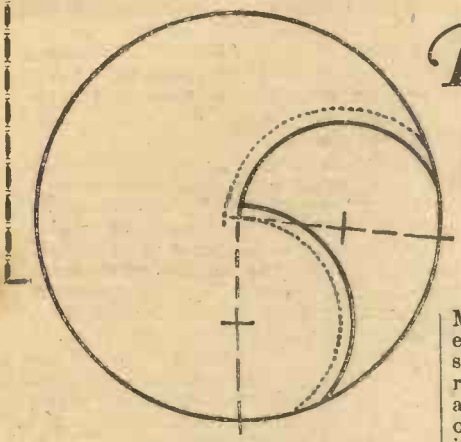


Fig. 1.—How to make the spiral cuts round the diaphram.

IN spite of the present popularity of moving-coil loud-speakers, many listeners are still using balanced-armature cone models, and no doubt many more would use them if they realized what a surprisingly high standard of reproduction can be obtained from these inexpensive loud-speakers, when arranged in a way that does them full justice. It must be admitted, of course, that a moving-iron unit of the balanced-armature type cannot compete with a moving-coil speaker in handling a really big output. But to the majority of ordinary wireless enthusiasts, who merely want to fill an average-sized room with a pleasant volume of undistorted sound, and who have no need of what might be called "concert-hall volume" (even if their sets were capable of producing an undistorted output of such magnitude, which is seldom the case), the power-handling limitations of a balanced-armature speaker are not a very serious drawback.

The Possibilities of the Balanced-Armature Speaker

As regards general clarity of reproduction with a moderate volume of sound, the balanced-armature type of speaker (if properly arranged) is capable of giving results that, on the whole, compare very favourably indeed with those afforded by a good many of the moving-coil and inductor-dynamic speakers on the market. Moreover, it has the additional advantages of low cost and high sensitivity. It is highly probable, however, that a large proportion of the listeners who possess home-made cone speakers of the balanced-armature type are not getting anything approaching the standard of reproduction that it is possible to obtain with these speakers when arranged to the best advantage.

In a great many instances, a remarkable improvement in quality, volume and frequency-response could be achieved by carrying out a few practical experiments, and acting on the suggestions indicated by the results. The reproduction obtainable with a balanced-armature cone speaker depends very largely on the particular unit employed, but to an even greater extent, perhaps, on the design and arrangement of the cone diaphragm, and baffle—if any. Most listeners have no opportunity of experimenting with a wide variety of loud-speaker units; but given one unit of reasonable efficiency, it is quite an easy and inexpensive matter, within the scope of almost any listener, to carry out some interesting experiments with cone diaphragms.

The tonal quality of reproduction with any given B.A. unit can be varied within astonishingly wide limits by the very simple expedient of altering the design of the cone diaphragm and the baffle-board—especially

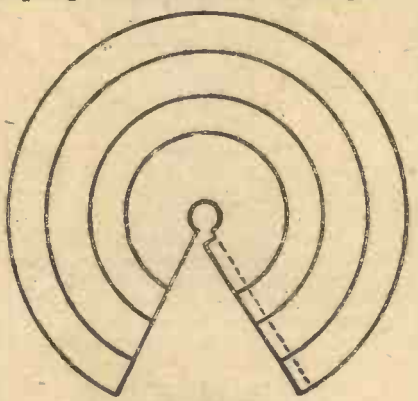


Fig. 3.—Marking out the cone in concentric circles.

the former. If you want convincing proof of this statement make up a simple free-edged cone diaphragm about 18ins. in

Fig. 4.—Setting out the arcs for a scroll-cut join.

diameter out of a sheet of suitable paper; and attach it in the usual way to the driving-rod of a balanced-armature loud-speaker unit. Connect it up to your receiving set

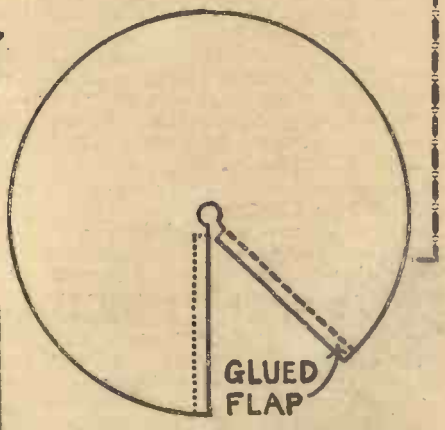


Fig. 2.—Showing the overlapping join.

and switch on. Tune in a musical transmission, and note the tonal quality of reproduction.

A Spiral-cut Diaphragm

Then take a pair of scissors and carefully make a spiral cut round the diaphragm, starting from the outer edge and working inwards, as shown in Fig. 1. In this way you will gradually reduce the effective diameter of the cone. As you do so you will find that the whole tone of the music alters; the reproduction becomes at first clearer and crisper, then, after a certain point is reached, the low notes gradually disappear, and signals become unpleasantly shrill and "thin." By the time you have reduced the diameter of the cone to about 2ins., the reproduction will have become "tinny" and squeaky, while the volume will have diminished enormously.

Several factors affect the reproduction with a cone diaphragm; these include the diameter of the cone, the apex angle, and the thickness and nature of the material from which the diaphragm is constructed. The general tone of reproduction with a large, flat cone usually tends to be low-pitched, while that with a small, sharp-angled diaphragm tends to be high-pitched and shrill. Between these two extremes, of course, an infinite variety of gradations in tone may be obtained.

The type of cone-washers used in attaching the diaphragm to the driving rod of the unit; whether the cone is of the free-edged or floating type, or how, if at all, the edges are attached to a baffle-board; the dimensions and thickness of the baffle, if one is used; the position in the room occupied by the finished loud-speaker; and the acoustic properties of the room, are among other points that often have a pronounced effect on results, and offer a wide field for experiment. But in the present article we are concerned chiefly with experiments affecting the design and construction of the cone itself. It is quite an easy matter to evolve a design that will give optimum results with any particular unit, by simply carrying out practical experiments with representative specimens of different sizes, angles and thicknesses. Individual experiment is necessary for best possible results, as a cone that is ideal for one type of unit

may be far from ideal where another type is concerned.

Results, of sorts, *can* be obtained with diaphragms of almost any material, including even wood, metal, glass and cardboard! But for practical purposes the materials which may be regarded as most suitable for experimenting with home-made speakers resolve themselves into different kinds and thicknesses of paper. A kind which is very widely used for cone diaphragms is the imitation parchment paper commonly sold for making lampshades, etc. This can be obtained in several grades of thickness and is quite inexpensive.

Making a Cone Diaphragm

Having obtained some suitable paper, the first step in making a cone diaphragm is to mark out the circle and segment from which the cone is developed. The diameter and apex angle of the finished cone depends on the radius of the "development circle" and the angle of the segment that is cut away to form the cone. The following table gives useful data on dimensions and angles. In this table, "A" represents the apex angle, "S" the segment angle, and "R" the ratio of the radius of the development circle to the diameter of the cone (approximately):

A	S	R
90°	105°	0.71
100°	84°	0.65
110°	65°	0.61
120°	48°	0.57
130°	34°	0.55
140°	22°	0.53
150°	12°	0.52

To illustrate the use of this table, let us suppose that you wish to make a cone with an apex angle of 110° and a diameter of 10ins. From the table you will see that you need to describe a development circle with a radius of approximately 10 x 0.61 in., that is, of course, 6.1in., and to rule two lines, radiating from the centre to the circumference, forming a segment with an angle of sixty-five degrees.

Some sort of flap is needed to make an overlapping join when the edges of the segment are brought together to form a cone. Before cutting out the development disc, therefore, it is necessary to rule a third line parallel to one of the existing radial lines, and about ¼in. or ⅜in. away from it, as shown in Fig. 2. The disc and segment are cut along the continuous lines in this diagram, and then, after smearing a thin coating of liquid glue on the flap and allowing time for it to become slightly "tacky," the edge of the flap is brought over to meet the dotted line in Fig. 2, and the flap pressed down firmly to make a secure join in the cone thus formed. One might suppose that, in order to investigate the effect of all the possible combinations of diameters, apex angles, etc., it would be necessary to make an enormous multiplicity of cones. Fortunately, however, it is by no means essential to go to this trouble and expense in actual practice.

As regards apex angles, for instance, it should be possible to secure quite enough data by selecting three or four representative values—say, 90, 120, and 150 degrees—and experimenting with cones having apexes of these angles. There is no necessity to make up a separate cone for each different diameter you wish to try out, if you adopt the simple expedient shown in Fig. 3. The cone paper is marked out with a number of concentric development circles, instead of only one; the radius of the smallest circle may be that needed to form a cone, say, 6ins. in diameter, and that of the largest circle may be suitable for a cone, say, 16ins. in diameter.

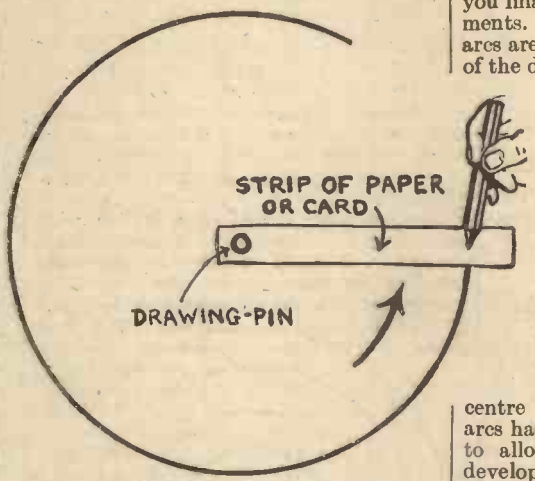


Fig. 5.—A simple method of marking out circles.

To start with, cut round the largest circle, and make up into a cone 16in. in diameter with an apex angle of, say, 90 degrees. After noting carefully the effect of reproduction with this diameter, you can gradually reduce the diameter of the cone (without troubling even to remove it from the loud-speaker unit) by the simple expedient of cutting round each of the circles in turn, making a careful note of the tone and volume of reproduction with each diameter. You can then proceed in an exactly similar manner with cones having apex angles of, say, 120 and 150 degrees. The effect of different kinds and thicknesses of cone paper can also be tried, and there is considerable scope for experiment with different types of baffle-boards.

Although a straight join is good enough for a temporary cone that is being used purely for experimental purposes, it is worth while to go to the little extra trouble of making a scroll-cut join in the cone that you finally adopt as a result of your experiments. Fig. 4 shows how the necessary arcs are marked out. First of all, a segment of the desired angle is marked out by ruling straight radial lines in the ordinary way; then the point of the compasses is placed on each of these lines in turn, and arcs described as shown in Fig. 4. The inner pair of arcs, which must pass through the centre of the development circle, have a radius equal to a little more than half the radius of the latter. Supposing, for example, the radius of the development circle to be 10in., the centres of the arcs might be located at a distance of, say, 6in. from the centre of the circle. The outer pair of arcs have a radius, say, ¼in. or ⅜in. greater, to allow for an overlapping join. The development disc and segment are cut out along the *continuous* lines in Fig. 4. The *dotted* lines indicate how the edges of the curved segment overlap to make a join when they are brought together to form a cone.

In the absence of proper drawing instruments, the circles (or arcs) can be marked out by means of the simple expedient shown in Fig. 5. The strip of paper is pivoted at the centre of the desired circle by means of a drawing-pin; a small hole for the pencil point is pierced in the strip at a distance from the drawing-pin equal to the radius of the circle that is to be described. The pencil and strip of paper are then swung round in a complete revolution about the drawing-pin that acts as a pivot, and a perfect circle is thus described on the cone-paper.

ELECTRIC GRAMOPHONE MOTORS

A Discussion on the Various Types

By S. F. PHILPOTT, A.M.I.E.E.

ONE of the most important units in the building of a radio gramophone is the electric turntable motor, and too much care cannot be taken over its selection. As far as the gramophone side of the instrument is concerned, the motor is the prime source of the reproduced sound, and only first-class performance can be tolerated. The existence of a poor motor is rapidly evident even to the untrained musical ear. The fact that the motor is also one of the most expensive items in the equipment adds further weight to the need for careful buying.

Electric gramophone motors on the market fall into two broad classes, according as to whether they are used on direct or alternating current circuits. A.C. motors are cheaper, and generally more satisfactory in every way for radio gramophone work than a direct current type.

Motors for direct current are usually termed "Universal," because they are also suitable for running on alternating current circuits, with slight modification, and are, therefore, useful where an instrument is to be moved from place to place.

A universal motor should never be chosen for alternating current use only, because the purely A.C. motors, besides being cheaper, are definitely better

A.C. Motors

There are two types of A.C. motor, the synchronous and the induction. The synchronous is the cheapest of all electric motors on account of its simplicity. There are two types—self-starting and non-self-starting. As the name implies, the turntable of the non-self-starting type has to be given a "flick" with the hand to start it. The self-starting type is switched on like any other type of motor. The principal characteristic of the synchronous motor is that its speed is fixed by the frequency of the electricity supply, and cannot be varied by the user.

From the point of quality of reproduction this is an advantage, because to get the best results records should be played at the same speed at which they were cut, and this is the set speed of the motor. A

(Continued at foot of page 818.)

A FEW RADIO MISNOMERS

By "CYNIC"

AT the risk of being considered something of a pedant, I must confess to a great love and respect for the English language, and to a conviction that technical terminology ought to conform to the best traditions of our mother tongue. It is, therefore, always a shock to me when I come across a scientific or technical term which betrays either a wilful disregard of the niceties of English, or loose-thinking on the part of those who coin the words. It is to be regretted that these words have become so far accepted in the realm of our mutual hobby that writers are now more or less forced to use them, otherwise they run a grave risk of being misunderstood by readers.

However, let us examine the situation, for the jargon of radio is full of such misnomers. This to a great extent, is due to the rapidity with which the new science has developed, calling for new words which have to be invented hastily and without due forethought. Some of the older terms, again, were quite appropriate when originally applied, but owing to more recent developments or discoveries their aptness and first significance have disappeared. You will want me to substantiate my criticisms; well, it will not be difficult.

"Wireless" and "Waves"

To begin with, one of the most popular names for our science is, perhaps, the worst misnomer of all. "Wireless"—was there ever a more inapt word? I should hesitate, offhand, to venture a guess at the number of yards of wire employed for the leads, the resistances, the coils and transformer windings in the average receiver. "Radio," if you please—not "wireless." Then the radio "waves" about which so much has been said and written. This term should never be employed by those who do not realise that in the radio wave there is nothing which approaches the physical motion associated with the waves of the seashore. Radio waves are simply rhythmic variations in the intensity of the electric field set up by the transmitting aerial, and we might say that their only connection with sea waves is their periodic character. It is true that at the moment I cannot suggest a better word, but the existing term should only be applied with due mental reservations.

The signals intercepted by your aerial are led down to the aerial "terminal" of the receiver, which is not a terminal at all. A terminal is surely the point where something terminates, while the milled-headed nut and threaded stem which masquerades under this title is simply a connecting screw for joining two pieces of apparatus together. Then your receiver is tuned by means of a "condenser" which does not condense; it simply stores energy for a minute space of time and releases it again, much in the same way as a coiled spring stores and releases energy.

"Valve," "Tube" and "Lamp"

The nomenclature of those wonderful productions termed "valves" is replete with misnomers. Very few valves are truly and simply valves in the original sense of the word—which is a piece of apparatus permitting a flow in one direction only. A diode rectifier is a true valve—and so is the metal rectifier, and a crystal detector for that matter. But the three-electrode valve, the screened-grid valve and the pentode add to their non-return property, many of the functions of a throttle valve, a governor valve or a sensitive relay, for not only is the current passing through them unidirectional, but its intensity is varied and regulated by the electric pressure applied to the grid and also the anode. The name "tube" which our American cousins employ, is not now strictly apt. It is a relic of the original experiments with evacuated tubes which played so prominent a part in the discoveries leading up to the development of thermionic currents. The French term—"Lamp"—is still less suitable, although it serves as a reminder that the first valves was developed as the direct result of experiments with faulty electric lamps.

Coming now to the "filament" of a directly heated valve, this should really be called the cathode. The fact that it is a fine thread or filament is merely incidental, while in an indirectly heated valve the filament should be called the "heater." Again, in most valves the term "plate" is a misnomer. The anode of the first valves certainly was a plate of metal, but cylindrical anodes were quickly introduced. A few valves even now have plate shaped anodes, but there are usually two such plates. Others retain cylindrical anodes, some have rectangular box-like structures, while in many of the latest types, especially in large output valves, the anode is composed of nickel gauze which presents a large surface for the dissipation of heat.

It is a moot point whether the "auxiliary grid" of a pentode and the screening grid of a four-electrode valve should strictly be considered as a grid or an auxiliary anode. It is true that it is of grid formation, but it is maintained at a high positive potential, and current flows to it from the cathode within the valve. In the anode circuit of your detector valve there will be, in all probability, a "transformer." But what does it transform? Electricity? Well, electrical energy is passed into the primary winding—so there is no transformation in that. It will be agreed that most transformers "take in" a comparatively large current at a low voltage and give out a smaller current at a correspondingly higher voltage, but this is scarcely a transformation, either. No, a transformer is simply a voltage amplifier if it has a step-up ratio or a current amplifier if the ratio is a step-down.

"Detection"; "Impedance"

By the way, the detector valve itself is a bit of a hypocrite, for it detects nothing. What it does is to suppress alternate half-waves of the radio frequency signal and amplify the remaining half. Its action, therefore, partakes of the nature of a rectifier *and* of an amplifier. In anode bend "detection" the radio frequency signal is first amplified and then rectified, while in leaky grid detectors the rectification occurs first and the amplification occurs at audio frequency. One of the constants of a valve is called its "impedance." Another misnomer, for engineers have agreed that the word "impedance" shall be applied to a property, analogous to resistance, but varying with the frequency of an alternating current.

(To be continued.)

RADIO CLUBS & SOCIETIES

HUDDERSFIELD RADIO RESEARCH SOCIETY

The above society is now known as The Huddersfield Branch of the A.A.R. and T.S. Our branch membership is 2s. 6d. per annum. We have arranged a series of five lectures on Television and these will not be highly technical, but of an easy understandable nature. We are also arranging to visit Moorside Edge Transmitting Station. The first Television talk will be given on January 10, 1933, in our meeting room. Also, should we receive sufficient enquiries, a special Beginners' Night will be held. The Secretary's address is 10, West Grove Avenue, Dalton, Huddersfield.—(J. Sutcliffe, Chairman.)

H. F. AMPLIFIERS

An interesting lecture was given by Mr. Carter (Messrs. Mullard Wireless Service Co.) on the above subject at a recent meeting of the Southall Radio Society. The evolution of the H. F. Amplifier was discussed and its development followed from pre-broadcasting days. Mr. Carter indicated that future requirements would demand improved reception conditions in the receivers, and the present trend of design was to arrange for the inclusion of automatic volume control and noise suppression. The discussion which followed the lecture clearly indicated the interest with which these latter statements were received.—Hon. Secretary, H. Rayner, 114, North Rd., Southall.

SHORT-WAVE LISTENING LEAGUE

It may interest some readers who are short-wave listeners, to know of the Short Wave Listening League, of which I am a member. We were up to lately known as the Short Wave Listening Station. Our organisation, whose object is to further the cause of amateur and professional interest in short and ultra short wave work, is willing to collaborate with any organisation or institute of Radio Science. The subscription fee is 2s. 6d. per annum for all members, and any member, who wishes to take part in an American amateur transmission reception test shortly to be held is asked to subscribe 1s. towards prizes. Another branch of our work is the exchange of reports between members.

A report of anything heard on the short waves is sent in every month to headquarters and in return, members receive copies of other reports sent in. We hope shortly to possess a fully equipped technical laboratory specially fitted for experimental and research work, and should be pleased to accept any donation to this end in the shape of measuring instruments or apparatus from members or commercial manufacturers interested in our work. All members will receive a report of any developments taking place in this class of work. The director of the S.W.L.L. is B. Dyson, headquarters, 213, Green Lane, Rawmarsh, Rotherham, Yorks, and intending members should communicate direct to him and enclose a stamped addressed envelope for reply.—(Hector Lawson, Secretary.)

SLADE RADIO

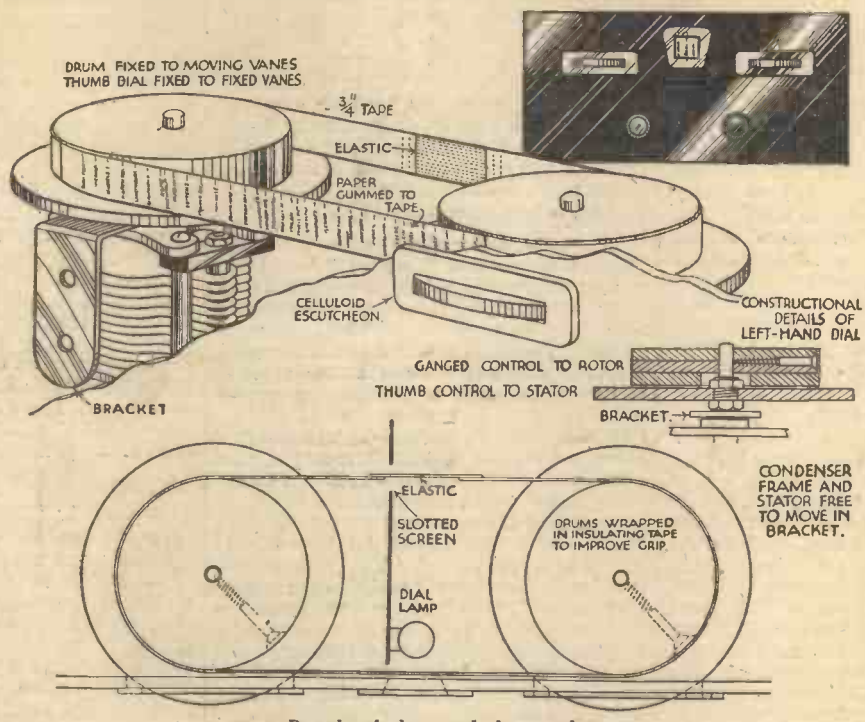
A lecture on "Photo electric cells and gas filled relays" was given by Mr. F. Inchley, of Messrs. The General Electric Co., Ltd., at the meeting of the above society held recently. Commencing with the cells the following items were covered: visible light, radiations in the ether, sound waves and speeds, speed of ether radiations, light frequencies, chemical construction of matter, construction of the atom and light's effect on electrons. Then followed a description of the various elements used, cathodes, emission, sensitivity and construction of cells. An experiment was then carried out by means of a model showing how the headlights of a car could be used to open the doors of a garage and switch on the interior lights, also a few of the applications of photo electric cells were described. The lecturer then described a new gas-filled relay which will pass up to .6 of an amp. Two of these can be used to change A.C. to D.C. and also they can be controlled by photo electric cells, the voltage on the grid, or capacity effects. Several interesting experiments were carried out including that of the capacitive effect of the body controlling the lighting of a 60 watt lamp. The lecture proved exceedingly interesting and was thoroughly enjoyed by those present.

A UNI-DIAL CONTROL

By E. S. JOHNSTON

A SHORT TIME ago I built a "screen-grid four" and used the ordinary type of variable condensers and dials. Thinking that a ganging system would make the tuning much simpler, I succeeded in fixing one up at very little trouble or expense, in the following manner. From a piece of ply ¼in. thick I cut six discs of 4in. diameter, together with two of 5½in. diameter. By gluing together three small discs and one large one, a drum with a thumb control was formed, and this was drilled to fit the spindle of one of the variable condensers. The necessary fixing screw for this drum was a thin wood screw with the point filed down. The remaining three small discs were glued together in a like manner, and a similar fixing screw provided. Out of a piece of aluminium I made two brackets and fixed them on to the condensers, one firmly and the other in such a manner that it was permitted to move freely.

After cutting in the panel a window and also the two slits for the projecting thumb controls, I fixed the condensers in position by means of two small bolts through each bracket.



Details of the uni-dial control.

Fixing the Drum Controls

To the left hand condenser I then fixed the odd thumb control by means of the panel fixing nuts provided, and slipped the drum on the spindle. The combined drum and thumb control was then fixed to the spindle of the right hand condenser. A turn or two of insulation tape round each drum was sufficient to provide a good belt grip. The belt was a piece of ¾in. tape kept tight by means of a piece of elastic. A strip of paper to take the name of each identified station was gummed to the tape. The right hand thumb control works the moving vanes of both condensers and the left hand control works the fixed vanes of the left hand condenser, thus providing for necessary trimming. A small pointer in the centre of the window indicates the name of the station to which the set is tuned. Since a few turns of insulation tape round either drum will increase or reduce the gearing between them, a perfect relation may be thus obtained between the two condensers.

ELECTRIC GRAMOPHONE MOTORS:

(Continued from page 816.)

variable speed motor may easily be several revolutions fast or slow without being noticed, but to the detriment of the reproduced music.

On the other hand, particularly with dance records, it is frequently desired to play them above and below speed, and for this, of course, the synchronous motor is not desirable.

The synchronous motor can be made very shallow in construction, and models are available in which the windings are actually contained in the turntable itself.

Induction motors possess the advantages of variable speed. They are governed mechanically, and are more expensive than the synchronous type. They also take slightly more current to run, but this is not a serious disadvantage, as no type of gramophone motor is costly in this respect. The induction motor has no rubbing contacts or brushes, and rarely causes any interferences with reproduction due to magnetic induction.

Universal Motors

This is the most expensive class, both in cost and running. Owing to their greater complication, it is also the most troublesome type, although little trouble is likely to be experienced with modern makes of repute. The universal motor usually comprises a small electric motor similar in construction to the ordinary power type, such as used in fans, sewing machines, etc., coupled to the turntable by belt, gear or direct valve. The speed of the turntable is regulated by a centrifugal governor.

In order to keep down the speed of the motor, it is usual practice to reduce its voltage, and for this purpose a resistance is always included with the outfit. This has to be set to the approximate voltage before use. Generally, the setting for a given voltage on alternating current differs from that for a similar voltage of direct current. The setting must be carefully done or noise, faulty playing and overheating will result.

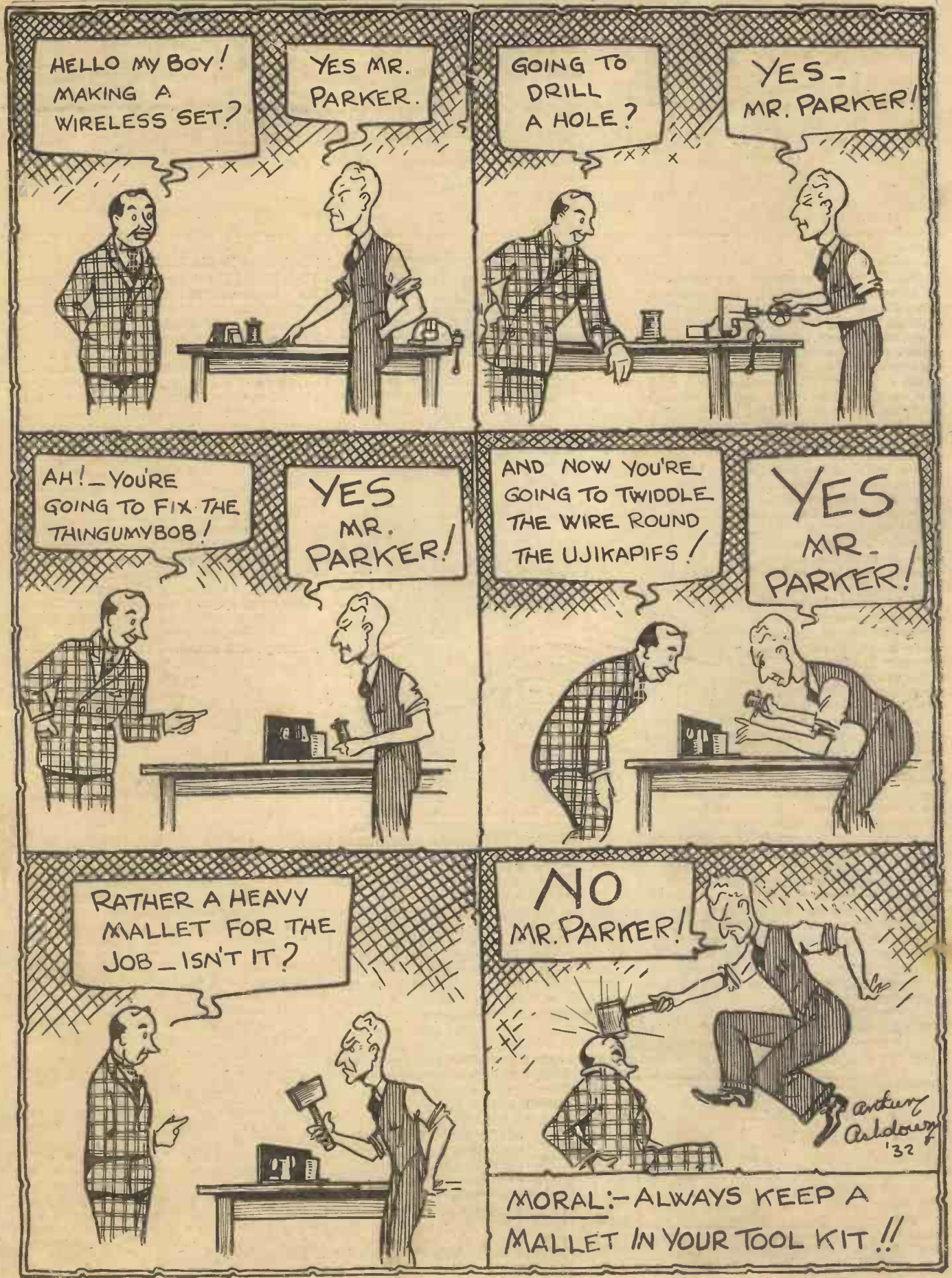
General Notes on Buying

Having outlined the various types available, we will now consider the various points to watch in buying *any* type of electric gramophone motor.

The motor must have an ample reserve of power so that it will play the heaviest passage in any record without slowing up. The best test is to take a 12-in. record which has a loud opening passage, and play this over several times, listening intently for any sign of "flatting," denoting a weak or badly governed motor. If desired, constancy or otherwise, of the speed, can be observed by means of a stroboscopic disc, but the writer prefers, and recommends, relying on the ear rather than the eye.

A good test record is Marche Militaire, Columbia 9919. Another test for power is to grip the top of the turntable spindle firmly, while running, with finger and thumb. It should be difficult to stop it unless excessive pressure is applied. If it is easily stopped the motor is probably weak. Governing is another important factor. Long, sustained single notes, such as piccolo, flute or bells, should be reproduced without any sign of vibration, tremolo, or "dither."

One of the best test records for governing is the reverse side of the one mentioned above, *viz.*, Villanelle. A gramophone motor must be silent in running, and various makes differ in this respect. Motors whose armatures or rotors run at turntable speed are generally better than high-speed motors with reduction gearing in this respect, but are generally more expensive. There are two kinds of noise—mechanical, emanating from gears, brushes (in universal motor) or elsewhere, and magnetic hum. A motor showing signs of noise should be rejected, as such noise will in all probability develop. Remember, too, that a motor which may sound "passable" in a large shop may seem very noisy in the quiet of the drawing-room at home.


HELLO MY BOY! MAKING A WIRELESS SET?
YES MR. PARKER.
GOING TO DRILL A HOLE?
YES - MR. PARKER!
AH! - YOU'RE GOING TO FIX THE THINGUMYBOB!
YES MR. PARKER!
AND NOW YOU'RE GOING TO TWIDDLE THE WIRE ROUND THE UJIKAPIFS!
YES MR. PARKER!
RATHER A HEAVY MALLET FOR THE JOB - ISN'T IT?
NO MR. PARKER!
arthur Aldous '32
MORAL:- ALWAYS KEEP A MALLET IN YOUR TOOL KIT!!

RADIO RAMBLINGS

Valve Decay

MOST users of radio sets are now well aware of the fact that after a certain length of time (generally from eighteen months to two years), the valves begin to wear out. But the process takes place so slowly that it is often difficult to know just how bad they are or whether it would be worth while to replace them with new ones. Other valves are not always available for comparison, but if a milliammeter is to hand, it is possible to check them with fair accuracy. When the valves are first bought, they should be put in the set and a milliammeter connected in the anode circuit of each in turn by joining the meter between the H.T. positive terminal and the corresponding terminal of the anode coupling component (transformer, choke, speaker, etc.). Make a note of the current registered for each valve and also of the exact H.T. and G.B. voltages in use.

Subsequently, when it is suspected that the valves may be losing their efficiency the tests should be repeated, taking care to use the same battery voltages as before.

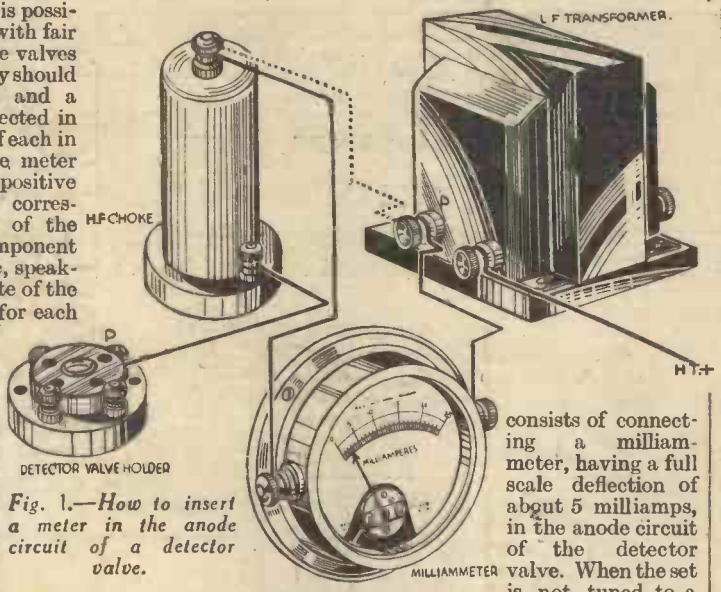


Fig. 1.—How to insert a meter in the anode circuit of a detector valve.

If any valve passes appreciably less or more current than when new, it can safely be considered unsatisfactory for further service. Generally, senile decay will be denoted by a fall in current, but, occasionally, a power valve will pass more current due to it having become slightly "soft." The above-mentioned tests can, of course, be applied with greater accuracy if a reliable voltmeter is available to make sure that H.T. and G.B. voltages are identical for both tests.

Tuning by Sight

THERE are times when it is not desirable to tune-in the set by ear, and even when the dial reading for any station is known, a certain amount of final adjustment to the tuning condenser is nearly always necessary. Do you know that it is possible to tune "by sight"? The method consists of connecting a milliammeter, having a full scale deflection of about 5 milliamps, in the anode circuit of the detector valve. When the set is not tuned to a station the meter will give a reading corresponding to the steady anode current consumed by the detector valve. But as the tuning condenser approaches the wavelength of a station, the needle will move until it reaches a position of maximum deflection, when the set is exactly in tune with the transmission. If the approximate tuning position is known, the station can accurately be tuned in with the speaker disconnected. After tuning, the speaker can be connected up, and no further tuning adjustments will be required.

The method is also useful when searching for distant stations, because the latter can often be located by a change in anode current, even though they are not heard in the speaker. Thus, signals can be brought up to full strength without running any risk of oscillating. Incidentally, oscillation would be indicated by a sudden (in contrast to a steady) change in anode current. The best position for the meter is between the H.F. choke and the L.F. coupling transformer, as shown in Fig. 1.

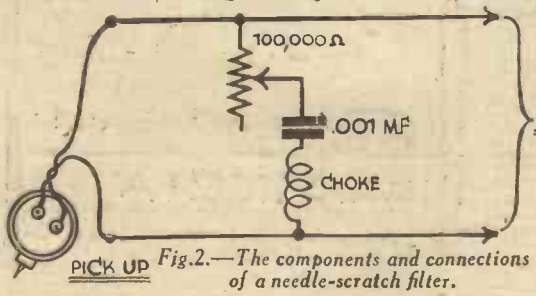


Fig. 2.—The components and connections of a needle-scratch filter.

Eliminating Needle Scratch

DESPITE the many advances that have been made in respect to the electrical reproduction of gramophone records, the annoying "hiss," caused by needle scratch, is often present when using an amplifier in which no provision has been made for its elimination. The hiss does not consist entirely of a single frequency, but is a mixture of various frequencies. But as these are in excess of about 4 kilocycles they can generally be removed by means of a suitable filter. The simplest kind of filter consists of a fixed condenser and variable resistance connected in series across the pick-up terminals, and I gave particulars of this in a recent note.

A simple filter of that kind is not always sufficient, especially when the pick-up has a "resonance peak" in the region of the scratch frequencies—and very many pick-ups have. A more effective filter in such cases is one consisting of a tuned circuit made up of a choke and condenser. These latter are connected in series between the pick-up terminals, as shown in Fig. 2. Although not essential, it is better to include a variable resistance in series with the choke-condenser combination, so that the effect of the filter can be varied within certain limits. Suitable values for the resistance and condenser are indicated on the circuit diagram, whilst the choke can be made very easily by winding about 10,000 turns of 38 gauge enamelled wire on a spool made to the approximate dimensions given in Fig. 3. So that the optimum inductance can be chosen for any pick-up, it is best to take tappings after, say, 5,000 and 8,000 turns.

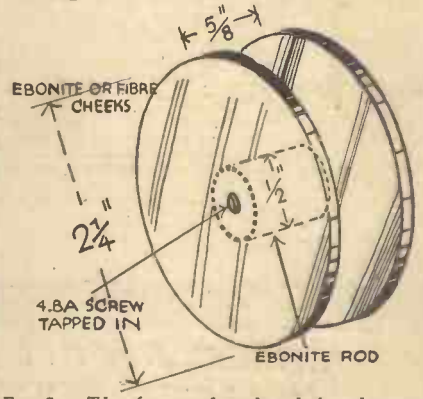


Fig. 3.—The former for the choke shown in Fig. 2.

As the scratch is eliminated there will, of necessity, be a slight attenuation of high notes of similar frequency to the scratch, but by carefully adjusting the variable resistance, it will be possible to find a position at which needle scratch is reduced to a minimum without entailing too great a loss of high note reproduction.

JOTTINGS FROM MY NOTEBOOK
By "DETECTOR"

A Mains Transformer Fault

I RECENTLY came across a rather unusual, though interesting, fault in a home-made 4-valve A.C. receiver. After switching on, a period of quite two minutes elapsed before reproduction attained its normal volume. It appeared fairly certain that the fault was confined to the cathode heater circuit, so I measured the voltage across the "4-volt" low-tension winding, and found that it was actually slightly less than 3¼ volts.

The mains transformer was home-made, and the design given in a recent number of PRACTICAL WIRELESS had been followed. I therefore assumed that the number of turns for the L.T. windings had been counted wrongly, and dismantled the transformer to verify my assumption. I was not quite right; the proper number of turns had been used, but the last five were short circuited. The short was caused by the use of enamelled wire of which the insulation had cracked due to the wire being bent to a sharp angle at the corner of the winding bobbin. Anyhow, PRACTICAL WIRELESS was not to blame, because it was pointed out in the article that cotton-covered wire should be used for low-tension windings.

Another Way to Improve Selectivity

MANY readers who have a fairly old set, which is not sufficiently selective for present-day conditions, might find that it can be improved by changing from the more usual "grid leak" detection to that known as "anode bend." The alteration of the set is a very simple matter and can be made as follows: Remove the grid leak and condenser, and join the grid terminal of the detector valve-holder to that coil terminal to which the grid condenser was previously connected; disconnect the other end of the coil from the earth wire and from the coil terminal take a flexible lead to the grid-bias battery. It might, in some cases, also be desirable to connect a .1 mfd. condenser between the grid-bias tapping and earth to act as a by-pass. The connections are shown diagrammatically in Fig. 4, where the previous ones are indicated by broken lines.

An anode bend-detector is not quite so sensitive as one operating on the leaky grid system, but its efficiency is comparatively high if care is exercised in choosing the correct grid-bias voltage. It might be added that contemporary opinion is not in favour of anode bend detection, because it is supposed to introduce more distortion than the leaky grid method. But this need not deter anyone from trying it, for the difference in quality as between the two systems can only be observed in an extremely well-designed, up-to-date set. Even then the difference is by no means obvious to any except the expert musician.

Diode Detection

IF you are particularly anxious to obtain perfect reproduction (if there is such a thing) and are prepared to buy transformers and loud-speaker capable of doing justice to the full range of harmonic frequencies, you should certainly try "diode" detection. This is the form of detection used in the South Kensington Science Museum's "quality" receiver, and is recognised as the *par excellence*. The diode is really a two-electrode valve, but in practice an ordinary three-electrode one is used, although the anode is left discon-

(*Continued on page 822.*)

RADIO RAMBLINGS

(*Continued from page 821.*)

nected. The circuit of a diode detector, followed by a low frequency amplifier, is shown in Fig. 5. Reaction is not generally employed with a valve of this kind, but it can be if desired, by connecting the anode as shown by broken lines. To obtain best results the two .0001 mfd. pre-set condensers must be carefully adjusted. A diode will handle a large grid swing without overloading and is as good in this respect as the power grid detector. It has a great advantage over the latter, however, in that it does not require a high anode voltage. In fact, it does not require any anode voltage at all unless reaction is used and even then its consumption of H.T. current is quite negligible. It has one serious disadvantage, however, in that it is less sensitive than either the leaky grid or power grid detector, and in consequence an extra stage of L.F. amplification is nearly always necessary. But a 4-valve set consisting of an S.G.-Diode-2 L.F. combination will give all the volume necessary for most purposes.

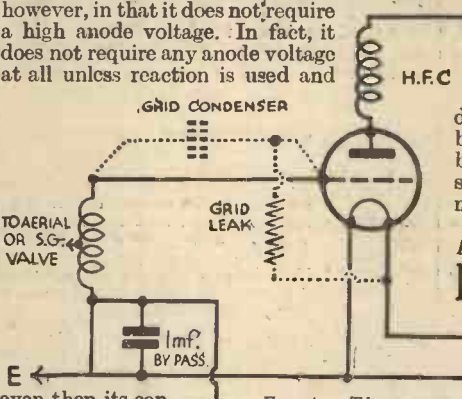


Fig. 4.—The connections required when changing over to anode bend detection.

Good American Stations

I HAVE several times suggested that you should run round the dials some night after midnight to see how many American stations you can "bag." If you haven't already acted on my suggestion, "there is no time like the present." American stations are romping in and it does not need an ultra-sensitive set to get them. Perhaps you have no desire to listen to Yankee drawl, but I am sure you would find it very fascinating to tune in to stations upwards of 3,000 miles away; I must confess that I do, although I first received America in 1922. But even if the experience does not fascinate you it will make you realize what excellent programmes the B.B.C. puts out—compared with those that have to be endured in Uncle Sam's country.

Assuming you are interested, I can strongly recommend you to try for the following seven stations, all of which are coming in with particular constancy just now: Miami (W1OD) on 230.6 metres; Rochester (WHAM) on 260.7 metres; Atlantic City (WPG) on 272.6 metres; Springfield, Massachusetts (WBZ) on 302.8 metres; Pittsburgh (KDKA) on 305.9 metres; New York City (WABC) on 348.6 metres; New York (WEAF) on 454.3 metres. The best way to find them is to make a note of the dial settings for European stations of similar wavelengths and use the settings as "landmarks." Unlike European stations, the Americans always announce their call signs. In this respect it should be remembered that they pronounce the letter "Z" as "Zee." It is not usually difficult to recognize the stations received, because in America the announcers are bound by law to give the name of their station at intervals of not more than fifteen minutes.

A Variable Condenser Fault

BAKELITE dielectric variable condensers of the type generally sold for reaction purposes are, on the whole, very reliable components, but I recently happened on one that was a real curse. It was fitted in a sensitive Det-2 L.F. receiver with which reaction control was rather critical, and although everything went well whilst the fingers were held on the reaction knob, the set howled immediately they were taken away. "Elementary, my dear Watson," you may say, "a simple case of hand-capacity." But was it? No, because when another reaction condenser was fitted the trouble ceased. Examination revealed the fact that there was a good deal of side play in the spindle mounting so that the moving vanes were "rocked" when any weight was put on the operating knob, and the capacity varied fairly considerably in consequence. This is an important point which should be considered when buying a solid dielectric reaction condenser.

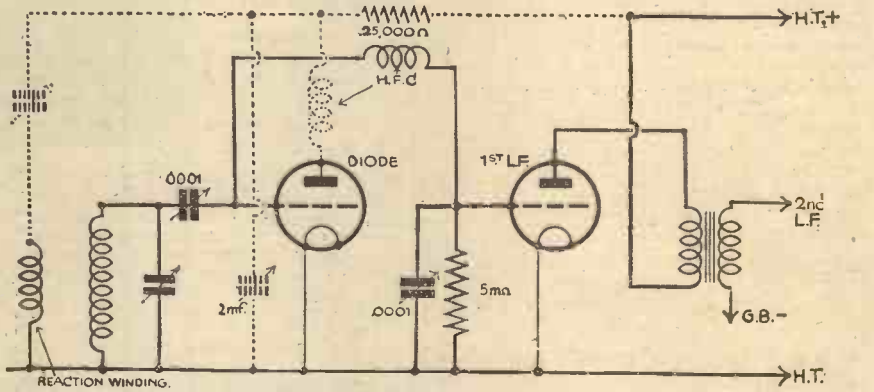
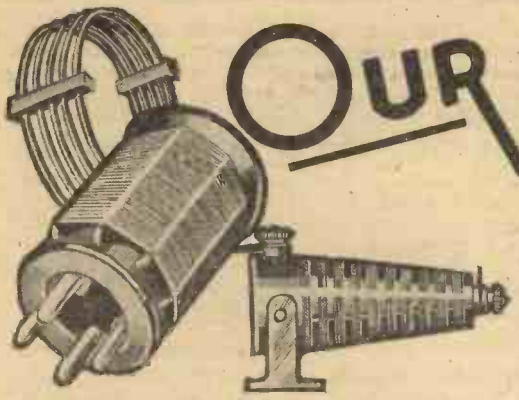
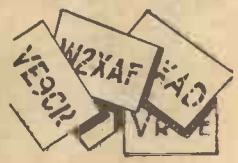


Fig. 5.—Skeleton circuit of a diode detector followed by an L.F. stage.



OUR SHORT-WAVE SECTION



MAKING SIMPLE SHORT-WAVE PLUG-IN COILS

By R. P. COLE

NOW that there are so many new listeners on the short waves, we feel justified in again giving details of a simple method of making short-wave plug-in coils of proved reliability and yet extremely simple construction.

There are still many experimenters who prefer to make their own parts, or as many as possible, rather than purchase them. At the same time a distinct saving is shown in the cost of the set. The first essential of a short-wave coil is that the self-capacity must be kept low. Secondly, the coil must be of rigid construction as a slight wobble will vary the frequency considerably owing to the high frequencies being used (see PRACTICAL WIRELESS No. 4: "Below 100 Metres"). Thirdly, the resistance of the wire must be kept as low as possible consistent with the size of the coil. It is therefore necessary to use a heavier gauge wire than is used for the medium and long wave bands.

The commercial article is usually made of tinned or enamelled copper wire of fairly heavy gauge (No. 16 or No. 18 s.w.g.) threaded through holes in fibre or celluloid strip insulators. This keeps the turns definitely air-spaced and gives rigidity to the coil. This method may be adopted if desired, but a simpler, although just as effective, method is that which is based on quite an old style of making coils. Also, the larger coils do not reach to the same proportions as the commercial coils mentioned above.

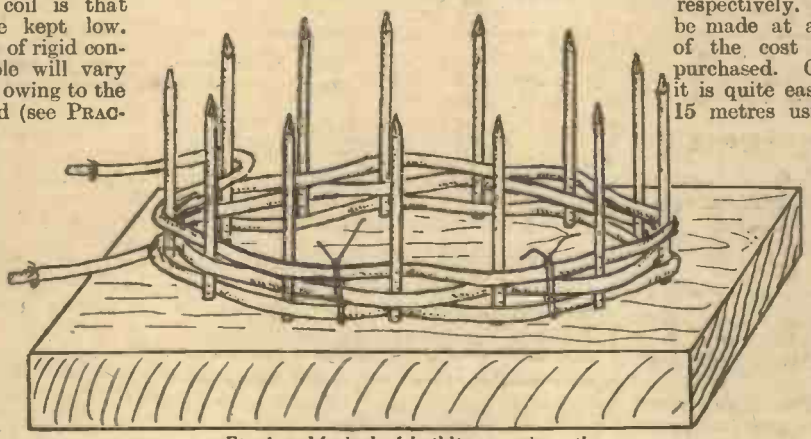


Fig. 1.—Method of building up the coil.

Construction

On a piece of wood 5in. square and between ¼in. and ½in. thick draw a circle 3in. in diameter and mark out on the circle thirteen equally spaced points. Drill holes through the wood at each of these points to take 2in. French nails with a tight fit. Force the nails through the holes up to their heads. Now, using No. 18 D.C.C. s.w.g. copper wire, start winding the wire alternatively in and out of each nail until the desired number of turns are completed. Gently prise the coil away from the wood so that lengths of cotton can be tightly tied round the coil at short intervals (Fig. 1).

Mounting the Coil

The coil can now be removed either by lifting it off the ends of the nails or, if the coil is inclined to stick, by withdrawing each nail separately. The coil should now be self-supporting and is ready to mount on the plug. These may be bought very cheaply nowadays. If the ends of the wire are carefully bent over the sides of the plug and screwed down to their respective terminals the coil should be fairly rigid. It can be made quite firm by glueing a narrow strip of empire tape right round the coil and plug between the socket and pin (Fig. 2).

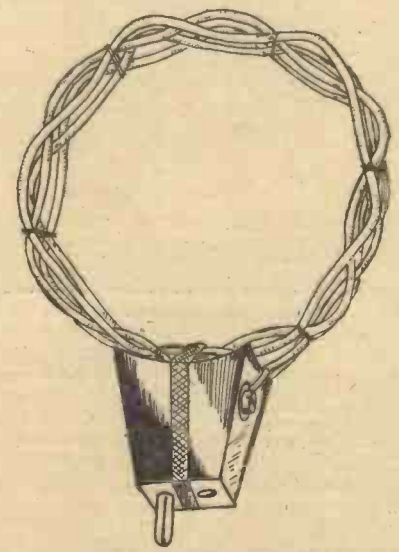


Fig. 2.—How to mount the finished coil on a two-pin plug.

Care must be taken to connect each coil in exactly the same way, as if the connections are reversed the set will not oscillate.

In order to cover the whole of the wavelengths in use below 100 metres, it will be necessary to make probably six coils, including a loose-coupled aerial coil, if one is used. The smallest coil can be either two or three turns, depending on how low it is desired to tune. The other five coils being four, five, eight, ten and twelve respectively. Six coils of this type can be made at approximately a quarter of the cost at which they can be purchased. Given a well-designed set, it is quite easy to tune down to 12 or 15 metres using these coils.

An Interesting Film.

A DAY or two ago I had the opportunity of seeing a film issued by the British Insulated Cables Co., Ltd., of Prescot and Helsby, showing the manufacture of cables of all kinds. The name of this firm is well known to all engaged in wireless, and the amount of wireless we would have without wire would not be very much. Paradoxically, then, I suppose the most important part in our sets is played by the wire, and the speed with which this is manufactured is a revelation. The film shows the production of the uncovered wire from the electrolytic copper ingots, this being drawn down by innumerable "stages" through wire-drawing machines to the required gauge, and later the elaborate arrangements for the application of different kinds of insulating materials. The paper or braiding insulator is wrapped on the cables at an incredible speed by uncanny machines, and we saw great drums containing tons of cable being dipped bodily into insulation compounds for impregnating. We also saw enamelled wire being made, and there seemed to be sufficient going through the works to supply all the aerials in England. Sufficient to say that the output of enamelled wire in a month is of a length enough to twice circle the circumference of the earth. The wires and cables are moved about the various departments by battery operated trucks, some of which are capable of handling many tons. The film concludes with views of high-speed erectors assembling the large numbers of pylons, which are being used for the Grid Scheme. If the film comes to your district—see it!

Practical Letters from Readers.

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

A Grateful Reader

SIR,—I would just like to write a few words to thank you for publishing such an excellent paper. I have taken it for six weeks, and every page is packed with most interesting and instructive reading matter. In the November 19th issue, T. Stephens described the construction of a dual cone-speaker. I have been using one made to these particulars for two or three days, and every word that he says about it is true. The bass response is excellent without boom, and the higher register is very faithfully reproduced. In fact, moving-coil output without its disadvantages.—A REGULAR READER (Lincoln).

The Test Match Broadcast

SIR,—I respectfully wish to point out a slight error that appeared in Jace's "Round the World of Wireless," of this week.

Under the heading "Poste Parisienne" he states that in the recent ball-to-ball description of the First Test Match broadcast from this station, the commentator was actually in Sydney and was giving a description of the play as he could see it.

Although I will admit that I also was deceived originally, it was announced from Poste Parisienne at the conclusion of the Saturday's commentary how the whole broadcast was being arranged. It was stated that the sponsors had arranged for cables to be despatched every few minutes from Sydney and that Mr. Alan Fairfax would read them. It was explained that the time interval between despatch and receipt was approximately six minutes and that the description therefore was virtually a running commentary.

I think that most listeners to this series of broadcasts would agree that the whole thing was very well put over, but on the other hand there were at times some surprising leaps in the scores from moment to moment, and other apparent flaws that raised suspicion in the mind of at least one listener.

I trust that Jace will correct the erroneous impression his paragraph is likely to create.—C. J. THOMPSON (Manor Park).

Topping Up Accumulators

SIR,—With reference to the article "Topping Accumulators," page 745, December 31st issue.

I think your correspondent has confused the mixing of water and acid, he having in mind *Concentrated* Sulphuric, not Battery Acid.

I have taken actual tests with the result given below.

Acid, 1.250 sp. gr., before addition of dis. H_2O, 44 deg. F.
Temp. at Acid and Water line (after adding H_2O), 50 deg. F.
Temp. of Bulk after thorough mixing, 44 deg. F.

Thus, you will see that the maximum rise in temperature is only approximately 6 degs., which I do not consider likely to crack the glass accumulator, or do any damage to the plates.—E. VERSEY (Nottingham).

Dimensions of Components

SIR,—I am a sea-going man and make wireless my hobby. I carry one good portable with me, one good set at home, which I have dared not touch, and several other sets with which I tinker. When PRACTICAL WIRELESS came on view, I thought it was going to be another one to soon wear out, but each week it has surprised me. I am only sorry I did not place a standing order with some newsagent and go in for the Encyclopædia, for I have each number from the beginning which I have bought at the bookstalls at Southampton and Southsea while travelling backward and forward from the ship to my home. I expect I am too late for one now, and will soon be going on a four months' cruise, but I will certainly leave an order at the bookstall before I sail for PRACTICAL WIRELESS and *Complete Wireless*, of which I have the first volume bound of the latter. Now I am coming to the prime reason for writing to you and I have waited very patiently for a long time for it to happen without writing. Different components are continually advertised in all the wireless books, but very seldom do they appear in our local shops or shop windows. Advertised in picture form they give one very little idea of their size. One component in particular, the electrolytic condenser, should have its main dimensions clearly marked and this applies also to the metal screened H.F. Choke, and also the parallel-fed transformer. Only one firm gives the size of this latter item, because it is so very small, but there are many others who do not, too numerous to mention here. However, I think you would be doing both the readers and the manufacturers a good turn if you printed this letter or words to the same effect in the best book which comes out each Wednesday morning. Wireless sets have been utilising smaller baseboards for a long time now, and if a person knew the right size of the component advertised he would replace it on his baseboard or in his portable. Best wishes to PRACTICAL WIRELESS.

In taking a glance through one of your numbers, the only advertisement I notice with size of permanent magnet speaker, diameter and depth is the Ormond; very necessary sizes are the dry H.T. battery, depth of variable condenser, H.T. mains units, height of screened coils, fixed condensers, all types, mains transformers, screened H.F. chokes, unscreened H.F. chokes, etc., etc.—S. G. MATTOCKS (Southsea).

The Old Favourite

SIR,—As an old hand in wireless, who has fallen to the bait you put out each week, I cannot fail to note the number of appeals for something cheap and simple.

The so-called Old Det 2LF circuit will supply most of the requirements, and if the owners will spend a little time in learning how to handle same, they will find that a great deal of the ether is available.

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT the resistance of a wire varies with its temperature, especially in the case of special resistance wires.
—THAT for the above reason, wire-wound resistances used for biasing purposes should be chosen so that there is no rise in temperature in use.
—THAT hum troubles in a mains-operated receiver may be caused acoustically; that is, through vibration from a transformer setting up microphonic valve hum.
—THAT the weight of a gramophone pick-up will affect the quality of reproduction.
—THAT a difference of 10 metres on the short waves (50 to 60 metres) is equal to a difference of 1,000 kilocycles.
—THAT a difference of 300 metres on the medium waves (300 to 600 metres) is equal to a difference of only 500 kilocycles.
—THAT the above two examples prove the necessity for accurate tuning in short wave work, and the necessity for thinking in terms of frequency instead of wavelength.
—THAT a correctly designed exponential horn-type loud-speaker is better than a moving-coil.
—THAT a "permanent" gramophone needle should not be removed from the sound-box or pick-up until it is worn out.

NOTICE

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

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

Does any other type of set lend itself so readily to additions, alterations of circuit, etc., or is so easily adjusted ?

I have spent many, many happy hours pulling down, and rebuilding, often to the original circuit, after testing fresh ideas, and at the moment use a Dual Range Coil, with a *four* noughts five (.00005) min., pre-set condenser in the aerial lead, this being shorted if desired by an ordinary pull-push switch, and this arrangement enables me to secure a mass of stations, each clear of the other, or with such little background as to be of no consequence.

I ceased many years ago to brag of the number of stations received, but recently, out of curiosity, the round was made, with the result that twenty-seven stations were received at satisfactory loud-speaker strength, surely enough for any home ?—E. VERSEY (Nottingham).

That Heterodyne

SIR,—Under the above heading a reader whose letter was published in PRACTICAL WIRELESS, No. 13, points out some apparent contradictions which appeared in different parts of issue No. 7. Being personally responsible for two of the statements, I feel that some explanation is due from me. On the face of things the statements that in the case of stations heterodyning each other "—we listeners can do nothing to stop it" and "—the heterodyne whistle can be removed by fitting some kind of tone control to the set" certainly do appear very conflicting. I think, perhaps, the best answer I can give is that it is all a matter of "degree"; if the heterodyning is of a fairly mild form caused by two stations separated in frequency by, say, 8 kilocycles, the actual whistle *can* be eliminated by means of a tone control or "stopper" (of the kind described on page 352 of PRACTICAL WIRELESS, No. 7), but if the frequency separation is reduced to only 3 or 4 kilocycles the consequent interference is more than we can satisfactorily cope with. To eliminate the whistle we must adjust our set so that it is insensitive to sound frequencies similar to the frequency of the whistle. When the latter is above 6,000 cycles (6 kilocycles) or so it can be removed without our losing very much in the way of the higher musical notes, but when it is so low as 3,000 cycles it can only be eliminated at the serious expense of "quality," and, in fact, if the set were made insensitive to all frequencies above 3,000 cycles the reproduction of music would be unbearably poor whilst even speech would be far from pleasant. I thank Mr. Mann for pointing out the apparent error, and hope my explanation will clear away the difficulty.—FRANK PRESTON.

Plug-in Coils

SIR,—I am glad to note in the December 31st issue of your paper that the question of a circuit employing plug-in coils is likely to receive your attention when opportunity permits, and I welcome the news. I possess some perfectly sound coils made by one of the firms having a very high standing in the radio world. I don't so much mind the coil changing, but if some means could be devised whereby a wave-change switch could be incorporated, so much the better. Another point which occurs to me is that short-wave coils could be made to use in the same receiver, and this would be of added interest to those wishful to experiment in this class of reception. I like your paper and appreciate the drawings, which are clear and free from "fussiness."—GEORGE HARDIE (Sale).

"Stars and Studios"

SIR,—Your columns revealed a controversy between readers who only want practical articles and readers who ask for a few of the entertainment type. I unhesitatingly side myself with my Paddington namesake and write myself down as being in favour of articles on *stars* and *studios*.—W. EVANS (Erdington).

Congratulations

SIR,—After so many letters congratulating you on your paper, perhaps my letter will appear to be rather late, but still I must congratulate you. It is of general interest to everyone because it deals with every subject in simple language, but what about a super-het ? I use a 7-valver and a super-het. short-wave converter, and the American stations come over well after 12 p.m. on the medium waves. Let me congratulate Mr. Chapple on his real plain talk article on television. I hope he will crown his article by describing a real easy way to make a *cheap* television set which will work without that enormous amplifier described in "Television" by him; also could not some of the parts be made by the constructor himself ? Wishing every success to your paper.—G. A. B. (Liverpool).

Building the Selectone Battery Three

(Continued from page 807.)

by laying the end of the wire on a flat surface, pressing the edge of a knife against the insulation and slowly rolling the wire over. After cutting through the insulation the waste piece can be drawn off with the thumb nail. Next make a good loop with a pair of round nose pliers, bending the wire in a clockwise direction so that it will be gripped firmly as the terminal nut is screwed down. It is best to make the loop a good fit on the terminal shank. If you feel like making a rather better job you can flatten the looped part of the wire by laying it on a hard surface and giving it a light blow with a hammer. The holes in the baseboard through which the wires pass are most easily made with a 5-32in. twist drill, but can be made with a large bradawl if a suitable hand drill is not available.

There are four flexible wires passing through the baseboard—three to the grid bias battery and one to the aerial tuner. The easiest way to deal with these is to "split" a length of twin flex, scrape the insulation away from one end for a distance of ¾in. or so, twist the strands of bare wire tightly together and then form a loop. Now attach the loop to the appropriate terminal underneath the baseboard and by trial find the proper length of wire required. Cut off, and strip the insulation from the other end; bend the bare end of wire back and bind it round the end of the insulation. It can then be gripped in the wander plug by pushing it in the side hole of the insulated knob, and screwing up the brass split pin. When all the wiring is complete carefully check it over in conjunction with the wiring plans; make sure that it is quite correct, and that all the terminals are tightly screwed down.

Next week I will give full particulars as to how the Selectone should be connected up and how to obtain the best results from it.

What we Found..

LISSEN SUPERHETERODYNE COILS

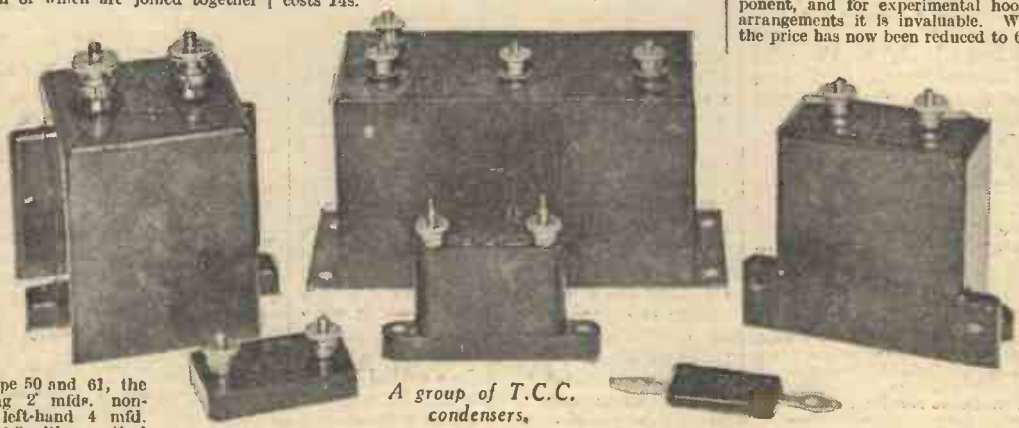
WITH the increased use of the superheterodyne feature in home-made sets, there is a wide field for good coils suitable for that feature. Ordinary coils are not, of course, suitable for various reasons. Messrs. Lissen have now produced a set of three ganged coils on a metal base, on the same lines as the previous ganged coils. The base incorporates a combined wave-change and on-off switch. Two of these coils are of the ordinary aerial and secondary types as employed in standard circuits, whilst the third is an oscillator coil. These are most accurately ganged and matched, and cover both medium and long waves. The medium band is from 200 to 550 metres, and the long 800 to 2,000 metres. The control knob when turned to the left tunes to the long waves, and when turned in the opposite direction tunes to the short-waves. In the central position the receiver is switched off. Each coil is provided with its own can, and this is readily removable for attaching the necessary leads. Accompanying the coils is a very complete descriptive pamphlet giving circuit details and instructions for adjustment, so that even the beginner could build up a receiver incorporating these coils without any difficulty. The price of this set of coils is 30s.

WARD AND GOLDSTONE SWITCHES

AN interesting new range of switches has now been released by Messrs. Ward and Goldstone. These are of the push-pull type, but are built on more substantial lines than is usual for this type of component. Two lock nuts are provided, one of which is recessed. In addition, two fibre washers are fitted to the throat of the switch, and this method of building up enables the switch to be attached to panels varying in thickness from ⅛in. to 1/32in. The screws on the switch are deeply recessed to avoid short-circuits when fitted to metal panels. The spring contacts on these switches are exceptionally strong, the ordinary two-contact type requiring a leverage of over 2lbs. to pull the spring away from the contact plate. Such a method of construction ensures that there will be no trouble through faulty contact, and also ensures a long life, as such a spring will not wear out in a good many months of continual wear. The prices are very reasonable, and these components can be thoroughly recommended.

T.C.C. CONDENSERS

A REPRESENTATIVE group of fixed condensers is shown in the illustration at the bottom of this page. The central condenser in the back of the picture is the Type 8.B.1, a combined condenser for use in mains eliminators and similar apparatus. The assembly consists of one 4 mfd. condenser and two 2 mfd. condensers, all of which are joined together and the junction wire taken to one common terminal. This greatly simplifies wiring in eliminators and other smoothing circuits as the connection of one wire (preferably the H.T. — busbar) completes the wiring to all of the condensers. In addition to this assembly, a further type, R.M.12, contains one more 4 mfd. condenser. The Type 8.B.1 costs 14s. 6d., and the latter model 17s. 6d. The two large condensers on right and left are of the Type 50 and 61, the right-hand one being 2 mfds. non-inductive and the left-hand 4 mfd. These may be mounted in either vertical or horizontal positions by means of the lugs fitted to the base. The case is of bakelite. In the front row, from left to right, are the Type S, Type 34 and Type M. The prices of these vary from 1s. to 3s. according to the capacity. It will be noticed that the Type M condensers are not provided with terminals, as they are intended to be soldered direct in place, and are, therefore, highly suitable for use in portables or other light-weight sets. The three condensers in the front have mica dielectrics, whilst the others are of the paper dielectric type. This is, of course, only a small proportion of the condensers manufactured by the T.C. Company, but it serves to illustrate the interesting types which are manufactured.



A group of T.C.C. condensers.

BULGIN WHISTLE FILTER

TWO interesting filters are supplied by Messrs. Bulgin for obviating the nuisance of heterodyne whistle which is now so pronounced on the majority of stations. The filter consists of a sharply tuned series circuit, provided with two parallel paths. One filter is designed to have a cut-off at 3,250 cycles, and the other a cut-off at 4,750 cycles. The former, known as Type "A," is most suitable for use in conjunction with moving iron loud-speakers, and the latter, Type "B," is for use with most moving-coil speakers. The price of either type is 10s. 6d., and it is mounted in the now standard metal Universal mounting case.

ATLAS RECEIVERS

WE are informed that the receivers manufactured by Messrs. H. Clarke & Co. (Manchester), Ltd., bearing the trade name "Atlas," are now obtainable on new easy payment terms. The cash price remains the same, but the deposit and easy payment terms are now as follows:—

"Atlas Two," Model R.A.2, for A.C. mains. Cash Price £10 10s., or on easy payments £1 down and 12 monthly payments of 18s. 6d. each.

"Atlas Two," Model R.D.2, for D.C. mains. Cash Price £10 10s., or on easy payments £1 down and 12 monthly payments of 18s. 6d. each.

"Atlas Two," Model R.B.2, for Battery Operation. Cash Price £6 10s., or on easy payments £1 down and 12 monthly payments of 11s. each.

NEW ETA VALVES

TWO new valves are announced from the Electrical Trading Association Ltd. One, the D.W.4011, was described in last week's issue, and the other is a 2-volt pentode. This has an impedance of 60,000 ohms and the amplification factor is rated at 150. The filament consumption is .3 Amps, and the H.T. for both anode and screen should be 150 volts maximum. The average Anode current under normal working conditions is stated to be 10 mA. This will therefore be seen to be an ideal output valve for small battery operated receivers, and is quite economical in operation. This valve is known as the BY3 and costs 14s.

R.I. SHORT-WAVE CONVERTER

THERE is usually a certain amount of difficulty in connecting a short-wave adaptor or converter to a mains operated receiver owing to the difficulty of obtaining the necessary supply for the heater and H.T. of the adaptor. The ordinary plug-in adaptor cannot be employed owing to risk of interference from hum and other forms of instability, and therefore there are not many short-wave adaptors or converters available for users of mains receivers. Radio Instruments have solved the difficulty in a very efficient manner, and the "Anti-nodal" Short Wave Converter is the result of their experiments and research. This is a small cabinet with metal panel containing four controls and an on-off switch. The main control is the tuning dial, which is a slow motion drive condenser, whilst two of the remaining controls are wave-change and anti-nodal control. This latter feature, as our readers are by now aware, is a method of removing "dead spots" and other short-wave difficulties. The remaining control is for the reaction condenser. The unit contains its own mains supply, providing, by means of a transformer and metal rectifier, the supply for the heater of the valve and the high tension. The valve is a metallised Mazda AC2HL, and from the back of the unit there is a twin flex lead, provided with a lamp-holder plug, and two flexible leads provided with a red and a black plug. These plugs are to be attached to the aerial and earth terminals of the receiver, and the plug inserted into a convenient mains socket. The aerial and earth are then attached to the A and E sockets of the Converter, and the complete apparatus then becomes an efficient super-heterodyne receiver. The wave range covered is from 14 to 88 metres, in two bands, controllable by the switch. This greatly simplifies tuning, as each band is only roughly 40 metres. In use the unit was found most satisfactory. It was attached to three different mains receivers, two having one S.G. stage, and one having two S.G. stages. In each case the complete arrangement was perfectly stable, and it was possible to handle the receiver as easily as for ordinary broadcasting. All the principal short-wave stations were received, the arrangement containing the two S.G. stages naturally giving a much greater range. The instructional pamphlet supplied with the unit enabled the arrangement to be fully understood within an hour, so that the veriest novice will find it extremely simple to connect this unit to his existing receiver and enjoy the pleasures of short-wave listening. The price of the complete unit, inclusive of valve, is only £6, which is extremely modest considering the fact that the unit contains a complete eliminator for the valve.

BELLING LEE TERMINAL MOUNTS

TO avoid the necessity of drilling and fitting the usual type of terminal strip at the rear of a receiver, the Belling Lee Terminal Mounts will be found extremely handy. These are moulded in bakelite, and may be mounted in either a horizontal or vertical position. A central hole will accommodate a screw for horizontal fitting, and two holes are drilled and recessed to take the Type "B" terminal. The keen experimenter will find a hundred-and-one uses for this handy component, and for experimental hook-ups and similar arrangements it is invaluable. We understand that the price has now been reduced to 6d.

The type "B" Belling Lee terminal is, of course, the well-known large type insulated model, with non rotatable indicating head, and costs 6d.

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

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

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

SPECIAL NOTE.

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

(1) supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.

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

MAINS HUM

"I have a powerful four-valve receiver which I have just finished building. When I tune in to any station which is only moderately loud, reception is perfect. No hum can be heard and quality is all that I can desire. When, however, I tune to the London stations there is a terrible loud humming which spoils reception. I have tried altering the position of the transformers and coils, but nothing which I can do seems to cure the nuisance. I have not seen any note in your pages of a dodge which I have not tried, so am writing to you for help. I should like to know also what the trouble is due to, in addition to its cure."—(R. T., Golders Green.)

There is no doubt that your trouble is due to what is known as "modulation hum." This is caused by a strong signal acting on the slight ripple which is present in the eliminator section of your set. This is only caused by a really powerful signal, and the remedy is quite simple. Two .1 mfd. condensers must be obtained, and one terminal of each condenser is joined to each Anode of the rectifying valve. The other two condenser terminals are joined together and the junction is taken to earth. Special condensers for this purpose are obtainable. They are known as "Buffer condensers" and have three terminals only. In some cases, two .01 mfd. condensers may be joined together and connected across the Mains input leads to the eliminator, with the junction of the condensers earthed. You should try both methods and see which gives you the best results.

SCREENED CONDENSER ASSEMBLY

"I have built a three-circuit screened receiver employing three canned coils and a three-stage ganged condenser. This set is terribly unstable, and nothing which I have done seems to stop the trouble. All wiring is nicely spaced, all leads are as short as possible, yet the trouble persists. The coils are two Band-pass and One H.F. coil. Any help you can give me will be appreciated."—(F. G., Bexley Heath.)

There are numerous causes of instability, and it is hardly possible to state exactly what your particular case may be due to. However, there is one important point which you may have overlooked, and this concerns the ganged condenser. The circuit arrangement you are using demands a completely screened assembly, and you may have obtained a condenser with no cover to complete the screening. In some cases this will result in instability due to coupling between two condensers. This is the most likely cause, assuming your voltages are correct, and that the receiver has been built exactly according to the instructions of the designer.

CHOICE OF CHOKE

"I wish to buy an L.F choke to build an Output Filter circuit, but I notice from the catalogues that there are quite a number of different types of L.F. choke. These all seem to have different values and are different prices, so I should be glad to know what are the important features which I must watch when choosing my choke."—(S. D. F., Galway.)

The main features are high inductance, with low D.C. resistance. The D.C. resistance is important, as the anode current from the last valve is fairly high and will result in a voltage drop. You cannot afford to lose much voltage on the last valve, and therefore the smallest D.C. resistance should be obtained. In addition, the inductance must be high to allow for the fact that it is actually in parallel with the loud-speaker windings. The best form of choke would be one which is tapped so that the impedance may be varied and so provide the most accurate matching, and therefore, if you find this item too dear, we would suggest that you make up one on the lines of that described recently in these pages.

ATMOSPHERICS

"I find that when trying to pick-up a distant station on the headphones, there are a lot of sizzling and crackling noises. These are very troublesome when a very weak station is being heard. I think you call these atmospherics but whatever the name I should like to remove them if possible so as to enjoy uninterrupted signals. What is the most used method, please?"—(A. C., Glasgow.)

If the noises you are troubled with are in fact atmospherics, then there is nothing you can do to remove them. They are due to electrical disturbances in the ether, and owing to the fact that they have various frequencies, there is no simple way of removing them and leaving a signal uninterrupted. They may be reduced in strength by connecting the earth lead to the aerial terminal, and the lead-in to the earth terminal, but this usually results in a reduction in strength of the station. In America where these disturbances are particularly severe, special types of aerial are obtainable, and these consist in the main of coils of wire enclosed in metal cans. These are intended for burying in the ground and it is claimed that they greatly reduce the interference from atmospherics. You can make up something on these lines to try, but we think you will find that the signal will be proportionately reduced.

HUM REMOVING

"I have made a set to work from the mains, using all first-class Components. The mains transformer has centre-tapped windings throughout, but in spite of care in wiring, etc., there is a faint background of hum. I have oriented the various components which have fields, but so far without success attending my efforts. Perhaps you have a valuable wrinkle which will be of assistance in my search for a dead silent background to a mains-operated set."—(G. B. N., Epsom.)

It is not an easy matter to obtain a receiver which is absolutely silent. There is invariably a slight background, but this should not be sufficiently loud to spoil reception. We would recommend you to try the effect of a variable potentiometer across the heater windings. Special components are obtainable for this purpose, and they have a value of about 30 ohms. The arm of the resistance should be adjusted until the hum is removed. In addition to this device, all leads carrying A.C. should be of twisted flex, and if found necessary all grid leads should be of the metal-screened variety. This latter arrangement sometimes leads to instability, but it may be tried out as a hum remover.

IMPROVING REACTION

"My two-valve receiver is home-made, and includes a simple home-made dual range coil. The reaction winding is quite O.K. on the medium waves, but on long waves there is terrible oscillation all the time. I can stop this by reducing the H.T., but then it has to be adjusted again for the medium waves. Is there any way of adjusting the spacing of the reaction winding so that I can get smooth control on both long and short waves?"—(C. T., Edgware.)

A very simple device may be incorporated in your receiver to remove your trouble. Remove the reaction condenser, and in its place put a semi-variable condenser of the same capacity. Adjust this to obtain reaction effects on the medium waves. In the hole in the panel from which the reaction control was removed, fit a variable potentiometer (value about 5,000 ohms). The ends of the potentiometer should be joined to the ends of the reaction winding, and one end of the potentiometer should also be joined to the arm. You will then find that the potentiometer will make a very excellent reaction control, and by suitable adjustment of the semi-variable condenser you will be able to obtain smooth reaction on both long and short waves.

REMOTE CONTROL

"I have fitted an on-and-off switch in four rooms of my house, and joined these to ordinary lighting flex connected to the accumulator. The idea was to switch the set on and off from any room in which I might be listening. (Or course, I have loud-speaker extension points in these rooms.) Unfortunately, I find that the strength of the signals is very weak in two of these rooms, and there is no break or weakness in the flex. I have tried to overcome it, but unsuccessfully, so I should like to hear what you suggest. The accumulator is one of the heavy plate type, so it should supply sufficient current."—(F. B. U., Bradford).

Your last remark hits the point concerning the weak signals. The accumulator *should* supply enough current, but it does not. If you remember that the valves require a certain potential, you will realize that the accumulator should not be joined to a length of flex, such as used in your case, before the valves get their supply. If you work out the resistance of the leads, and then take the total current required by the valves in your set, we think you will find that the actual voltage on the valves is between 1 and 1½ volts, and they will not work efficiently at this voltage. You should fix one of the orthodox remote control devices in place of lengthening the accumulator leads, and this will not give you any voltage drop at all. In addition, it will be found much cheaper to run.

DATA SHEET No. 17

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

RESISTANCE OF METALS AND ALLOYS

Alloy or Metal.	Resistance compared with copper
Aluminium ..	1.6
Brass	4.4
Constantan ..	30.0
Eureka	29.0
German Silver ..	15.0
Gold	1.5
Iron (Soft) ..	6.1
Manganin ..	27.0
Mercury	59.0
Nichrome	55.0
Nickel	4.4
Nickelin	27.0
Phosphor Bronze	4.4
Platinoid ..	21.0
Platinum ..	6.3
Silicon Bronze ..	1.5
Silver	0.94
Steel (hard) ..	12.0
Tin	13.0
Zinc	3.7

For the above table, copper is given the value 1. Therefore, Mercury has a resistance fifty-nine times as great as copper.

FREE ADVICE BUREAU

COUPON

This coupon is available until Jan. 21st, 1933, and must be attached to all letters containing queries.

PRACTICAL WIRELESS 14/1/33.

CATALOGUES RECEIVED

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

DARIO RECEIVERS

A FINE range of receivers, at prices to suit all pockets, is shown in an attractive booklet we have just received from Impex Electrical, Ltd. The Dario Portable Regional Receiver, although specially designed for local reception, is capable of receiving as many as twenty-five foreign stations at good loud-speaker strength. The set, which is housed in a polished oak cabinet of modern design, includes three Dario Bivolt valves and a balanced-armature loud-speaker unit. The price of this model, for use with outside aerial and earth, is £4 12s. 6d., or with inside frame aerial, £4 15s. 6d.

The Dario Regional de-Luxe receiver, also a three-valver, is a table model, and is housed in a well-finished walnut cabinet. Excellent reproduction is claimed for this receiver, which is priced at £6. Another fine receiver is the Europa, a three-valve table model fitted with drum control tuning and capable of receiving numerous foreign stations at full strength without interference and free from distortion. The circuit includes a screened-grid valve, and the loud-speaker unit is of the balanced armature type. This model is listed at £7 17s. 6d. Also included in the booklet is the All-Electric Regional, one of the latest Dario models. It is a three-valve instrument incorporating indirectly heated valves, provision for a pick-up, and an energised moving-coil speaker. Made for use with either A.C. or D.C., this model is priced at £9 9s. The address is 538, High Road, Leytonstone, London, E.11.

BULGIN KIT SETS

A. F. BULGIN AND CO., LTD., have just issued two folders, one giving full particulars of their "Simple Two-Three" battery-driven kit set, and the other, details of the Bulgin "Drive-All" A.C. Power Box Universal Eliminator Kit. This eliminator, which incorporates a Westinghouse metal rectifier, is designed for use on all A.C. mains 200–250 v., 40–100 cycles. It has three alternative H.T. outputs, fully smoothed, and also provides a L.T. output of up to 6 a. at 4 v. The "Simple Two-Three" Set is a two-valver incorporating a pentode valve in the output stage. The folder gives a full-size lay-out and wiring diagram, together with point-to-point wiring instructions. The price of the kit, complete with moving-coil speaker and polished walnut cabinet, but exclusive of valves and batteries, is £5 The address is Abbey Road, Barking.

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

IN order to reproduce the wide range of frequencies impressed on a modern electrically cut record, and to ensure a musical output of the highest quality, a high-class pick-up, such as the new B.T.H. "Minor," should be used. This instrument is sensitive over a range from 50 to 5,000 cycles, and gives an output of ½ volt at about 900 cycles, thus ensuring a good volume and a high quality of reproduction. Full particulars of this model, and also the B.T.H. Senior De Luxe Pick-Up and Tone Arm, are given in a neat folder we have received from the Edison Swan Electric Company, Ltd.

Replies to Broadcast Queries

RADIO FIEND (Manchester): HBL, Radio Nations (Prangins) on 31.31 m. NITA (N.1): LR4, Radio Splendid, Buenos Aires (303 m.), direct.

OPTIMIST (Sheffield): (1) WKF, Lawrenceville (N.J.) on 4800 kc/s.; (2) GFHK, is the call sign of Mr. H. S. Beckett, 448, Redmire Road, Lodge Moor, Sheffield; would probably welcome a report from you and give you information required; (3) GBC, Rugby (4975 kc/s) and on other wavelengths. MORSE (Leeds 6): (Germany).

ADVERTISEMENT INDEX

TIT-BITS GREAT SOUVENIR OFFER

VALUE 8/6

This illustration is from an actual photograph of the Tit-Bits "Souvenir" Camera. It is the latest-pattern "Coronet" Type Box Camera with fixed Portrait Lens, British made and fully guaranteed by the Makers. The fixed Portrait Lens is an exclusive feature of this magnificent Camera.

WITHOUT question, the most Sensational Souvenir offer ever made by a paper to its readers. Whether you are an old or a new reader of *Tit-Bits*, you are invited to avail yourself at once of this amazing offer. There are no "hidden conditions." You merely have to comply with a few simple rules, and this up-to-date, high-grade Camera with fixed Portrait Lens, complete with valuable handbook, "Prize-Winning Snapshots," and Instruction Booklet will be sent to you in time to take "Snaps" at Easter. So simple is this Camera, and so efficient, that even though you know nothing about photography, you will be able to take perfect "Snaps" right away.

WITH a *Tit-Bits* Camera you can not only secure a truly invaluable collection of photographic records of your Holidays, your week-end Rambles and Motor-runs, your Garden, your Friends, your Children, your Pets, etc., but can also obtain at very slight cost permanent enlargements which, suitably framed, will adorn your home with beautiful and intensely interesting pictures.

ALL CAMERAS WILL BE DESPATCHED IN TIME FOR THE EASTER HOLIDAYS

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Buy TIT-BITS

2d ON SALE TO-DAY

Geo. Newnes, Ltd.

P.W. Gift Stamp No. 16

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Presented with PRACTICAL WIRELESS, dated January 14th, 1933.

"PRACTICAL WIRELESS" DATA SHEET No. 5

WIRE GAUGES AND CORRESPONDING DATA.

S.W.G.	Diameter in Inches.	Yards per Lb.	Weight in Lb. per 1,000 Yds.	Lb. per Ohm.	Resistance in Ohms. per Yard.	Resistance in Ohms. per Lb.	Turns per Inch.					Calculated Sectional Area.		Current Rating at 1,000 per sq. in.
							Enamel Covered.	Single Silk Covered	Double Silk Covered	Single Cotton Covered	Double Cotton Covered.	Sq. in.	Sq. m/m.	
10	.128	6.67	148.8	83.3	.001868	.0120		7.64	7.55	7.35	7.04	.012868	8.3019	12.868
11	.116	8.16	122.2	50.0	.002275	.0200		8.41	8.30	8.06	7.69	.010568	6.8183	10.568
12	.104	10.23	98.22	35.7	.002831	.0280		9.35	9.22	8.93	8.48	.008495	5.4805	8.495
13	.092	13.00	76.86	18.1	.003617	.0550		10.5	10.4	10.0	9.43	.006648	4.2888	6.648
14	.080	17.16	58.12	12.2	.004784	.0820		12.1	11.8	11.4	10.6	.005027	3.2429	5.027
15	.072	21.23	47.08	7.14	.005904	.1400		13.3	13.1	12.5	11.6	.004072	2.6268	4.072
16	.064	26.86	37.20	4.95	.007478	.2021	15.0	14.9	14.6	14.1	13.2	.003217	2.0755	3.217
17	.056	35.00	28.48	2.38	.009762	.3423	17.1	16.9	16.5	15.9	14.7	.002463	1.5890	2.463
18	.048	47.66	20.92	1.56	.01328	.6351	19.8	20.0	19.4	18.5	17.2	.0018096	1.1675	1.8096
19	.040	68.66	14.53	.757	.01913	1.315	23.7	23.8	23.0	21.7	20.0	.0012566	.8107	1.2566
20	.036	85.00	11.77	.497	.02362	2.012	26.1	26.3	25.3	23.8	21.7	.0010179	.6567	1.0179
21	.032	107.6	9.299	.309	.02990	3.221	29.4	29.4	28.2	26.3	23.8	.0008042	.5189	.8042
22	.028	140.6	7.120	.181	.03905	5.498	33.3	33.3	31.8	29.4	26.3	.0006158	.3973	.6158
23	.024	191.6	5.231	.098	.05313	10.14	38.8	38.5	36.4	33.3	29.4	.0004524	.2919	.4524
24	.022	228.3	4.395	.069	.06324	14.38	42.1	42.1	40.0	35.7	31.3	.0003801	.2453	.3801
25	.020	275.3	3.632	.0471	.07653	21.08	46.0	46.0	43.5	38.5	33.3	.0003142	.2027	.3142
26	.018	340.0	2.942	.0309	.09448	32.21	50.6	50.6	47.6	41.7	35.7	.0002545	.16417	.2545
27	.0164	410.0	2.442	.0215	.01138	46.55	55.9	55.1	51.6	44.6	37.9	.0002112	.13628	.2112
28	.0148	503.0	1.989	.0141	.1398	70.12	61.4	60.4	56.2	48.1	40.2	.00017203	.11099	.1720
29	.0136	596.6	1.680	.0101	.1655	98.65	66.2	65.2	60.2	51.0	42.4	.00014527	.09372	.1453
30	.0124	716.6	1.396	.0069	.1991	142.75	73.3	72.0	67.1	54.4	44.7	.00012076	.07791	.1208
31	.0116	820.0	1.222	.0054	.2275	183.80	77.8	76.3	70.9	56.8	46.3	.00010568	.06818	.1057
32	.0108	943.3	1.059	.0040	.2625	248.20	83.0	81.3	75.2	63.3	50.5	.00009161	.05910	.0916
33	.0100	1100	.9081	.0029	.3061	337.50	88.9	87.0	80.0	66.7	52.6	.00007854	.05067	.0785
34	.0092	1300	.7686	.0023	.3617	471.00	98.0	93.4	85.5	70.4	54.9	.00006648	.04289	.0665
35	.0084	1556	.6408	.0014	.4338	676.50	106	101	91.8	80.6	61.0	.00005542	.03575	.0554
36	.0076	1903	.5246	.00098	.5300	1009	116	110	102	86.2	64.1	.00004536	.02927	.0454
37	.0068	2380	.4199	.00064	.6620	1574	128	120	110	92.6	67.6	.00003632	.02343	.0363
38	.0060	3056	.3269	.000385	.8503	2598	143	133	121	100	71.4	.00002827	.018241	.0283
39	.0052	4066	.2456	.000217	1.132	4645	168	149	134	109	75.8	.00002124	.013701	.0212
40	.0048	4766	.2092	.000156	1.328	6360	180	159	142	114	78.1	.000018096	.011675	.0181
41	.0044	5700	.1758	.000112	1.581	9020	194	169	150	↑	↑	.000012566	.008107	.0126
42	.0040	6866	.1453	.000076	1.913	13150	211	191	167			.000010179	.006567	.0101
43	.0036	7500	.1177	.000050	2.362	20120	230	206	179			.000008042	.005189	.0080
44	.0032	10766	.0930	.000030	2.989	32210	253	225	192			.000006158	.003973	.0062
45	.0028	14066	.0712	.000015	3.904	54980	282	247	208			.000004524	.002919	.0045
												.000003142	.002027	.0031
												.000002011	.0012972	.0020
												.0000011310	.0007297	.0011
												.0000007854	.0005067	.0008

RESISTANCE WIRE DATA.

S.W.G.	Eureka.			German Silver.		
	Resistance per yd.	Yards per lb.	Current Capacity. (Amps.)	Resistance. per yd.	Yards per lb.	Current Capacity. (Amps.)
18	.37	48	4.3	.117	51	3.6
20	.66	85	3.0	.315	90	3.5
22	1.10	140	2.2	.520	147	2.0
24	1.77	227	1.5	.844	238	1.2
26	2.65	340	1.0	1.26	349	.65
28	3.91	502	.76	1.85	527	.4
30	5.58	714	.59	2.65	750	.29
32	7.35	943	.47	3.50	984	.25
34	10.13	1300	.37	4.82	1360	.19
36	14.84	1905	.28	7.06	2000	.095
38	23.81	3060	.19	11.33	3295	.076
40	37.18	4761	.15	17.70	4920	.065

CURRENT-CARRYING CAPACITY OF WIRES.

S.W.G.	Current Capacity. (Amps.)	S.W.G.	Current Capacity. (Amps.)	S.W.G.	Current Capacity. (Amps.)	S.W.G.	Current Capacity. (Amps.)
10	19.305	19	1.8855	28	.258	37	.0545
11	15.855	20	1.527	29	.218	38	.0425
12	12.7425	21	1.206	30	.1812	39	.0318
13	9.872	22	.9237	31	.1586	40	.0272
14	7.5405	23	.6786	32	.1374	41	.0228
15	6.108	24	.5702	33	.1178	42	.0189
16	4.8255	25	.4703	34	.0998	43	.0153
17	3.6945	26	.3818	35	.0831	44	.012
18	2.715	27	.3168	36	.0681	45	.0093

NOTE: S.W.G.= Standard Wire Gauge. B.W.G.= Birmingham Wire Gauge.

Practical Wireless, January 21st, 1933

G. Dyson

Free Next Week! WIRELESS CONSTRUCTOR'S HANDY METAL GAUGE

Practical Wireless

3D

Published every Wednesday by
GEORGE NEWNES LTD.
Vol 1.——No. 18
JANUARY 21st, 1933
Registered at the G.P.O. as a Newspaper

—Fascinating New Serial—

NO MONEY TO MARRY ON

By EDGAR FRANKLIN

The wedding of William and June, the daughter of a rich business man, was to take place in a fortnight's time. But suddenly June sprang a bombshell on everybody by insisting that William must elope with her that very day.

William Gwynn was once more face to face with the large, wealthy father of June.

"Hello, Will. Sit down! This is something that has to be discussed at once, of course."

"What is?"

"This business of your marrying June. You're expecting to do that a week from Friday? Well, you're not!"

"What?" gasped William.

"No. June has changed her mind," said Henry Stannard. "Fact is, June doesn't want to wait till next week. She is going to marry you to-day!"

"But—but we can't do that!" William stammered. "The invitations are all out for Friday week and——"

"I know, Will."

"What for?" William asked. So many things were racing through his mind. Sheer joy, of course, that the only perfect girl so far produced by the human race was to be his own at once. And also a quantity of plain consternation as he realised that in his pocket reposed exactly six dollars and in his bank account—nothing!

"I don't know!" Stannard said irritably. "Seems she has some damned romantic notion of being carried off this evening at nine. So there you are, and you'll have to hustle, you haven't got much time."

"It's impossible," said William. "We can't let it go through. I'll have to talk to June. Where is she?"

"She's here, Will," said June, with a sigh, as she entered.

William rose to greet her.

"You've something to say to me, Will?"

"You bet I have!" said Mr. Gwynn. "Let's sit down and talk this out."

Miss Stannard shook her head.

"Not here. It's nicer in the porch, I think. You needn't come, father, I can make Will understand."

William followed her hurriedly.

"Were you telling father that you didn't want to marry me to-day?"

William laughed.

"Want to?" If I did just what I want to do, I'd pick you up and carry you off through that window, *now!*"

"No, Will," June sighed. "My things—my travelling things, that is—won't be up here before three or four this afternoon. They're sending them up by special messenger. We'll have to wait till evening. Billy, boy," purred the Stannard heiress, "you've got your new car now?"

"No—not yet."

"You'll have to get it this afternoon, then."

"It sounds mighty fine, darling. There's nothing I'd like better. But, don't you see, darling, we can't. What in thunder ever put this notion into your head, anyhow?"

"I think it's a lot more romantic!"

"That isn't the only reason."

"I'll tell you, then. It's high time, Billy, that you were married and settled down. You're much too susceptible to the charms of anything in skirts that happens to be in the neighbourhood."

William found himself caught up in a bewildering host of difficulties as a result of June Stannard's ultimatum. Read of his desperate attempts to obtain money for his honeymoon in the brightest and cheeriest serial story of the year.

Starting in the February

SUNNY

SEVENPENCE **MAG.**

Obtainable at all Newsagents and Bookstalls, or by post 8½d. from George Newnes, Ltd., 8-11, Southampton St., Strand, London, W.C.2.

Geo. Newnes, Ltd.

FOR EVERY SET — *there's a*

PILOT AUTHOR KIT

CASH — C.O.D — or H.P.

EVERYTHING RADIO

CARRIAGE PAID TO YOUR DOOR

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

EPOCH "20 C" PERMANENT MAGNET MOVING-COIL SPEAKER. (New Edition). With 5-ratio input transformer. Cash Price £1/15/0. Carriage Paid. Balance in 5 monthly payments of 6/6. — Send 6/6 only

BLUE SPOT UNIT AND CHASSIS, Type 99 P.M. Including matched transformer. Cash Price £2/19/6. Balance in 11 monthly payments of 5/6. — Send 5/6 only

ROLA PERMANENT MAGNET MOVING-COIL SPEAKER F.6. With universal tapped input transformer. Cash Price £2/9/6. Carriage Paid. Balance in 11 monthly payments of 4/6. — Send 4/6 only

R & A "VICTOR" PERMANENT MAGNET MOVING-COIL SPEAKER DE LUXE. With 6-ratio input transformer and protecting grille. Cash Price £3/10/0. Carriage Paid. Balance in 11 monthly payments of 6/5. — Send 6/5 only

R & A "CHALLENGER" PERMANENT MAGNET MOVING-COIL SPEAKER. With special Ferranti multi-ratio input transformer. Cash Price, Carriage Paid, £1/15/0. Balance in 5 monthly payments of 6/6. — Send 6/6 only

LISSEN "SKYSCRAPER" S.G.3

COMPLETE WITH VALVES

CHASSIS KIT with (Lissen) S.G., Detector and Pentode Valves. Cash Price, Carriage Paid, £4/9/6. Delivered, carriage paid, on first payment of .. .. .. *Balance in 11 monthly payments of 8/3.* **8/3**

CABINET KIT with (Lissen) Valves, Walnut Cabinet and special Balanced Armature Loud-speaker. Cash Price, Carriage Paid. £6/5/0. Delivered, carriage paid, on first payment of *Balance in 11 monthly payments of 11/6.* **11/6**

ATLAS ELIMINATOR. Type A.C.244. Three tappings: S.G., Detector and Power. Output: 120 volts at 20 m/A. Cash Price £2/19/6. Carriage Paid. Balance in 11 monthly payments of 5/6. — Send 5/6 only

HEAYBERD HOME BATTERY-CHARGER Model A.0.3. for A.C. Mains only. Charges 2, 4, or 6v. accumulators at 1 amp. Cash or C.O.D. Carriage Paid. £2/2/6. Balance in 8 monthly payments of 5/3. — Send 5/3 only

GARRARD INDUCTION GRAMOPHONE MOTOR. For A.C. mains. Model 202. Mounted on 12-inch nickel motor plate with fully automatic electric starting and stopping switch. Cash Price £2/10/0. Carriage Paid. Balance in 11 monthly payments of 4/7. — Send 4/7 only

PETO-SCOTT 1933 ADAPTAGRAM. Beautifully constructed of solid walnut with contrasting Walnut Veneers. Ready to take your set and gramophone motor. Cash or C.O.D, £3/3/0. *Carriage 2/6 extra.* Balance in 11 monthly payments of 5/9. — Send 8/3 only

W.B. PERMANENT MAGNET MOVING-COIL SPEAKER, Type PM4. Complete with transformer. Cash Price £2/2/0. Carriage Paid. Balance in 7 monthly payments of 5/9. — Send 5/9 only

SELECTONE Described this week

KIT "A" CASH OR C.O.D. *Carriage Paid.*

Author's Kit of specified parts, including *ready drilled panel.* but less valves and cabinet. **£4-8-0**

or 12 monthly payments of 8/-

KIT "B"
As Kit "A" but with valves, less cabinet, CASH or C.O.D. Carriage Paid.
£5 - 10 - 9
or 12 monthly payments of 10/2.

KIT "C"
As Kit "A" but with valves and cabinet, CASH or C.O.D. Carriage Paid.
£6 - 13 - 3
or 12 monthly payments of 12/3.

KIT-BITS

Selected C.O.D. lines—You pay the postman—We pay post charges on orders over 10/-.

	£	s.	d.
1 PETO-SCOTT Oak-faced plywood panel, 14in. by 8in., *ready drilled*; Peto-Scott 5-ply baseboard, 14in. by 8in., *ready drilled* ebonite strip, 14in. by 1½in.; connecting wire, screws, and wood as specified		8	0
1 UTILITY Standard .0005 mfd. Condenser with UTILITY type W.181 Microdial		16	0
1 COLVERN type "T.D." Coil		8	6
1 BENJAMIN Transfeeda		11	6
1 VARLEY Rectatone Transformer		15	0
3 Specified Valves	1	2	9
1 CAMCO Excelsior Oak Cabinet as specified ..	1	2	6

SOLO KNOB 3

KIT "A" Author's Kit of specified parts, *drilled panel,* and cabinet. Carriage paid. including *ready* but less valves CASH or C.O.D.

£3 - 0 - 0
or 12 monthly payments of 5/6.

Specified Valves £1-2-9. *Cabinet* 15/-.

STOP PRESS OFFERS

AMPLION PERMANENT MAGNET MOVING-COIL SPEAKER with tapped input transformer. Cash or C.O.D. Carriage Paid. £1/19/6. Balance in 5 monthly payments of 7/4. — Send 7/4 only

GARRARD AUTOMATIC RECORD HANGER for A.C. mains. Mounted on unit plate complete ready for fitting in position, including Garrard pick-up and tone-arm. Cash Price £10/0/0. Carriage Paid. Balance in 11 monthly payments of 18/6. — Send 18/6 only

AMPLION PICK-UP with arm base and volume control. Cash or C.O.D. only. Post Paid. **25/-**

PETO-SCOTT S.G.3 RADIO

A great technical achievement. Self-contained in one Cabinet of beautifully-grained walnut. High-grade components on all-steel chassis. Slow-motion single-dial tuning. Screened grid, detector and power valves. MOVING-COIL SPEAKER. Designed to give reliable Radio Reception in every part of the British Isles of B.B.C. and Foreign Programmes.—Complete, ready to play, with Exide and Drydex Batteries and Aerial Equipment. Fitted Mullard Valves.

SEND NOW 12/-

No Extra for Easy Terms

This is an honest-to-goodness offer from a firm established in 1919—solely for the purpose of building Wireless Sets and bringing radio within the reach of all. Peto-Scott himself gives every purchaser of his Set a personal guarantee of satisfaction. We give you credit over sixteen months, making no extra charge for Easy Terms. Carriage Paid complete with Aerial Equipment, £9/12/0. You send us 12/- with order and 3/- per week (paid monthly) for 15 months. This means you own the best British Radio money can buy.

Recommended for the Selectone

THE PETO-SCOTT WALNUT CONSOLE (RADIO ONLY)

Constructed in Walnut with contrasting inlaid Walnut Veneers.

Comes to you with vignetted front, as illustrated, ready to take your own set. No skill or expensive tools are required to transform your radio into a beautiful Console instrument, presenting the professionally finished appearance of the most luxurious Radio Receiver money can buy. Carriage and Packing 2/6 extra England and Wales.

Deposit 8/2 and Cash or C.O.D. 11 monthly payments of 5/8 Carriage Paid. **62/-**

Baffle Board ready Drilled 3/6 extra.

Dimensions: 36 in. high; 21¾in. wide: 15½in. deep. Panel 18in. by 8in. Baseboard 14in. deep.

1933 ADAPTAGRAM CABINET for RADIO and GRAMOPHONE 63/-. Carriage 2/6 extra.

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Tune-in the Short-Wave Stations on your present set. Plug the Kelsey Short-wave Adaptor—it fits without any alteration. No extra valve required; no extra apparatus. Ready for immediate use and sold complete with Dial Calibration Chart and simple tuning notes, specially compiled by an expert.

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

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West End Showrooms: 62, High Holborn, London, W.C.2. Telephone: Holborn 3248.

Dear Sirs, Please send me CASH/C.O.D./H.P. ..... for which I enclose £..... s. .... d. CASH/H.P. Deposit,

NAME .....

ADDRESS .....

..... Pr.W. 21/1/33

ANY ITEM SUPPLIED SEPARATELY—ORDERS OVER 10/- SENT C.O.D. CARRIAGE AND POST CHARGES PAID

The Most Talked About Set of the Season

"SKYSCRAPER" RADIO

Its builders are its best Salesmen

Never before was there such a set within the reach of the home constructor. Never before such power from a battery set. Never before so many enthusiastic letters from constructors or so much talk about any radio set as this Lissen "Skyscraper" Kit has elicited. 50—60—70 loudspeaker stations—everybody who builds a "Skyscraper" gets results like that!

THE ONLY KIT YOU CAN BUILD YOURSELF EMPLOYING METALLISED S.G HIGH MU DETECTOR AND ECONOMY POWER PENTODE VALVES

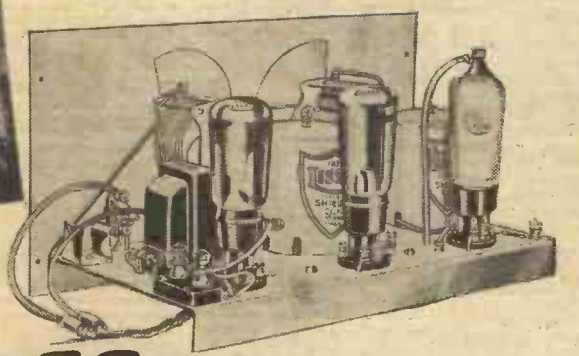
This new Lissen "SKYSCRAPER" Kit Set is the only one on the market that you can build yourself employing a Metallised Screened Grid Valve, High Mu Detector and Economy Power Pentode. Around these three valves Lissen have designed a home constructor's kit the equal of which there has never been before. Why be satisfied with whispering foreign stations when you can BUILD WITH YOUR OWN HANDS this Lissen "SKYSCRAPER" that will bring in loudly and clearly distant stations in a profusion that will add largely to your enjoyment of radio?

GREAT LISSEN CHART FREE!

You can get the Lissen "Skyscraper" Chart FREE from any radio dealer, or by posting the COUPON below direct to factory.

Lissen have published a 1/- Constructional Chart, giving the most detailed instructions ever printed for the building of a wireless set. You can't go wrong—every part, every wire, every terminal is identified by photographs. Everybody, without any technical knowledge or skill, can safely and with COMPLETE CERTAINTY OF SUCCESS undertake to build this most modern of radio receivers from the instructions given and the parts Lissen have supplied.

YOURS FOR ONLY 8/6 DOWN



To-day you can buy the LISSEN "SKYSCRAPER" KIT on Gradual Payment Terms. "Skyscraper" Chassis Kit, complete with Valves. CASH PRICE 89/6. Or 8/6 down and twelve monthly payments of 7/6.

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LISSEN

"SKYSCRAPER" 3 KIT

THE "FURY FOUR" By F. J. CAMM! See Page 833

ROUND *the* WORLD *of* WIRELESS

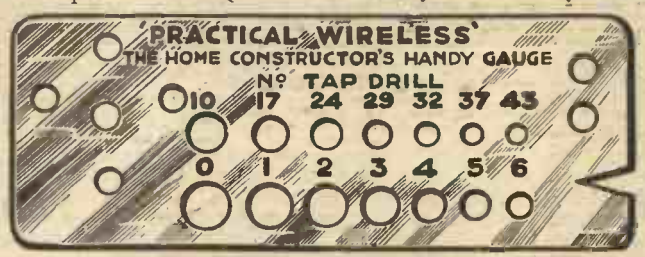
Next Week's Great Free Gifts!

READERS have had plenty of evidence since the publication of No. 1 of PRACTICAL WIRELESS on Sept. 24th last that this paper exists earnestly to foster the interests of the home constructor. The WIRELESS CONSTRUCTOR'S ENCYCLOPÆDIA, specially prepared and made exhaustively comprehensive, was made available to regular readers of the paper. Our series of WIRELESS DATA SHEETS provides the reader with valuable facts and figures in easily consulted form.

NEXT WEEK, however, we are giving TWO FREE GIFTS, for in addition to Data Sheet No. 7 (which is entitled "Condensers and Condenser Values") there will be presented Free with every copy, in an envelope, the Home Constructor's Handy Gauge, made in a stout gauge of steel, which you see illustrated actual size in the centre of this page. This gauge is an almost indispensable tool, for it may be used as a screw gauge, as a tap drill gauge, as a valve leg gauge (for triodes and pentodes), as a wire loop former, as an insulation stripper, as a wood scraper, as a universal trammel for scribing holes on panels, baseboards, etc. The exact uses to which the gauge may be put forms the subject of a special article, which will also appear next week. You cannot buy one of these gauges, for it has been specially made for PRACTICAL WIRELESS. Note that you have *nothing to do* in order to get it, except to buy next week's issue. YOUR Gauge will be secured to the cover of YOUR copy. There is always a great demand for gift issues, and it is necessary for you to order now. Note also that next week's issue (on sale on Wednesday, January 25th) is the same price —3d.

NEXT WEEK'S GREAT FREE GIFTS!

(ACTUAL SIZE)



THIS HANDY UNIVERSAL GAUGE, MADE OF STEEL, ALSO

DATA SHEET No. 7

"Condensers & Condenser Values"

The "Fury Four."

ON page 833 of this week's issue you will find a preliminary announcement concerning a new wonder set—the "Fury Four"—which is destined to make radio history. Fuller details of the "Fury Four" will be given in January 28th issue! This receiver has engaged the designer, Mr. F. J. Camm (Editor of PRACTICAL WIRELESS), in exhaustive experiments over the past four months. It is entirely new in principle, and it has been designed so that even those with a limited purse can make it up. So remarkable is the set that we venture to think it will be made in its thousands. It will receive, on any evening, over 100 stations without jamming; it is extremely selective, simple to operate, easy to build, cheap, incorporates the very latest ideas (including two S.G. valves) and, what is more important from the point of view of the reader, it has the personal guarantee of the designer, the Editor of PRACTICAL WIRELESS, that it will do all we claim for it. Every reader who builds the set may rest assured that the Editor will give his personal attention to every query relating to this set, to ensure that readers obtain the same phenomenal results which he has achieved. Turn to page 833 and read his preliminary notes on the set.

"The Wireless Constructor's Encylopædia"

IF you have not yet sent in your coupon according to the conditions given in our December 24th issue, you should do so without further dealy. We are, of course, despatching the volumes with all speed If you have not yet done so, therefore, affix the gift stamps to your subsciption voucher and forward the completed voucher in accordance with the instructions thereon to-day.

Wireless Set in a Walking Stick

ANOTHER well-meaning experimenter in Berlin has devised a means of cramming a wireless receiver into a hollow walking stick. the whole of the apparatus, apart from the headphones, being contained in the stick. Modern traffic conditions allow of no distractions for pedestrians, and when walking in the country I personally can think of no better programme to listen to than Nature's own broadcasts.

Brussels Extends its Programmes

THE Brussels No. 1 and No. 2 stations are now giving a continuous broadcast on Sundays from 10.0 a.m. until 2.0 p.m., and from 5.0 p.m. until midnight; on Saturday evenings dance music is also transmitted until midnight.

New Long Wave Station at Droitwich

WHILE the next "big noise" to be heard in this country will be the new West Regional I hear it is practically certain that the new long-wave station at Droitwich will follow closely on its heels. This will be a good thing for I do not think I would be a mile out if I said that the long-wave National has a greater following than any other British station. If you consider this you will see that it is not surprising because 5XX'S signal is always consistent, the quality is good, although not always excellent, and the ether around that wavelength has enjoyed a long run of comparative freedom from interference.

Sponsored Programmes by "Atlas"

MESSRS. HADDON, CLARKE and Co., the makers of the famous "Atlas" series of receivers and components, have now arranged for sponsored programmes to be broadcast on their behalf from Radio-Paris, 3.0–3.30 p.m. and Radio-Normandie, 5.30–6.0 p.m. and 10.0–10.30 p.m. each Sunday.

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

Broadcasting Films in France

MANY Continental stations in the course of their radio entertainments relay performances from local cinemas. Radio Strasbourg (France) now makes a regular feature of this kind of broadcast. All necessary explanations are given by the announcer in a running commentary where the film in itself is not sufficiently explicit.

Penny-in-the-slot Wireless

A RADIO engineer in Durham has patented an invention which he proposes to offer to manufacturers and dealers selling wireless instruments on hire-purchase terms. Unless regular instalments are paid by dropping coins into a special slot by means of a time switch, the instrument automatically "closes down." Arrangements can be made by which a set will work for a day, week or month according to the amount paid.

Early-Morning Transmissions

ALTHOUGH broadcasts may be heard in the early hours of the day from a number of Continental stations, up to the present most of the French studios do not take the air before breakfast time. In future, the *Poste Parisien* (Paris) will awaken its listeners with a fanfare of trumpets at 7.30 a.m., to be followed by a news bulletin, a course of physical exercises, and a concert of gramophone records.

The Luxembourg Giant

IN view of the fact that official authority to operate has not yet been received from the State, the Radio Luxembourg super-power station is not supposed to broadcast. It may be heard testing, however, daily between 11.0 a.m. and midday, and again between 6.15 and 8.30 p.m., G.M.T., on a wavelength in the neighbourhood of 1,190 metres. The opening signal consists of a series of prolonged siren-like notes and buzzes. For an obvious reason, no call is given out during the broadcast, and no announcements are made between items of music, yet every listener in France knows that it is Radio Luxembourg. Owing to the delay in opening the station, the inhabitants of the Grand Duchy are refraining from buying wireless instruments.

Moscow on High Power

THE new 500 kilowatt transmitter which the Soviet authorities have installed at Noghinsk is now nearing completion and will shortly be brought into operation. It will replace the old Komintern station, which until recently was working on 1,481 metres. A 20 kW. transmitter at Rostov (Don) and another power station at Kiev, in the Ukraine district, may be inaugurated simultaneously at an early date.

Radiodiffusion in Switzerland

THE Swiss Administration of Posts and Telegraphs, in order to enable subscribers to hear the broadcast programmes by telephone, has established a network of instruments in over twenty-five cities. With a view to giving a choice of home and foreign radio entertainments, the receivers to be leased to subscribers are to be modelled on the dial system.

Their Neighbour's Loud-speaker

THE Municipality of Tunis has decreed that too much radio is bad for the nerves of the inhabitants of its city. From 8.0 p.m. to 7.0 a.m. listeners must either switch off their sets or take steps to ensure that wireless entertainments or gramophone music cannot be heard by their neighbours or by passers-by in the street.

INTERESTING and TOPICAL PARAGRAPHS

THE POLICE AND WIRELESS

Receiving in a wireless car orders which have been transmitted by police headquarters.

Free Listening Licences

FOLLOWING raids by the Belgian police with a view to the discovery and prosecution of radio pirates, the Labour Party in Belgium has requested the Government to issue free licences to the unemployed. This step was taken in Germany some months ago, where, in addition, no tax is collected from the blind or from war invalids.

Another Super Station for Romania?

EXPERIMENTS which have been carried out with a 1 kilowatt transmitter relay of the Buccarest programmes having proved very satisfactory, it is reported that if financial conditions will permit a 150 kilowatt station is to be erected at Craciunelu. The most favourable channel for the broadcasts was found to be 1,980 metres.

Flying Radio Reporters

AS news bulletins form the major portion of the Moscow broadcasts, in order to develop this feature the studio officials have organized a fleet of six aeroplanes which will enable special reporters to make running commentaries on any event of general interest. Each aircraft is fitted with a short-wave telephony transmitter to permit it to keep in touch with the nearest broadcasting station. It is further intended to equip two of these planes with recording apparatus, and thus allow a re-broadcast of the talk at a future date.

Hilversum and Huizen

FROM January 1, listeners may have noticed that the A.V.R.O. and V.A.R.A. broadcasting associations are being transmitted on the higher waveband. Although it is generally stated that the stations *exchange* wavelengths, this is incorrect, inasmuch as the transmitters continue to operate in the same channels. What actually does take place is that the studios exchange *transmitters*. During the period January-March, therefore, you will hear Hilversum announcements on 1,875 metres, and Huizen entertainments on 296.1 metres.

D.X. Work

SOME time ago I mentioned in these notes that there was every indication that reception conditions during the present winter would be as good as they had ever been before during the past seven or eight years. My prophecy has been more than fulfilled already, and I can honestly say that conditions are better than I have ever known them. I have kept a more or less continuous reception log since the days when Eiffel Tower, Writtle (Two Emma Tock) and The Hague were the only sources of broadcast entertainment, but never have distant stations come in so well as they do at present. In saying this I make full allowance for increased transmitting power and receiver improvements.—JACE.

SOLVE THIS!

Problem No. 18.

Smith converted his three-valve receiver for use on the Short Waves. The conversion consisted of altering the value of the grid-leak and better wiring, with the addition of a 400 ohm potentiometer across the L.T.— and L.T.+ terminals. The set worked quite well for a time, but Smith found that, although the valves had not been altered, the accumulator required much more frequent charging. What was the cause of this? Three books will be awarded for the first three correct solutions opened. Mark envelopes Problem No. 18, and send to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, London, W.C.2, to reach us not later than January 23rd.

SOLUTION TO PROBLEM No. 17

Rogerson forgot to insert the coupling condenser between anode and transformer primary, and therefore the H.T. was short-circuited by the resistance and transformer primary in series.

Only two readers succeeded in giving a correct solution of Problem No. 16, and books have therefore been forwarded to:—
D. W. Lemmon, 32, Surnton Park Road, Irlams-o'-th'-Height, Manchester; Patrick J. Best, 32, Derry Road, Ribbleton, Preston, Lancs.

AN IMPORTANT ANNOUNCEMENT—

MY "FURY FOUR"

Preliminary Statement by F. J. CAMM Concerning his Remarkable New Receiver, Details and Photographs of Which will be Given Next Week!

IT is with extreme pleasure that I announce to every reader of PRACTICAL WIRELESS that, after four months of earnest endeavour, experiment, and test, I have succeeded in producing a new type of wireless receiver yielding such remarkable results that I confidently predict that it will be made in its thousands. As Editor of this paper, I am in a unique position to gauge from the hundreds of letters I receive every day the type of set which the home constructor requires, and which no designer of home-built receivers, as far as I am aware, has as yet supplied. The difficulties readers have encountered form a valuable guide to the snags encountered in home-constructed sets, and the queries received by my Technical Staff accentuate the fact that excellent as so many home-constructed sets are, no designer of sets for the amateur has, so far as I am aware, incorporated in one receiver the requirements which those letters indicate to be, under modern conditions of the ether, an urgent necessity.

The unassailable and unrivalled position now occupied by PRACTICAL WIRELESS directed my thoughts to the production of a receiver which would be, in the first place, worthy of the paper, and which, secondly, would exorcise from the home-constructed receiver the drawbacks and the bugbears which the amateur unfortunately has come to regard as inseparable from home-built receivers. That was four months ago. My efforts to produce such a receiver have been intensified by the letters which continue to reach me daily. My endeavours, unceasingly directed to this end in our laboratory, guided my efforts along certain lines, culminating in the production of the "**Fury Four.**" I am an engineer by education and training, and with the caution which that training gives I suppressed the enthusiasm which is the natural corollary to achievement, and embarked on a series of strenuous tests **to satisfy myself that every reader of PRACTICAL WIRELESS could, by following the very complete constructional details to be given in following issues, duplicate, immediately he had attached the last wire to the set, the remarkable results of which my set is capable.**

With the one object of providing my readers with a really outstanding receiver which would not readily go out of date, I have very carefully analysed modern radio reception and difficulties so that I could anticipate the snags instead of, as is so often the case, leaving the reader to do so. **The "Fury Four" is no ordinary set.** I have built into it my sixteen years' experience of radio design and construction, and having got the design right, I felt that time could not be delayed in placing before the readers of this paper an announcement of the utmost importance to every home constructor of wireless sets in the country. **To accelerate the tests necessary before the announcement could be made, not alone myself, but members of my staff and many other radio experts have been despatched by aeroplane all over the country, and their reports agree in striking manner with mine. It is no chance set merely put out as a journalistic stunt, for wherever it has been put on test (and the testing zones have been far flung and specially selected because they provide the difficulties necessary to make those tests of value), it has responded in a remarkably uniform degree, and confirmed the results which I have sincerely set out to attain.**

You will be afforded ample proof that these claims are not an over-statement of the capabilities of the set. Logging charts from various parts of the country will be placed before you. Every detail necessary to construct the "Fury Four" will be published in these pages, and I guarantee that, using the components I specify, you will immediately have a receiver which represents a marked advance on anything before published.

The "Fury Four" is, as its name implies, a four-valve receiver employing two S.G. valves and a pentode output stage. It is, I believe, the practice in the electrical and radio industries for designers to name sets after themselves, a practice originated by the pioneers of electricity, who vied with one another in their efforts to produce a new electrical unit which could be named after them. The vanity of these pioneers can, of course, be excused, for one can forgive geniuses like Ohm, Volt, Coulomb, Ampere, and others the vanity of naming their discoveries after themselves, so that their names might reverberate down the centuries. My aim has not been to produce a set for such purposes, but to serve my readers, and the "Fury Four," you will agree, is an easily remembered and euphonious title.

Expert wireless designers frequently fail to achieve success because they set up wrong standards. Opticians, for example, set up impossible standards and proclaim that everyone needs glasses who falls short of them. The home constructor, therefore, is perhaps to-day excusably weary of the claims for particular sets, which fail to materialize. **If the standards are wrong the design must be wrong; my standards are not impossible standards.** Briefly, they are these: The set must be extremely selective, with absence of overlapping; it must provide ample volume on all stations received; it must be capable of receiving at least 100 stations; it must be simple to operate, it must be cheap to build, it should be free from background, it should be economical to run; it should operate equally well on medium and long wave-bands; it should be trouble-free, stable, easy to construct, **and, most important of all, it should be backed by a guarantee of satisfaction by its designer.** In other words, a reader who fails to achieve what the designer claims should be entitled to free advice until it functions in the manner claimed. **This guarantee I readily give,** for every builder of the "Fury Four" may avail himself of my personal advice, free of charge, on any little difficulty he may encounter, and I shall not be satisfied until every reader obtains the results I claim. If he follows the instructions I shall give later this he is bound to do.

One little feature I have incorporated in the "Fury Four" is the use of voltage dropping resistances so that the builder is relieved of the necessity of adjusting H.T. voltage. He merely places the negative plug into the negative socket of the H.T. battery and the positive wander plug into maximum H.T. voltage. The fixed resistances will ensure that the correct voltages are applied to the anodes of each valve. I have also made use of these resistances to act as decouplers, a purpose which they quite successfully serve, for a feature of the "Fury Four" is its entire absence of background noises.

A point which the home constructor will appreciate is that I have eliminated the need for accurately balancing the three tuned circuits necessary in a modern receiver by tuning the detector grid coil by a separate condenser and the remaining two coils by a double gang condenser. I shall have more to say later about this ingenious method of tuning. **I do not think it possible to incorporate in one receiver arrangements for receiving short, medium and long waves, for short-wave reception is admittedly tricky, and to render it efficient the medium and the long waves must suffer.** Having in mind the depth of the pocket of the average home constructor, **I have purposely kept the cost extremely low, for it may be built for about Five Pounds. The "Fury Four" is a set which will make radio history.** Next week I shall describe the set and its performance in great detail.—F. J. C.

WHAT STATION IS THAT?

How to Calibrate Your Receiver

A Practical Answer to the Question

By HAROLD E. J. ORTON

AMATEUR constructed receivers have a number of possible advantages over commercially-constructed ones, but in one respect, many commercial receivers score. I speak of the calibration in wavelengths of the tuners.

At first sight, it might be thought that except when using one of the few wavelength-calibrated "packs" on the market, the difficulty of calibrating must prevent amateurs from competing in this matter with manufacturers. However, this is far from the case. By the means I shall describe in this article, every amateur can calibrate his receiver in wavelengths, and provided he takes reasonable care he will be rewarded by an accuracy considerably greater than that found in most commercial receivers.

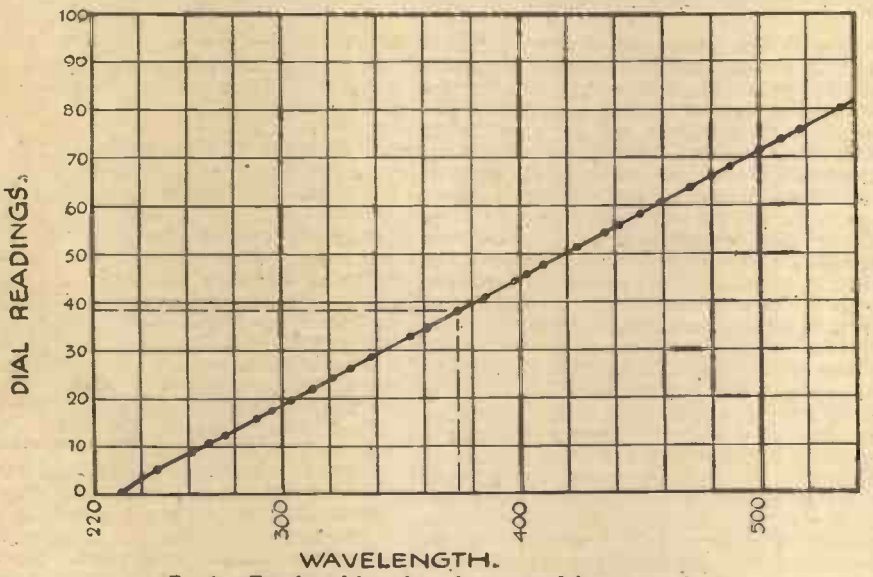


Fig. 1.—The dotted line shows how to read from a graph.

Making a Graph

To provide the wavelength settings for calibration, a graph has to be used. A considerable number of amateurs will have already made graphs, and in any case the necessary procedure of making a graph is pretty well known, so I do not propose to say more than a few words on the subject. If you do not understand what is meant or done as regards graphs, please study carefully Fig. 1, and I think you will soon realize what it is all about. The graph shown is a very diminutive affair; graph paper is usually sold in sheets of about 18in. by 24in., and a full sheet should be used for calibration. The dots on the graph represent stations, of course, and the position of each dot is obtained by tuning in a reliable station, noting its dial-reading and wavelength, and marking the point on the graph where a horizontal line from the dial-reading (as represented on the graph) would cross a vertical line drawn from an appropriate position on the wavelength scale. The lines need not be drawn, of course, the lines on the graph paper serving as guides. When a considerable number of dots are marked, they are linked together to form a line or curve, and the graph is finished.

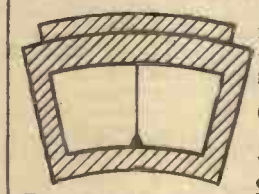


Fig. 4.—An aperture dial with hair line fixed to give accurate readings.

Calibrating the Dials

Now, to get on with the calibrating of the dials. A disc has to be prepared, similar in shape to the original one, inscribed in degrees. As to the material to use, white celluloid, with one surface roughened by fine emery-cloth, is ideal. As substitutes, one can use a good, hot-pressed drawing-paper, or any other material upon which fine inscriptions can be made with indian ink. As somewhat of a novelty, a dial in which the numbers are white and the background black can be made by using a thin paper, and having a photographic print taken from it in the same way as when printing from a negative. If a dial of the old-fashioned rotating type is used, a disc can be fixed to the panel, and some mark on the dial can be used as a pointer.

When the blank disc has been made, a line should be drawn on it, starting from the equivalent to zero, to a position equivalent to the top of the scale. In the case of aperture dials, this line should coincide with the middle of the aperture. The line is the dividing line between the respective markings for long waves and medium waves. At each end, on this first line, a short line should be drawn to mark the limits of the tuning range. Fig. 2 should make this quite clear.

The next thing that has to be done is to locate, on the blank disc, the positions of each 10 metres on medium waves, and each 100 metres on long waves. With the old-fashioned type of dial, the new disc can be fixed in position on the panel, the wavelength positions then being easily marked. If an aperture dial is being calibrated, the new scale should be temporarily fixed in position over the original scale and illuminated from behind—the idea being to enable the positions of the degrees to be seen through the new disc. If illuminated dials are used, the light is automatically provided, but when such dials are not used, the original scale may have to be removed from the dial and, together with the blank disc, held up to a light.

(Continued on page 836.)

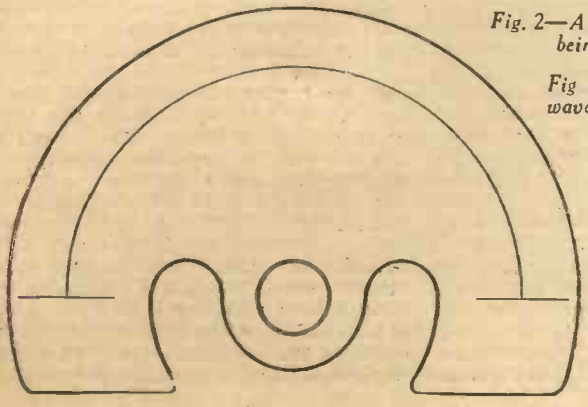


Fig. 2—A disc preparatory to being calibrated.

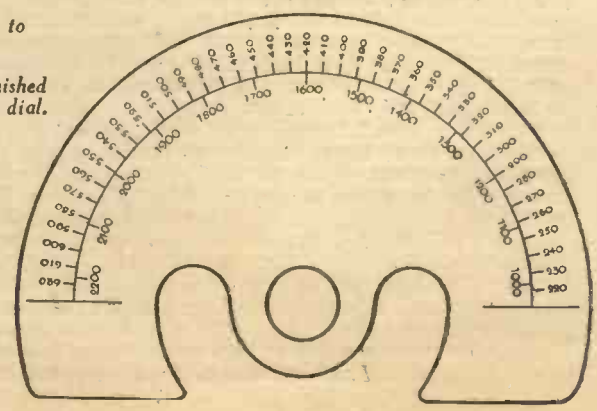


Fig 3.—A nearly finished wavelength calibrated dial.

BARTON CHAPPLE on

HOLDING THE FOREIGNERS

Various Methods of Ensuring Consistent Reception of Long-distance Stations.

THE SECOND ARTICLE

FROM the conclusions arrived at in the first part of this series, it would appear that by feeding back to the grid circuit of a multi-mu valve some negative voltage developed in a later stage of the receiver, and varying with the signal strength, a constant volume level could be maintained. The reason is, of course, that the increased voltage drop due to an increased signal would act as additional negative grid bias on the multi-mu valve, and thus reduce the effective degree of radio-frequency amplification.

Let us now see how such automatic control can be applied. There are a number of points in a radio circuit the potential of which varies with the signal strength. Most of them, however, are not admissible for automatic volume control purposes. In some instances the use of a certain voltage drop in this way would result in raising the potential of the multi-mu grids to that of the high-tension supply, involving considerable practical difficulties. In other cases the snag is that the available voltage drop is also modulated at radio or audio frequency. It will be shown later how these difficulties can be overcome.

Using the Grid Leak

Perhaps the most successful method of applying automatic volume control to a multi-mu valve or valves is by making use of the difference of potential which exists across the grid circuit of the ordinary leaky grid detector. Fig. 1 shows the conventional diagram for such a detector. It will be realized that the whole operation of cumulative grid detection is based on the flow of grid current. There must, therefore, be a difference of potential across the ends of the grid leak (through which, of course, the grid current flows).

If, therefore, the "grid" end of the grid leak is connected back to the grid coil of the multi-mu valve, any increase in the signal as reaching the detector grid would impress a correspondingly increased negative potential on the multi-mu valve's grid, and thus tend to restore the signal to normal strength. A theoretical diagram of this arrangement is given in Fig. 2. Note that this is *not* a practical circuit as many essential and incidental components have been omitted for the sake of clarity. The heavy line A—B represents the connection between the grid of the detector valve and the grid coil of the multi-mu valve. It is through this connection that the negative potential at A is transferred to B. The condenser C.3, which is of fairly large capacity compared with the aerial tuning condenser, serves, of course, to complete the resonant circuit L.1, C.1.

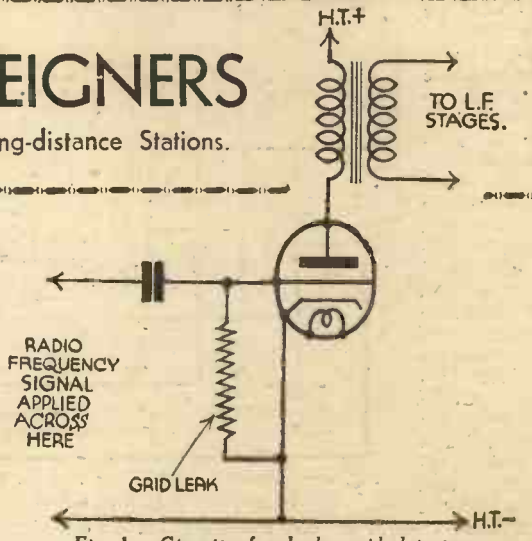


Fig. 1.—Circuit of a leaky grid detector.

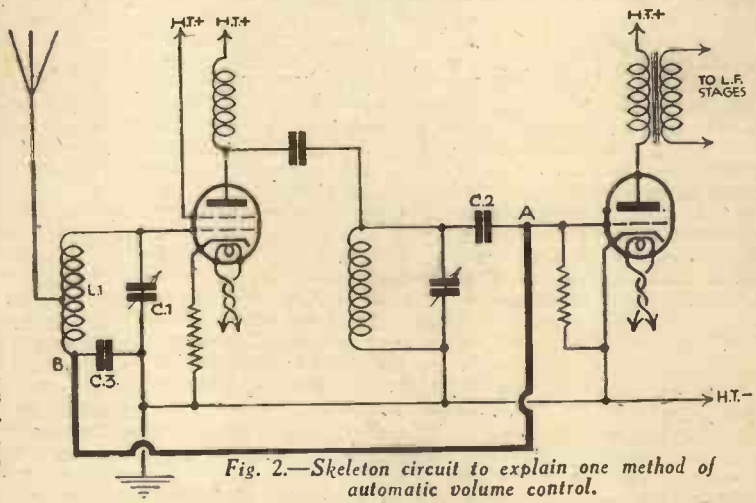


Fig. 2.—Skeleton circuit to explain one method of automatic volume control.

Modifications

The scheme thus outlined forms the basis of an entirely satisfactory method of automatic volume control, but several additions have to be made before a practical working arrangement can be produced. In the first place it must be remembered that the current flowing in the grid leak bears a radio frequency modulation. It is therefore necessary to provide rather complete filter and decoupling arrangements in order to avoid radio frequency voltage variations being fed back to the grids of the multi-mu valves, where, of course, they would produce a reaction effect leading to instability.

The circuit depicted in Fig. 3 includes a radio frequency choke L.3, and a by-pass condenser C.5. for this purpose, while further smoothing is obtained by the decoupling resistance R.4. Here again it is necessary to point out that the actual values of the various components cannot be given quite so precisely as could be wished as they depend largely upon the characteristics of the valves employed and upon general circuit conditions. For the same reason only conventional tuning arrangements are indicated in the diagram. In a practical circuit the constants of the normal receiving network must be taken into account and each receiver dealt with on its merits. However, there are probably many listeners who may like to carry out a little private research work on the problem of automatic volume control, so it will be advisable to analyze the circuit given in Fig. 3 and allocate provisional values for the various components to form the starting point for experiments.

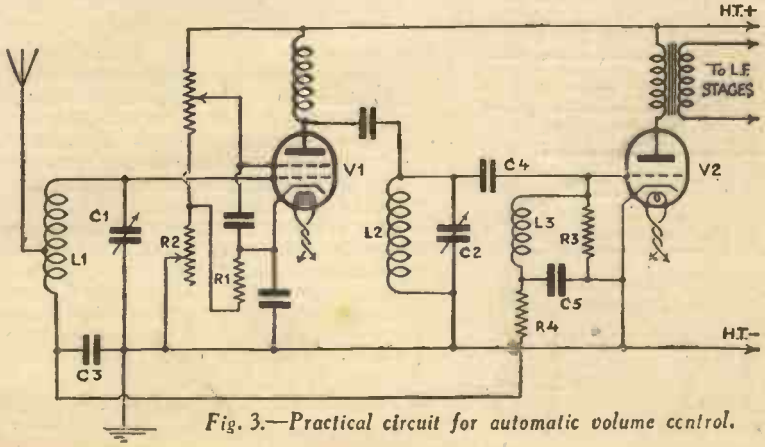


Fig. 3.—Practical circuit for automatic volume control.

Analyzing the Circuit

V.1 is the multi-mu screened grid valve, and V.2 the detector valve, both of the indirectly heated A.C. mains type. A simple tuning system, L1, C1, is shown for the aerial tuning and a similar simple arrangement for the tuned grid coupling between the multi-mu valve and the detector valve. Naturally, in a modern set such devices as, for example, band-pass tuning would exist, but here we are concerned only with the essential arrangements for automatic volume control. R.1 and R.2 are resistors in the cathode circuit of the multi-mu valve and are so arranged that they automatically bias the valve. R.1 is of fixed value and the bias it provides is the normal amount required to prevent the valve from running into grid current.

Its value is always quoted by the valve maker, but it can also be calculated by the well-known formula: — resistance in ohms equals desired minimum grid bias divided by the anode current of the valve in milliamps and multiplied by 1,000. R.2 is a variable resistor and can be used for hand control of the multi-mu valve in the ordinary way and for pre-setting the volume level which it is desired to maintain automatically. Its maximum value will again depend upon the anode current of the valve and upon the amount of bias it is desired to provide. A value of about 10,000 ohms is of the right order for the average long grid base multi-mu valve and a much smaller value, say 2,500 ohms or less, for valves with a short grid base. C.4 is the normal detector grid condenser and R.3 the grid leak. The voltage to be used for automatic volume control is taken from the grid end of R.3 through the high-frequency choke L.3, which can be of the ordinary type. A condenser C.5 of, say, .0001 mfd. provides a bypass for any high-frequency component, while R.4 is a decoupling resistance having a value of twice or three times the grid leak resistance. The condenser C.3 to which reference has already been made should be of about .05 mfd.

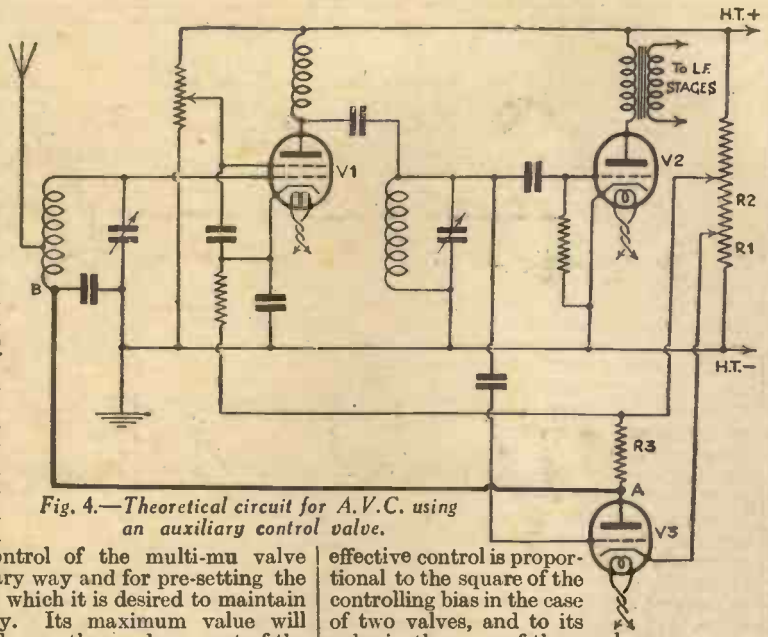


Fig. 4.—Theoretical circuit for A.V.C. using an auxiliary control valve.

A Defect

Although technically correct, the method of automatic volume control described above, and the several variants of it, suffer from one defect, namely, that the varying negative potential available at the grid of the average detector is comparatively small, so that the control it offers is not of great magnitude. It is doubtful, therefore, whether the scheme as outlined could be successfully applied to a single multi-mu valve, or, at any rate, to one of the long grid base valves requiring a maximum bias of the order of 40 volts. If, however, two or three multi-mu valves are employed, the control is more valuable because its effects are cumulative. That is to say, the effective control is proportional to the square of the controlling bias in the case of two valves, and to its cube in the case of three valves.

There is, however, another and very interesting method of applying automatic control by which almost any desired degree of control may be obtained. This method makes use of a separate control valve for supplying the varying negative grid-bias to the multi-mu valve or valves. This separate valve is connected as an anode bend detector, and its grid receives the same signals as are applied to the grid of the normal detector-valve of the receiver. Since the anode current of an anode bend detector *rises* when a signal is being received, it is a simple matter to connect in the anode circuit of this auxiliary control valve a resistance of suitable value, and to so arrange matters that the voltage drop across this resistance, which, of course, will increase as the signal increases, is fed back as a variable biasing voltage to the grid of the multi-mu stage or stages.

A Better Method

This system will be understood best from the skeleton theoretical circuit reproduced in Fig. 4. In this circuit, V.1 and V.2 are respectively the multi-mu and normal detector-valves of the receiver, and V.3 is the automatic volume control valve. This is shown as a three-electrode indirectly heated valve. The cathode of V.3 is connected to a low positive voltage, so that its grid is negative with respect to the cathode—that is, the valve is adjusted for operation as an anode bend detector. The grid is connected to the normal detector grid, *via* a small coupling condenser, and its anode is maintained at a suitable positive potential. The resistance R.3 is connected in the anode circuit of the control valve. When the amplitude of the signal reaching the grid of the detector-valve and the grid of V.3 increases, the anode current of V.3 also increases, the voltage drop across R.3 increases in proportion, and the decreased potential at the point A is transferred to B by the connection shown as a heavy line.

Additions and Modifications

As in the previous case, considerable additions and modifications are necessary to convert this theoretical circuit into a practical one. In the first place, the arrangement for obtaining the cathode bias and anode voltage of the control valve may be improved by using, instead of a separate potentiometer across the high-tension supply, a series resistance at the negative end of the high-tension supply. This resistance must be capable of carrying the whole high-tension current of the set, and may be tapped to provide grid-bias to the output and other valves. Then, because the signals applied to the grid of the control valve are of radio frequency, and the anode current of that valve must, therefore, contain a heavy radio frequency ripple, the smoothing circuit in the link between the points A and B must be very carefully designed. An efficient radio frequency choke, with a by-pass condenser arrangement on similar lines to the smoothing circuit of a high-tension supply unit, but, of course, modified as to type of choke and values of condensers to suit radio-frequencies, is indicated here, and this may be followed also, with advantage, by a decoupling resistance. Neglect of this portion of the circuit would undoubtedly result in instability.

As a basis for experiment, a sensitive valve, of a type known to operate successfully as an anode bend detector, should be selected for V.3. The cathode bias of this valve should be calculated in the usual way, and the point at which the anode voltage for V.3 is tapped off should be adjustable. A maximum of about 60 volts would provide sufficient margin for experiment, while the anode load R.3 should be in the neighbourhood of 10,000 to 20,000 ohms, depending, again, on the amount of control bias it is required to apply to the multi-mu valves and on the value of the anode current of V.3. In the third part of this series it is hoped to give a more complete practical circuit, and more definite values of the various components.

HOW TO CALIBRATE YOUR RECEIVER

(*Continued from page 834.*)

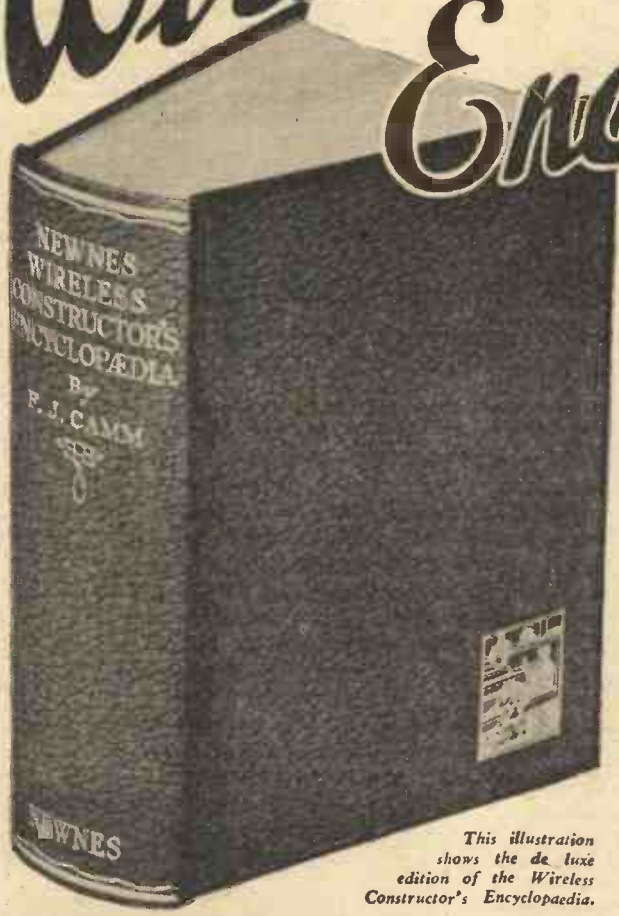
When the preliminary marking, which should be in pencil, is finished, the lines and numbers should be neatly filled in with a mapping-pen. See Fig. 3. Further filling in can next be done. On an average dial, there is only room for a tick for every two metres on medium waves, which is quite satisfactory. On long waves, a tick at every twenty or twenty-five metres is convenient.

Fixing the Disc in Position

When the marking of the new disc is complete, the disc has to be attached in position. With drum and disc dials, the new calibrated scale can either be attached over the original scale or substituted for it. The material of the new disc, and the method of fixing of the old one, have to be taken into account, so choice in the matter must be left to the reader.

One other point is worthy of mention. A number of aperture dials have pointers so situated that accurate reading is rather difficult. In these instances, it is distinctly advisable, and nearly always readily practicable, to attach a piece of thin wire or cotton across the aperture, as in Fig. 4, which enables highly accurate reading to be readily taken, and the full advantage of wavelength calibration to be realized.

The Wireless Constructor's Encyclopædia!



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PART VI.

WHAT *is* TELEVISION?

A Short Series Explaining the Fundamental Principles.

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

DURING the course of some of the previous articles I have been forced to gloss over the exact interpretation of the expression "Synchronism," but in view of its extreme importance in relation to successful television reception I propose to devote this instalment to a consideration of the problems involved and describe how they are solved.

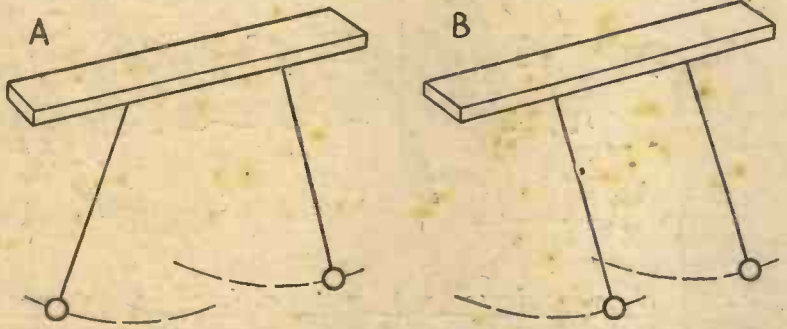


Fig. 1.—The analogy of a pair of pendulums.

First of all let us tackle the subject by clearing the air as to the true meaning of synchronism, for I find so often that this simple term is confused and only a hazy impression exists in the mind of the individual. Obviously, the term has an application in divers directions other than television, and it may help to make matters plain if I give two simple every-day analogies.

Analogies

In Fig. 1A is shown a pair of pendulums, identical in length and weight, suspended from a beam and set swinging. The time executed for each swing by each pendulum is the same, but they are not in "phase," that is to say, when one is reaching the top of its motion in one direction, the other is reaching the top of its motion in another direction. In consequence, at no time are they "in step" and the condition fulfilled is known as isochronism, a term indicating identity of speed or time movements, but an absence of "phase." We have to turn to the condition shown in Fig. 1B before we have true synchronism. Here the same pair of pendulums not only execute exactly timed swings, but both their motions at any instant are identical, and it is this double condition which must be satisfied for synchronism to be fully established.

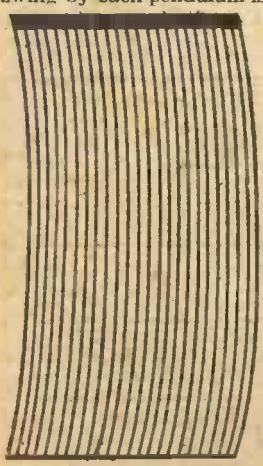


Fig. 2.—A black band introduced artificially. The spot light is masked out, and there is a momentary period of darkness, and thus no light is reflected on the photo-electric cell.

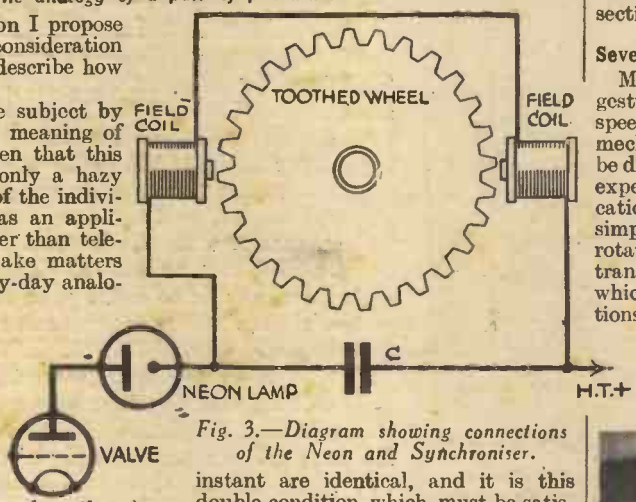


Fig. 3.—Diagram showing connections of the Neon and Synchroniser.

For a second example suppose we take the case of two electrically driven clocks used in the same house, that is to say, they are working off the same mains. The angular movements of the minute and hour hands will be the same, but unless they have both been set to the same Greenwich time they will register different times at the same instant. Under these circumstances they will be only isochronized and synchronism will not take effect until the hands of both clocks are set to register the same time at the same instant.

It is thus seen that while we can achieve isochronism without bringing about synchronism, it is impossible to establish synchronism without having first satisfied the condition of isochronism. In any television system isochronism is first of all achieved through the agency of the mechanism incorporated in the apparatus and generally this is done automatically, but the question of "phasing" has to be undertaken by each individual operator and is quite simple, as we shall see later.

The Simplest Scheme

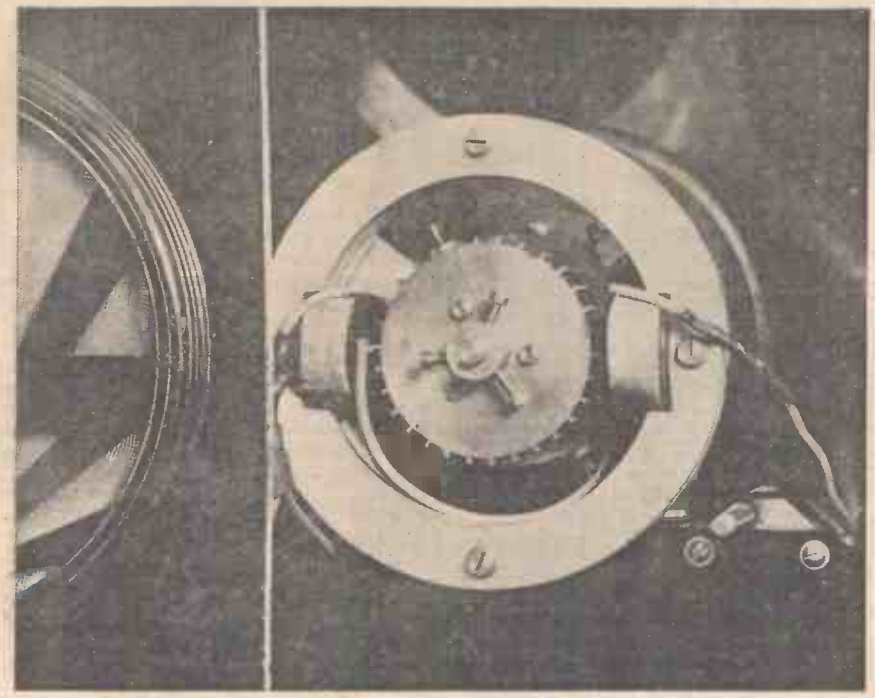
Having appreciated what synchronism demands, the next point to consider is how it can be achieved for the purpose of successfully establishing proper television reception at any point. The simplest of schemes will no doubt occur to the reader, namely, that of driving the transmitter and receiver motors from the same alternating current mains network. Synchronous motors worked under these conditions are admirable and in the U.S.A. quite wide networks are linked up covering large areas, and this in itself solves what is admitted to be television's most acute problem. In this country, however, it will be necessary to wait until the ambitious "Grid" system is well advanced before advantage can be taken of linked electricity mains over large areas. For the benefit of readers who happen to reside in the localities, however, it is as well to mention that the same electrical supply company which feeds the motors of the television transmitter at Broadcasting House covers the Marylebone area and sections of Hampstead.

Several Suggestions

Many and varied have been the suggestions put forward to maintain identical speeds between the transmitter and receiver mechanisms, but the majority have had to be discarded on the grounds of complication, expense, additional channels of communication, and so on. What is required is a simple and inexpensive method whereby the rotating mechanism of the television transmitter can produce regular signals which in some way can control the revolutions of the scanning disc or mirror drum at the receiving end.

One suggestion put forward was to arrange to short-circuit the photo-electric cells six times per revolution

An early form of automatic synchronising using a thirty bar commutator working in conjunction with a relay.



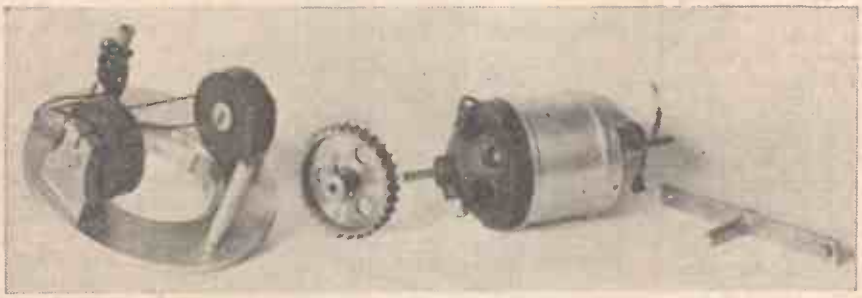
One of the earliest models of cogged wheel automatic synchroniser.

of the transmitter scanning disc, through the medium of a commutator mounted on the end of the transmitter motor shaft. While this drastic treatment cannot be said to improve the photo-electric cells, it is likely to cause a flash over the wireless transmitter. The maximum signal must always be controlled by the wireless transmitter, therefore the picture signal would have to be unreasonably reduced to allow for this. The signal at the receiving end has its high frequency component by-passed into the neon circuit, while the synchronizing pulses are filtered out, amplified and finally made to drive a phonic wheel to which is coupled the receiver disc.

Using the Television Signal

It is generally agreed, however, that the first step towards a real solution of the synchronizing problem was made in this country by Mr. Baird, being disclosed publicly for the first time as far back as 1928. Here the television picture itself at the transmitting end is made to provide the signal pulses used to keep the television receiver in a condition of isochronism or equal speed with the transmitter. The first requirement is a component of the main television signal which is dependent only upon the rotating mechanism and takes no cognisance of the nature of the subject being televized.

A moment's reflection on the details of the transmitting process described in earlier articles will enable the reader to see that there is an actual light strip sequence which is unvarying during the whole period of the transmission, provided, of course, the transmitter motor runs at a constant speed. Assuming the present standard of twelve and a half pictures per second used in this country and remembering that there are thirty strips to each picture, this strip sequence signal has a frequency of 30 by 12½, that is 375.



A small television motor with the synchronising mechanism partly dismantled to show the details.

Artificially Introduced

To make this signal of a very definite character it is usual to introduce artificially a black band at the top of the sweep of the transmitter light spot. It is created by masking out a depth equal to the size of one scanning spot, and this is shown in Fig. 2. There is a momentary period of darkness as far as the photo-electric cells are concerned, and hence the signal current has a marked decrease 375 times per second. Naturally this signal, dependent itself upon the transmitter mechanism, forms part of the complete television signal, and the next point to explain deals with the methods adopted to make the receiver mechanism respond to these synchronizing impulses.

One method, used for quite a long period, employed a thirty-bar commutator working in conjunction with a relay which open-circuited a resistance in the motor field. The main details of this device are shown in an accompanying illustration, but the scheme suffered from several drawbacks arising very largely from sparking and relay adjustments. It has now been replaced by the cogged wheel method, and the first model of this which was used is seen in another photograph.

Cogged Wheel Method

The exact description of the functioning is rather involved, but stated simply we have two small electro-magnets mounted diametrically opposite to one another on a framework of magnetic material. This framework in turn is held on the driving motor carcase but magnetically insulated from it, and in addition it should be capable of moving round relative to the motor. Positioned centrally between the pole tips of the electro-magnets is a thirty-toothed cogged wheel held rigidly on the motor shaft. The average clearance between pole face and tooth face is .006 inch, so it is essential to carry out the mounting quite accurately.

A third illustration shows a small television motor with the synchronizing mechanism partly dismantled. The two magnet coils are connected so that the pole

(*Continued on page 859.*)

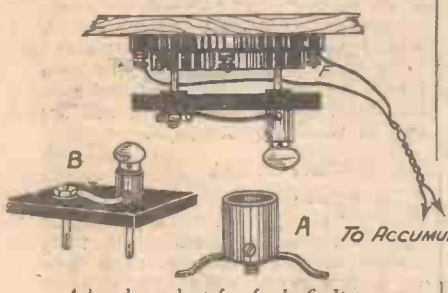
An amateur making adjustments to his home-made television receiver, the synchronising mechanism being seen in the centre.

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

A Plug-In Bulb for Fault Finding

MANY readers no doubt find it difficult to examine the interior of their sets—for broken wires, or other faults. Here is a little gadget, easily and cheaply constructed, which leaves both hands free, and illuminates the interior of the set. Take a fuse-holder, the type shown at A, and remove its base. Cut a piece of ebonite about 1½in. by ⅞in. and drill two holes to take valve pins. These pins should be

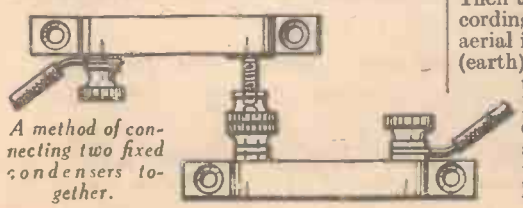


A handy gadget for fault-finding.

⅞in. apart—to enable them to fit the filament sockets of an ordinary valve-holder, and should be connected to the fuse-holder as shown at B. An ordinary valve-holder should be fastened to the woodwork by a couple of wood screws—the most suitable place must be determined by the reader, the back near the lid being a very likely place—and connection made from the filament terminals, to the L.T. terminals of the set. A flash-lamp bulb of the 2 or 3½ volt type, when inserted in the fuseholder of the completed gadget will give ample illumination for all ordinary purposes. The gadget can be taken out of the valve-holder when not required. This also makes a quite useful tester when trying out new circuits, as it can easily be placed in each valve-holder of the set, and with L.T. and H.T. connections made in usual way, prove whether everything is correct or otherwise. If the flashlamp bulb blows—well, something is wrong and the price of a valve saved. There are several other uses this little tester can be put to, but the reader will readily visualize them himself. —Richard Gibson (Blyth).

Connecting Condensers in Series

TO connect two fixed condensers together in series a better way than using wire is to connect the condensers by placing two of the terminal screws together and running one of the terminals over the two ends, as shown in the sketch. To make a tight connection use the other terminal as a lock-nut. By connecting in this manner a neater appearance is obtained than by using wire, besides which there is no chance of the connection working loose.—D. W. Stone (Morden).



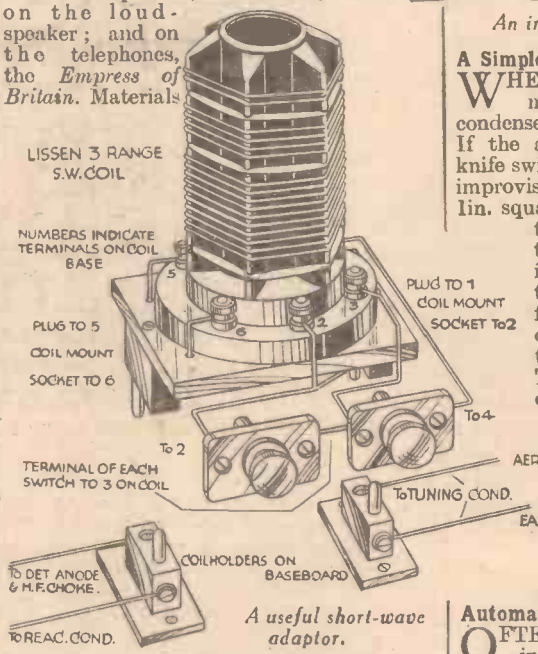
A method of connecting two fixed condensers together.

THAT DODGE OF YOURS!

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

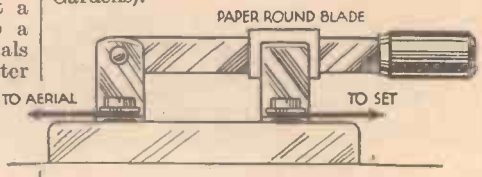
A Cheap Short-Wave Adaptor

THIS simple arrangement will convert a three-valve broadcast receiver into a good short-wave receiver. With materials costing only a few shillings the writer has received American and Canadian transmissions every night for a week: W8XK (Pittsburgh) once on the loudspeaker; Rome very loud on the loudspeaker; and on the telephones, the *Empress of Britain*. Materials



A useful short-wave adaptor.

are as follows: One short-wave coil (Lissen), one .0003 fixed condenser (Telsen), and one "Formo-densor" maximum .0001, and two small push-pull shorting switches. Two plug-in coil mounts to fit existing coil holders are also required. Firstly, the two shorting switches should be wired with Glazite to the terminals shown on the diagram issued with the coil, between 2 and 3, and 3 and 4. These switches cut out sections of the coil not used. Then the coil holders are wired according to Lissen's diagram, *i.e.*, aerial in at No. 1 and out at No. 2 (earth). Reaction from the plate of the valve to No. 5 and from No. 6 to the reaction condenser. The "Formo-densor" is connected in series with the aerial and unscrewed halfway. The fixed condenser .0003 is connected in series with the tuning-condenser, thus reducing it to a value of .00015. Now remove the tuning and reaction coils from the set, and insert the short-wave tuner with its coil-holders and switches as shown. Unscrew the "Formo-densor" until the reaction is obtained and vary the plate voltage until reaction is smooth. The advantage of this switching arrangement is that wavelength of three ranges may be covered by pushing two switches and without changing coils at all. Also by replacing the original coils and shorting the aerial condenser, the London stations can be heard.—John V. Wild (Kew Gardens).



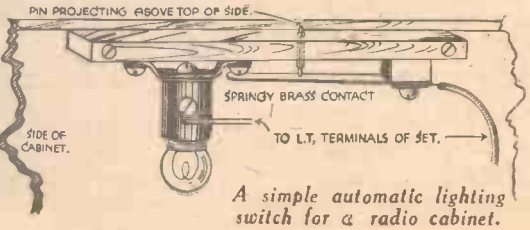
An improvised aerial series condenser.

A Simple Aerial Series Condenser

WHEN carrying out selectivity experiments or in short-wave work, a small condenser in the aerial lead is often useful. If the aerial is earthed by means of a knife switch, such a condenser can be easily improvised. A piece of notepaper about 1in. square is folded in half and placed on the blade of the switch, which is then pushed home into its contacts in the normal way as if connecting the aerial to the set. The paper forms the dielectric and the blade one plate, while the contacts form the other plate of the condenser. The capacity may be varied quite considerably by altering the area of the blade actually between the contacts or by varying the thickness of the paper dielectric. The actual capacity of the condenser so formed varies with different types of switches, but in most cases is well below .0001 mfd.—R. T. Ward (Oxford).

Automatic Lighting Switch

OFTEN a wireless receiver is situated in a dark corner of the room, thus making it difficult to see inside the cabinet. The sketch shows an arrangement for automatically lighting the interior of the set. When closed, the cabinet lid pushes down the projecting pin, which forces the springy brass contact away from the screw holding down the flashlamp holder. The circuit is then broken, and the lamp extinguished. On raising the lid contact is restored and the lamp lights.—H. H. Crawley (Oxford).



A simple automatic lighting switch for a radio cabinet.

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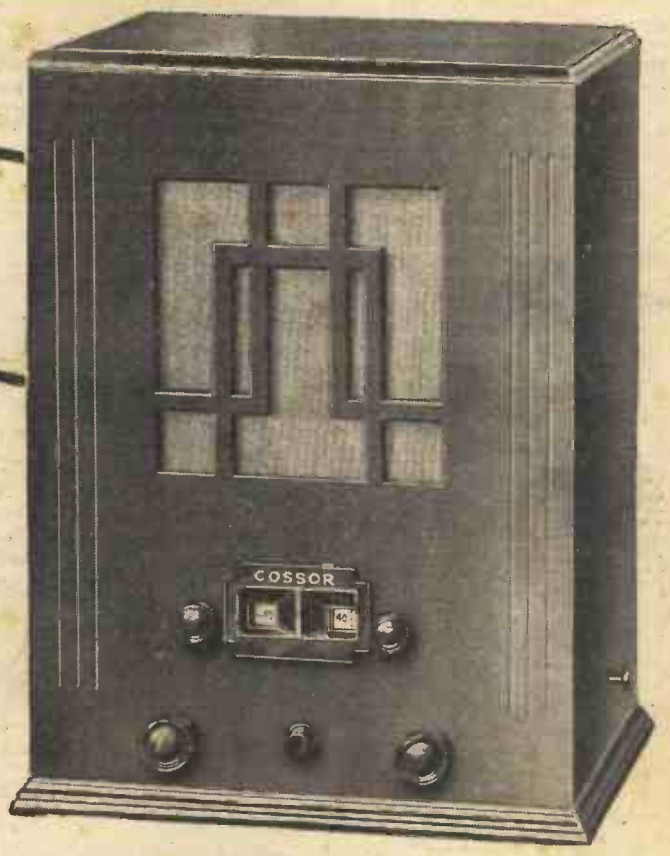

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Kit of Parts for All-Electric Melody Maker Model 337 similar to Model 335 (as illustrated) but for all-electric operation, including Cossor Valves, handsomely finished Cabinet, 18½in. x 17½in. x 10½in., Loud Speaker and all parts. For A.C. Mains only 200-250 volts (adjustable), 40-100 cycles. Price **£10.17.6**

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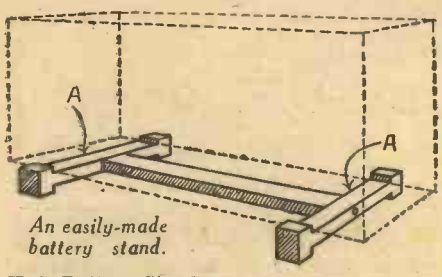


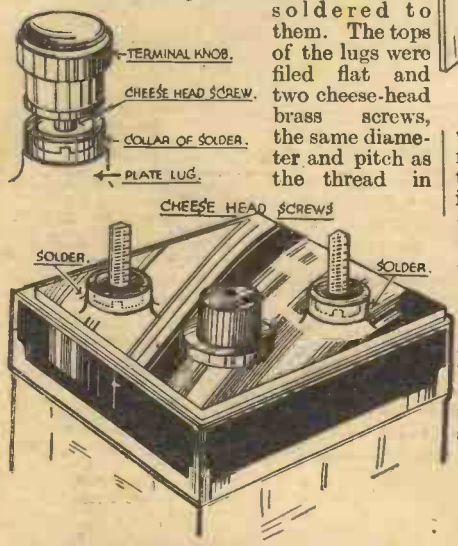
An easily-made battery stand.

H.T. Battery Stands

HIGH-TENSION batteries are still a comparatively expensive item of equipment, and one cannot afford to take any risks that may shorten the life of a big battery through premature deterioration. As damp is one of the things that are detrimental, it is important to keep the battery cool and dry. The best plan is to arrange the battery so that the air can circulate freely all round the outer case. A simple way of achieving this end is to place the battery on a wooden stand that will raise it off the table, shelf, or cabinet-floor on which it would otherwise rest. The battery-stand shown in the sketch can be made very easily at little cost. The end pieces marked "AA" in the sketch can be cut from stripwood 1in. square section, while the central bar may be 1in. wide by ½in. thick. The three strips are assembled with glue and a couple of wood screws or nails. The dimensions of the stand depend, of course, on the size of the battery that is to be accommodated.—NORMAN HURST (Wimbledon).

Repairing Accumulator Terminal Screws

DOUBTLESS many wireless enthusiasts have experienced the trouble of terminal screws on an accumulator breaking off through corrosion. Such terminal screws can be made good by the following method. On referring to the sketch, which is practically self-explanatory, it will be noted that the lugs which are attached to the plates have two screws soldered to them. The tops of the lugs were filed flat and two cheese-head brass screws, the same diameter and pitch as the thread in

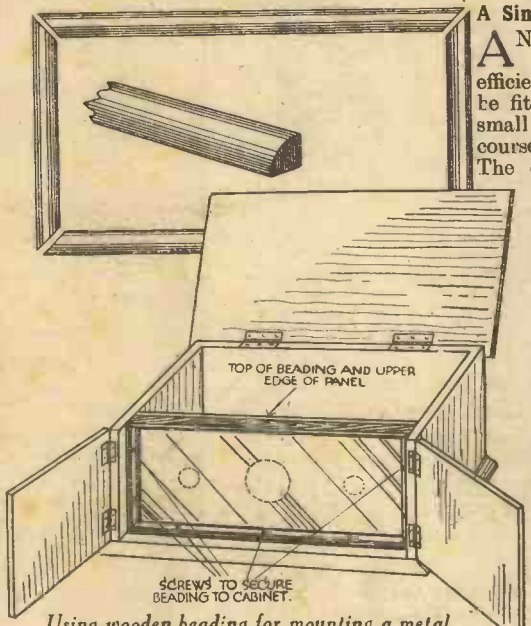


A method of repairing broken terminal screws on an accumulator.

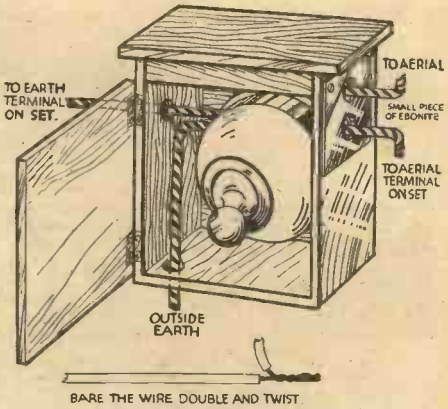
terminal nuts, were obtained. A large blob of solder was then placed on each lug with a soldering iron and the heads of the screws were then tinned and held in position with a pair of pliers, a collar of solder being worked around the heads with a hot soldering iron. The top parts of the collars were afterwards filed flat to give a good bearing surface for the terminal tags. The method was only adopted as a temporary repair, but it has stood up to its work for several months without failing, and appears to be as strong as the original screws. It also has the combined advantage of being easy to repair in the event of breaking again, and the cost of the repair is practically nil.—G. F. BARNETT (Ravenscourt Park).

Mounting a Metal Panel

ALTHOUGH metal panels are not very often used in the ordinary type of broadcasting receiver, they nevertheless have a distinct advantage in preventing hand capacity effects when using a short-wave receiver. The following method of arranging the metal panel without the aid of angle supports is simple, and has an exceptionally neat appearance, completely screening from view any jagged edges which might otherwise be visible. Obtain two (or more according to the size of the panel to be mounted) polished wooden stair rods (costing about 3d. each), as shown in the accompanying illustration. Cut same into four lengths, taking care that the ends of each are cut at 45 degrees. Next, place the lengths around the front of the cabinet and secure by means of screws in the positions indicated. The panel should now be placed in position, and a pencil impression made on same from the front around the inner edge of the beading, which will help as a good guide for drilling the holes which are necessary to hold the panel in place. After drilling these out—also the holes required for the condensers, switches, etc., according to the circuit in use—the panel can then be screwed in position from the rear. If a separate baseboard is used the panel can



Using wooden beading for mounting a metal panel.



An efficient earthing switch.

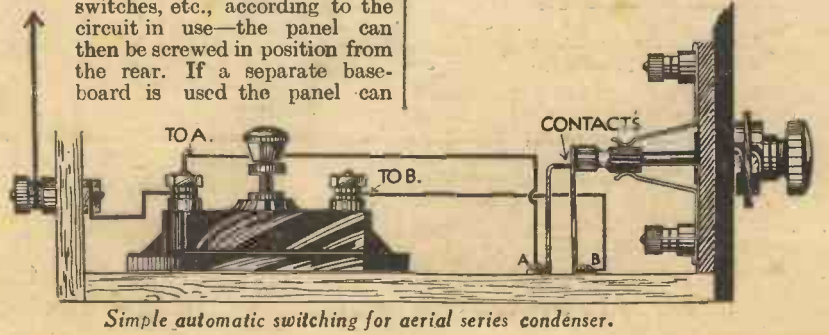
easily be attached to same and the instruments mounted before placing in position in the cabinet.—H. WEARING (Devonport).

A Simple Earthing Switch

AN ordinary house lighting switch of the tumbler type makes a very efficient earth switch. The switch should be fitted outside the house, enclosed in a small box with hinged front, the box, of course, serving to exclude rain and dirt. The connections need little explanation. The lead in should not be cut at the switch, but the wire bared, doubled, and twisted and inserted into one point of the switch, the free end of lead being taken to lead-in tube. The earth lead is treated likewise and connected to the other point of switch, and the free end to earth on set. To operate, switch on for earthing aerial, and switch off to use set.—E. P. FROST (Colchester).

Automatic Switching for Aerial Condenser

MOST owners of inexpensive sets, such as a Det., and 2 L.F., have found that much volume is lost on long waves through the aerial condenser being in circuit, although it is indispensable on medium waves. The majority have some method of shorting it, with a piece of wire or otherwise, but this means fiddling inside the set when it is desired to change the waveband. Here is illustrated a device which automatically shorts the series condenser on long waves only. The device consists of two pieces of springy metal bent as shown, the rear piece being bent over at the top and cut to a point. The length of these pieces is determined by the height of the switch spindle above the baseboard. When the switch is out, for the medium waves, the contacts should come apart, the front one clearing the spindle of the switch. The terminals A B are, of course, connected to the terminals on the aerial condenser.—READER (Walker-on-Tyne).



Simple automatic switching for aerial series condenser.

Connecting Up, and Using the Selectone

By FRANK PRESTON, F.R.A.

NOW that you have finished the construction of your Selectone you will naturally be very anxious to give it a test and see what it will do.

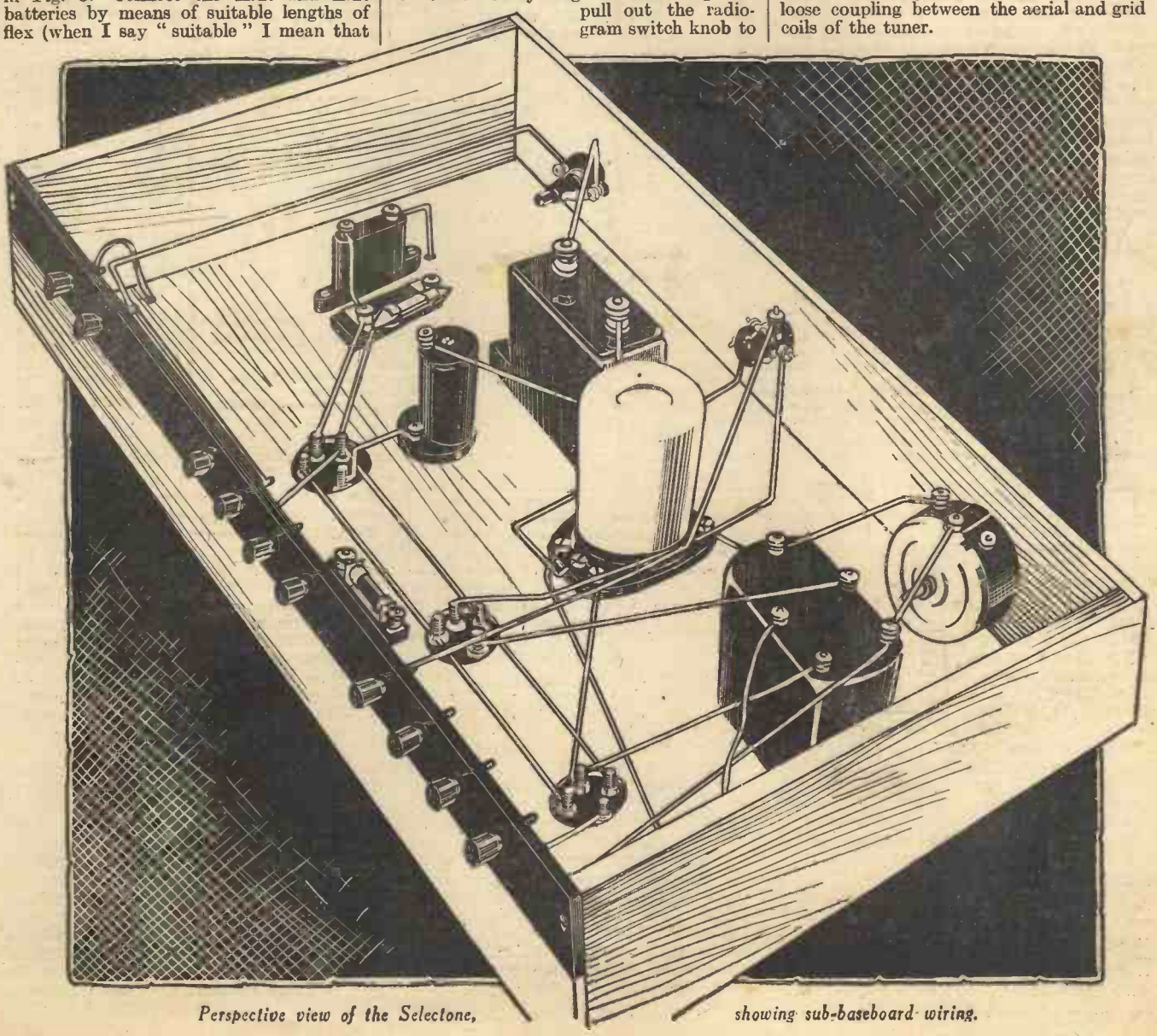
First, fit the G.B. battery in its clip, and put in the wander plugs. Plug "G.B.+" goes into the "+" socket, but the positions of the other plugs will depend to a certain extent on the voltage of the H.T. battery employed. Assuming it to be of 108 volts, "G.B—" should be put in the 1½-volt socket, "G.B—1" in the 3-volt socket, and "G.B.—2" in the 6-volt socket. If a 120-volt battery is to be used, plugs "G.B.—" and "G.B.—1" should be taken to the 3 volt and 4½-volt sockets respectively, whilst plug "G.B.—2" should be put in the 9-volt socket. Now insert the valves into their respective holders as indicated in Fig. 3. Connect the H.T. and L.T. batteries by means of suitable lengths of flex (when I say "suitable" I mean that the lengths must be such that the wires will reach to the batteries, wherever you propose to store them).

Attach the aerial and earth leads to terminals "A" and "E," and then connect two speaker wires to terminals "L.S.+" and "L.S.—"—it doesn't matter which way round the latter wires are connected. The speaker is fitted with an output transformer, having ratios suitable for either ordinary or pentode output valves; in this case the wires should be connected to those terminals provided for "ordinary" valves.

The First Trial

And now we are ready for giving the Selectone a "trial run." Do not put it in the cabinet until you have tried it and so verified everything. Do not forget to pull out the radio-gram switch knob to put the set into the "radio" position, and to put the wave-change switch into the position required—for long waves, push in, and for medium, pull out, the knob.

For a start, put the coil plug into socket No. 1, which provides maximum sensitivity and minimum selectivity. Set the reaction condenser to its minimum (fully anti-clockwise) position, turn the tuning dial to zero and commence to rotate it by means of the slow-motion knob. Continue this until a station is heard and then increase strength by carefully adjusting the reaction condenser. If the condenser is turned too far, the set will oscillate (whistle), so care must be taken not to turn it past the point at which distortion begins. Incidentally, it should be added that oscillation can cause interference to neighbouring receivers, but it is not of a very serious nature, due to the loose coupling between the aerial and grid coils of the tuner.



Perspective view of the Selectone, showing sub-baseboard wiring.

Having brought the signal up to full strength you can adjust the tone control; when set to the maximum clockwise position the resistance is entirely out of circuit and, consequently, reproduction is low pitched and rather boomy, but by turning the knob in an anti-clockwise direction reproduction is gradually raised in pitch until it becomes "thin" and "screechy." Somewhere between the two extremes you should be able to obtain just the tone you require. Do not be misled by the fact that as the control is turned towards the "shrill" position there is a certain reduction in overall volume; this is quite normal.

Overloading

Due to the high amplification properties of the Selectone it is possible to overload the second and last valves when listening to local stations. Overloading is indicated when good reproduction cannot be obtained with any setting of the tone control and can be obviated in two ways. The first is to turn back the reaction condenser, and the second is to transfer the coil plug to a lower tapping (sockets 2, 4 and 5). In one or two cases, where a long aerial is used near to a powerful station, it might be necessary to connect a .0001 mfd. pre-set condenser in series with the aerial lead-in. The latter has not been included in the set itself because it will only be necessary in very rare instances. Overloading could be avoided by replacing the 210 H.L. and 220 P. valves by types 215 P and 230 X.P., respectively, but the latter valves would give less amplification on distant stations besides consuming considerably more high-tension current.

Getting Distant Stations

After having tuned in the first stations, others can be received in a similar manner. Remember, that the set is in its most sensitive condition when it is just off the point of oscillation—indicated by a faint "breathing" sound—and so when searching for very distant or low-power stations, it should be kept in this condition by advancing the reaction knob at the same time as the tuning condenser. For most purposes, however, it will be sufficient to set the reaction condenser roughly, and tune in with the slow-motion knob of the tuning dial only. When two stations can be heard together, selectivity must be sharpened by advancing the reaction condenser and/or by putting the coil plug into a socket of a higher number. The optimum setting of the tone control will be dependent upon the degree of selectivity employed, and will vary for different stations. Of course, it is not essential that the tone control should be altered from, say, its midway position, but by making suitable adjustments, distant stations can be brought in as clearly as the locals. As you are well aware, the latter is quite impossible with ordinary receivers, and explains why distant stations are not usually so clear as the nearer ones.

If you make a note of the dial settings for stations identified, these will be of great assistance in helping you to locate others. Once you have made a log of stations received it will be an easy matter to get any particular one just when you want it. Suppose, for instance, that you have logged Fécamp on 50 degrees. To get it again you will set the tuner to 50, advance reaction almost to oscillation point, and slightly re-tune, if necessary. Tuning can be carried out with great accuracy because the micro dial gives a reduction drive of 100 to 1. In other words, the knob must be turned through fifty complete revolutions to drive the pointer from 0 to 180 degrees. Moreover, tuning is so sharp that many stations can be tuned in and out again in little more than half a degree.

After having had some experience of tuning you can try altering the grid-bias voltages to plugs "G.B.—" and "G.B.—2." Before making any changes, switch off the set, and then try moving one plug at a time. Remember that the H.T. consumption will be least when the maximum amount of bias is employed; therefore, use the highest G.B. voltages which give good results.

Using A Pick-Up

The Selectone can be used as an excellent gramophone amplifier by connecting a pick-up to the terminals provided, and pushing in the radio-gram switch knob. Find the best value of grid-bias for plug "G.B.—" in the same way as before—it will probably be either 1½ or 3 volts.

If it is required to use the tone control on gramophone reproduction, the pick-up volume control must be of rather lower resistance than normal. When a volume control is not used, the pick-up should be shunted by a resistance of suitable value—generally about 30,000 ohms for a low resistance instrument, and 150,000 ohms for a high resistance one.

LIST OF COMPONENTS FOR THE SELECTONE

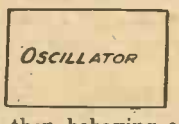
1 Vibrant plywood panel 14in. by 8in.
1 Utility Standard .0005 mfd. condenser.
1 Utility type W. 131 micro-dial.
1 Lissen .00015 mfd. differential condenser.
1 Colvern type "T.D." coil.
1 Lissen 3-point wavechange switch.
1 Telsen on-off battery switch.
1 Wearite type "G.C.O." radio-gram switch.
1 Lissen 5,000 ohm potentiometer.
3 Eddystone chassis mounting valve-holders.
1 T.C.C. .0002 mfd. fixed condenser.
1 Dubilier 3 megohm grid leak.
1 Dubilier grid leak holder.
1 Telsen Standard H.F. choke.
1 Benjamin Transfeeda.
1 T.C.C. 2-mfd. condenser.
1 Varley Rectatone transformer.
1 Belling Lee baseboard fuseholder with 60 m.a. fuse.
10 Belling Lee "Junior" terminals; 1 each marked A, E, L.T.+, L.T.—, H.T.—, H.T.+, L.S.—, L.S.+ and 2 marked Pick-Up.
6 Belling Lee wander plugs; marked G.B.+, G.B.—, G.B.—1, G.B.—2, H.T.+, H.T.—.
1 Strip Becol ebonite, 14in. by 1½in.
1 Bulgin G.B. battery clip.
1 Coil Glazite connecting wire.
1 short length flex.
1 5-ply baseboard, 14in. by 8in.
2 pieces hard wood, 7½in by 3in.
1 piece 3-ply, 14in. by 2in.
Approximate total cost—£4 10s. 0d.

Accessories.

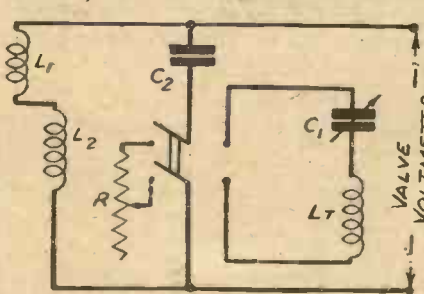
1 Camco "Excelsior" or "Aston Senior" cabinet.
3 Cossor valves; 1 type 210 Det. (metallized), 1 210 H.L. and 1 220P.
1 Ediswan 9v. G.B. battery.
1 Ediswan 105v. super capacity H.T. battery.
1 Ediswan 2v. 40 a.h. accumulator.
1 Celestion Soundex permanent magnet moving-coil loud-speaker.

MEASUREMENT OF H.F. RESISTANCE

THE following is a method by which the H.F. resistance measurement of tuning coils can be accurately obtained. In the diagram, L_1 is the coupling coil to oscillator, L_2 C_2 any coil and condenser to tune, R the H.F. resistor, L_T the coil under test, and C_1 a good condenser to tune L_T.



Firstly, with switch in R position, tune L_2 C_2 to resonance with oscillator. Secondly, throw over switch and tune L_T C_1. This circuit is then behaving as a pure resistance in the L_1 L_2 C_2 circuit. Therefore, by returning switch to R position and adjusting R until the same reading is obtained on the valve voltmeter, the R thus obtained is the effective resistance of L_T C_1 at the frequency of measurement. It is advisable on obtaining an approximate value for R, to retune L_2 C_2 to eliminate any error of tuning due to any large alteration of R, and also to check tuning of L_T C_1. The resistance thus obtained is the effective resistance of coil L_T and condenser C_1, and if C_1 is extremely good, the resistance can be taken as the resistance of the coil for most purposes. This error, however, can be corrected as follows.



The circuit arrangement for measuring H.F. resistance.

Obtaining the Power Factor

By means of a shearing bridge, or similar low-frequency method, the power factor of the condenser C_1 can be obtained accurately at any capacity within its range. The capacity of measurement should be noted. Now for condensers of this nature, R w C can be assumed to be the power factor. The error thus introduced will be of the order of .08 per cent. on a commercial broadcast condenser. Again, $R w C^2$ is a constant for condensers of this type for all frequencies; so if the power factor obtained is multiplied by the capacity of measurement, a value is obtained for $R w C^2$. In the case of the above mentioned condenser, this would be about 50×10^{-14}.

Referring to the L_T C_1 circuit again, C_1 (in farads) to tune L_T is known from the calibration of the condenser, $w = 2 \pi f$ is known from the calibration of the oscillator; so the resistance of C_1 can be obtained at the frequency of measurement. This value is then subtracted from the obtained resistance of L_T C_1 circuit, giving the effective resistance of L_T. The error due to the switch can be neglected, for it is common to resistance and L_T C circuits. It is also advisable to screen everything except the L_T C_1 circuit in order to avoid direct pick-up in this circuit, which would give a lower effective resistance, or possibly even a negative resistance.

PRACTICAL HINTS ON

WIRELESS RECEIVER DESIGN

The Conclusion of the Notes on Lay-out and Construction

By JACE

The Wiring

AFTER the general layout has been decided upon, all the components should be mounted loosely by single screws, and the panel fixed in position; any slight alteration can then be made quickly before finally putting in the remaining screws and making everything quite secure.

The wiring must be done next. In a simple set, where very few wires are required, bare 16 gauge tinned copper wire is most convenient. If the wiring is at all involved, or if the set is mains operated, it is best to use insulated connections. The bare wire can be insulated by passing it through suitable lengths of systoflex sleeving; or insulated material, such as Glazite, can be employed. In any case the wire will be coiled when bought, so it should be straightened by holding one end in a pair of pliers and pulling it through a duster held in the hand. Another way is to grip the end of the wire in a vice and pull steadily until it stretches slightly. There is an old and fairly well-known rule to the effect that wires in the grid and plate circuits of valves operating at high frequency should be kept as far apart as possible, and should not run parallel to each other. This rule is still as important as ever, and many cases of H.F. instability and uncontrollable oscillations can be traced to its neglect.

Shielded wires are often useful if employed judiciously, but, generally speaking, they should not be used for grid-circuit connections, because the screening might have some effect on tuning. Wires of this kind are particularly useful for making connection to the anode terminal of a metallized S.G. valve, or for connecting the anode terminal of the detector valve holder to the reaction condenser; in either case they tend to improve H.F. stability. When building a portable set it is very desirable to use shielded wire for making loud-speaker connections, since it prevents them from "picking up" H.F. currents from the near-by frame aerial. In all cases the braided metal forming the screen should be effectively connected to earth, for otherwise it will not serve its intended purpose. The simplest way to make the earth connection is by means of a length of thin wire bound round and soldered to the braid as shown in Fig. 7.

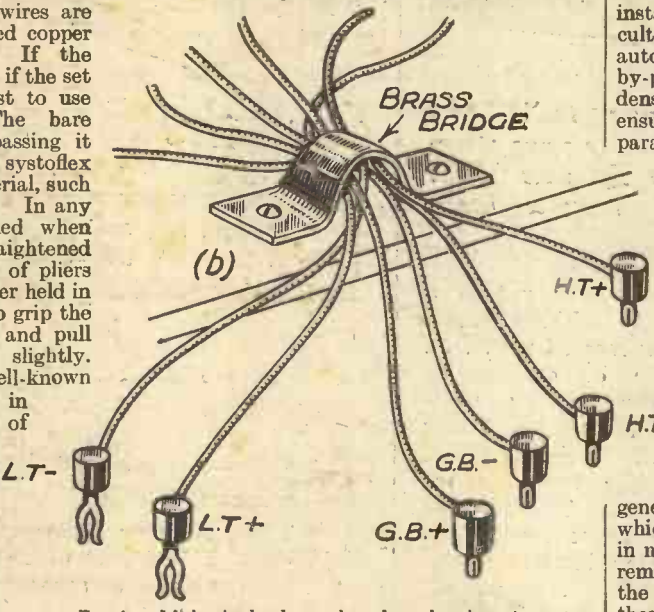


Fig. 6.—Multiple leads anchored to baseboard by a metal bracket.

Another practical point in wiring up a receiver concerns the cores of L.F. transformers and chokes; where possible they should be connected to earth. Some makers provide an earth terminal specially for this purpose, whilst others connect one of the holding-down screw eyelets to the core so that an earth connection can be made to the holding-down screw. Where neither of these provisions is made, a wire can often be attached to a core-clamping bolt.

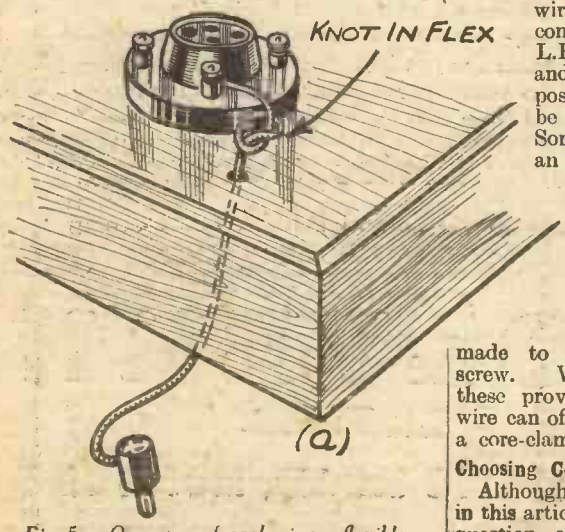


Fig. 5.—One way of anchoring a flexible battery lead.

Choosing Components

Although it is not intended in this article to deal with the question of choosing components, it might be as well to refer to a few of the more important ones which can have a very marked effect on the set's performance. Among these latter must be classed the fixed condensers used to by-pass the H.T. supply to the screening grids of S.G. valves, and also that used for coupling a pair of band-pass coils; in each case the components must definitely be of the non-inductive type. Ordinary condensers might cause various kinds of instability which would probably be difficult to trace. Resistances used to provide automatic grid bias to S.G. valves or for by-passing the band-pass coupling condenser should also be non-inductive to ensure that they shall not be the cause of parasitic oscillation or similar trouble.

Ordinary push-pull switches should on no account be employed for connecting the mains supply; their contacts would quickly burn away due to sparking, and the danger of receiving a shock would be very great. Mention of this matter might appear superfluous, but I recently saw the result of a mistake in choosing a mains switch. Luckily the constructor concerned escaped without injury, but his set caught fire from sparks caused by bad contact at the switch points.

Of course, it should be borne in mind that manufacturers are, in general, well aware of some of the points which have been raised in this article, and in many cases have made some attempt at removing the difficulties encountered by the home-constructor. Quite a number of these are, however, of the home-constructor's own making, and can be obviated by careful thought when planning a receiver, or adhering strictly to the instructions laid down by the designer of the receiver which is being built.

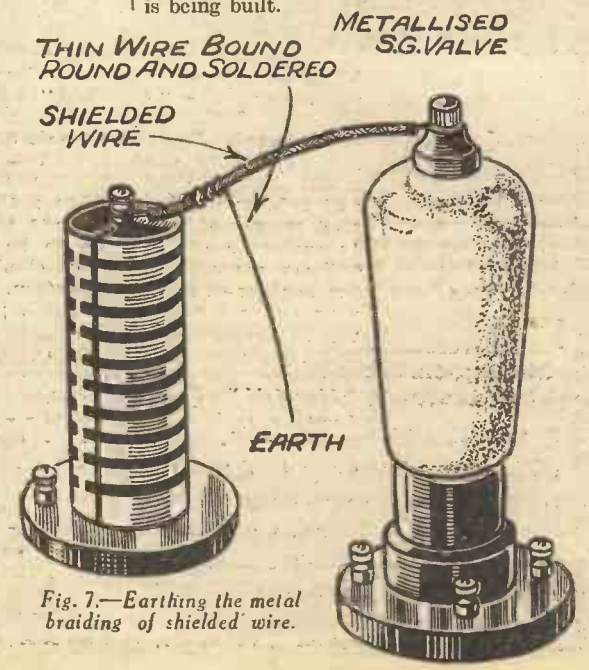


Fig. 7.—Earthing the metal braiding of shielded wire.

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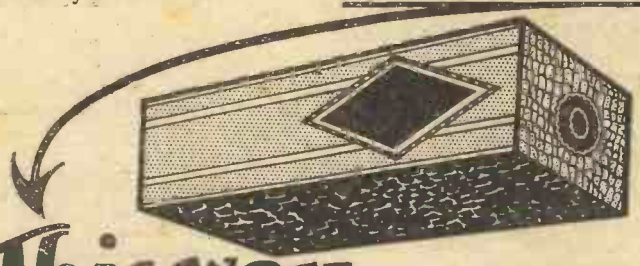

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CHOOSING AND USING

In this Article FRANK PRESTON, F.R.A., Deals with the Va... the Point of V...

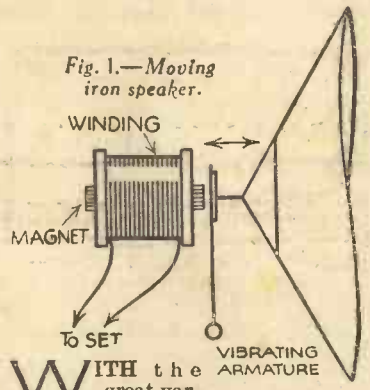

Fig. 1.—Moving iron speaker.

WITH the great variety of loud-speakers now available, the choice of any particular instrument is an extraordinarily difficult and somewhat embarrassing proposition, unless one has a fair knowledge of the relative merits of various types. And one's troubles are more likely to be intensified than relieved if the help of friends (however well meaning) is sought.

The musical friend who has a powerful set will say, "Really, old boy, you can't *expect* to get good reproduction unless you have a moving coil; you will miss the bass altogether," whilst the man with an inexpensive home-made three-valver will declare that "moving coils are all right for those who like a boomy kind of music, but give me a balanced armature every time." Another will be quite emphatic in his aversion for both moving coils *and* balanced armatures. "The inductor has 'em both whacked," he will say. Among the circle of friends one is sure to meet the man of small means who started wireless with a crystal set, graduated to a single-valve-with-phones, and later managed to scrape together a three or four valve set and to buy a horn type of speaker. This is the real enthusiast without doubt, and he will probably tell you that, although he has heard scores of speakers on dozens of sets, he has not yet found one he likes as well as his own. In the end the intending purchaser will be more perplexed than ever, and will either change his mind about buying a speaker or will go to the nearest dealer, put a couple of pounds on the counter and ask for "the best loud-speaker you can give me for the money."

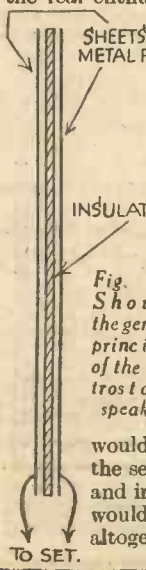

Fig. 5.—Showing the general principle of the electrostatic speaker.

Obviously the ideal way to choose a speaker would be to try one of each kind on the set with which it is to be used and in one's own home. But that would be most impracticable, if not altogether impossible. I therefore propose to discuss with you the pros and cons of the five or six different patterns, so that you can decide which will best suit your own conditions. Having settled on the type, I shall recommend you to hear a few different makes of that type in your own home and then decide which pleases you most. It is impossible to be dogmatic or specific regarding the matter of choice because individual tastes are, after all, of most consequence. And besides, you might be prepared to spend five pounds, or even more, or the permissible outlay might be restricted to as many shillings.

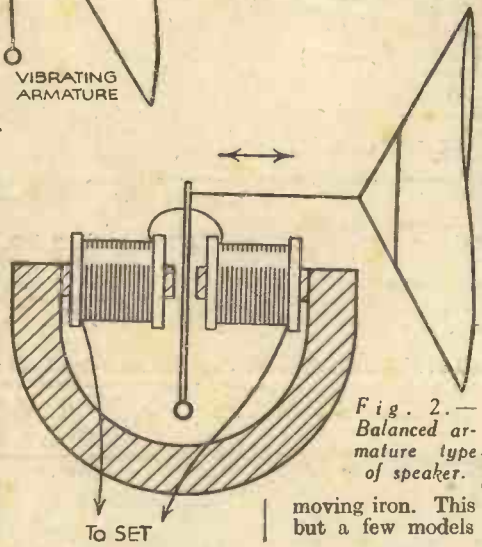

Fig. 2.—Balanced armature type of speaker.

"Moving Iron" Speakers

Let us make a start by considering the very cheapest type, the moving iron. This is now almost obsolete, but a few models are available at about five shillings. The "cheapness" is not confined to price, however, but is reflected by performance; the moving iron will give very little bass and will probably have a "resonance peak" in the region of 3,000 cycles. The latter will have the effect of rendering the reproduction of violin music "hard" and metallic and will probably make a piano sound more like a harp. On the other hand, this type of speaker is undoubtedly sensitive and might give better results than most on, say, a two-valve set which has a very small output of signal energy.

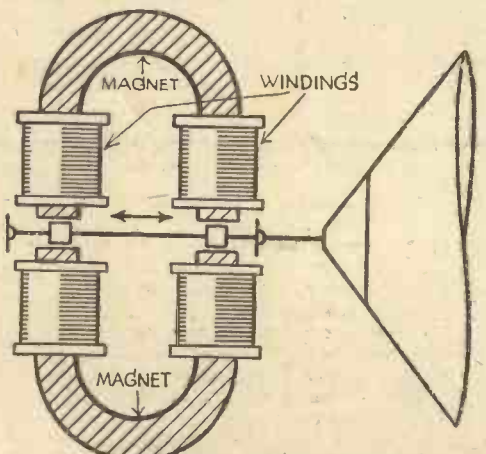

Fig. 3.—Inductor dynamic speaker.

The Balanced Armature

The balanced armature is really an improved form of the moving-iron speaker, which it has almost entirely supplanted. It is undoubtedly the most sensitive type of speaker obtainable, and a good sample (costing about a guinea for the unit and chassis) is capable of giving quite a good performance on frequencies from about 150 to 5,000 cycles. The very form of construction makes it impossible for a balanced-armature speaker to do justice to bass notes; if good sensitivity is to be obtained, the vibrating reed (see Fig. 1) must be close to the pole pieces, and its movement is consequently restricted. In other words, the diaphragm (or cone) can only move through a small distance. As you are well aware, the diaphragm vibrates more slowly at low than at high frequencies, and thus, if the sound output is to remain more or less constant throughout the range, a greater diaphragm movement is necessary in the former case. The result is that, if a balanced-armature speaker is used with a fairly powerful set, there is every probability that a certain amount of "jarring" or "grating" will be experienced on very low notes, due to the armature actually touching the pole pieces. Like the moving iron, the balanced armature almost invariably has a resonance peak round about 3,000 cycles. This is not always a disadvantage, because very often the low-frequency amplifier does not give good response to the higher notes, with a result that the over-amplification due to the speaker is automatically cancelled out. Of course, tone correction devices could be made to "iron out" the resonance peak, but they would probably prove too costly.

Despite the disadvantages stated above, the balanced armature has much to recommend it, especially for a not very powerful two or three valve battery set and when the question of price is of distinct importance. It will give good reproduction of speech, whilst music is rendered with a certain crispness, even though it does show rather a lack of "body" and "depth." This type of speaker is undoubtedly better for a set of the kind referred to than is a similar-priced instrument in the moving-coil class.

Inductor Dynamic

An inductor-dynamic speaker is almost equal in sensitiveness to those we have

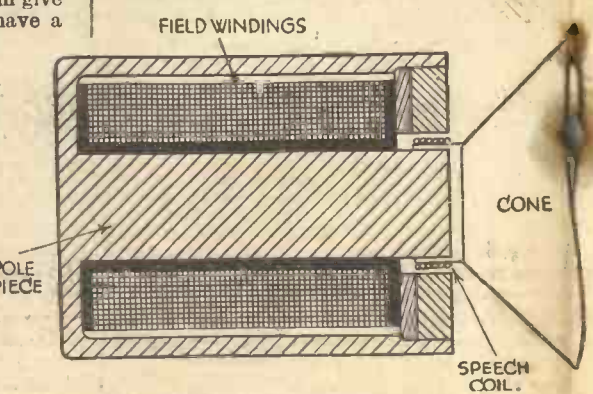

Fig. 4.—Energised moving-coil speaker.

G YOUR LOUD-SPEAKER

rious Types of Loud-speakers and Examines Them from iew of the User.

already considered, and at the same time is able to give good bass response, due to the fact that the armature moves parallel to the pole pieces and is therefore not restricted by the latter. (If you are not familiar with the construction of this type of speaker, you will get a good idea of the salient features from Fig. 1.) The inductor is probably the best kind of speaker for a battery set of medium power, but it is, of necessity, somewhat expensive. At the same time a good specimen will provide a noticeably greater volume than will a similar priced moving coil for a given input of sound energy. Moreover, the inductor will handle a large volume without distortion, and is in this respect equalled only by a moving coil. Perhaps the only "fault" in the opinion of many is that the inductor has a tendency to give over-emphasis to low notes and so to produce rather a "boomy" effect. This criticism does not apply to every specimen, and, in any case, the extra bass response is a definite advantage when the set itself rather favours the upper register.

Moving Coils

And now we must pass on to the moving coil. This type of speaker has gained immense popularity during the past few years, and I personally think its merits have in many ways been grossly exaggerated; the moving coil is certainly not every set's "meat." A good moving coil, if used with a fairly powerful set having a super power output valve, will undoubtedly give the best possible form of reproduction, but under any other circumstances its superiority is by no means a foregone conclusion. In the first place a moving coil is never quite so sensitive as a balanced armature, although one taking its field current from the mains does not fall far short. For this reason I should strongly recommend any set user who has a D.C. mains supply to employ a moving coil with any except the smallest set. When the mains supply is A.C., however, the cost of the necessary rectifying equipment brings the price of the complete speaker up to a fairly high figure. And that is not justifiable with most domestic receivers, because an inductor would give equally good results for a smaller expenditure. Of course, a separate rectifier is not required if the set is an all-mains one consuming upwards of, say, 40 milliamps H.T. current, because in that case the field winding of the speaker can be energized satisfactorily by using it as a smoothing choke in the high-tension circuit (see Figure 6). By employing this arrangement an actual economy would result, due to the saving of a separate smoothing choke, and thus a moving coil would be the ideal speaker.

In addition to those speakers whose fields require to be energized by some external voltage source, we have the permanent-magnet models which have recently been brought to such a high state of perfection. Despite the many improvements, however, the small permanent-magnet moving coil is distinctly less sensitive than a good balanced armature, and although it does give somewhat better reproduction than the latter, it is not quite so suitable for a battery set having only a small power valve in its output stage. At this juncture it might not be out of place to explode a common fallacy—a large speaker does *not* require a greater input power than a small one of similar type for efficient operation, and, as a matter of fact, the very reverse is generally the case; a larger speaker has a more powerful magnet system and is consequently more sensitive. This applies to speakers of all types.

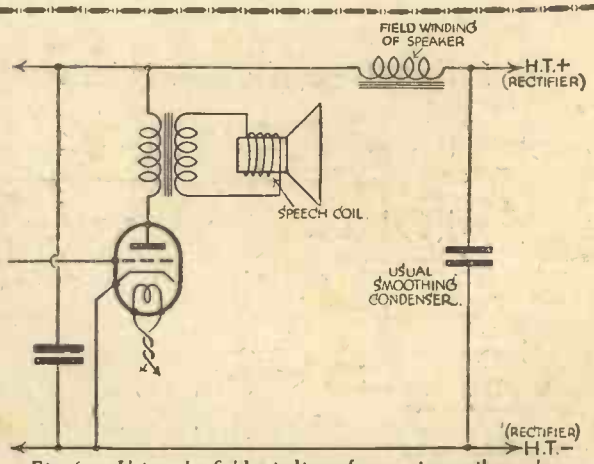

Fig. 6.—Using the field winding of a moving-coil speaker as smoothing choke in A.C. receiver.

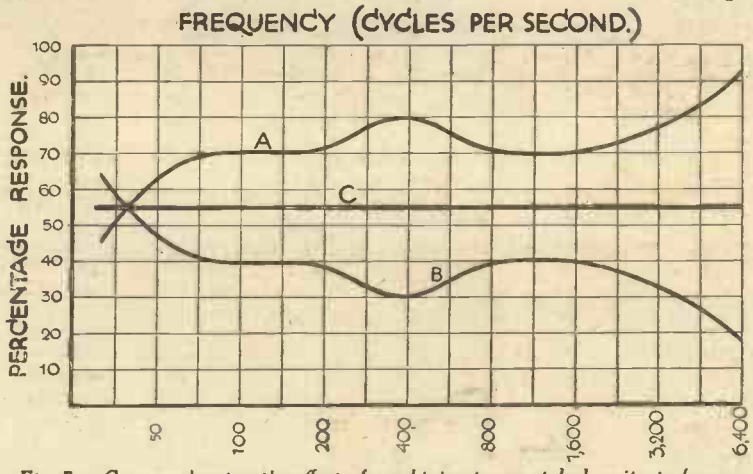

Fig. 7.—Curves showing the effect of combining two matched units to form a dual-compensated speaker.

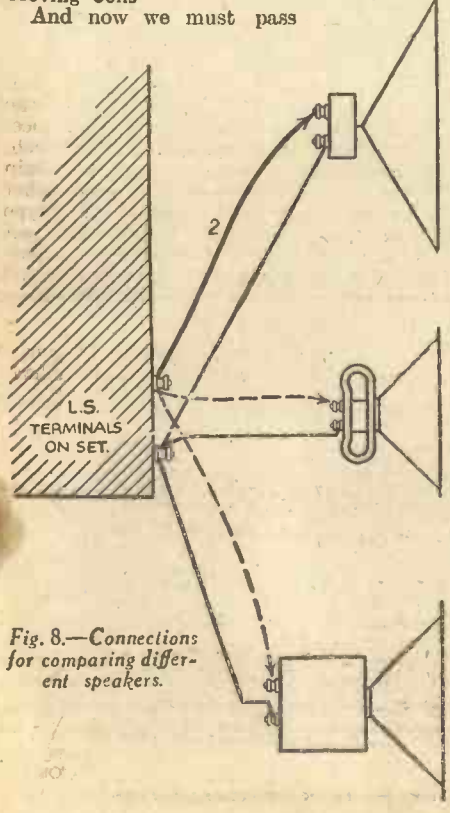

Fig. 8.—Connections for comparing different speakers.

For Larger Sets

For use with a receiver having a power output in excess of about 500 milliwatts the speaker must be either an inductor or a moving coil whilst for an output greater than 1,000 milliwatts or so a moving coil is essential. But as an output of over 1,000 milliwatts could only be obtained from a fairly powerful mains-driven set, a moving coil would be chosen in any case because its field could be energized from the H.T. supply.

After reading the last two paragraphs you might have drawn the conclusion that the really small permanent-magnet moving coil is merely an "extra" for which we can find no special niche. That is not the case, as any reader may judge by the numerous examples of this class of speaker on the market. It is eminently suitable for the person who requires "correct" and not merely "pleasant" reproduction from a medium-power set and at the minimum of expense. As we have seen before, it is not quite so sensitive as speakers of other types and is thus suitable only when the set gives a fairly generous output. In all fairness it should be pointed out that, although the type of speaker under observation is considered rather insensitive as judged by present-day standards, it is immeasurably more sensitive than any type of speaker obtainable only a few years ago.

(To be continued)

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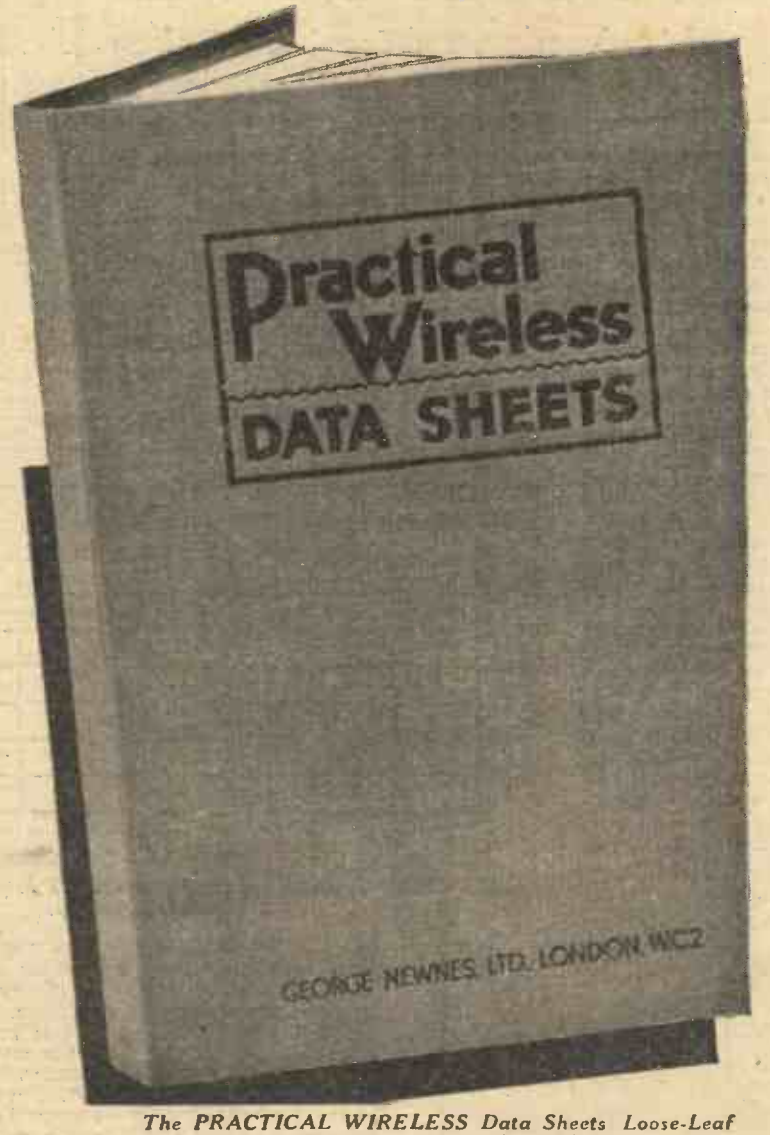

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Data Sheet No. 3—
Resistances - - - Dec. 31st, 1932

Data Sheet No. 4—
Mains Transformers - Jan. 7th, 1933

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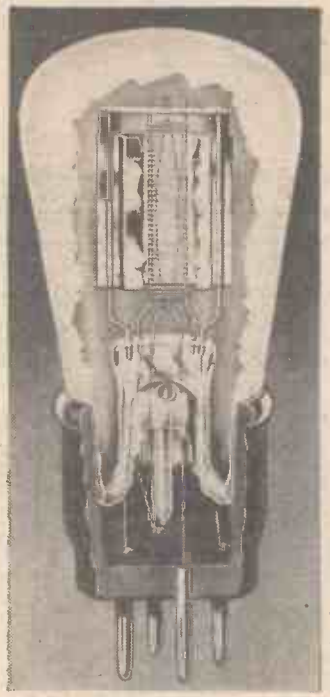


Fig. 1.—Reference to this sectionised valve will help you to follow the descriptions in this article.

THE INSIDE OF THINGS

How Radio Valves are Made

A Tour of a Modern Valve Factory

By A. E. OAKLEY

JUST as wireless broadcasting and its enjoyment by the individual was made possible solely by the invention of the thermionic valve, so its development has been technically due to valve development, and to little else. Transformers, condensers, and induction coils were with us many years ago, and have altered little in a decade; but the valve has improved fundamentally, and developed almost out of recognition. First the diode, then the triode the screened grid and the pentode, while, doubtless sextodes and octodes are not very far away. It is not many years back that our four- and six-volt valves used a minimum of .7 amp., and their brightness almost illuminated the wireless den. Sometimes they were "soft," and a few volts too many on the anode caused them to "blue glow" like a mercury vapour lamp, and then they produced the most horrible distortion. In spite of this, a soft valve was a lovely detector if you treated it kindly.

But this story concerns the valves of to-day; for, having received an editorial command to look round a modern valve factory in the interest of "P.W." readers, I duly presented myself on a cold December afternoon at the great Cossor factory at Highbury, London, N. Here, after a chat with the works manager, I am taken in hand by a high technical official. If you, gentle reader (can anyone tell me why readers must be referred to as "gentle"?), will accompany our tour we shall be more than pleased.

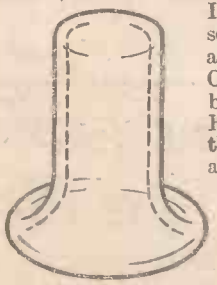


Fig. 2.—The flange is the foundation on which the valve is made

The floor forming the major portion of the "battery valve section" is not divided into rooms or compartments. Brightly illuminated, with hundreds of more brilliant cones of light striking down on an army of operatives at benches and machines, the jewel-like sparkle of racks of glass and metal parts, it stretches before us in endless perspective. Over all is a noise, not loud, but insistent, due to the click, clack of many machines, the roar of many flames; and a comforting heat.

Automatic Flange Machine.

Manufacture may be said to start at the automatic flange machine. This, typical of many other of the machines we shall see, performs all the many operations essential to the part it makes at one time. Circular in form, it resembles somewhat a multi-spindle vertical drill. The circle of chucks, which carry long lengths of glass tube about ¾in. in diameter, revolve continuously, and also travel around the machine, halting a few moments for each operation. Successively hotter gas jets, impinging on the bottom of the tube, bring it gradually to a working heat; dies or formers move up and spin the plastic "metal" into a flare and finally a flange; a steel cutter parts the flange from the tube, and more gas jets smooth the edges and anneal the glass. The finished flange, which now drops out of the machine, is the foundation on which the valve is gradually built up.

Fig. 3.—Winding the grid.

The Automatic Foot-making Machines

These machines are larger circular apparatus of somewhat similar form. Let us follow the operations of one of them. It is fed with the flanges we have just seen made, the composite lead-in wires (which are to connect the internal elements with the external pins), and the small glass tube which will be used later for evacuating the air. In its rotation the flange is several times heated, and squeezed between jaws, thus forming the "pinch" and sealing the wires tightly into their precise position. At this stage the end of the exhausting tube has also been sealed in the pinching process, and it needs to be opened out in order to connect with the bulb interior. So at the next stop more hydrogen jets get to work, soften the glass at the right place, and at the next operation air pressure is applied to the tube and blows the passage free. The tube is then smoothed. Having watched, almost with awe, the intricate operations of this massive machine, we are forced to smile at the slender little arm which picks out the finished foot, deposits it in a shoot, and swings back for another. The foot slides down the incline, and as it nears the bottom we see that it must topple over and smash. But no; a wire check over its path just touches the tip of the evacuation tube in time and corrects the angle, to our great relief.

We have just seen these sealed into the foot, and they may seem small items. Actually they have involved much thought and invention. You may not know, perhaps, that copper, though an excellent conductor, will not permit a tight seal in glass, owing to its widely different heat-expansion coefficient. Platinum is the only suitable metal, and that is too costly. We will walk over to another section and see how this problem is solved. Before us a machine is working, unattended, which looks rather like a light lathe. At opposite

(Continued on page 853.)

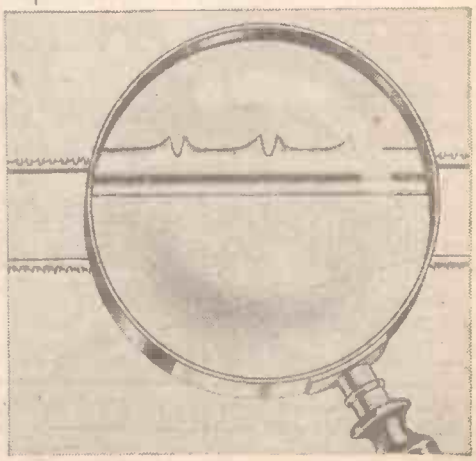


Fig. 4.—The support wire is grooved to receive the grid wire.

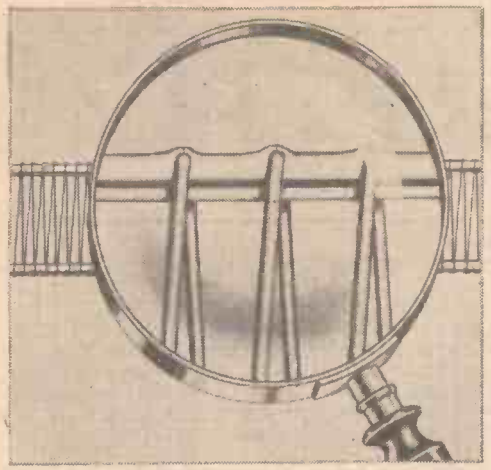


Fig. 5.—Finally the grooves are burred over, fixing the grid wires immovably.

HOW VALVES ARE MADE

(*Continued from page 851.*)

ends are reels, one containing fine copper, the other heavy nickel wire. The two wires are drawn together, passing through serrated fibre jaws to ensure dead straightness, till their ends, pointing towards each other and in line, have a gap of about 5/16in. Immediately before us is another reel of wire. A tiny piece of this is snipped off, held in fingers like a calliper, and positioned in line between the other two. Tiny oxy-hydrogen jets impinge on the four ends, the side wires are pushed into contact with the added section, snipped off, and the lead-in wire, of three sections welded together, is dropped into a receptacle. The nickel part will probably be an anode support, while the small section is of borated copper with a special core, this composite wire having the correct expansion coefficient to ensure an airtight seal. The motions in this machine are electro-magnetic.

The Hydrogen Furnaces

The next appliances to attract our attention are the hydrogen furnaces. In these are placed the electrodes and other interior metal parts, which are subjected to a high temperature in order to drive off air particles imprisoned in the surface of the metal, and which might otherwise be released during the working life of the valve. At the same time every trace of organic matter is driven off, and the parts made chemically clean. As the intense heat would oxidize and destroy these delicate parts if air were present, an atmosphere of hydrogen is maintained within the furnace; thus the temperature may be taken to very nearly the melting point of the metals under treatment. At some little distance from the furnaces we notice the large, easily-read dials of the pyrometers, which enable the attendant to keep an eye on the temperature, which is automatically controlled. These are really large voltmeters, operated on the principle of a thermopile and, of course, calibrated in degrees centigrade. Next in order, and startling in its ingenuity, is the machine employed for—

Making the Grid

The automatic grid-making machine rather resembles a lathe in general form, and, looking at the "head," we see two stout wires fed out parallel to one another. These are the grid supports. They commence to revolve, a finer wire is wound over them, and in a few seconds a long length of grid is completed. But, unless we knew what to expect, the essentials of this seemingly simple operation have escaped us. Let us watch more closely while another section is made. A cutter slots the outsides of the support wires as they revolve, the mesh wire is wound into the slots, a burring tool presses upon and seals the wire immovably into the slots—for the length of a single grid only; then it recedes, misses a few turns, returns to seal another grid length, and so on, till the section of a dozen or so grids is finished. This is so that the mesh which is not actually required at the ends of the grid can be easily removed later. This mechanical method of fixing the grid wires to the supports has certain important advantages over welding.

Do not imagine, from what you have seen so far, that this is entirely a factory of robots, for the building up of the electrode assembly is very largely the work of nimble fingers and keen eyes. Let us walk through a part of the assembly department.

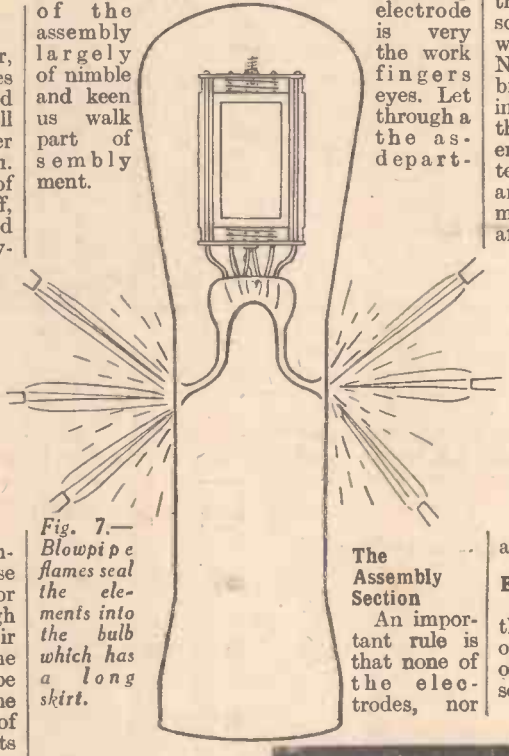


Fig. 7.—Blowpipe flames seal the elements into the bulb which has a long skirt.

The Assembly Section

An important rule is that none of the electrodes, nor any part of the mount which will be inside the bulb, may be touched with the hand, for this would largely undo the work of the furnaces; so gloves are generally worn, and the small parts handled with forceps. Here is an operator welding on filaments. A "foot" is laid in a jig, the end of a reel of filament wire held with forceps on one of the lead-in wires.

A slight pressure of the operator's foot, and the electrode of the spot welder presses down on the junction; a tiny flash and it is done. Flying fingers wind the wire round the jig to the other lead-in wire, the pivoted jig rocks into position, and the second weld is made, all in far less time than I can tell it. These filaments are the finest in general use, the "point one." We take a piece of the filament wire in our hands, and are surprised at the force required to snap it.

Farther along, operators are mounting grids, a somewhat similar process. But now comes a delicate operation. The filament must be immovably held in that narrow space within the grid. Were it to touch while in use, the valve would be finished, and even the slightest movement would alter the valve's characteristics, or make it microphonic. Looking at Fig. 1, you will see that the filament is apparently pulled towards the grid supports at two points on each side. So it is, with tiny pieces of wire, ending in a porcelain hook. The Cossor girls are marvels of dexterity. Eyes can hardly follow the operations of picking up these microscopic pieces, hooking the filament, and welding the hook in correct position. Next is fitted the mica distance piece or bridge, which plays so important a part in locking the elements in position, then the little spring hook which holds the top end of the filament, and automatically tensions it. Anodes are now welded on, and also the "getter" plate (of which more anon), and the internals of our valve are complete.

Sealing-in Machines

This is another circular robot, on the many spindles of which the operator places the complete mounts, electrodes uppermost. Over them are placed the bulbs, with long sleeves or extensions, as shown in Fig. 7. As the machine turns, the spindles also revolve, hydrogen flames of progressively increasing intensity play upon the junction of the bulb and flange. Ultimately the sleeve drops off, and the valve, looking now something like the real thing, is removed from the machine, and its spindle refilled.

Exhausting

The last big operation, and probably the most important of all, is carried out on a huge machine rather reminiscent of the smaller "merry-go-round" one sees at village fairs. The lower platform

(*Continued at foot of page 855.*)

Fig. 6.—The valves are tested for performance and characteristics.

GILBERT E. TWINING on

SOME INTERESTING WIRELESS FACTS

of Particular Interest to the Beginner

An Article Explaining the Working of Certain Components Incorporated in the Make-up of a Receiver.

IF the owner of a set has any inclination to understand the "Why and the wherefore" of the several different parts which are necessary in his set for the faithful reproduction of wireless, then the following article should help to enlighten him on several points in this direction. All the illustrations are drawn in pictorial form as well as in theoretical representation, therefore making them very easy to follow, the intention being to enable the reader to understand and interpret their positions in wireless theoretical circuits. Perhaps the most important items in a set are the batteries, for it is from these that the set is energised, and the valves made to function correctly.

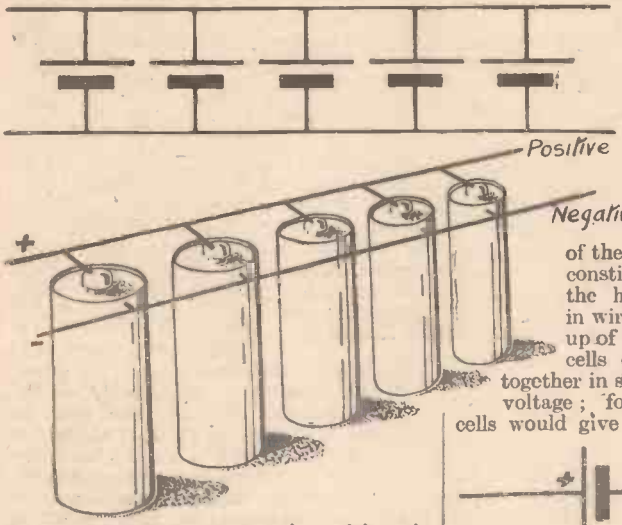


Fig. 2.—Voltage remains unchanged but the capacity is the sum of all the individual capacities when cells are joined in parallel.

Primary Batteries

A simple battery has two elements, positive (plus) and negative (minus); the work of these two plates when immersed in acid is a chemical action which creates an electron shortage—an electron is a very minute electrical charge—with the result that one plate, and this is the positive, becomes shorter of electrons than the negative plate. The very word positive means an electron shortage, whilst that of negative means an excess of electrons. It may be understood then that if the battery is connected to a closed circuit, current will flow from the negative to the positive in an attempt to regain the balance of electrons. This chemical action, however, will tend in time to eat into, and eventually destroy, the negative or zinc element, and the life of the battery is finished. This constitutes the construction of the high-tension battery used in wireless practice. It is made up of a number of these primary cells of 1½ volts each, joined together in series to obtain the desired voltage; for example, 80 of these cells would give 120 volts. Series means that the positive of the first cell is the positive or + of the battery, the negative of this cell being joined to the positive of the second cell, negative of which goes to the positive of the third, and so on until all the cells are connected, the last cell of course, ending with negative or — (see Fig. 1). This type of battery is always termed a "dry" battery, but in point of fact the acid is composed of a special paste and is not actually dry; this chemically attacks the zinc container, which is the negative element, the positive being a carbon rod which goes through the centre of the cell. If the cells are joined in parallel, that is to say, all the positive elements connected together and all the negative elements connected together (see Fig. 2), then the voltage would remain unchanged, but the resultant capacity would be the sum of all the individual capacities.

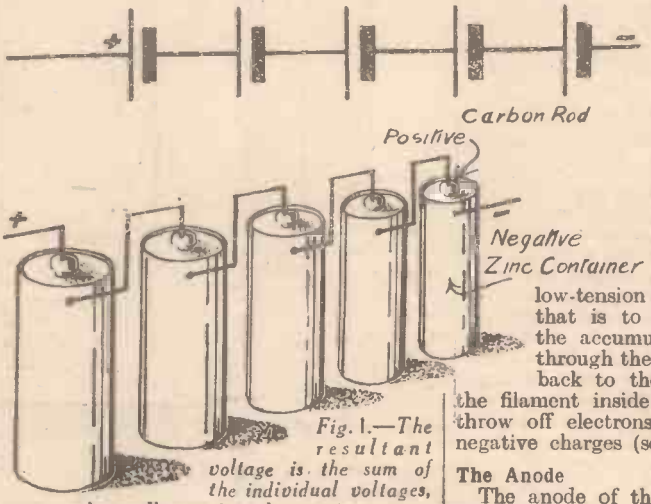


Fig. 1.—The resultant voltage is the sum of the individual voltages, when cells are joined in series.

Secondary Batteries

These are generally known as low-tension accumulators, and are used for storing electricity. Their efficiency depends upon the chemical changes undergone by certain substances when subjected to the action of an electrical current. This charging current produces a gradual chemical change of decomposition in the active element of which it is constructed. When the charging current is stopped and the accumulator is connected to a circuit, a reversal of the process commences until the accumulator is exhausted and has to be recharged.

The Filament

The work of the low-tension accumulator, or secondary battery, in a set is to heat the filament of the valves, for when the set is switched on the low-tension current circuit is closed, that is to say, the current from the accumulator is able to flow through the filaments of the valves back to the battery; this causes the filament inside the valve to heat and throw off electrons, i.e., minute electrical negative charges (see Fig. 3).

The Anode

The anode of the valve has to attract these electrons, and to enable it to do so it is connected to the positive side of the high-tension battery, for, as before stated, a positive charge—absence of electrons—attracts a negative

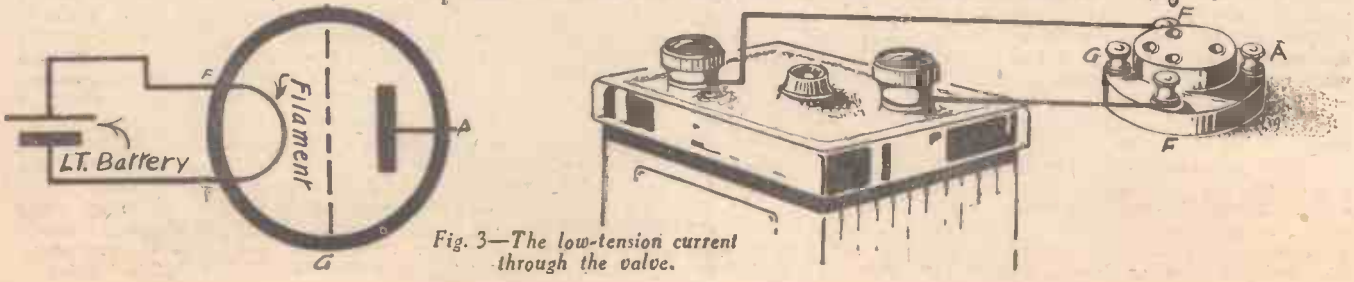


Fig. 3—The low-tension current through the valve.

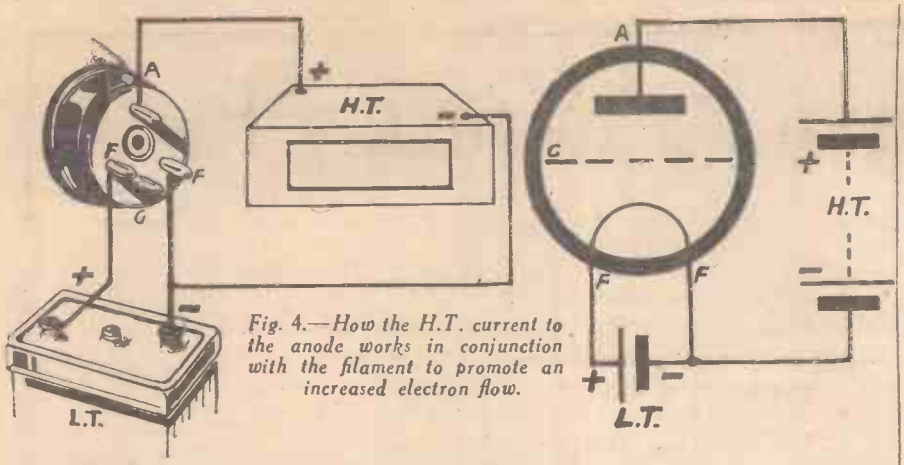


Fig. 4.—How the H.T. current to the anode works in conjunction with the filament to promote an increased electron flow.

charge—superfluity of electrons—the other side of the H.T. battery, the negative side, is connected to L.T. negative (see Fig. 4). In this way the voltage of the anode with respect to the filament is greatly increased and with it the electron flow.

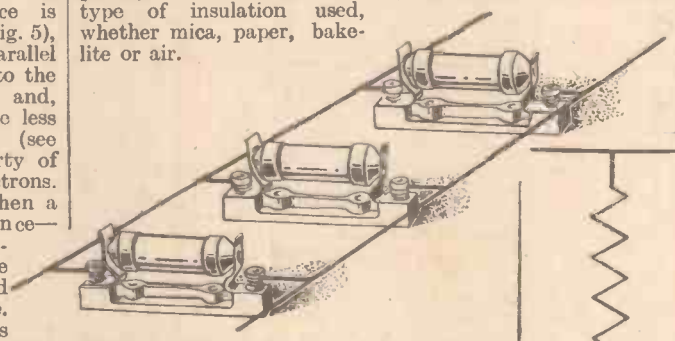
Resistances

The terms series and parallel, as referred to for connecting primary cells together, may also be applied to resistances, for if a number of resistances are connected to a battery so that the current has to pass through each in turn, then they are said to be in series and the total resistance is the sum of all the resistances (see Fig. 5), but a number of resistances in parallel provides as many alternative paths to the current as there are resistances and, therefore, the total resistance will be less than the smallest individual one (see Fig. 6). Resistance is the property of matter opposing the flow of electrons. The flow of electrons takes place when a difference of voltage—potential difference—is introduced. It is always well to remember, that if the conductor is in the form of a wire, then the thicker and shorter it is the less its resistance. Some metals are better conductors of electricity than others, and these then have less resistance. Many substances, and these are well known, such as ebonite, mica, glass, china, etc., offer a very difficult passage for the electrons and these are therefore known as insulators.

Fig 5.—Total resistance is the sum of all the resistances when connected in series.

Condensers

A condenser consists of two or more conducting plates separated by air or some other kind of insulating material. The capacity depends upon the size of the plates, the distance between them and the type of insulation used, whether mica, paper, bakelite or air.



Fixed Condensers

These can be connected in series or in parallel, as stated for primary cells and resistances, but the result is somewhat different, in fact, opposite, for the capacity of a number of condensers in series is smaller than the smallest individual capacity, while if they are joined in parallel, the resulting value is the sum of the individual capacities. An important point to remember when dealing with condenser values, is that when high-frequency currents have to be by-passed to earth only a small capacity of condenser is necessary (in the neighbourhood of .0001 microfarad), but when a low-frequency current has to be by-passed to earth a large condenser of 2 microfarads is used. Such a condenser would be used on a choke output filter; it would then by-pass the low-frequency signals from the loud-speaker windings to earth.

Variable Condensers

As the name portrays, the capacity of the condenser is variable, and this is achieved by arranging that one set of plates can be moved in or out of mesh with plates which are fixed, the more the vanes overlap the greater the capacity. When a tuning condenser is said to have a capacity of .0005 microfarads it means that its maximum capacity is .0005 mfd. The principal consideration should then be that the minimum capacity is as low as possible, otherwise it will be found impossible to get down to the lowest wavelength which is employed by the coil with which the condenser is employed. For instance, if a given coil is said to cover a range of 200 to 600 metres with a .0005 mfd. condenser, it means that when no capacity is joined across the coil the wavelength is approximately 200 metres, and when a capacity of ·0005 mfd. is joined across the coil the wavelength is 600 metres.

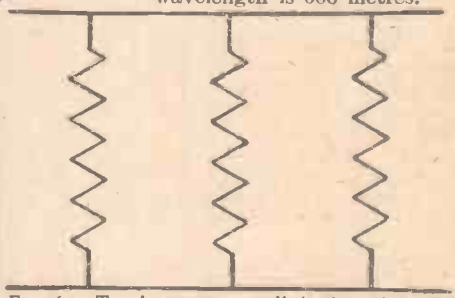


Fig. 6.—Total resistance will be less than the smallest individual one when connected in parallel.

How Valves Are Made

(*Continued from page 853.*)

carries the pumps, while above is the circle of pipe ranges carrying the valves undergoing exhaustion. The operator is kept busy removing the finished valves, and plugging in fresh ones, the evacuating tube being first dipped in castor oil to make a tight seal in the rubber socket. Exhaustion proceeds continuously while the valves travel through a long tunnel, where they are heated to a high temperature to assist in getting rid mechanically of every particle of air possible. Walking round to the other side of the machine, we notice an apparatus impressively enclosed in a cage structure. This, we are informed, is a 4-kilowatt oscillator. Turning again to that part of the exhausting machine nearest to us we realize its use. Six skeleton coils of heavy copper are spaced on a bar; a range of valves comes beneath these; they descend, encircling the valves, and a moment later the whole of the internal elements are glowing with a red heat. This high temperature is caused by eddy currents induced in the electrodes by the entire power of the oscillator, working on a wavelength of 350 metres, and concentrated on the induction coils. The evacuating tubes are now sealed off, the machine has completed its circuit, and the valves are removed, almost completed.

Gettering and Ageing

The very striking machines which carry out these processes rear their heads in the air after the manner of a fire escape, or elevator. At the base is seated an operator, busily removing and plugging in valves, some hundreds of which travel slowly up and down on a sort of endless band. Early in their journey filaments light up, and, shortly after, a range of eddy current heating coils similar to those on the exhausting machine descends over a row of valves in such a position as to heat up and fire the "getter." (A small magnesium plate which we saw attached to the anode in an earlier process.) This volatilizes, its particles being attracted to the inner surface of the bulb, where it forms the silver lining with which we are familiar. The getter has now fulfilled its purpose of enveloping and imprisoning any remnants of air or gases which it is mechanically impossible to remove by pumping. Continuing their journey, the valves are subjected to anode current and working conditions equal to many hours operation, the necessary switching being automatically effected by contacts beneath the band. This test ensures uniformity of characteristics of the finished valve.

RADIO RAMBLINGS

JOTTINGS FROM MY NOTEBOOK
By "DETECTOR"

Frame Aerial Direction

A FRIEND of mine was very puzzled the other day when he was proposing to carry out a few elementary experiments in respect to direction finding. He was using a standard type of portable receiver fitted with self-contained frame aerial and rightly supposed that if a station was tuned in, and then brought up to maximum strength by rotating the frame, the station would lie somewhere on an imaginary line drawn through the axis of the frame. But—even though at least twenty stations were tuned in, the optimum position for the frame aerial was the same in every case. A pretty problem, eh? I wonder if you have solved it? I will give you a clue: the frame was found to be pointing to the down-lead of a nearby outside aerial. The outside aerial was actually picking up the signals and passing them on to the inside one, so that, so far as the latter aerial was concerned, all the signals were coming from the same source—the outside aerial.

Aerial and Earth Leads

THIS reminded me of another frame aerial peculiarity; a frame has absolutely no directional effect if either an aerial or earth wire is attached to the set. The latter is a very good reason why external and earth wires should not be used with a portable except in rare instances. Generally speaking, extreme selectivity is not provided in the tuning circuits of a portable, much of the apparent selectivity being due to the directional effect of the frame aerial. Thus, when external aerial and earth wires are used, tuning becomes very broad and the separation of powerful stations almost an impossibility.

Fine G.B. Voltage Adjustment

IT is often found that when using a certain grid-bias tapping, the voltage is rather too high, whilst if the plug is moved to the next lower socket the bias voltage is insufficient. This occurs most frequently in respect to the bias voltage applied to an S.G. or first L.F. valve, normally requiring only a very small negative bias. Do you know that a voltage somewhere between those provided by the two G.B. battery sockets can be obtained by transferring the positive grid-bias connection from the usual low-tension negative to low-tension positive? The change-over will not have any effect on the normal and correct operation of the set, but might make it necessary to move the G.B.— plug for the power valve to the next higher socket. The reason for this will be understood if it is remembered that the actual grid-bias voltage is that between the *centre portion* of the filament and the grid. But as there is a voltage drop across the filament, one end is slightly negative and the other positive in respect to the centre. Thus when the positive end of the G.B. battery is connected to L.T. negative, the grid-bias voltage is greater than that of the battery by the small negative voltage drop occasioned by the filament. On the other hand, when G.B.— is joined to L.T. positive, the grid bias is slightly less than the voltage of the battery. The above explanation will more readily be followed by examining the circuit of the accompanying diagram.

Super Capacity H.T. Batteries

IT is very surprising to me to find how few users of battery sets employ H.T.B.'s of the large or super capacity type. The large batteries are more than worth their price for any three or four valve set of a fairly powerful kind taking upwards of 7 milliamps. Admittedly they cost twice as much as small ones, but they will last at least three times as long, and will in all probability give better results for the whole of their lives.

Not very long ago a friend who has a 3-valve kit set of very popular make complained to me of his high-tension batteries having to be replaced every month or so, and asked what could be done about it. I looked at his set to make sure that the current consumption was not greater than it should be (if it had been I should have suspected a fault somewhere), but found it to be just over 9½ milliamps. This was just about correct for the set, so I advised my friend to try a triple-capacity battery in place of the ordinary one he was using. He did this, and marked the new battery with the date of purchase, so that a proper check of its life could be kept. It lasted for just over eight months.

The Grid-Bias Battery

I SHOULD think every reader knows that the consumption of high-tension current depends more upon the grid-bias voltage than anything else, and yet I find that in five cases out of ten where H.T. batteries run down too quickly the trouble is attributable to the use of insufficient grid bias. The rule to remember in regard to grid-bias voltage is that it should always be as high as possible, consistent with good quality of reproduction. If this rule were always followed very many complaints regarding short-lived tension batteries would be obviated.

Quite often the grid-bias voltage applied to the valves is appreciably less than the owner of the set thinks, due to the fact that the G.B. battery has become exhausted without his knowing it. The difficulty is that in most cases the set does not give any audible sign that the battery is failing, as it does when the high or low-tension voltages begin to fall off, and so he thinks it is in good condition. I admit that the G.B. battery should last longer than the H.T., because it is not called upon to supply any current, but it will not last for ever. It is a real economy to replace the battery every eight or nine months to make quite sure that the drain on the H.T. is not too great.

Variable-Mu

WHEN variable-mu valves are used, conditions are rather different, because a certain amount of current is taken out of the G.B. battery by the potentiometer volume control. Thus, the battery will not last quite so long, and should certainly be replaced after five or six months' use.

Choosing a Valve Base

I CAME across a case during the week of a radio fan complaining about the inefficient way manufacturers were now attaching the base of the valves to the "bottle." He was taking a valve out of its socket, which apparently was fitting very tightly, when, unfortunately, the glass section came away from the base. The proper way to take a valve from the valve holder is to hold it firmly by the base, and it will be found, if one of the non-microphonic type of holder is used, there is far less risk of such accidents happening.

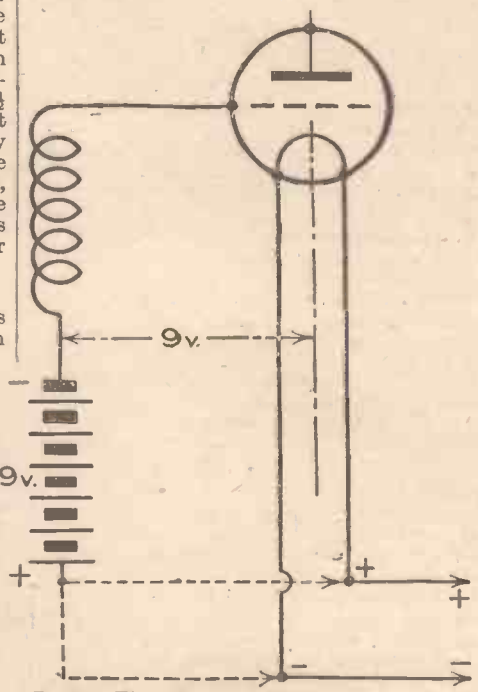


Fig. 1.—The G.B. voltage is slightly increased by connecting G.B. positive to L.T. negative, and reduced by connecting it to L.T. positive.

Television Broadcasts from New York

TELEVISION in America is being developed considerably and the National Broadcasting Company is building new television studios on the eighty-sixth floor of the Empire State Building in New York at 1,000ft. above the level of the street. A short-wave transmitting aerial is being erected on top of an airship mooring mast on the top of the building at 1,250ft. above the street, from which the television signals will be broadcast. In addition, the General Electric Company, at their laboratories at Schenectady, are experimenting with the transmission of television signals along a light beam. Of course, broadcasting is possible along light beams or cathode rays, and I have related in these columns how this was done from the U.S. airship, "Akron," but it is new to attempt the transmission of television by this means. The images as received will be some 6ins. square and will be seen directly on the end of a cathode ray.

Sponsored Broadcasts from Athlone

THERE is a possibility of our being able to listen to still further sponsored programmes in the near future, when the wireless station being built at Athlone by the Marconi Company is completed. A new company, known as the International Broadcasting Co., has been formed with the object of developing advertising programmes from the new Irish station. It is believed that the new concern is connected with a company of similar title which is responsible for many of the sponsored broadcasts from Continental stations, and it is stated that several British manufacturers are considering making use of the Athlone transmitter for advertising purposes. I hope the material sent out will be of better quality than some of the sponsored stuff we have had lately, and I should like to throw out a suggestion that more use be made of nights for the broadcasting of these ammes. We get rather a surfeit itish advertising on Sundays, where- certain dull nights during the a few more alternative British mmes to turn to would be welcomed

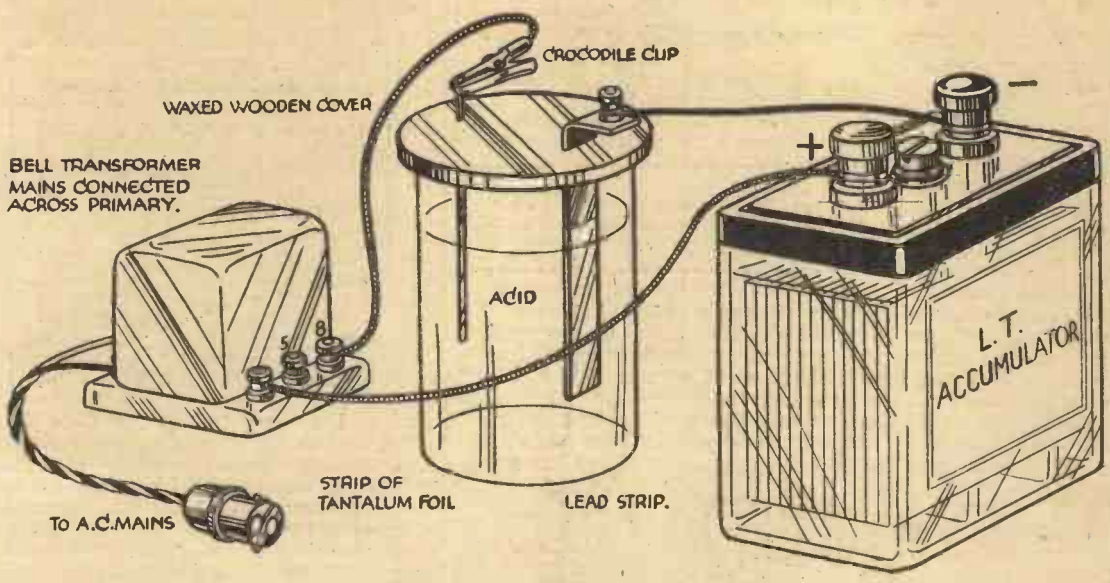
at Britain's Large Proportion of Home Constructors

THERE is no doubt that this feature of being able to be ahead of the times, coupled with the fact that many pet ideas may be incorporated in one set, form the main attraction of home construction as we know it. I further believe, too, that the British pride of workmanship is a further contributory cause of the way in which wireless receiving-set making captured the imagination of the intelligent young and not-so-young men in this country. It is certain that no other country in the world—even America—possesses so many home-built sets in proportion to the population as Britain, and sets, moreover, that for the most part are of a quality seriously to challenge some commercial receivers. Then, again, those of us who started in radio at the commencement of broadcasting are now ten years older—but have we stopped building sets? We certainly have not, and I am beginning to think that once a radio fan, always a radio fan! This means that while a new generation of set-builders have grown up, the old hands are still at it, so that with a concerted publicity campaign of most of the big noises in radio it is difficult to see how radio can do otherwise but progress.

A Trickle Charger for 7s. 6d.

By F. W. CHAMPION

IT is really surprising how few people with A.C. mains charge their accumulators at home, when for a few shillings an excellent charger can be made. The trickle charger described in this article uses a tantalum rectifier, which can be made for about 2s. 6d by anyone with a smattering of electrical knowledge, and which will operate for many months without attention.



Firstly, as probably the reader knows, the A.C. mains voltage must be stepped down to about 4 volts or so for charging a 2-volt accumulator this is accomplished in this particular charger by an ordinary bell transformer which can be purchased at most electricians for about 4s. to 5s. 6d These little bell transformers give an output of roughly ¾ amp. at 5 volts, and are quite satisfactory for the purpose. The alternating current output from the transformer must then be rectified, which could, of course, be carried out with a metal rectifier, but this method is ruled out on the score of expense. The only really satisfactory alternative is an electrolytic rectifier which may take several forms. A very common type is the aluminium-lead combination, consisting of a strip of aluminium and a strip of lead immersed in a solution of ammonium phosphate; this type of rectifier is not very satisfactory, however, as it needs a good deal of cleaning and attention and also needs "forming" before use.

An Electrolytic Rectifier

However, there is one really satisfactory electrolytic rectifier which can be made easily and cheaply, and will run for long periods without attention. This is the tantalum rectifier, which consists of a tantalum strip and a lead strip immersed in dilute sulphuric acid.

The writer has had a half-wave tantalum rectifier in use for eight months, during which time the electrolyte has been changed once, while the lead and tantalum electrodes are good for many thousand hours' further use.

Tantalum, of course, is a very inert metal, and should last for ever, providing the electrolyte is pure and not too much current is passed. The actual tantalum rectifier used in the trickle charger, consists of a lead electrode 5ins. long by 1in. wide and ⅛in. thick; also a tantalum strip 3½ins. long by ½in. wide and about the thickness of stout paper. These two electrodes are immersed in ordinary accumulator acid contained in a glass jam jar provided with a wooden cover well doped with melted candle wax to make it acid resisting. A slot is cut to accommodate the top of the lead strip, and a hole is drilled for the piece of tantalum foil. Melted sealing wax can be forced well into the cracks to make a firm, acid-tight joint. Connection is made to the electrodes with crocodile clips or by small clamps. The complete trickle charger should be connected up with ordinary red and black flex exactly as shown in the accompanying diagram.

Two refinements may be made, which although not essential, tend to improve the working of the rectifier, and prevent sparking and spluttering. One is to pour a small quantity of heavy oil on top of the acid to form a film about ¼in. deep; the other is to add a small quantity of iron filings or a small nail to the acid before using the charger. The filings will dissolve in the acid and form iron sulphate, which will improve the conductivity of the electrolyte. The rectifier then runs much cooler than it otherwise would.

After connecting up the rectifier and inserting the adapter in the lighting socket, immerse the two output leads in salt water, when it will be found that the wire from the lead electrode gases furiously while the other wire remains normal, the wire which gases is, of course, the negative connection, and must be connected to the negative terminal of the accumulator. The average 2 volt 10 amp. accumulator should be put on charge all night once or twice a week and will be kept in tip-top condition without any visits to the charging station.

As regards running costs, the consumption of current from the mains is about 3 watts, which, of course, is negligible. Finally, tantalum is obtainable from any scientific supply store and is quite inexpensive, as only a very small quantity is needed.

The cost of the complete charger need not exceed 7s. 6d., which amount is made up as follows:—

	s.	d.
Bell transformer	4	6
Tantalum strip	1	0
Acid		6
Strip of lead		2
3yds. flex		6
Bayonet plug		6
2-terminal spades		4
	7	6

"WHAT IS TELEVISION?"

(Continued from page 839.)

tips are of opposite polarity, and there are several methods of joining this section of the apparatus to the wireless receiver tuned in to the television signals. Fig. 3 illustrates one scheme where the output valve, neon lamp and synchronizing coils are all in series, a fixed condenser being connected in parallel with the pair of coils.

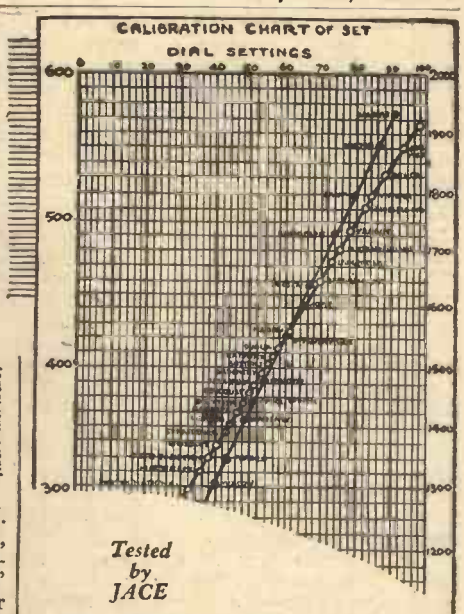
Electrical Brake

In action the current passing through the small field coil makes them of opposite polarity, and if the speed of the disc at the receiving end is identical with that at the transmitting end the resultant magnetic pull on the teeth of the cogged wheel introduced by the synchronizing impulse at a frequency of 375 times per second will balance out in each cycle of changes. If the disc tends to run fast, however, the impulse occurs at a different part of the cycle, and produces a magnetic pull on the cogged wheel teeth tending to drag them back. This retarding impulse acts as a brake and the disc is forced to drop back to its normal isochronous speed.

The method works very well in practice *when set up correctly* and fed with sufficient current, but there is always a tendency for a slight vertical "hunting" motion. On the other hand, since there are no wearing parts needing replacement the scheme has found favour, and in a fourth illustration will be seen an amateur making adjustments on his home-made vision apparatus which includes the cogged-wheel synchronizer plainly visible in the centre of the picture. In the last instalment of this series I shall deal with all the important points arising from the actual procedure of watching a television image received by wireless.

Receivers and their Records

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



Tested by JACE

WITH the progress made on the transmitting side of broadcasting, coupled with the vast improvement in the quality of signals, and the daily increasing number of wireless entertainments available from both near and distant foreign countries, the listener to-day demands radio receivers which are in keeping with the present conditions. He is no longer satisfied to hear mere musical sounds backed by the information that they emanate from some hundreds of miles from his station. To-day he requires from manufacturers receivers which will permit him to "reach out" for foreign transmissions with the *certainty* that he will hear programmes at such quality that they may be considered of entertainment value. Moreover, with the continued increase in the number of transmitters squeezed into the wavebands allotted to the broadcasting services, both on this side of the Channel and in Europe generally, tuning the average set has become more difficult, and the separation of stations from others operating on near-by channels has compelled makers to design receivers which will answer more exacting requirements. Fortunately, the solution of the problem has been facilitated by the revival of the superheterodyne circuit, and of those at present launched on the market the *R.I. Six-valve A.C. mains* table model under review is a successful example.

The receiver has been housed in a walnut cabinet of a striking design; it is a handsome piece of furniture which, without doubt, will meet with the approval of the female members of the household. The lower part of the front, below the loudspeaker fret, has only three knobs—namely, the tuner, that operating the combined wave-change, gramophone and "on" and "off" switch, and the volume control.

Tuning is remarkably easy as there is only one knob to operate. The volume control has a smooth action, but must be used with judgment. Excessive amplification of loud signals causing valve overload will result in poor quality of production, and somewhat less strength is obtained in this case than if the volume control is carefully handled. Moreover, excessive amplification produces the effect of double hump tuning—*i.e.*, the signal will be received at two positions of the dial at maximum strength with a relatively weak region between the two readings. The range of wavelengths covered is from 210–560 metres and from 850–2,000 metres. It is a particularly liberal allowance which permits the reception of a number of stations below, say, Radio-Normandie, and yet will readily tune in broadcasts from Budapest.

R.I. SIX-VALVE SUPER-HETERODYNE (A.C. MAINS)

A novel feature adopted in the *R.I. Superhet.* consists of a shutter which, operated by the wave-change switch, automatically reveals the "short" and "long" wave scale of the illuminated dial, whichever happens to be in use. This well-thought-out contrivance will be found of great practical assistance when tuning in stations as, by limiting the area of degrees seen, it is possible to secure greater exactitude in the condenser readings. The illuminated scale itself is calibrated in wavelengths. The shutter also serves a multiple purpose, as not only does it show the actual wave range which is being tuned, but it also indicates when the receiver is used for gramophone reproduction; a special label appears when the set has been switched off. The simplicity of its working would enable a mere child to operate this superhet., which, in reality, for the local stations, merely needs plugging into a power or light socket in any room where electric mains current is available.

The R.I. six-valve Super-Heterodyne Receiver, A.C. mains model.

The circuit has been well designed to cope with to-day's conditions as well as, so far as can be anticipated, with those of the near future; it complies well with the requirements of listeners who demand good quality reproduction with the highest degree of selectivity. To ensure this latter quality band-pass tuning has been incorporated in both the pre-selector stage and the intermediate coupling circuits, and, what is an important point, in connection with the separate oscillator and pre-selector band-pass circuits triple-ganged condensers have been adopted. For the second detector stage power-grid detection is employed, this being transformer coupled to the pentode output valve.

Six valves, including the rectifier, have been found necessary to attain the required results, four of which are effective amplifying stages. These have been carefully selected for their individual qualities; they consist of a full wave rectifier (UU120/350), AC/HL, AC/2HL, AC/SGVM, all metallized, and an AC/Pen., for the output stage; in fact the most modern Mazda products. The layout is very neat; it has been symmetrically planned; the metal chassis is of robust construction, and ample room has been allotted to the components. The receiver is adjustable to work on an A.C. mains supply for voltages varying between 200-250 volts and from 40/100 cycles. The mains and smoothing equipment are of good design, and in every way conform to the regulations of the I.E.E. The set is very silent in operation and practically no mains hum was perceptible. For the reception of distant broadcasts it is essential that a good outside aerial should be used, but it need not exceed forty to fifty feet; in addition, both leads connecting the set to aerial and earth should be kept as short as possible, and should be well separated and effectively insulated. Where an outdoor aerial is inconvenient, the capacity aerial in the receiver itself may be plugged into the aerial socket for reception of broadcasts from moderate distances and from local transmitters. Within fifteen miles from Brookmans Park perfect reception of both London Regional and National programmes was secured *without* either aerial or earth; with a capacity aerial the volume control had to be brought back almost to zero point.

The receiver is equipped with an electrically-excited moving-coil speaker which provides good quality of production; it is fitted to an internal baffleboard specially

supported in order to obviate any risk of cabinet vibration. Bass is well reproduced and speech is crisp and clear providing the volume is not pushed to extremes. The tone quality, however, may also be regulated by the knob at the rear of the cabinet; according to its adjustment bass or treble may be increased as desired, and it can be suited to the actual broadcast tuned in. The control is also useful for suppressing "atmospherics," and in many instances heterodyne whistles, etc., which frequently mar a transmission. The *R.I. Superhet.* possesses the advantage, when used for the electrical reproduction of gramophone records, of *not requiring* any extra external potentiometer volume control. The leads from the pick-up are merely plugged into their respective sockets at the back of the set, the switch is turned to the position showing the word "Gram," and both volume of sound and tone of reproduction can be regulated in the same way as when the receiver is set for the reception of broadcast transmissions. Moreover, when reverting to radio, the pick-up leads may remain connected. The reproduction of gramophone records was found to be very satisfactory, the volume of sound being ample for a large-sized room.

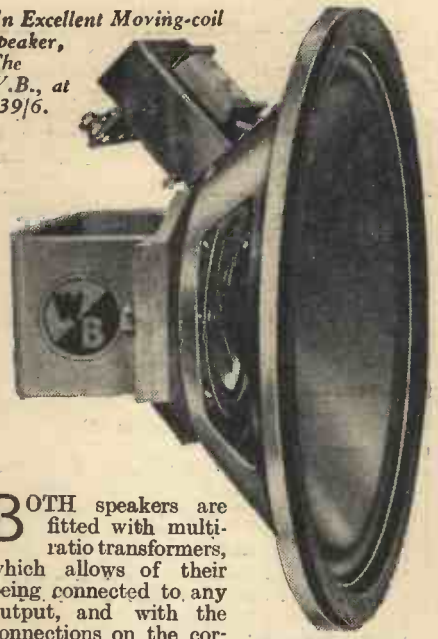
As regards sensitivity and selectivity the set put up an excellent performance. The slightest movement of the condenser tuned in transmissions, and a large log was rapidly compiled. Clear reception was secured of many stations at the lower end of the medium waveband; these included loud-speaker signals from Warsaw (No. 2), Aberdeen, Königsberg, Radio-Normandie (Fécamp), Kiel, Lodz, and Nürnberg, in varying strength in apparent relation to the power of the transmitters. Such broadcasts as those from Stavanger and Belfast could be distinctly heard, although not at a useful volume, but for the purpose of identification and calibration they were clearly readable.

On the evening on which the test was made the B.B.C. carried out relays of European transmissions, and for the sake of experiment the self-same broadcasts were directly tuned in. Greatly to the credit of the Superhet., the programmes, through this medium, were better heard. In some instances, as in the case of Warsaw, Vienna, Hilversum, Milan, louder signals were obtained, and, if anything, a purer quality. No difficulty was experienced in the course of the evening in separating Breslau from Poste-Parisien, and providing the volume control was turned back it was possible to hear Frankfurt-am-Main and Radio Alger (Algiers) clear of the London National and Regional broadcasts. In the same way Bratislava and Heilsberg were fairly well separated, and a programme from Söttens was logged with but occasional "side splash" from Midland Regional. In the later hours such stations as Barcelona (EAJ1), Madrid (EAJ7), Katowice, and Wilno were easily identified; in fact, most stations with a power of 3 kW. or more provided good signals. On the longer waveband the receiver was equally efficient, and starting at Leningrad, which in its new position could just be caught at the bottom of the scale, four Russian stations were heard working, in addition to Oslo, Kalundborg, Motala, Warsaw, Eiffel Tower, Daventry, Radio-Paris, and Huizen. Königswusterhausen, although clear of its neighbours, did not appear to work at its usual power.

To wander from station to station with this receiver afforded considerable pleasure. As the condenser knob was twirled it was found that the programmes, with but few exceptions, could be received with the minimum degree of interference. Tuning, as already stated, was remarkably easy, and even in the hands of a novice the *R.I. Superhet* will furnish a large number of broadcasts at ample volume for even a large-sized living-room.

The receiver is made by Radio Instruments, Ltd., Purley Way, Croydon; its price is 25 guineas. A receiver of this calibre, which combines razor-edge selectivity with good reproduction, should satisfy the requirements of every purchaser.

An Excellent Moving-coil Speaker, The W.B., at 39/6.



BOTH speakers are fitted with multi-ratio transformers, which allows of their being connected to any output, and with the connections on the correct terminals I next tried them on a three-valver with pentode output. I must confess the bass response of both did not come up to that obtained when connected to the large all-mains set with super-power output, but manipulation of the tone control remedied this without noticeable loss of volume. This loss of volume is one of the outstanding features of low-frequency tone control and serves to illustrate to us how much "noise" we obtain from the upper registers. I used a "Lissen" tone-control potentiometer and attachment for connecting to the L.F. transformer which retails at 12s. 6d. complete. All terminals are plainly marked and the device can be quickly tried out without extensive alteration to the existing wiring of the set.

Output Transformer

A word may be said about the output transformer usually fitted to modern moving-coil speakers. Instructions are given with the speaker regarding the connecting up of the transformer tappings of which there are generally four or more. The lowest ratio tapping is intended for super-power valves of low impedance, and the tappings increase in ratio to approximately cover the range of valve impedances up to that of the pentode, this being the last tapping provided. Do not, however, be guided by the instructions too rigorously. Try the tappings on either side of the one suggested by the makers if you are using a power output valve and determine for yourself which gives the best results. With a pentode valve you are practically limited to the one tapping provided, although you may ring the changes still further if your set is already fitted with an output transformer. Again, if your set has a choke output-filter incorporated the moving-coil speaker may be attached to the output terminals without difficulty, and in this case the best results would often be obtained from a different tapping to that advised by the instructions. A choke output considerably improves the quality by checking any tendency to motor-boating that your receiver may possess and the absence of high-tension current in the output-transformer windings is an added protection both to the speaker and to the transformer. A warning must be given with regard to the alteration of the connections to the tappings of the transformer.

Are You Getting MOVING-COIL QUALITY?—2

(Concluded from page 813, Jan. 14th issue.)

Never alter these connections while the set is switched on, as the danger of peak voltages is acute with sudden changes in load. This is particularly the case with pentode valves as the current surge on open circuit is often of sufficient magnitude to seriously damage the emission of the valve or the fixed condensers in the set or eliminator.

Interaction Troubles

The speaker should not be placed too close to the set if interaction difficulties are met with, as with a badly microphonic detector or output valve "singing round the ring" troubles are sometimes set up. In the case of sets of the console type where the moving coil is incorporated in the same cabinet, encasing the offending valve with Sorbo rubber or similar material will often effect a cure. I have seen Plasticine and even chewing-gum used to advantage in stopping microphonic noises! As some moving coils are rather susceptible to mains hum, it is as well to keep the speaker leads as far away from the power-supply leads as possible, and in extreme cases the use of metal-sheathed cable is indicated.

Before perfect quality can be expected from your moving coil it is essential that the output from your set should be as perfect as you can get it, because, as I have already stated, the remarkable sensitivity of the moving-coil speaker gives prominence to your output deficiencies. I propose dealing with some of the causes of poor quality directly due to troubles in the set itself; cures are suggested, and should be applied before criticism of the speaker's reproduction is made. It is an excellent plan to insert a milliammeter in the H.T. negative lead in order that the correct value of grid bias be applied to the output valves or valve. The grid bias should be adjusted until the "kicking" of the needle is brought down to a minimum, and I must again add the warning that no adjustments of the grid bias be carried out until the set is completely switched off.

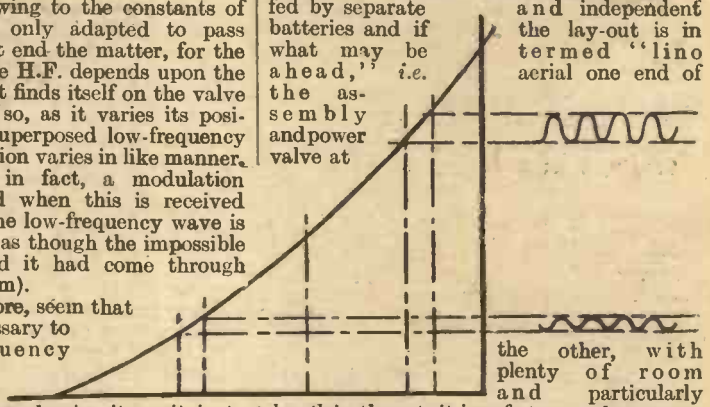
Distortion and poor quality troubles can be grouped into two main categories as a rule, those that are directly caused through inherent defects in the circuit or design of the set, and those that are caused through defects in the components used or in the valves or current supply. If you carefully follow the designs for sets published in PRACTICAL WIRELESS, you should not be troubled with any of the first, but you will realise the importance of using the components and valves specified and of strictly adhering to the lay-out suggested. Components and wiring badly spaced are a frequent source of poor quality difficulties, and the cure is too obvious to need further comment.

HAVE YOU CLAIMED YOUR WIRELESS CONSTRUCTOR'S ENCYCLOPÆDIA? SEE PAGE 837

The Decoupling of the H.F. Circuit

THE advantages of decoupling from the point of view of stabilizing the set, and preventing reactions on the aerial circuit have already been discussed. It was not specifically pointed out that it is the aerial and aerial-circuit that have to be protected from reaction or feed back of any kind, but this follows from the general principle that self oscillation or squealing is most commonly caused by the reaction of a more advanced stage on an earlier stage. Obviously when there are two or more stages of H.F., it may be a question of *any* later stage reacting on an earlier stage or on the aerial.

But there is an entirely different reason why the H.F. stage or any H.F. stage should be effectively decoupled. The modern S.G. valve, and especially the *variable-mu* type has a graph or characteristic that may be described as all made up of anode bend, there is little or no straight. Now the amplitude due to the incoming signal after amplification in the aerial tuned circuit (whatever it may be) is still of very small amplitude, of the order of .05 volt (vector), and this being so, the curvature of the characteristic does not give rise to distortion. But when an audio-frequency surge from the H.T. battery is admitted, as is inevitable if the precaution of decoupling is omitted, the H.F. oscillation finds itself riding on a wave of low frequency sometimes high up on the valve characteristic, and sometimes low; this is indicated in the accompanying diagram. Now, although the low frequency wave cannot itself come through to the detector, owing to the constants of the circuit being only adapted to pass H.F., this does not end the matter, for the amplification of the H.F. depends upon the position in which it finds itself on the valve characteristic and so, as it varies its position, due to the superposed low-frequency wave its amplification varies in like manner. This constitutes, in fact, a modulation of the signal, and when this is received by the detector, the low-frequency wave is reconstructed just as though the impossible had happened and it had come through direct (see diagram).



It would, therefore, seem that it is just as necessary to avoid low-frequency (acoustic frequency) feeding back to the H.F. anode circuit, as it is to prevent a feed back from the power stage to a previous L.F. stage, and the consequence of neglect may give rise to similar forms of instability such as "motor boating." How far this is to be feared in practice it is difficult to say, the whole subject of "motor boating" is of such complexity, that the greatest authorities on Radio seem to give it the widest possible berth. Morecroft in his large tome "Principles of Radio Communication," does not throw any more light on the subject than would be expected from the veriest tyro amongst amateur constructors of receiving sets. In Turner's "Wireless" there appears to be nothing either. The only thing that the author of the present note can from his own experiences assert, is that if each stage is fed by separate and independent batteries and if the lay-out is in what may be termed "lino ahead," *i.e.* aerial one end of the assembly and power valve at the other, with plenty of room and particularly *length* in the set, it is safe to say that motor boating will not take place. Few people can go much further or say much more with certainty.

FROM THE FLASHLAMP

By Photon

MORE RADIO MISNOMERS

By "CYNIC"

THE "impedance" of a valve, however, is varied principally by the voltage applied to the grid. While, therefore, it is not subject to the same laws as a pure resistance it is not a true impedance. "Anode resistance" is probably the most suitable term coined so far. Some radio engineers use the term "differential resistance" which sounds very learned, but is not very clear as to its actual meaning.

Valves are often compared on the basis of their "mutual conductances," the mutual conductance being the change in anode current occasioned by a one-volt change in grid voltage, and expressed in "milliamps per volt." Now the conductance of a circuit is the reciprocal of its resistance, and a little juggling with Ohm's Law will reveal that the reciprocal of the resistance is equal to the current divided by the voltage. The unit of conductance is the "mho" and the conductance in mhos is equal to the current in amperes divided by the pressure in volts. The mutual conductance of a valve, in milliamps per volt, therefore, is, if anything, a number of milli-mhos. But in a true conductance, the factors of current and voltage are the current and voltage in one and the same circuit, whereas the factors in the valve's mutual conductance are the current in the anode circuit and the voltage in the grid circuit. It is on account of this that the word "mutual" was introduced, but the term is rather unconvincing, and does not convey much to the non-technical mind. "Factor of goodness" is a far more descriptive phrase.

The mutual conductance is sometimes referred to as the "slope" of a valve. As most valves are fixed dead upright in the receiver, this term requires a little explanation. It is not the slope of the *valve* which is meant, but the slope of the grid volts anode current characteristic curve; and this is, in fact, a measure of the mutual conductance.

"Reaction."

Many receivers employ "reaction" in the detector stage—a very vague and misleading term. In this device, part of the energy in the anode circuit of the valve is passed back to the grid circuit and is re-amplified by the valve. "Re-amplification" is a far better term than "reaction."

Some of the alleged misnomers we have just discussed might become the subject of a highly technical discussion for which these pages are not the right place, so let us examine a few of the simpler radio terms. The "high tension" and "low tension" supplies will do to begin with. "High" and "low," for example, are only relative terms. The 150 volts "high" tension of the average receiver is distinctly "low" compared with the 132,000 volts of the "grid" electric power scheme. So why not call the "high tension" the "anode supply" and the "low tension" the "heater current"? Again, "low" frequency is high compared with commercial electric supply periodicities, and "high" frequency is low compared with, say, light or X-rays. Please let them be "audio-frequency" and "radio-frequency" in future. The last stage valve of a receiver is *not* a "power amplifier." It is, in actual fact, a "power release valve," but "output valve" is a well-known and very satisfactory term. This valve operates a "loud-speaker," I feel a little sorry for the poor instrument which is only credited with the power of speech when it can also sing, and play the saxophone and a half a hundred different instruments! I do think we might promote him to the title of "sound reproducer" from now on.

"Battery."

When I meet the term "battery" it rather annoys me. The dictionary states that "battery" is the act of beating, or a collective name for a number of cannon (things that can "batter"). Of course, the electric "battery" is the collective name for a number of electric cells—but surely a more apt collective noun could be found. An accumulator, again, does not accumulate in the correct sense of the word. It merely stores energy. It never possesses more energy than has been put into it, so that "charging" an "accumulator" is somewhat like putting money into a box and taking it out as required. It is certainly not analagous to investing it or placing it on deposit at interest so that a profit *accumulates*. There are dozens of other radio terms I would like to pick to pieces, but my space is nearly exhausted. I must, however, have one final thrust—this time at the "set-makers" and the "sets" they make. "Sets" of what, if you please? The term has been in common use since the inception of broadcasting and I cannot make out how it originated. It cannot mean a set of parts—for the first "sets" were complete instruments. If any reader can enlighten me on this point I shall be most interested—and meanwhile I shall continue to refer to my box of tricks as my "receiver" on every possible occasion.

Practical Letters from Readers.

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

Topping Accumulators

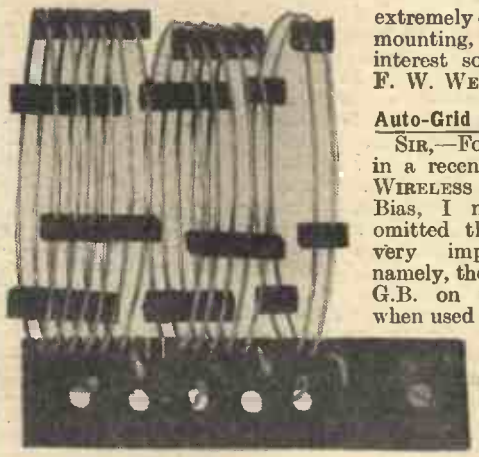
SIR,—Your efforts to substitute practical instruction in the art of wireless for the "mumbo-jumbo" one is accustomed to come across from time to time are deserving of commendation. The tendency to foist a species of technical mysticism on the wireless public generally is not only useless but at times positively harmful. Simple apparatus is vested with an undeserved reputation of being difficult to maintain or instal, and your efforts in counteracting this attitude are all to the good. In connection with this I would take to task Mr. W. Burchell (Westcliff) for his letter on "Topping Accumulators." The elaboration of the really simple job of topping-up is not only unnecessary but disadvantageous, in that it suggests that an accumulator is a difficult and indeed a dangerous thing to maintain. It is true that water should not be added to sulphuric acid, but this, like many other statements, requires qualification—water should not be added to concentrated acid or great heat may be generated. There is, of course, no harm in adding water to electrolyte which already contains a preponderance of water, but to demonstrate this point I have taken some actual tests. A number of Exide accumulators in various states of charge and discharge were topped up with an amount of distilled water equal to 10 per cent. of the total quantity of electrolyte, both the electrolyte and the topping-up water being at ambient temperature. The experiment was repeated and the amount of topping-up water increased to 20 per cent. The results of these tests are given below and the figures speak for themselves :—

Sp. Gr. of Acid.	*Temperature Rise.*	
Before Topping-up.	*10% dilution.*	*20% dilution.*
1.140	0.25°C.	0.4°C.
1.200	0.5°C.	0.8°C.
1.250	0.95°C.	1.5°C.

In conclusion may I assure your readers that any good battery is not likely to become at all "hot under the collar" if topped-up in the ordinary way, but is, in fact, eager to reciprocate in good service the ordinary simple care and attention which I have no doubt you will advise in your admirable publication.—STANLEY BROWN (Manchester).

Short-wave Coil Unit

SIR,—I enclose a photograph of a short-wave coil unit which I have made with the valuable help of the article on page 326 of PRACTICAL WIRELESS, November 5th, 1932. The unit consists of aerial, grid, and reaction coils, mounted in the simple manner shown in the illustration. The coil will eventually be mounted in the upright position on the baseboard of a 2-valve Super-Heterodyne short-wave adapter to cover a wavelength 18 to about 50 metres with 0.00025 variable condensers. Connections to the unit will be made by soldering direct on to the ends of the coils. This unit having only cost about threepence to make, owing to the extremely economical method of mounting, I thought it may interest some other readers.—F. W. WESTLEY (Leyton.)



The finished short-wave coil unit by F. W. Westley.

Auto-Grid Bias.

SIR,—Following your article in a recent issue of PRACTICAL WIRELESS on Automatic Grid Bias, I note that you have omitted that which may be a very important illustration, namely, the application of Auto-G.B. on the detector valve when used as the first amplifier on a gramo pick-up.

You will observe by the accompanying diagram that no G.B. is applied to the valve when used as a detector on radio. I find that decoupling resistance is best left out altogether.—P. EDGELL (Hanwell).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT IMITATION IS THE SINCEREST FORM OF FLATTERY.
—THAT the lowest station transmitting broadcast programmes is Buenos Aires on a wavelength of 14 metres.
—THAT amber is not the only material which becomes electrified by friction.
—THAT there is a formula which enables one to find the peak separation of band-pass filters.
—THAT the wiring of the electric bell system often provides a better aerial than the electric light mains.
—THAT the detector stage is the most important in a mains set from the point of view of H.T. smoothing.
—THAT the voltage of an accumulator should be read whilst the valves are switched on if a true reading is desired.
—THAT a valve volt-meter is the most efficient type of measuring instrument.
—THAT a stroboscope is the most efficient instrument for finding the speed of the gramophone turntable.

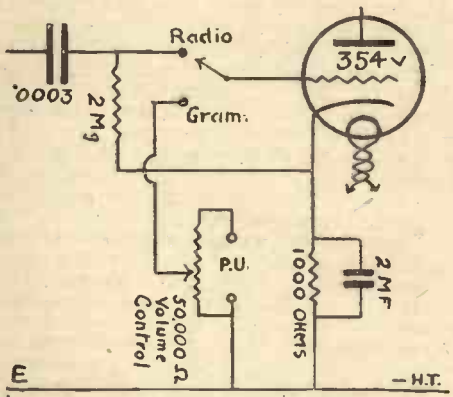


Diagram illustrating Mr. P. Edgell's letter.

NOTICE.

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

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

A Scottish Reader's Satisfaction

SIR,—F. M. B.'s request for a Det 2LF set interested me. About six years ago I purchased an American "Fada" 3-valve Neutrodyne. Despite its origin it gave first-class service up to last autumn. After definitely refusing to perform further, I decided it was time I knew more about its working parts than that of the switch. I then made my first purchase of a wireless journal and it turned out to be PRACTICAL WIRELESS, No. 3. Issue after issue I searched in vain for someone seeking knowledge about a similar set. Being Scotch, and thus timorous by nature, I didn't like to consult your wireless doctor, for I felt that something like 4,999,999 wireless fans would, on seeing my letter, say, "Here goes Aberdeen." To-night I feel considerably bucked up, for evidently it is not only hard-hit Scottish glen farmers

who still have to be putting up with ancient circuits. F. M. B., who dwells in London, and should know, says thousands of pioneers in "listening-in" love and retain their first loves. From knowledge gained by reading your paper I tested my set and discovered two dud transformers. These I replaced with two Hypermu R1 LF. Nothing but the best for an old and faithful servant. Through further praise in your journal of up-to-date valves I decided that the three Yankees were a bit hefty on current consumption. I next purchased three English type valve holders, split the 6 volt accumulator in three, found one section dud, and purchased a 2 volts P.M. 2 DX for detector, a PMIHL for 1st stage and a PM 202 for 2nd and output stage. After reading the instructions enclosed in the valve containers I found my PM 202 would develop inward troubles if not worked in conjunction with a grid-bias battery. My next purchase was a 17 volt grid bias and a bit of flex. I disconnected the GB 1st stage from the HT—added a bit of flex and plugged it into the negative 1.5 tapping. The GB 2nd stage from the earth required another bit of flex which was plugged into — 10. Into the positive tapping I plugged a bit of flex and connected it to LT—. Results are entrancing with an uncased old Brown V hanging from a peg in the ceiling. All the big fellows in Europe and Asia Minor walk in with a slight touch of the dials. No crowding, and volume enough to make the ham which hangs on the other peg above the old hearth dance.—WILLIAM WALLACE (Aberdeen.)

Much Better Even Than Expected

SIR,—I was very pleased to receive my "Wireless Encyclopædia," and write to thank you very much for it. I was surprised to see the size of it and large number of pages. It was much better even than I expected, and full of useful information. The first subject covered, *i.e.*, accumulator charging, will be of great assistance to me as I am hoping to get into the wireless business soon. Thanking you again for the splendid encyclopædia.—R. BRAND (Loughton.)

Another Appreciation

SIR,—I feel I must thank you for the safe reception of the Wireless Encyclopædia and should like to add my appreciation, both of it and also PRACTICAL WIRELESS, the former being as practical as our weekly. Again thanking you.—W. G. BALMAN (Peckham.)

"A Capital Book"

SIR,—Wireless Encyclopædia to hand. It is a capital book, and will be very useful.—E. RUSHWORTH (Alsager.)

"A Wonderful Book"

SIR,—I have received my copy of "The Wireless Constructor's Encyclopædia" and think it is a wonderful book. I shall always have it in front of me when dealing with anything connected with wireless. I shall always be a reader of PRACTICAL WIRELESS. Thanking you.—S. WRIGHTON (Swanley Junction.)

An Appreciation

SIR,—Having taken PRACTICAL WIRELESS since No. 1, I must express my sincere appreciation. Every individual is separately catered for and considered, and I am very much interested in your way of encouraging readers to submit Radio wrinkles. Wishing your valuable paper every success.—L. GABBITAS (Shoreditch.)

RADIO CLUBS & SOCIETIES

UNITED RADIO SOCIETIES

The United Radio Societies aim to promote peace by encouraging interchange of correspondence, etc., between members of societies comprising the Union.

The Union is not joined by individuals but by societies, each society joining will be supplied with the names and addresses of members of the other societies of the union and, in exchange, will supply them with names and addresses of their own members. By this means the aims of peace are far more readily and rapidly promoted than if societies carry on international correspondences between themselves. In other words, "United we stand, divided we fall." Besides the great help this will do towards promoting goodwill and fellowship between nations, individual societies of the Union cannot fail to enrol new members through the scheme, for members of the different societies will discuss their own societies with each other, resulting in many enrolments.

The Union charges nothing for admission, and any society interested, or even local clubs, are invited to write to the organiser, Leslie W. Orton, "Kingsthorpe," Willowbank, Uxbridge, England, for details. Please enclose a stamped addressed envelope.

BRISTOL AND DISTRICT RADIO AND TELEVISION SOCIETY

The British representative for the Ostar Ganz high-voltage valves in Great Britain, Mr. Eugen Forbat, together with Mr. K. E. Alford, B.Sc., are making the first official announcements regarding these revolutionary valves in the form of a lecture in the Bristol and District Radio and Television Society (President, F. W. Rixon) at the Bristol University Geographical Lecture Theatre at 7.30 p.m. on January 20th, 1933. As this lecture is sure to be of special interest to all interested in modern radio valve design, a cordial invitation is extended to all who can make it convenient to attend.

SLADE RADIO

There was a lantern lecture on Rotary Converters, etc., by Mr. R. H. Woodall, of Messrs. Rotax Ltd,, at the meeting of the above Society held last week. In this he explained the devclopments which have taken place and also described the various types now available.

Among those dealt with was a hand type which can be used in the case of emergency, and which would be particularly useful in some of the isolated parts of the world and could be used to summon help, etc. A demonstration was given using an Eddystone ALL WAVE FOUR, H.T. and L.T. being supplied by a 6-150v. converter.

The results were good, and it was noticed that the machine was entirely silent in operation.

It was stated that using this machine it is possible to get down to 8-10 metres without interference.

Full details of the Society may be obtained on application to the Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

INTERNATIONAL SHORT WAVE CLUB

I should like to bring the London Section of this organisation to the notice of readers of PRACTICAL WIRELESS.

We are holding regular meetings at the R.A.C.S. Hall, Wandsworth Road, S.W.

The object of these meetings is to help the short-wave listener get better reception. We arrange demonstrations and lectures which are very much appreciated. Also listeners can meet and exchange their ideas and reports.

I should be pleased to give future dates of meetings, also full particulars of the I.S.W.C., together with specimen magazine if your readers will enclose 1½d. stamp. A. E. BEAR, 10, St. Mary's Place, Rotherhithe, London, S.E.16.

COMMENTS ON COMPONENTS

What we Found..

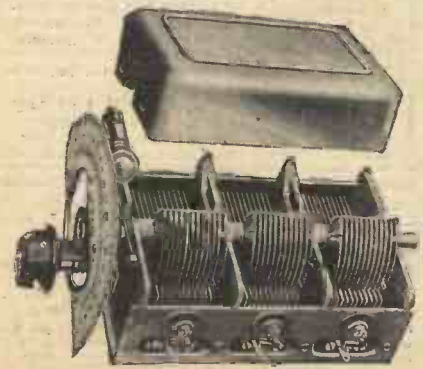
MORLEY SHORT-WAVE COILS

THE Morley is a very interesting model of short-wave coil, designed to cover the wave-band from 12 to 70 metres with a .00025 mfd. tuning-condenser. An eight-ribbed former is used for the coil, and this is slotted and wound with heavy gauge wire, widely spaced. The winding comprises an Aerial Coil, Grid Coil, and Reaction coil, and the grid coil is tapped and connections taken inside to a silver-contact, self-cleaning switch, operated by the rod and control knob on the panel. Terminals are provided on the ebonite base for connection, so that the complete coil may be conveniently fitted into an existing set. The two wave-bands covered by the coil are from 12 to 30 metres and from 28 to 70 metres, and the size and position of the aerial coil has been so chosen that it gives a satisfactory coupling on both bands. The price of this coil is 6s. 9d., at which it represents very good value. This firm also manufactures a series of ganged and screened coils, which differ from others on the market in that the screening-can has a domed top. The most interesting of this range is a pair of Three Range (Ultra-Short, Medium, and Long-Waves) Coil, consisting of the short-wave coil above mentioned, together with a standard dual-range coil, both mounted on a single base. The switch knob is adjusted to cover the three bands. The price of this is 15s. complete, and the base is 7½in. by 3in.

The Morley short-wave coil.

LOTUS 3-GANG CONDENSER

THIS is a splendid example of a completely screened and ganged condenser suitable for tuning three circuits. This is supplied complete with disc drive, fitted with lamp-holder for illuminating the dial. The sections of the condenser are accurately matched up, the now familiar split-end-plates being provided for factory matching. This is one of the features which necessitates that the home-constructor should not take the cover off the assembly and attempt to interfere with the inside. It is extremely difficult to design each section of a three gang assembly, so that at every degree on the tuning scale the three sections have exactly the same value, and in order that this should be so, the end vane of each moving section is slotted, and by means of an oscillator circuit at the factory, each section is adjusted by bending the sections so that no matter what part of the scale is chosen, the reading for each condenser is identical. Only a slight movement of one of these sections is required to upset the balance. The disc drive supplied with the condenser is a substantial affair with no backlash or slip. The degrees are clearly marked, and a neat escutcheon window is supplied for fitting to the panel.



The Lotus 3-gang condenser.

ANOTHER BRITISH RECORD FOR AN ALL ENGLISH WORKS

THE steady growth in the number of Radio Licenses issued in Great Britain is a matter of the greatest interest. It seems only recently that the number reached the amazing figure of one million. Then our astonished eyes read two millions, then three, and now it is announced that the colossal number of over 5,000,000 listeners-in have purchased their annual licence. The enterprising efforts of various radio manufacturers made this progress possible by bringing within the reach of everybody cheap and reliable components and assembled sets. One of the most important of these was the early introduction of Electron wire, which by its simplicity and low price immediately made broadcasting possible for the millions, removing the bogey of expensive and unsightly aerial masts always difficult and sometimes impossible to erect, more particularly in large towns. The Electron series of aerials comprises a New Superial, Electron's Super Aerial, in various lengths, and the Electron 100 per cent. Copper Aerial, for those who require an all copper stranded conductor with a protective covering against verdigris and atmosphere, particularly corrosion by the sea. Superial being insulated with vulcanized rubber, covered with the finest quality braiding, heavily waxed and compounded, is proof against exposure, proof against lightning, and so sure are the manufacturers of the infallibility of the New Superial, Electron's Super Aerial, they offer a £100 Free Lightning Insurance. This explains why the sales of the Electron Aerials have kept pace with the growth of radio enthusiasts. Sales already exceed 7,000,000 and Electron are going to sell another 7,000,000 of "the aerial which made broadcasting popular."

MELBOURNE SHORT-WAVE COILS

THE Melbourne short-wave coils are of the plug-in type, having air-spaced windings, spaced and held rigid by small ebonite strips clamped at three points round the circumference. The wire employed is of heavy gauge and enamelled, and a neat two-pin plug is fitted to the base for connection purposes. These are obtainable with 2, 3, 4, 6, and 9 turns, and the price varies from 1s. 6d. for the smallest to 2s. for the largest. These provide a simple method of employing a set for all wave-lengths, as standard broadcast coils may be plugged-in in place of the short-wave coils and thereby cover a complete range. The makers are the Melbourne Radio Supply.

GRAMPIAN SPEAKERS

A NEW Permanent Magnet Moving-Coil Speaker has recently been placed on the market, and is illustrated below. This is the Grampian speaker manufactured by Grampian Reproducers Ltd., and selling at 39s. 6d. This has an overall diameter of 7½in. and weighs 5½lbs. The chassis is built up of aluminium, and the magnet is very substantial. The strength of the field is 34,000 lines, and the speech coil is wound to a resistance of 1.7 ohms. To enable this to be employed with any type of valve, a multi-ratio output is fitted to the chassis and six different ratios are obtainable from the four terminals which are fitted to the transformer. The lowest ratio is 15 to 1, and the highest 70 to 1. The power handling capacity is given as 3,750 milli-watts, and it will, therefore, deal comfortably with the output of practically every home receiver. On test, speech was found remarkably faithful, no lack of brilliance being noticed, and no boominess. On musical items the overall response seemed particularly good, with a good proportion of bass. This was found to be produced by a bass resonance below 100 cycles, which gave a depth to the reproduction without noticeable boom. At the price mentioned, namely 39s. 6d., this is a very satisfactory item. An energized model is also made by this firm, and sells at 30s. The principal details of this model are: Field winding, 2,500 ohms; Inductance of field 70 henries; Power handling capacity 3,750 milli-watts; Speech coil resistance 1.7 ohms; weight 4lbs. 10ozs. A similar output transformer is also fitted to this model.

The Grampian P.M. loud-speaker.

WHITELEY P.M. SPEAKERS

WE have recently drawn attention in our pages to the fact that moving-coil speakers require a fairly large output of undistorted signal in order to give satisfactory results. The Whiteley Electrical Radio Co. Ltd., have drawn our attention to the fact that their PM4 speaker will work comfortably on an output of only 60 milli-watts. This, of course, is a very low value, and it enables the user of even the smallest wireless set to get really first-class results from the moving-coil type of speaker. The illustration herewith shows the new cabinet which has been designed to house the Whiteley PM5 speaker, and this is now obtainable for 39s. 6d., complete. It is known as the Mansfield Junior Cabinet.

The Mansfield Junior cabinet loud-speaker.

OUR FIRST PICTURE

The Snags We Struck and How We Overcame Them

THE trouble started when a few of us clubbed together, bought a ciné camera and decided to produce a picture to be shown at the firm's annual dinner Everyone was enthusiastic, and a hastily-thought-out plot left us with only the cast to be arranged.

Comedy was to be the keynote. After all, our efforts might be mistaken if we attempted to be serious, and if we *did* happen to be funny—well, we were supposed to be, weren't we? So we chose the hackneyed theme of the heiress who must marry by a certain hour—introducing the villain "determined to marry the girl, by gad!"—and all that.

A Veritable Adonis

For the hero we chose a veritable Adonis — black marcelled locks, a "neat-line" moustache and the most charming "Colgate" smile. Had he a girl? He vaguely murmured that he had—rather too vaguely, I thought.

It was finally decided to have one big day out and get all the outdoor shots done in the fine weather and leave the interior scenes until the late autumn. We selected a spot in the wilds of Hertfordshire (yes, there are wilds even in Herts), and started off bright and early one morning with a lorry full of props and three private cars conveying the cast—on location.

The villain n

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themselves right on
numerous small boys
competition as to
nearest the camer
ranged themselves al
in the hope, I pres
the picture." Ho
directing (*sic*) and
the cameras most
obtained without i
unwanteds.

Just th

Our opening sc
house which was
a close-up of the h
bride-to-be. Som
had spotted "jus

The detective's office was certainly a work of art!

P.W. Gift Stamp No. 17

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THE HOME CONSTRUCTORS HANDY GAUGE

PETO-SCOTT RADIO BY MAIL

EVERYTHING RADIO

CARRIAGE PAID TO YOUR DOOR

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

TELSEN "JUPITER" S.G.3. Complete Kit less valves and cabinet. Cash Price, £3/17/0. Balance in 11 monthly payments of 7/-. — Send 7/- only

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CHASSIS KIT with (Lissen) S.G., Detector and Pentode Valves. Cash Price, Carriage Paid, £4/9/6. Delivered, carriage paid, on first payment of .. .. *Balance in 11 monthly payments of 8/3.* — 8/3

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KIT "B" As Kit "A" but with valves, less cabinet. CASH or C.O.D. Carriage Paid. £5/10/9 or 12 monthly payments of 10/2.

KIT "C" As Kit "A" but with valves and cabinet. CASH or C.O.D. Carriage Paid. £6/13/3 or 12 monthly payments of 12/3.

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1933 Walnut ADAPTAGRAM

Trade Mark

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

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..... Pr.W. 28/1/33

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Exact to specification

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Mr. F. J. Camm's message to the Trade.

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1 **TELSEN** .0003 differential reaction condenser W.185..		2	6
1 **TELSEN** Pentode Output choke (Type W. 72)		7	6
8 **ERIE** Resistances (1) 100,000, (2) 30,000, (1) 5,000, (4) 1,000 ohms. 1 Watt Type		8	0
1 **BULGIN** Fuse and Holder Type F.5 ..		1	0
1 **BULGIN** S.G. choke, H.F.4		5	0
1 **WEARITE** three point switch, GWC ..		1	3
1 **WEARITE** S.G. H.F. Choke, type HFPA ..		4	0
1 **PETO SCOTT** Standard screened HF choke		3	6
2 **DUBILIER** .1+.1 mfd. condensers type B.E. 31 L		6	0
3 **DUBILIER** 1 mfd. condensers type B.B. ..		7	6
2 **DUBILIER** .0003 mfd. condensers type 665		1	0
1 **DUBILIER** .0002 mfd. condenser type 665			6
1 **LEWCOS** 50,000 ohms Potentiometer ..		3	0
1 **SOVEREIGN** .0003 pre-set condenser ..		1	3
1 **READY RADIO** 3 to 1 L.F. Transformer ..		8	6
3 **CLIX** Wander Plugs, (2) GB—, (1) GB+ ..			4½
3 **CLIX** 4-pin Sub-Baseboard Valve Holders..		2	0
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1 **BELLING LEE** four-way Battery Cord ..		1	9
3 **BELLING LEE** Terminal Mounts		1	6
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Screws, Insulated Connecting Wire, Flex, etc.		2	6
KIT "A" CASH OR C.O.D.	£6	10	0

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THE PREDOMINANT WIRELESS WEEKLY

Practical Wireless

EDITOR:
Vol. 1. No. 19. || F. J. CAMM || Jan. 28th, 1933.
Technical Staff:
H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.M.I.E.E.
Frank Preston, F.R.A., W. J. Delaney, W. B. Richardson.

ROUND *the* WORLD *of* WIRELESS

Hungary Launches Out

THE 18.5 kilowatt transmitter at Lakihegy, which broadcasts the Budapest programmes, will be replaced in September, 1933, by a new 120 kilowatt station. To relay the capital entertainments, a 3 kilowatt transmitter on the Island of Csepel operates on 840 m. between 7.0 and 11.0 p.m., G.M.T. Two of the four relays to be added to the Hungarian broadcasting system are already testing; they are Magyarovar (6 kW) on 209.7 m., and Nyiregyhaza (6·kW.) on 267.8 m. A further station is under construction at Pecz, formerly Funfkirchen. Should it be found that with the existing transmitters a fully adequate service cannot be given to the country, Hungary proposes to build *five* more stations to work on the lower wavelengths.

Short Wavelengths for Broadcasters

ACCORDING to a decision taken at the Madrid Conference, a new waveband comprising 25,600-26,600 kilocycles (11.07-11.27 metres) has been granted for the use of broadcasting stations. With a 9 kilocycles separation, not less than 111 transmitters could be housed in this section. In addition, in future no spark stations will be allowed to use the 220 metre band between 9.0 a.m. and 10.0 p.m. G.M.T., and thus interference by morse signals from shipping, etc., will be obviated.

With a view to an attempt to clean up the ether, it was also generally agreed that the installation of new transmitters, proposed alterations in wavelengths, or the transference of stations to other than their original sites should first receive the approval of all European States.

Radio Camouflage

AT the studio of one of the small Belgian transmitters, the announcer, in addition to his duties, is compelled to double parts in plays broadcast. On a recent occasion, much to the delight of listeners, at the end of a dramatic sketch he was heard to say: *You have stabbed me! My blood be on your head;* following which, inadvertently in the same voice he added: *and that, Ladies and Gentlemen, concludes the broadcast of our play, The Red Hand Murder!*

Germany's Education Push

OF 55,000 schools existing in Germany, over 20,000, with an aggregate number of two and a half million pupils, are equipped for the reception of the educational courses broadcast by Königswusterhausen.

Birds in a Gilded (?) Cage

AT the WEAF, New York, studio, situated on top of the new Amsterdam Theatre in that city, the platform from which the broadcasts are carried out is separated from the audience by a huge glass screen. In this manner more than six hundred spectators may view the artists without disturbing the entertainment.

The First Radio Singers

IT is not generally known that the first relay of an operatic performance took place at New York on January 13th, 1910. On this occasion the voices of Caruso and Emmy Destinn in Puccini's *Tosca* were transmitted, at low power, from the roof of the Metropolitan Opera House in that city.

New Interval Signal

FOLLOWING a competition organised by the Poste Parisien, Paris, the studio officials have adopted, from the numerous suggestions put forward by their listeners, a posthorn, as used by the old mail coaches, for their interval signal. Every possible kind of sound was submitted by the twenty thousand competitors; they included a peal of laughter, and even the cooing of a dove, as the universal messenger of peace!

An Effective S O S

DURING recent manœuvres in California, fourteen naval aeroplanes, which were to land at San Diego, were caught in a thick fog. At the request of the authorities, the local transmitter (KGB) was requested to broadcast an appeal to the inhabitants of the city to rush as many motor-cars as possible to the airport so that their headlights would clearly show up the field. Within twenty minutes of the announcer's call *three thousand cars* left for the airport, and in the glare of six thousand head-lights all aeroplanes glided safely to earth.

MR. W. BRYAN SAVAGE, of 292, Bishopsgate, has moved his offices and works from the above address to a new model factory at 56/58, Clerkenwell Road, E.C.1, with a goods entrance at 25/27, Great Sutton Street.

Soviet Radio Developments

WITH the population of Moscow approaching the three million mark, the authorities now contemplate a listening tax which is to be graded according to the classes of the community. Members of the Red Army, who are forced to listen to the broadcasts during certain periods of the day, will only pay fifty copecks; students and war invalids will be placed on the same footing. On the other hand, a larger revenue may be derived from civil servants and military and naval officers, who are to be mulcted to the extent of two roubles. The heaviest tax is to be imposed on business men and other persons connected with industries and trade. At present Russia operates 59 broadcasting stations with an aggregate energy of 1,498 kilowatts, but further high-power transmitters are being shortly added to the system.

We hope the Berne Bureau will bear in mind the present state of the ether!

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

Listen to the Argentine

LR2 (*phon : Ell air dos*) Radio Patria is the call of a new transmitter at Buenos Aires, Argentine Republic, which, operating on 231.5 m. (1,295 kc/s), is frequently well heard in the British Isles between midnight and 2.0 a.m. G.M.T. If you wish to search for it, tune in either of the Hamburg relays, Flensburg or Kiel, in the earlier part of the evening, make a note of the condenser settings, and when the European stations have closed down, twirl the dial slowly over the small section included between 227.4 and 232.2 metres.

New Wavelengths for German Stations

IN view of the fact that certain channels allotted to other countries and borrowed by Germany must now be returned to their owners, a rearrangement is to take place in the wavelengths of some of the transmitters. It is expected that the 5 kilowatt Freiburg-im-Breisgau station, and the new Trier relay will be ready for operation within the next five or six weeks. They will take the Frankfurt-am-Main programme instead of that of Stuttgart as originally planned, and will work on 259 metres (1,157 kilocycles). In addition, as Portugal requires the 283 metre channel for the Lisbon high-power station under construction, the Berlin relays Magdeburg and Stettin in common with Bremen, Hanover, and Flensburg, which up to the present have broadcast the Hamburg radio entertainments will all operate on 227.4 m. (1,319 kilocycles). The construction of the new high-power transmitters destined to Berlin and to Hamburg is being hurried forward.

When the Regional plan is complete, an entire readjustment and re-allocation of the German wavelengths may take place in co-operation with neighbouring countries.

New Radio Musical Comedy

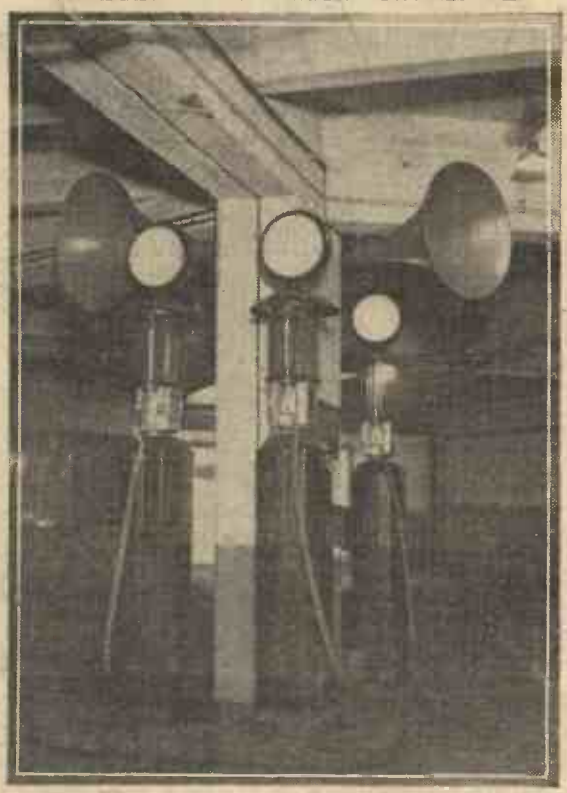
THE Castle on the Hill is the title chosen for an original operetta which will be broadcast by the B.B.C. transmitters in March. It is being specially written for the microphone by C. Denis Freeman with music by Mark A. Lubbock, the authors of *The King can do no wrong.* One of the main features of this show is the inclusion of three orchestras, one of which is a Tzigane band, as the plot is enacted in Hungary at the time of the 1919 revolution.

1932 Relays to the U.S.A.

IN the course of eleven months the National Broadcasting Corporation of America relayed 149 radio programmes from foreign countries and of which respectively twenty-one and fifteen were contributed by Great Britain and France. The list was topped by Switzerland, which supplied the United States with forty-three transmissions, Germany coming a good second with thirty-two broadcasts. In addition, the Columbia network carried out one hundred and ten foreign relays from thirty-three cities in nineteen different countries during the same period. Most of these transmissions are taken on short-waves *via* such stations as Rugby, Prangins, Berlin-Nauen and Kootwijk.

INTERESTING and TOPICAL PARAGRAPHS

WIRELESS AND THE CRIMINAL



In a French police headquarters motor garage is installed a central wireless post, connected up with the headquarters. A number of drivers are always near at hand ready to leave for any place on receipt of the order. In the garage are installed petrol pumps which can fill up at the rate of 60 litres a minute and the reservoirs have a capacity of 5,000 litres.

A Giant of Volts and Watts

THE new Munich super-power station which you may hear every evening on 532.9 metres, although possessing an aerial energy of 75 kilowatts, is so planned that its power can be doubled at comparatively short notice. For a radiation at the lower of the two ratings some 450 kilowatts are required, and this energy is drawn from the Finsing generating station which supplies through a five mile cable a current reaching some 20,000 volts.

Calls from Venezuela

BETWEEN midnight and 4.0 a.m. G.M.T. daily, and again between 5.0 and 7.0 a.m. listeners on the short-waves should pick up a transmission on 48.95 metres (6,127 kilocycles) emanating from the station *La Voz de Lago* (YV11BMO) at Maracaibo (Venezuela). Although its power is only one quarter kilowatt, signals in many instances may be received at good loud-speaker strength. YV1BC, a station owned and operated by the *Cia Anonima Venezolana de Radio* at Caracas is also to be found broadcasting between 10.0 p.m. and midnight on 49.6 metres. Announcements are made in both Spanish and English. Tests are made nightly, but the quality of the transmission is poor.

The Prince's New Aeroplane

OUR greatest propagandist, H.R.H. the Prince of Wales, has just placed an order for a big aerial limousine, which will be one of the largest and fastest private aeroplanes in the country. "Bristol" engines, of the same type as Captain Uwins used when he recently broke the world's altitude record, will be incorporated in the Vickers' "Viastra" aeroplane which will have a seating capacity for twelve persons besides the two pilots. But perhaps the most interesting part of the equipment is a large and powerful wireless set that will be installed in the cabin, and which will be able to pick up broadcasting as well as inter-aerodrome communications.

Mixed Pickles

IN a recent broadcast carried out by WEAF, New York, from Ellis Island, the immigration station in New York harbour, the programme included items by a Spanish soprano, an Italian tenor, a Russian bass, a Japanese xylophone player, a French singer, a German baritone, an English pianist, a Danish accordionist and a Lettish choir. The concert was conducted by a Hungarian, and all announcements were made by a Czech! An All-American programme!

New Brussels Studio

BROADCASTS of entertainments on a larger scale than has hitherto been attempted may be expected from the Brussels station in the near future. An up-to-date building is to be erected at Ixelles, one of the main suburbs of the Belgian capital, and will contain a number of studios and a concert hall.

SOLVE THIS!

Problem No. 19.

After nearly a year's use, Jackson found that the batteries of his set were nearly expired. He therefore bought a new H.T. and a new G.B. battery and connected these to his set. When he switched on, however, he got no signals, although he heard a "click" in the Loud Speaker. What do you think he had done to prevent the reception of signals? Three books will be awarded for the first three correct solutions opened. Mark envelopes Problem No. 19, and send to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2, to reach us not later than January 30th, 1933.

SOLUTION TO PROBLEM No. 18.

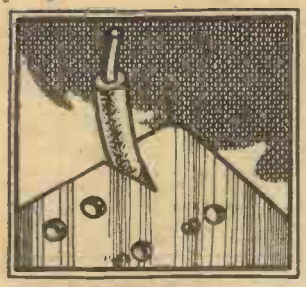
Smith joined the Potentiometer across the L.T. terminals instead of across the filament terminals of a valve-holder, and therefore the On/Off Switch did not disconnect the Potentiometer when the set was switched off. Consequently, the accumulator was discharging through the potentiometer the whole time.

The following three readers received books in connection with Problem No. 17.

E. Hurst, 82, Farrance Street, Limehouse, E.14; A. Reed, Grove Street, Kirton-Lindsey, Lincs; F. N. Bedwell, Rosemont, Evesham Road, Stratford-on-Avon.

How to use our free gift Handy Gauge

Your Gauge is in the envelope attached to the cover of this week's issue.



Using the gauge as an insulation stripper. This notch may also be used to clear screw threads.

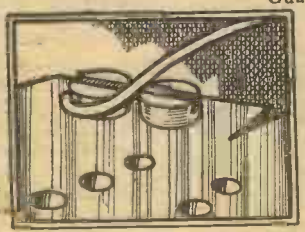
ON the cover ofevery copy of this week's PRACTICAL WIRELESS is an envelope containing our indispensable Home Constructor's Handy Gauge. It is made of steel and specially designed to withstand hard use. The various uses to which the gauge may be put are shown pictorially on this page. You should remember that it is an accurate engineer's gauge and treat it, therefore, with care.

The lower series of holes relate to the diameters of B.A. Screw Sizes from No. 0 to No. 6 and the centre series of holes give the corresponding Tap Drill Sizes. For purposes of comparison a table is given at the foot of the centre column showing the diameters of the screws, and the diameter of the corresponding tap drills. It should be remembered that the drill diameter corresponds approximately to the core diameter of the appropriate screw-thread.

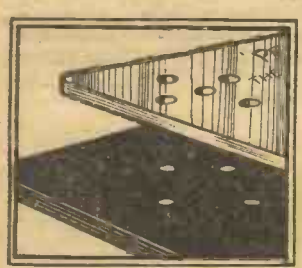
EXPLICIT INSTRUCTIONS ON THE MANY USES TO WHICH OUR FREE-GIFT GAUGE MAY BE PUT

As a Screw Gauge

The bottom series of holes marked "B.A. Sizes" may, therefore, be used as a gauge for the diameter of B.A. screws, so that if you require to know the number of a particular screw you merely try it in the holes and select one in which it is a nice fit. The number above the hole indicates the correct B.A. size.



Forming loops on the end of the wire.



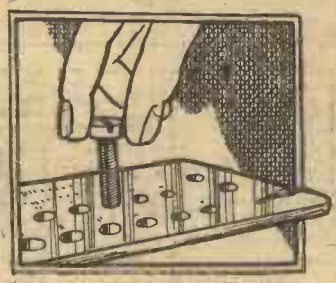
Using the gauge to mark out valve leg holes for three-electrode valves.

Valve Leg Gauge

It is often found necessary to drill holesthrough ebonite, etc., to take valve legs of triode and pentode valves. The holes to the left of the gauge, therefore, accurately made to B.V.A. standards, may be used as a drill gauge for this purpose, the holes being the correct diameter for valve legs.

Wood Scraper

Every woodworker knows that for the final finish on cabinets, and other work intended to receive a high polish, the finishing touches to the surface of the wood must be given with a wood scraper. Our Handy Gauge serves this purpose splendidly. It is only necessary to hold the gauge vertically on an oil stone and rub it backwards and forwards on the stone to give it a smooth edge with two cutting surfaces. The illustration shows how it should be used.



Gauging the diameter of a screw thread.

Gauging the diameter of a drill.

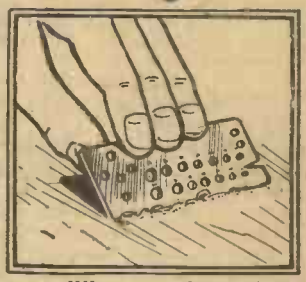
Stripping Insulation from Wire

On the right of the gauge is a V-slot chamfered off. This slot will probably be used far more than the other parts of the gauge, for by slipping the wire into this notch and rotating the gauge round the wire two or three times the insulation will be severed and a pull on the gauge will remove the desired piece of insulation. It will be found that this notch is a most effective insulation stripper.

B.A. SIZES:	0	1	2	3	4	5	6
DRILL SIZES FOR TAPPING	10	17	24	29	32	37	43

The Gauge as a Universal Trammel

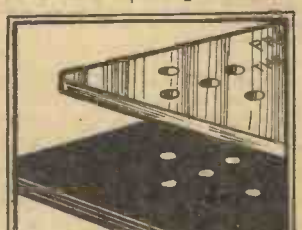
The gauge may also be used as a trammel for scribing the position of holes of odd diameters by screwing the gauge down by one of the two corner holes and using a pencil in an appropriate hole. It will be found that a wide range of hole diameters can be scribed in this way.



When one edge is sharpened on an oil stone, the gauge makes a splendid wood scraper.

Stripped Threads

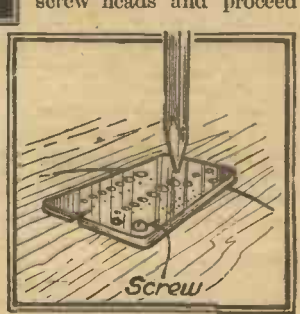
Every home constructor has experienced the annoyance caused by a screw whose top thread has closed over on to another, thus preventing the nut from being screwed on. In such a case insert the threads in the V notch and wind the gauge towards the end of the screw or bolt. This will rapidly clear the thread. The gauge itself is made in 21-gauge steel, equivalent to a thickness of .032in. This fact is mentioned as readers might like to use it as a comparator for 21-gauge, and under.



The gauge in use for marking out holes for 5-pin valves.

Loop Forming

In one end of the gauge you will find two holes close together. By placing a couple of screws in these holes loops may be formed on the end of wire. Place the end of the wire in the slot of one of the screw heads and proceed to pull the wire round the head of the second bolt. In this manner the gauge forms a perfect loop.



The gauge in use as a universal trammel.

THE DESIGN AND OF SIMPLE

In This Article, FRANK PRESTON, F.R.A., gives

Fig. 5.—A cabinet.

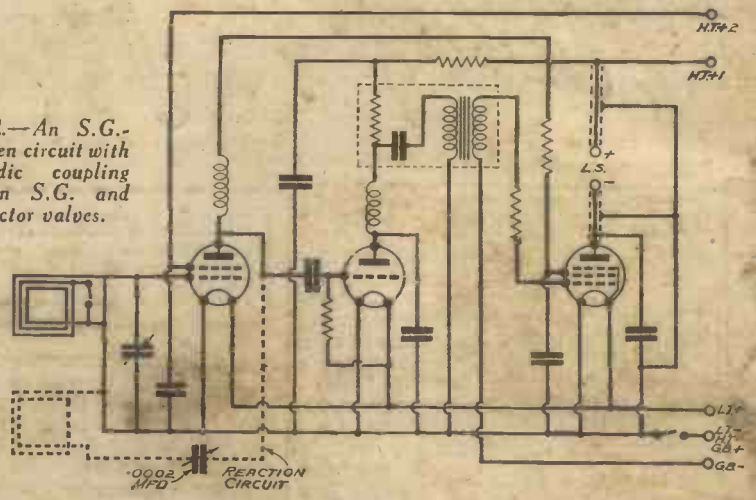


Fig. 2.—An S.G.-Det-Pen circuit with aperiodic coupling between S.G. and detector valves.

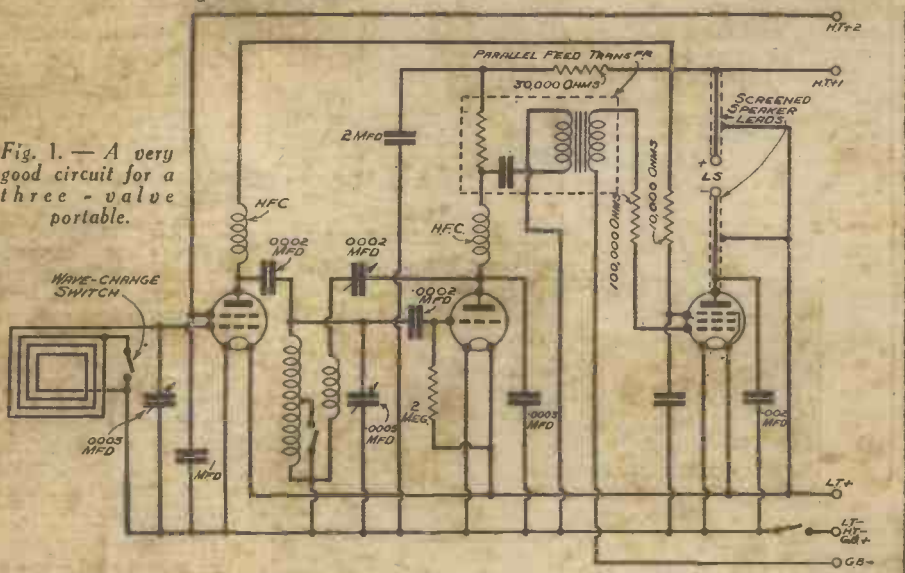


Fig. 1. — A very good circuit for a three - valve portable.

IT is very evident from the letters sent to us by many of our readers that portable sets, especially those which can be built easily and at low cost, are greatly in demand. Several readers have asked for a constructional article on a simple and effective portable set, and they may rest assured that their needs will be catered for by at least one complete design which will be published in future issues of PRACTICAL WIRELESS, but I have no doubt that there is a large number of experimenters and constructors who would like to design their own in such a way that use can be made of components which happen to be on hand. For this reason I feel sure that some information regarding the main features underlying the design of portable sets as a whole will be appreciated.

Principal Requirements of a Portable

Let us first consider what are the principal requirements of a successful portable. First and foremost the set must be compact; it must also be light in weight and economical in its consumption of high and low tension current. Since a frame aerial must be used as a "collector," efficiency at the high-frequency "end" must be as high as possible. The degree of low-frequency amplification need not be very great because enormous volume will not be expected; even if it were it could not be obtained since we are (due to considerations of weight) restricted to the use of a balanced armature type of speaker unit.

The Circuit

As when designing any type of set, the first thing to consider is the circuit which shall be employed. Naturally, this will depend very largely on the range of reception and volume level required, as well as upon the permissible weight and size of the complete outfit. As a matter of fact, the weight of the receiver itself will not be very great in any case, and will be much less than that of the batteries. But the design of the set will determine the battery current, and, therefore, battery size, and so we must consider the outfit as a whole rather than think of any one part separately.

Theoretically, it would appear that two stages of S.G. amplification would be desirable to compensate for the small signal pick-up of the frame aerial, but in

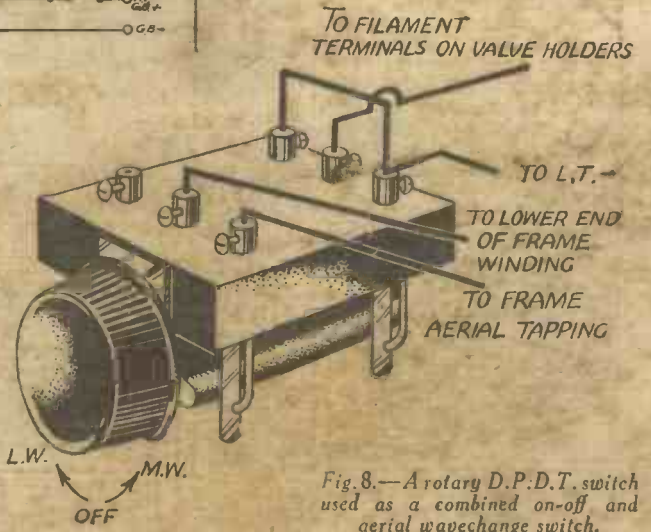


Fig. 8.—A rotary D.P.D.T. switch used as a combined on-off and aerial wavechange switch.

CONSTRUCTION PORTABLE SETS

you some Useful Information on a Popular Subject

practice it is found very difficult to obtain adequate stability with such an arrangement, and as a result the "two-S.G." portable is practically unheard of. Moreover, a single S.G. stage, if well designed, will permit of really astonishing long-distance reception, whilst being fairly easy to design and not difficult to tune.

S.G.-D.-Pen

The circuit of Fig. 1 has a single S.G. valve followed in turn by a detector and pentode, and is an arrangement which I can recommend with confidence. Coupling between the first two valves is on the tuned-grid system, and therefore two tuning condensers are required. But the two latter components *can* be ganged together if one is prepared to go to a little trouble in adjusting the size of the frame aerial and inserting "padding" condensers, of which I shall say more later on. Reaction is applied to the tuned grid coil through a .0002 mfd. variable condenser and reaction winding. Practically any type of screened dual-range coil will be suitable for the tuned grid circuit. The output from the detector is supplied to the last valve through a parallel-fed transformer which is more efficient, and lighter in weight, than a good transformer of the normal type. Ample decoupling of the detector valve is necessary to prevent interaction and is provided by a 30,000 ohm resistance and 2 mfd. condenser. A 100,000 ohm resistance is inserted in the grid lead to the pentode to improve stability by preventing the passage of H.F. currents. If by chance any H.F. currents *do* find their way into the output stage a .002 mfd. fixed condenser is connected between the anode of the last valve and H.T. negative to by-pass them. It will also be seen that the priming grid of the pentode is decoupled by means of a 10,000 ohm resistance and 1 mfd. condenser; this decoupling might not be essential in every case, but it will ensure L.F. stability. The values of all components not mentioned are indicated on the circuits; no details are given of the frame aerial, but this item will be fully dealt with later.

Aperiodic H.F. Tuning

The circuit of Fig. 1 is distinctly satisfactory, and if well "interpreted" will afford good reception of at least a dozen stations under average conditions. It could be made a little more powerful by substituting a two-stage L.F. amplifier for the pentode, and in that case a few more stations would be available at good strength. This circuit has one "fault," however; either two tuning controls are necessary or a fair amount of care and skill must be exercised in "matching" the tuned circuits.

Fig. 4.—A suitcase type of portable.

The latter objection can be removed by eliminating the tuned grid circuit, and so making the detector tuning aperiodic, as shown in Fig. 2. This will of necessity make the receiver noticeably less efficient, but it will still be suitable for more "local" reception. The greatest loss is caused, not by the elimination of a tuned circuit, but by the removal of the reaction control, which was previously effective on the tuned grid coil. But reaction can be applied by adding another winding to the frame aerial and connecting one end of this to the anode of the S.G. valve through a .0002 mfd. variable condenser as shown in broken lines. When reaction is employed in this way the set will show a fair degree of efficiency, and will have a range sufficient to cover a few of the more powerful stations both at home and on the Continent. All component values are the same as those shown in Fig. 1.

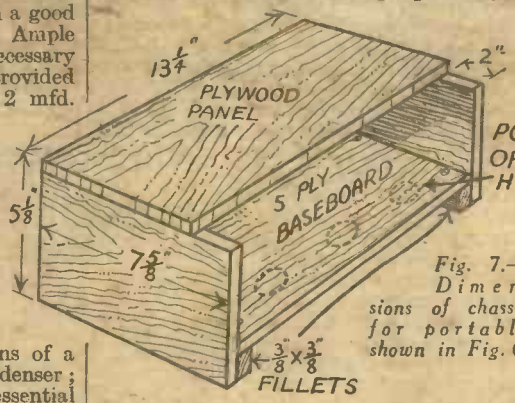


Fig. 7.—Dimensions of chassis for portable shown in Fig. 6.

A receiver made according to the circuit of either Fig. 1 or Fig. 2 will require only about .45 ampère of low tension and some 6 or 7 milliamps of high tension current, and both batteries may thus be of the smallest capacity. The high tension battery should have a maximum voltage of no less than 99, when "H.T.+ 1" will be taken to the highest tapping, and "H.T. + 2" to about 60 volts. To ensure that the H.T. consumption is as low as possible, the highest grid-bias voltage consistent with good "quality" should be employed.

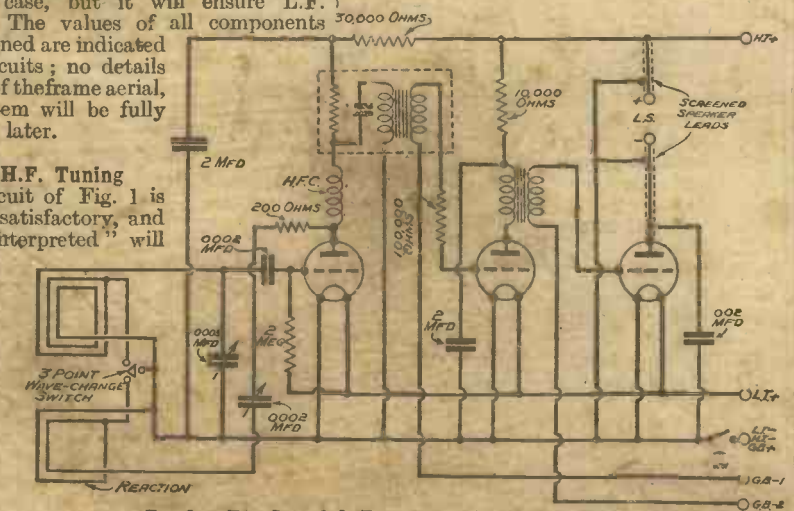


Fig. 3.—The Det.-2 L.F. circuit referred to on this page.

Det.-2 L.F.

Another type of circuit, which, so far as I am aware, is not used for any commercial portable on the market, is that comprising a detector followed by two L.F. stages. It would appear that such a circuit would be practically useless for a set operating on a frame aerial, but I can say from experience that this is not by any means the case. A well-designed Det.-2 L.F. portable, with sensitive reaction control, is a remarkably efficient instrument capable of excellent reproduction from the nearer Regional and National transmitters. I have a set of this kind in use at the present time, and although it was built for purely "local" reception, it will bring in such stations as Radio-Paris, Fécamp, Warsaw

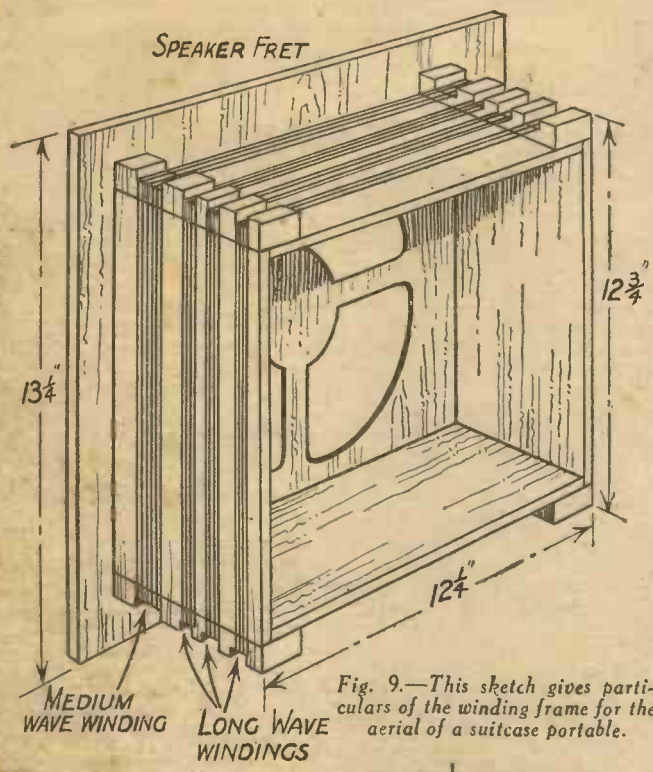


Fig. 9.—This sketch gives particulars of the winding frame for the aerial of a suitcase portable.

and Leipzig at almost any hour of the day. Admittedly, these latter are not received at great volume, but they are sufficiently loud to be worth listening to.

A circuit of the set just referred to is shown in Fig. 3, from which it will be seen that it is remarkably simple. The frame aerial is provided with a reaction winding which operates through the usual .0002 mfd. reaction condenser. A 200 ohm, non-inductive resistance is inserted in the lead from the anode of the detector valve to the reaction condenser to "steady" reaction control and to prevent the setting up of any spurious oscillation effects. The reaction winding is tapped, so that a portion is short-circuited simultaneous with the short-circuiting of the long-wave tuning winding by means of a three-point wave-change switch. By carefully choosing the correct number of reaction turns, and the most suitable tapping point, reaction control remains almost uniform over both wavelength ranges.

Apart from the use of a frame aerial, the circuit is very similar to that of a really modern Det.-2 L.F. receiver of the "fixed" kind, and is not unlike that of the "Selectone," recently described in these pages. Decoupling is very thorough, resistances and condensers for this purpose being included in the anode circuits of both the detector and first L.F. valves. The detector feeds the first amplifying valve through a parallel-feed transformer and a 100,000 ohm "stopper" resistance is included in the grid circuit of the second valve. The last (power) valve receives its input through a tone-control transformer, which is useful in compensating for the high-note loss almost inevitably occasioned by the extremely selective tuning circuit. As a result, the set is capable of providing very good quality reproduction at a reasonably high volume level. In the circuit reproduced, grid-bias is obtained in the usual way from a 9-volt battery, but it would be rather better to provide automatic bias in the manner explained on page 323 of PRACTICAL WIRELESS No. 7. A set made according to the circuit of Fig. 3 will be even more economical in both H.T. and L.T. current than one using the circuits of Figs. 1 and 2. It will, in fact, take only about .35 ampères of low tension and some 6 milliamps of high tension current, when operated at suitable voltages.

One of the three circuits given, or a slight modification of one of them, will satisfy practically any requirement, so, after deciding on the one to be used, attention can be turned to the practical constructional details.

The Containing Case

The exact form of construction will depend primarily upon the type of containing case preferred. This might be either of the suitcase or cabinet pattern, as typified by one of the sketches, Figs. 4 and 5. If the set is to be really portable, and carried about from place to place, the suitcase is certainly to be preferred, since it can be closed up and rendered less susceptible to jolts and jars. In addition, since the frame aerial is more remote from the set than is the case with a cabinet portable, there is rather less danger of unwanted reaction and H.F. instability. But, on the other hand, the cabinet style of container is rather easier to make (and cheaper to buy), whilst being somewhat more convenient for use in the home. It also has rather more speaker accommodation, so that a larger unit can be employed, and, being of greater over-all dimensions, allows the frame aerial to be rather larger and more sensitive. I think I have given a fair statement of the "pros" and "cons" of both types, so I must leave the final choice entirely with you.

Suitcase Type

And now, for the moment, I will suppose that you have decided to make your set in suitcase form. The size of the container must first be settled on, and the dimensions given in Fig. 6 are suitable for practically any set having up to four valves. The battery compartment will accomodate a 99-volt high tension battery of standard type (measuring 9½in. long by 5⅛in. wide by 3in. high), a 9-volt grid-bias battery, and a 2-volt unspillable accumulator, such as the Exide type PC3, measuring approximately 5in. by 3½in. by 3¼in. It need not be mentioned that it is absolutely essential for a set of this type that the accumulator should be unspillable, because it will occupy various positions when the set is being moved about. Notice that a space is left between the battery partition and the bottom of the case; this allows all the battery leads to be passed through without the necessity of removing wander plugs.

Receiver Chassis

The chassis of the set may be of various patterns, but that shown in Fig. 7 is one that I have found particularly good. Since the baseboard is carried on fillets, much of the wiring can be done below it, and this makes for improved appearance. All battery, frame aerial, and loud-speaker leads are taken from the underside of the baseboard, and so they can pass straight through the gap in the partition without being visible at all.

The actual disposition of the components will depend very largely upon the circuit used, but in any case the rules governing the layout of a normal receiver (and dealt with in a previous article) will apply. Screening, by means of aluminium plates, is difficult to arrange in a suitable manner, so it is much better to use screened components wherever possible. Screened-grid, detector, and first L.F. valves should certainly be of the metal-coated variety, whilst coils, if used, should be enclosed in screening cans. Although not always essential, it is also very desirable that screened H.F. chokes should be employed. In addition, when two chokes are used they should be of entirely different patterns, because if they have similar characteristics there is always a danger of uncontrollable oscillation setting in at certain wavelengths.

(To be continued)

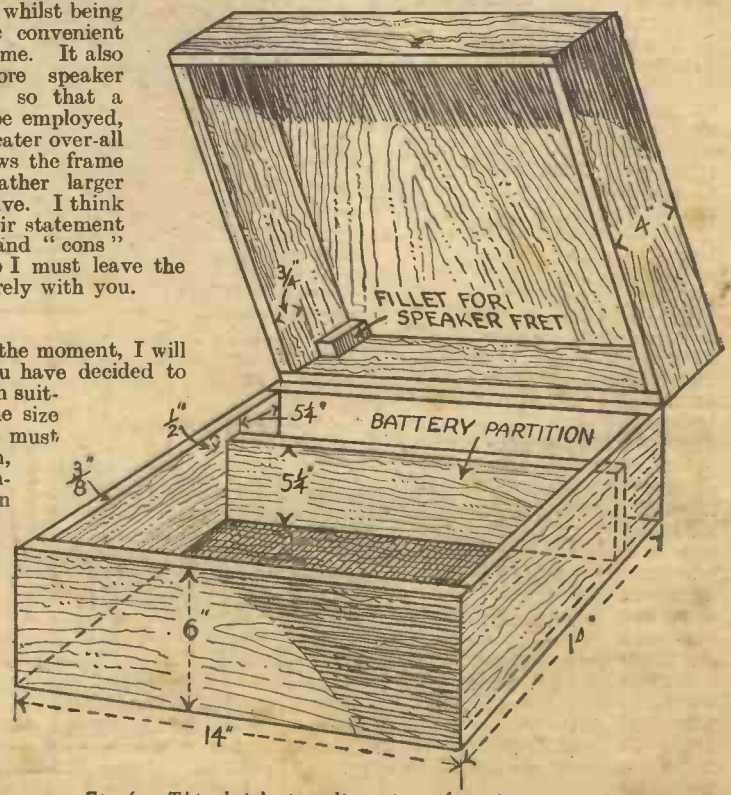


Fig. 6.—This sketch gives dimensions of a suitcase container.

POINTS RELATING to CAPACITY

This Article Describes some Interesting Facts about Condensers, both Fixed and Variable

By GILBERT E. TWINING

A CONDENSER is made up of two or more conducting plates separated by some kind of insulator known as a dielectric, such as air, mica, paper, or bakelite. The capacity of a condenser depends upon the area of the plates, the distance between them, and the nature of the insulation; the bigger the plates or the closer they are together, the greater the capacity. It offers a complete barrier to direct current but is often spoken of as not preventing the flow of alternating current. In Fig. 1 is shown in elementary form the make-up of a small fixed condenser having a capacity of .0002 microfarads.

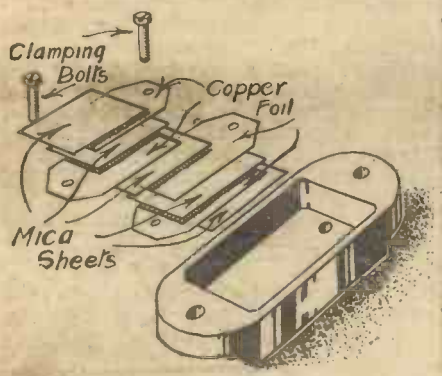


Fig. 1.—The construction of a small fixed condenser.

Capacity

Capacity is the measure of quantity of electricity which a condenser is able to store, the unit of capacity being the farad. In wireless practice, however, the farad is too large a unit, and so the microfarad is used, which is one millionth part of a farad (mfd.).

Connecting to a Battery

If the two terminals of a condenser are connected to the positive and negative plates of a battery respectively, see Fig. 2, a great movement or activity of electrons—particles of electricity—will take place, for there is always a universal balance of electrons to be maintained. This means that when there is a deficiency of electrons at any point, then to that point will they flow in an attempt to make good any shortage that may exist. Now the work of a battery is to create an electron shortage, and consequently its positive means an electron shortage and negative implies an abundance of electrons, the plates of the condenser which are connected to the respective terminals on the battery will likewise become positive (short of electrons), and negative (an abundance of electrons). This electron movement from the battery will cease when the potential difference—difference in voltage—between the plates of the condenser are exactly the same as the battery.

The Dielectric

The insulation, or dielectric as it is called, plays a big part in the working of the condenser, for when a current is applied, the electrons tend to move over to the positive plates in an attempt to balance the deficiency of electrons, although, due to their rigid cohesion to the matter with which the dielectric is composed, they are unable to do so, but the strain on the electrons is greatly increased. If the electron shortage is so intense on the positive plates, that is to say, if too high a voltage is connected across the condenser, the electron strain will become too great and the current will force its way through the dielectric from the negative side and the insulation will break down; the condenser will then have short circuited and sparked across.

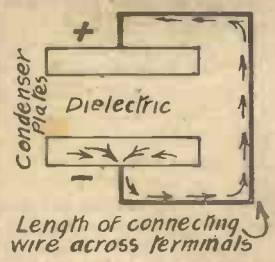
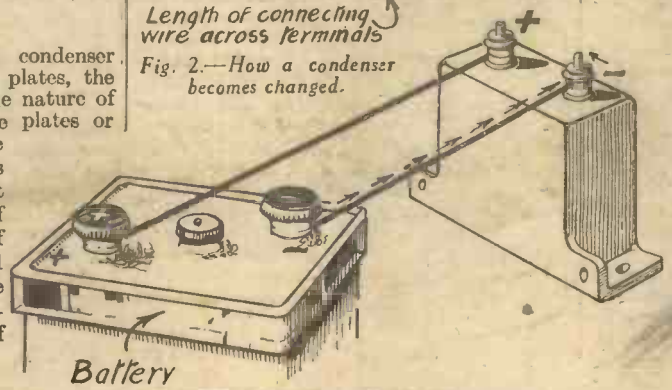


Fig. 2.—How a condenser becomes changed.



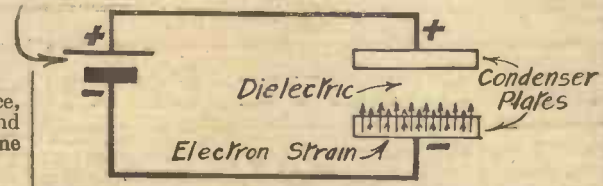


Fig. 3.—Discharging a condenser and thus enabling the electrons from the one plate to flow round to the other side through the conductor and so regain their balance.

Storing Electricity

When the battery which has been coupled to the condenser is removed the condenser will be left in a charged state, one plate will be negative and the other positive. If the two plates are joined together, or short circuited by a length of wire, a small current will momentarily flow, for the electrons at the negative terminal will rush round to the positive terminal until a balance is obtained and the strain on the insulation will be removed, see Fig. 3. Therefore, it can be understood that the condenser is able to store electricity or electrical energy in the form of an electrical field between the plates; this also explains the reason why quite an appreciable shock may be had from a large condenser of 2 mfd. or over if the terminals are accidentally touched after the working current of the set is switched off.

Reverting back to the remark that a condenser does not prevent the flow of alternating current, this is not quite correct, for, if it did not prevent the flow, it would of course mean that the condenser had broken down. What actually happens when the condenser is connected to an alternating current supply is that the electron shortage will be alternately created on each side of the condenser, the electrons rushing to and fro, first to one set of plates back to the source of supply and thence to the other set of plates, but the balance of electrons will not be obtained by the current passing through the condenser. It is generally assumed though, for simplicity sake, that an A.C. current is able to be communicated through a condenser.

Care When Choosing Condensers

It will be seen from what has been written why it is so necessary, when building up a set, especially a mains receiver, to make quite sure that the condensers selected are suitable for their positions, for, should they be placed in a set where they are subjected to too high a voltage, they are bound in time to break down with sometimes disastrous results to other components in the set. Where fixed condensers are used in mains sets for smoothing the supply and also those used as by-pass condensers, in fact, any of 1 mfd. and over, special attention has to be paid to their insulation, or rather the dielectric used, for when the supply from the mains is first switched on the surge of current might be so great, sometimes being two to three times the normal voltage, that if ordinary voltage condensers are used they would

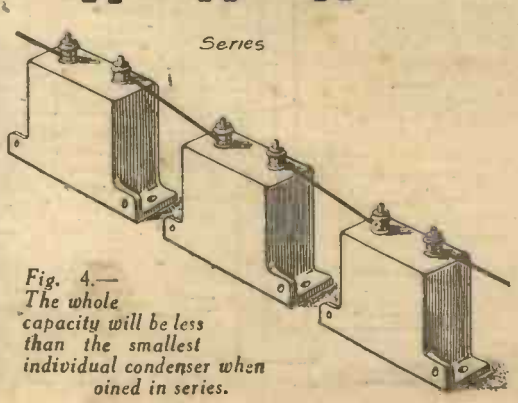
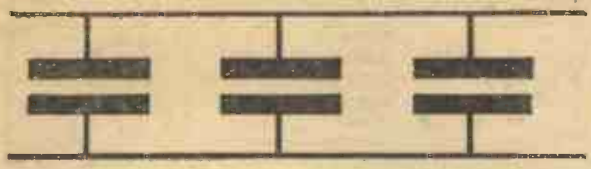


Fig. 4.—The whole capacity will be less than the smallest individual condenser when oined in series.



Parallel

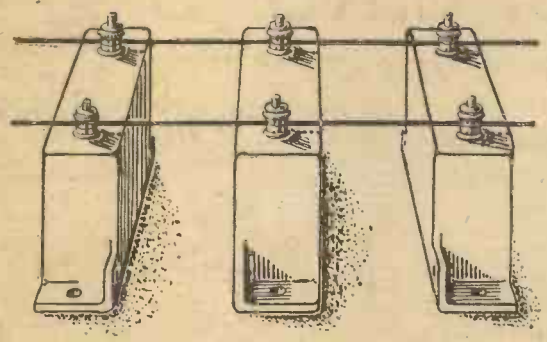


Fig. 5.—The capacity will be the sum of all the individual capacities when joined in parallel.

movable plates working within fixed plates. When the amount of overlap of the movable plates is at the minimum the condenser has very little capacity, but, when they are completely overlapping, the maximum capacity is obtained. The tuning condenser, generally of .0005 mfd. maximum capacity, is connected across the aerial coil (see Fig. 6); its work is to momentarily store up the current collected by the aerial. The aerial picks up an alternating current of very high frequency, and in exactly the same way as before explained for A.C. currents, it charges one side of the condenser, but through the condenser being connected to the coil it at once discharges from the one set of plates, and flows through the coil to the other side of the condenser in an endeavour to maintain the balance of electrons.

quite probably break down, therefore, condensers tested up to five or six hundred volts, or more, according to the voltage applied to the set, should be used.

Series or Parallel

When condensers are connected in series, as in Fig. 4, the capacity of the whole will be less than the smallest individual condenser, but when connected in parallel, as in Fig. 5, the capacity of the condensers will be the sum of all the individual capacities.

Variable Condensers

As mentioned before, a condenser is able to store electrical charges in the form of electrons. In the case of a tuning condenser the amount, or rather the capacity, is variable. It is adjustable by means of

Electron Flow

The flow of electrons through the coil sets up within it a magnetic field. The air in and around the coil and also the coil former will be in a state of strain caused by this magnetic field. Now a field of magnetic force always momentarily opposes any change in current flow, and as the current through the coil is fluctuating, that is to say, always changing, then the amount of opposition this magnetic field offers is known as the inductance of the coil, and this is measured in henries. The current oscillates at a tremendous rate through the coil to one side of the condenser, and then to the other; it is due to the tremendous speed of these oscillations, and the effect that they produce, that the wireless waves are able to be tuned. The frequency of the alternating currents depends upon the setting of the tuning condenser, *i.e.*, its capacity. That is the reason why the condenser is variable in order to adjust the capacity of the condenser in conjunction with the inductance of the coil, the oscillations of which will then correspond with the oscillations or frequency of the broadcasting station it is desired to listen to; the receiving set can then be said to be in tune with the transmitting station.

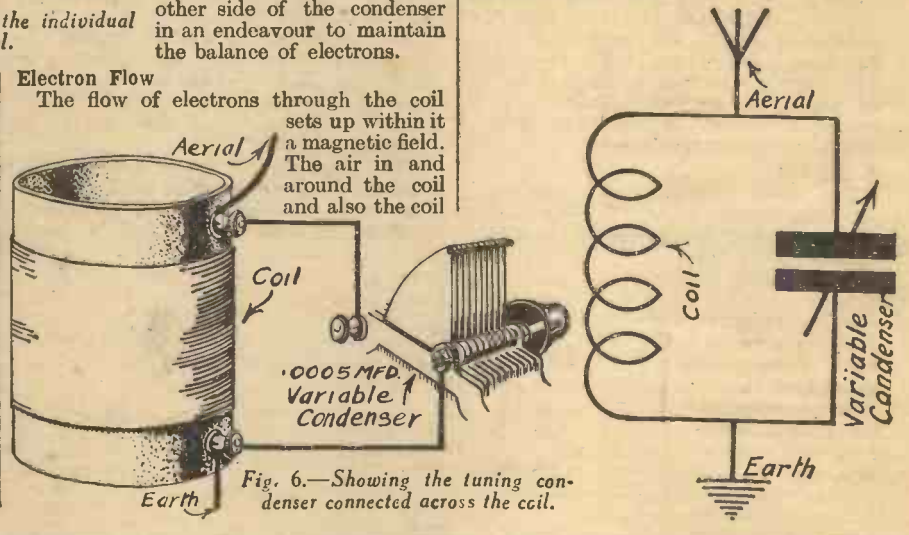
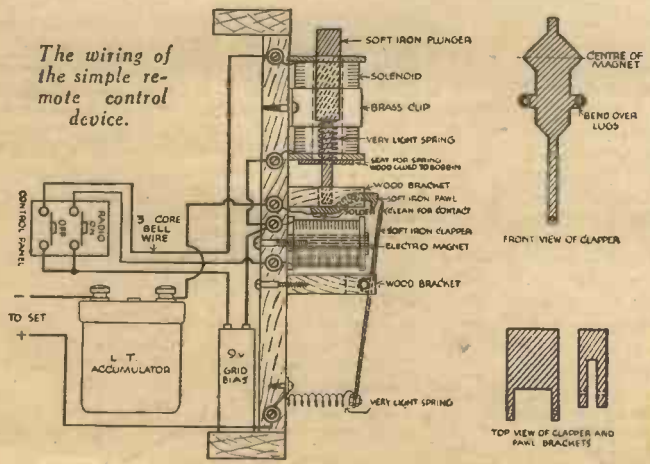


Fig. 6.—Showing the tuning condenser connected across the coil.

REMOTE CONTROL SWITCHING DEVICE

HERE is an idea for switching a set both on and off from anywhere in the house. As will be seen from the sketch, it is a miniature clapper panel with a solenoid for switching off. The materials are easily obtained out of an old bell, a piece of 1/32in. or 1/16in. sheet iron for the clapper and pawl, hard wood or brass for the brackets, a piece of light spring wire, and two bell pushes. The terminals in the sketch are placed for clearness in wiring, but they can be fixed anywhere on the panel. As most of the sizes depend on the size of the bell bobbins, readers will have to make their own sizes. However, the sketches give a fair idea of what is wanted, and the action is as follows.



The wiring of the simple remote control device.

When the "on" push is pressed it energizes the magnet which draws up the clapper. The pawl engages the clapper and holds it, contact being made between the pawl and the clapper, and so switching on the set. When the "off" push is pressed it energizes the solenoid and the plunger hits the tail of the pawl and releases the clapper. The clapper should be very light and the distance between the clapper and the face of the magnet as short as possible. The spring at the foot of the clapper should have practically no tension when the set is off. The lugs on the clapper should be at the point of balance. The nose of the pawl should have a slight downward tendency, but should be easily pushed up by the clapper when the set is switched on. The plunger must be an easy fit in the solenoid, and a touch of the finger on the plunger should lift the nose of the pawl. If the foregoing instructions are adhered to, a 9 volt grid-bias battery should operate the panel for a considerable period, as the current is only on momentarily.

The panel could be fixed close to the set and a three-core bell wire led to anywhere in the house, possibly next to the fireplace. When a "dud" spot comes on in the evening's programme a touch of the button cuts it off and puts it on again without leaving your seat by the fireside. Although the sketch may look rather complicated, the making of the panel should present no difficulty to the average radio constructor, and the remote control business is very fascinating.—WILLIAM LIDDELL (Dalmuir).

HOLDING THE FOREIGNERS—3

Various Methods of Ensuring Consistent Reception of Long-Distance Stations

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

IN Part 2 of this series, we discussed the general lines upon which the arrangements for the automatic control of volume, or rather the automatic regulation of the degree of high frequency amplification, should be designed. Several readers have written expressing their interest in this system of control, and avowing their intention of carrying out experiments in this direction. It may assist, therefore, if we go a little further into the practical detail of design, and give a further lead to those who desire a working circuit.

It has already been pointed out that the only really successful method of automatic control for use in sets where only one multi-mu valve is employed, is that involving a separate regulating valve. As receivers with only one high frequency stage are much more numerous than those with many stages, this method of control has been selected for fuller description. The same controlling arrangements can, of course, be applied equally to a set having more than one multi-mu valve or even to a super-heterodyne set.

A Difficulty

The chief difficulty in preparing a practical circuit is, as has been already explained, that the values of the various biasing and voltage dropping resistances depend upon the types and characteristics of the valves used throughout the set. In the accompanying design, therefore, the components are referred to by letter and clear instructions for calculating their values are given.

In order to simplify the diagram a single high-frequency stage is shown. The aerial tuning system is indicated as a conventional tapped coil with variable condenser, and the high frequency coupling as the popular choke-fed tuned grid. The low-frequency side of the receiver and all the refinements such as wave change switching and band pass filters are also omitted for the sake of clarity. It should be made clear, however, that no fundamental change in the control arrangements are necessary when band pass tuning is used.

Referring to the diagram shown as Fig. 1, the multi-mu valve is seen on the left, the detector valve in the centre, and the special regulating or control valve on the right. It will be noted that the grid of the control valve is connected, via the condenser C1, to the grid of the detector valve, so that any radio frequency signal reaching the detector is also applied to the grid of the control valve. The condenser C1 is necessary because, as will appear later, the detector grid is at a considerably higher potential than the control valve grid.

A Resistance Arrangement

The secret of the correct functioning of this arrangement lies in the somewhat alarming arrangement of resistances and condensers shown at the extreme right of the diagram. The resistances A, B and C, in series, are connected between the negative terminal of the high-tension supply and the earth wire of the set. This means that H.T. — is at a lower potential than earth to the extent of the voltage drop across A, B and C.

The cathode of the control valve is connected to the junction of B and C, so that it is at a higher potential than the grid of the same valve. This, of course, is equivalent to a negative bias on the grid, and readers will at once recognise that, if this bias is correctly adjusted, the control valve is in a position to function as an anode bend detector. Any radio frequency signal applied to the grid of the control valve, therefore, will be rectified.

Much of the success of the control scheme depends upon the careful adjustment of the bias resistances A and B so that, unless a signal is actually being received, the anode current of the control valve is zero. The anode supply for the regulating valve is taken from the point E which, we have explained, is at a higher potential than H.T. —. A resistance R4 is included in the anode circuit, and its value must be so chosen that, when the anode current of the control valve is at its maximum, the drop across the resistance is equal to the maximum additional bias it is required to apply to the grid of the high-frequency amplifier. The controlling bias voltage thus produced is fed to the multi-mu valve or valves by way of the smoothing circuit composed of a high frequency choke H.F.C. and a decoupling resistance R5 which are by-passed to earth by the condensers C2, C3 and C4.

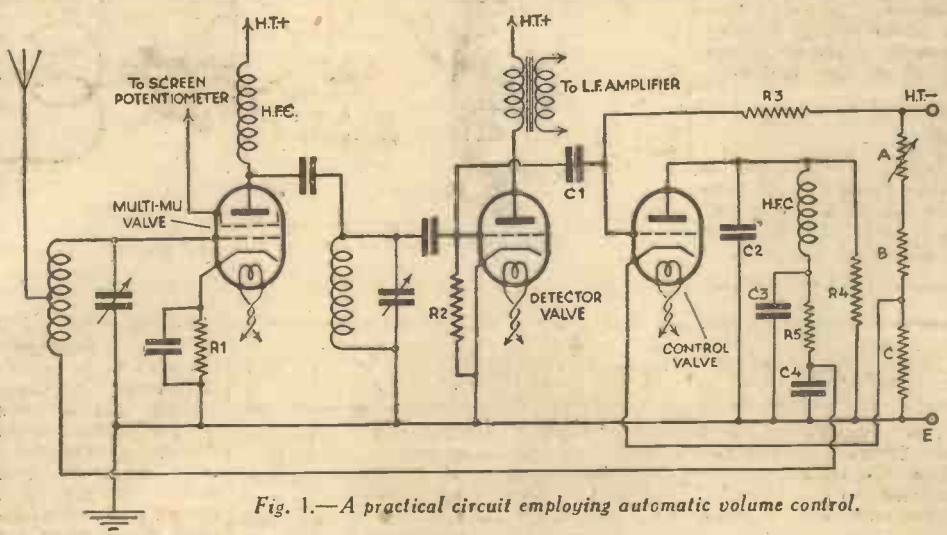


Fig. 1.—A practical circuit employing automatic volume control.

Quantitative Values

We must now turn to the quantitative side of the design, and will begin with the multi-mu stage or stages. It is assumed that in this position one of the usual multi-mu valves of the indirectly-heated type having a total grid base of some 40 volts is being employed. Usually valves of this class require a small permanent negative bias in order to prevent distortion due to grid current when operating at maximum sensitivity, that is to say when no controlling bias is being applied. This bias is provided in the usual way by a resistance R1 in the cathode connection. Its value is invariably given in the data supplied by the valve maker, and usually it is of the order of 200 or 300 ohms. Passing to the detector stage there is little which calls for special comment. The detector is of the usual leaky grid variety, R2 being the normal grid leak. The isolating condenser C1 between the grids of the detector valve and control valve may be fairly large—say .001 mfd. to .002 mfd. or thereabouts. Its value is not critical, neither is that of the grid leak R3, which may be of the order of 1 megohm or less. For the control valve itself, an indirectly-heated triode of the detector or L.F. type should be selected, such as the 164 V, M.H.L.4-C, 41MLF, or other type having similar characteristics.

The chief difficulty in the design is to arrive at the correct values for the resistances A, B and C. It will be necessary to provide about 60 volts for the anode of the control valve, so the first calculation must be that giving the total value of the three resistances in series, *i.e.*, the value of A B C. It is clear that these resistances will have to carry the total anode current of the whole set, so the first step is to find out the value of this current, which we will call "I." It can be found by adding together the anode current of the output valve, the detector valve and the multi-mu valve or valves, not forgetting to make due allowance for the screen currents of the multi-mu valves and the auxiliary grid current of the output valve if this happens to be a pentode. The "standing current" of the screen potentiometer must also be taken into account.

Having found the total current in A, B and C, the combined value of their

(Continued on page 882.)

resistance can be calculated in the usual way :—

Resistance (ohms)=60 (volts) multiplied by 1,000 and divided by I (milliamperes).

Splitting up the Resistance

The value of resistance **B** has next to be determined. It must be such that the voltage drop across it is equal to the normal bias required by the control valve when operated as an anode bend detector with an anode voltage of approximately 60 volts. About 2½ volts will usually be about right, and the calculation is made on the same formula as that just given, but using 2½ volts instead of 60 in the first term. Resistance A is intended to give a range of adjustment of the grid bias to the control valve so that the accurate adjustment of its working conditions can be made, and also to permit the point at which control starts to be pre-determined.

Its value should be approximately twice that of B.

In order to save a certain amount of calculation the table which follows gives values for A, B and C for various values of total high tension current. The figures are approximate to enable standard resistances to be employed.

Total high tension current (mA.)	A (ohms)	B (ohms)	C (ohms)
30	150	75	2,000
40	150	75	1,500
50	100	50	1,200
60	100	50	1,000

It must not be forgotten that these resistances will have to carry continuously the full high tension current of the set, so that they must be of the wire wound type of ample rating, resistors of the 5-watt type being indicated for C and of the 1-watt type for B. Resistance A should be of the wire wound variable type. Those who have the facilities for doing so may like to construct their own resistances, in which case a commercial rheostat might be employed for A, while B and C could be combined in one home-made unit with suitable adjustable clips by means of which the tapping for the control valve cathode and also for grid bias for the output valve can be taken off.

Preventing Feed Back

Because the anode current of the control valve is a rectified radio frequency current, and not a steady direct current, care must be taken to prevent any radio frequency component being fed back to the high frequency stage via the control bias circuits. The precautions indicated in the diagram are the high frequency choke, which may be of any good make, and the de-coupling resistance R5 which may be a grid leak of half megohm or more. The bypass condensers C2, C3 and C4 should be of the order of .5 mfd. and of the non-inductive type.

These few notes will provide the basis for some very interesting and instructive experiments. One or two small points can be added. In view of the 60 volts difference in potential between the cathode of the control valve and the cathodes of the multi-mu and detector valves, it is advisable to supply the heater current for the control valve from a separate 4-volt winding. The value of R4, across which the controlling bias voltage is developed depends largely upon the amount of bias it is required to apply. For the normal A.C. multi-mu valve a resistor of about 15,000 ohms will be about right. If the experimenter has a spare potentiometer of approximately this value, or, say, up to 20,000 ohms or so, he might employ this temporarily in order to ascertain the best value.

FROM HERE AND THERE

A Night In Montmartre

IF you wish to visit the Paris night haunts without leaving your armchair, tune in to Beromünster or to one of the French State transmitters on the evening of Tuesday, February 14th. You will be offered a typical programme of cabaret items by singers from some of the most popular night restaurants and clubs in the French capital.

Ultra-Short Waves

TEST transmissions on ultra-short waves in the neighbourhood of 5 metres are being carried out by the Post Office authorities between Weston and Cardiff; across the mouth of the Severn. The results have proved so satisfactory that a regular service will shortly be organized, as these transmissions can replace the existing landlines over a distance of forty-five miles.

Alternative Programmes for Berlin

UNTIL recently the Königs Wusterhausen high-power transmitter was used during the day for the broadcast of educational courses and lectures: entertainments relayed from Berlin and provincial centres were only transmitted after 7.30 p.m. In future, an entirely different programme will be available on this channel. The call has been altered to "*Hier Deutschlandsender Königs Wusterhausen*," and is no longer coupled with that of Berlin.

Copenhagen on the Short Waves

THE Danish transmissions usually heard through Kalundborg may be picked up almost nightly on 31.51 metres through OXY, Skamleback, a 500-watt short-wave station which relays the Copenhagen programmes. The opening signal consists of a short musical box melody in the form of tinkling bells. *Kobenhavn, Kalundborg og Danmark's Kortbolge sender* is the call you will hear between items in the entertainment.

Operatic Performances and Radio Broadcasts

THE Berlin Broadcasting station, following a series of tests, has succeeded in obtaining almost perfect results in the relay of performances from the Opera House. This has been secured by a complete alteration in the microphone installation. Pick-up units are placed in the wings, as well as on the front of the stage. In this manner it is no longer necessary to find room for a large number of the chorus on the stage. Their voices passing through amplifiers can be blended with those of the singers. Loud-speakers in the auditorium combine the sounds picked up from both stage and wings, thus obviating any risk of the singer's voices being swamped by the orchestra. Further experiments on these lines are being carried out.

RECEIVER IN WALKING STICK.

The daily stroll need not be dull if you take the advice of Herr Alfred Mintus, a Berlin engineer, and adopt his portable radio walking stick, with which he is seen here. The headphones he wears under his hat, the wires of them are fixed to the stick inside which the radio set is cunningly concealed.

New Latvian Station

THE Madona 35-kilowatt transmitter which will eventually replace the Riga station has recently broadcast on various wavelengths. As severe interference has been caused to the Florence transmissions, the wavelength has been temporarily altered to 453.2 metres.

Radio City, New York

THE world's greatest amusement centre barring Coney Island, namely, the Rockefeller centre, which includes a music hall and theatre will not be monopolised by radio alone as originally planned. In view of economic conditions the programmes will include films and side-shows (vaudeville) from which relays are to be made to the transmitters. Listeners to W3XAL, W2XAD, W2XAF, and other short-wave stations will be frequently given an opportunity of hearing excerpts from these performances.

Radio-Paris to Become PTT Transmitter

CONFIRMATION is now to hand that the French State is taking over the Radio-Paris high-power station at Essarts-le-Roi, and that the transfer may take place towards the end of March. According to a French newspaper, although the plant is of recent construction, the PTT engineers may spend a further half-million francs or so in bringing it up to date! It is now fully expected that the Eiffel Tower will shortly suspend its entertainment broadcasts. Further, according to rumours current in Paris, the State authorities are also negotiating for Radio Toulouse, which would then become a Regional transmitter.

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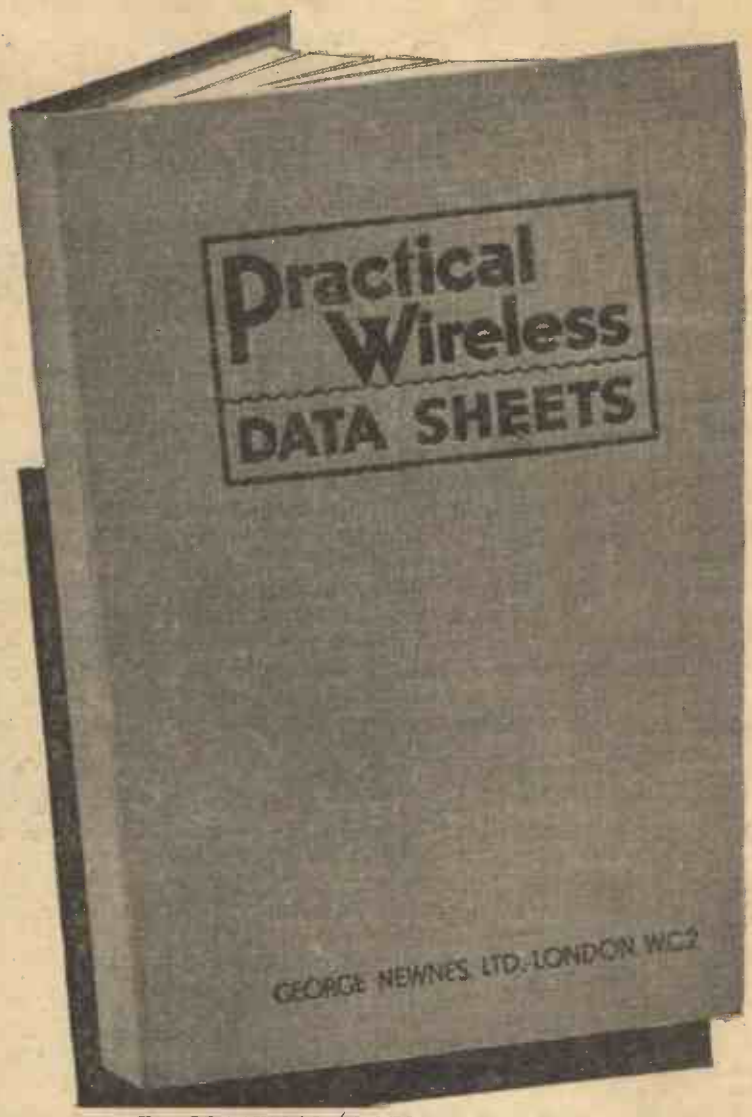

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Data Sheet No. 1—
Accumulator Charging - Dec. 17th, 1932

Data Sheet No. 2—
Coils & Coil Winding - Dec. 24th, 1932

Data Sheet No. 3—
Resistances - - - - Dec. 31st, 1932

Data Sheet No. 4—
Mains Transformers - Jan. 7th, 1933

Data Sheet No. 5—
Wire and Wire Gauge - Jan. 14th, 1933

Data Sheet No. 6—
Chokes, H.F. & L.F. - Jan. 21st, 1933

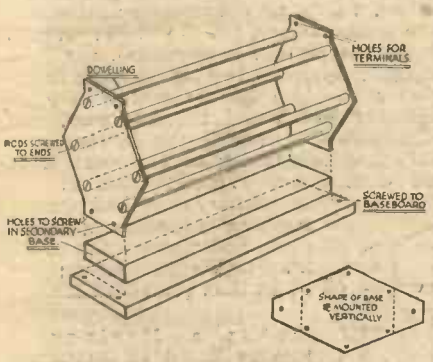
Those new readers who are desirous of completing their files of these Data Sheets may have those already issued for 2d. each from the address given above.

THE HALF-GUINEA PAGE

Radio Wrinkles FROM READERS

Easily-made Coil Formers

USEFUL coil formers can be made of wood, as shown in the accompanying sketch. The ends are hexagonal in shape and arranged to give the required diameter. At each of the six corners is screwed a length of dowelling rod which can

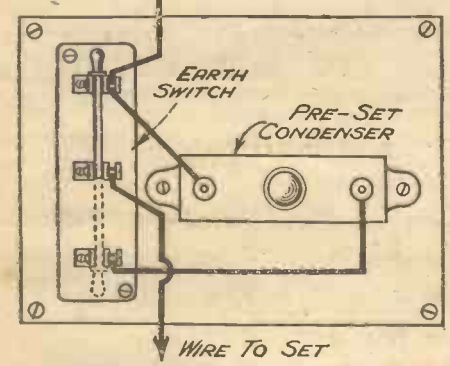


Useful coil formers made of wood.

be purchased cheaply from any woodworkers' store, and these are screwed to the ends, care being taken to prevent the rod splitting. When the parts are ready to put together it is better to soak them all for a few minutes in melted paraffin wax. If the coil is to be fitted horizontally the ends are cut as shown in the sketch, and the top portion used for mounting the terminals. If the coil is to be fitted vertically the base is better if shaped as depicted.—J. G. BRACK (Sunderland).

A Simple Selectivity Device

I HAVE found this dodge quite useful, when reception is very good, to cut out unwanted stations. When the switch is in the position shown in diagram, condenser is out of circuit, but when in reverse dotted position, as shown by lines, condenser is in use and can be adjusted to suit requirements. The whole is screwed on ebonite or any wood painted a suitable colour.—T. BOSTOCK (Blidworth).

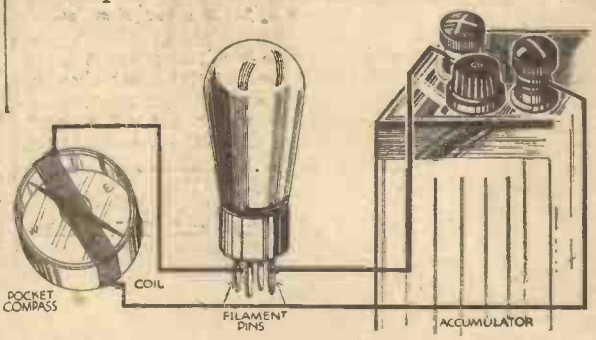


An easily-made selectivity device.

Testing Valve Filaments

IF your receiver fails suddenly for an unknown reason, it is advisable to make certain first of all that the valve filaments are sound. Many of the valves in common use nowadays are equipped with filaments which emit no visible glow when they are switched on, so that it is impossible to tell, by visual examination, whether a filament has burnt out or not.

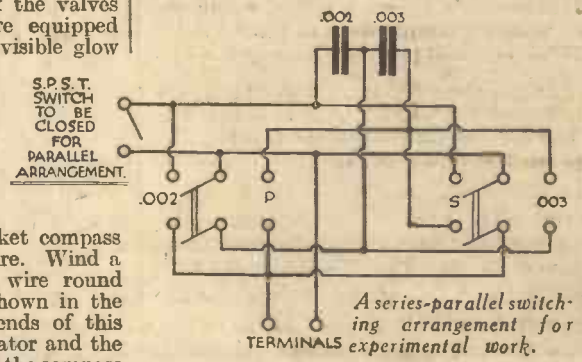
A simple test with an easily-constructed instrument will tell you what you want to know. All you need is a pocket compass and a few feet of insulated wire. Wind a dozen or more turns of the wire round the compass in the manner shown in the illustration and connect the ends of this coil in series with the accumulator and the filament pins of the valve. Put the compass on the bench and set it so that the needle lies parallel with the turns of the coil. A sound filament will be revealed by a deflection of the compass needle as soon as the circuit is completed. Break the circuit, and the needle will swing back to its original position. If the valve filament has burnt out, the needle will not move at all. You can use this instrument, which is really a simple form of galvanometer, or current-indicating device, to test the continuity of any circuit of low resistance.—A. V. D. HORT (Wembley).



Using a compass for testing valve filaments.

Series Parallel Switching

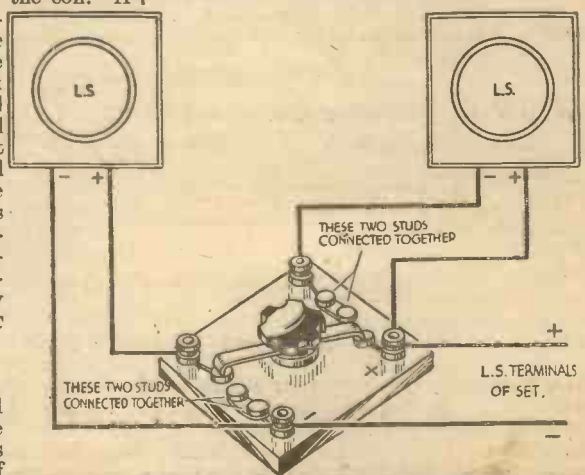
HERE is a simple method whereby more use can be made of any two condensers for quick changing over of values for experimental use and smoothing chokes, tone controls, etc. As will be seen, it is merely a switching arrangement to give the individual capacities, or a series or parallel arrangement to increase or decrease the individual capacities. I have found this arrangement very useful as a tone control, a smoothing choke, or for any purpose where a quick change over from one value to another is desirable without the trouble of disconnections. The two condensers chosen will, of course, depend upon the different capacities desired for the particular purpose in view.—B. M. (Teddington).



A series-parallel switching arrangement for experimental work.

Loud-speaker Switch

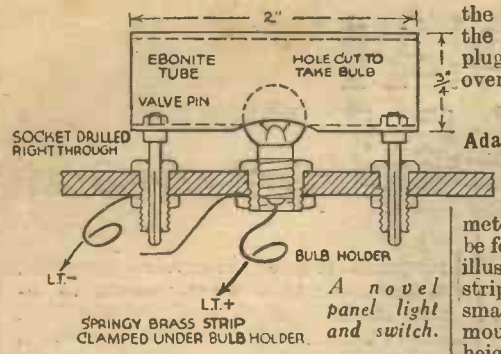
THE diagram below shows a simple switch which I have made to control two loud-speakers in different rooms so that I can use either speaker separately or both together by the simple action of turning one knob. It is made out of a small piece of ebonite about 2in. square, with six contact studs arranged in a circle at equal distances apart. A contact blade is then fixed to a revolving knob in the centre to give the connections needed. The sketch shown will make the arrangement clear.—R. LEWIS (Thornton Heath).



Switch for controlling two loud speakers.

THAT DODGE OF YOURS!

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



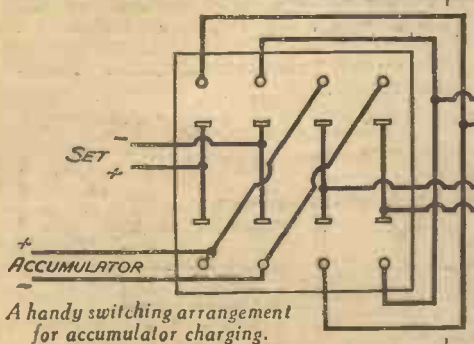
A novel panel light and switch.

A Novel Panel Lighting Arrangement

MANY of those innocent-looking little flash-lamp bulbs, as used for panel lighting, consume quite an extraordinary amount of current, and in view of this fact it is rather convenient to be able to switch the light off after tuning adjustments are completed. The arrangement described here is simple, effective, and cheap in use, as well as adding a touch of dignity to the panel itself, and incorporates an on-off switching arrangement. The reflector consists of a piece of ebonite tubing about 2in. long and ¾in. diameter. A hole is cut to take the flash-lamp bulb, which is mounted directly on the panel between the tuning controls. Two valve pins are mounted on the reflector, and two sockets (one of which must be drilled right through) are mounted on the panel in line with the bulb, and, obviously, the same distance apart as the pins. A piece of thin brass strip is fixed under the bulb holder, as shown in sketch, and the panel light is complete. By slight downward pressure on the reflector tube, the valve pin engages with the brass strip, and the bulb lights. On raising the reflector the circuit is broken.—W. C. LAKE (Aboukir, Egypt).

Accumulator Charging Switch

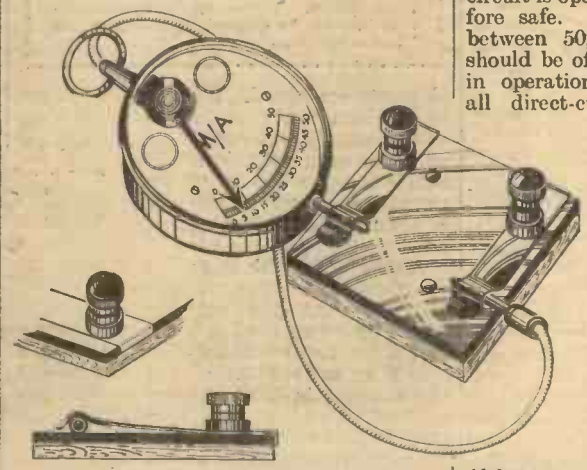
A VERY useful switching arrangement which will be of great convenience to those who charge their accumulators from D.C. mains, using as a resistance a lamp used for ordinary lighting purposes, can be obtained from a four-pole double throw switch, which may be either of the rotary or lever type. The connections should be made as shown on the accompanying diagram, which should be followed carefully to ensure correct polarity. When wired up, it enables one to make permanent connections to the set, mains and two accumulators. By throwing over the switch, the accumulator which was on charge is connected to the set, and the one which was connected to the set is put on charge. Further, the accumulator is charging whenever the light is on, whether the set is on or off, and the set will work, whether the light is on or off. This saves putting the room in darkness or using a shorting plug when an accumulator wants changing over.—WALTER H. STEAN (London, N.).



A handy switching arrangement for accumulator charging.

Adaptor for a Pocket-Meter

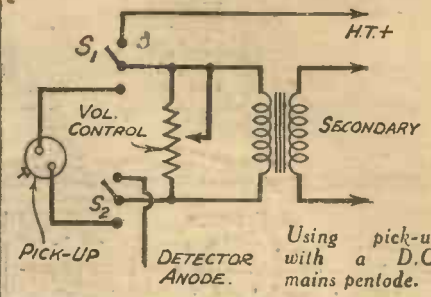
WHERE readings have to be taken in a confined space, so that the pointed terminal ends of pocket test meters prove inadequate, this adaptor will be found useful. Two spring clips, shaped as illustrated, are made from springy brass strip, and mounted under terminals on a small ebonite block, which, in turn, is mounted on a wooden one, the combined height of the two being equal to the distance from the back of the meter to the back of the pointed terminal end mounted at its base. The clips have their ends bent over the edge of the ebonite block to prevent them from swivelling on the terminal shanks. The terminal ends of the meter can now be held quite firmly under the clips, and connections taken from the terminals on the block.—T. W. WILLIAMS (London, N.19).



Useful adaptor clips for a pocket-meter.

Gramophone Pick-up and D.C. Mains Receiver

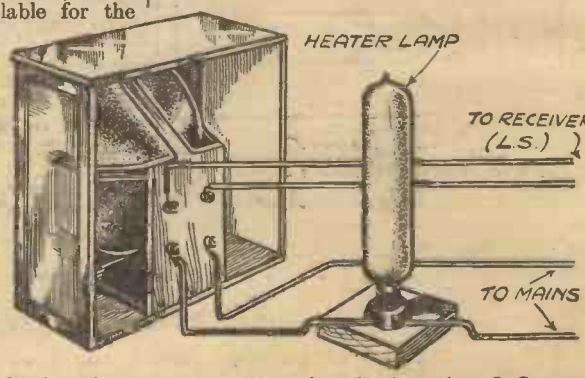
WHEN using a pick-up with amplifiers incorporating D.C. mains pentodes it is found that ample output for domestic purposes is obtainable using no previous low frequency amplifying valve. The Marconi-Osram pentode D.P.T. has been found very satisfactory used in this manner, the coupling between pick-up and pentode being a 3½-1 inter-valve transformer, which is generally available for the purpose. When used in the conventional manner the pick-up must be isolated from the grid and cathode circuits of the receiver by large and reliable condensers to avoid all possibility of shock. Using the present scheme, this may be avoided, and a single volume control may be made to function with both radio and record. The sole piece of apparatus required in addition to pick-up and volume control is a double-pole double throw rotary switch. The circuit proposed is shown herewith, and variations to suit other receivers in which a parallel-fed or auto-transformer is used will suggest themselves. S_1, S_2, are the separate members of the ganged switch, and it will be seen that when the pick-up is connected, the H.T. circuit is opened in two places, and is therefore safe. The volume control may be between 50,000 and 250,000 ohms, and should be of high quality to ensure silence in operation. Owing to the removal of all direct-current magnetisation of the transformer core, the frequency response on the gramophone is good, and reproduction of the lower register particularly so.—F. BUTLER (Stamford Hill).



Using pick-up with a D.C. mains pentode.

Working a Moving-coil Speaker Direct off D.C. Mains

MANY of the early types of moving-coil loud-speakers were fitted with a field coil designed to work off a low voltage, usually 6 to 10 volts, the same low-tension accumulator supplying both loud-speaker and valve filaments. Although most modern moving-coil speakers are suitable for working off electric mains, there must be a great many people who still have one of the low-voltage types, working it from an accumulator, with the inevitable heavy drain, usually half an ampère to one ampère. Now it is often not realized that these 6-10 volt speakers are perfectly suitable for working direct off D.C. mains. All that it is necessary to do is to connect the mains direct to the field coil terminals, inserting in one of the leads a suitable lamp as a resistance. A 250-watt heater lamp will usually be quite suitable, with the added convenience that it will fit the ordinary bayonet holder. This is really an excellent method of working these speakers because the field coil gets its full legitimate current without variation and the speaker will thus be working at its full sensitivity.—A. L. CURRY (Ipswich).



Method of operating a moving-coil speaker direct from D.C. mains.

ALL ABOUT YOUR RADIO BATTERIES

RADIO batteries may be divided into two broad classifications, primary batteries and secondary batteries, or accumulators. Primary batteries are usually of the "dry" type, although the "wet" pattern is in successful use, more particularly for high tension work. Let us take the primary battery first, and by learning something of its working principles, obtain better, and more economical results in our radio practice.

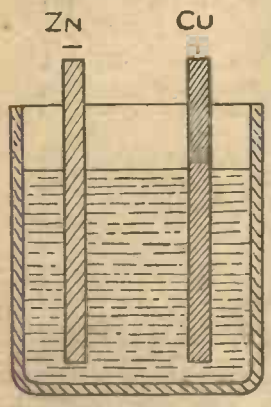


Fig. 1.—Diagram explaining the function of a primary cell.

Strictly speaking the term "dry" is a misnomer as if the cell were really dry, no current would be forthcoming. The proper term would be non-liquid, as the electrolyte, or exciting fluid, is held in paste form by a suitable absorbent material. In construction the dry battery follows very closely the principles of the original Leclanché cell. Here a notable advance in construction appeared in the use of manganese dioxide as a "depolarizer" or recuperant.

To grasp the value of such a feature, let us examine the working of a primary cell, and see what the depolarizer does. In Fig. 1, we have a jar containing dilute sulphuric acid in which are the two plates Zn. and Cu., which represent zinc and copper, respectively. This very elementary battery, actually one of the first ever devised, will give a small current at about one volt pressure—*for a limited time only.* And for the following reason. When the circuit is complete bubbles of hydrogen are released at the zinc plate which is at negative potential. These bubbles travel through the acid and attach themselves to the positive, or copper plate, which is normally at positive potential. As soon as this occurs the output of current will fall off rapidly, until it approaches zero at which point the battery is useless as a generator of current. But suppose we can supply the positive plate with oxygen, this will combine with the hydrogen and keep this "polarizing" effect under control. Here then, is the function of a "depolarizer," it keeps the unwanted hydrogen at bay, and whilst its beneficial action continues the battery will provide a useful supply until its elements are expended.

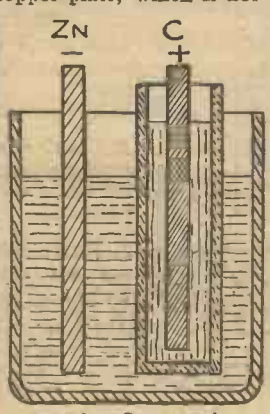


Fig. 2.—Section of a Leclanché cell.

Leclanché Cells

The original Leclanché cell consisted of a jar containing a zinc rod—zinc is always used as the active element in primary cells—and a carbon placed in a cell of porous earthenware. This porous pot also contained crushed carbon and manganese dioxide. The latter being rich in oxygen forms an admirable depolarizer. The electrolyte consisted of a solution of sal ammoniac. Such a battery is well suited for intermittent use as it recuperates after a short spell on open circuit. Fig. 2 gives a sectional view of the make-up of such a battery and brings us to the modern dry cell which is a convenient modification of the old Leclanché battery.

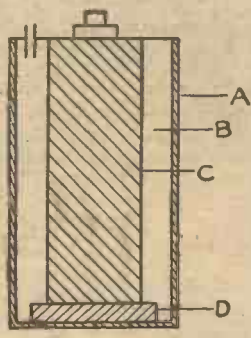


Fig. 3.—Section of a modern dry cell.

We now arrive at the modern dry cell, a section of which is shown at Fig. 3. Here we have the zinc in the form of a cup A, containing an absorbent which holds the excitant B in paste form. This excitant, with certain exceptions, is sal ammoniac—as used in the former Leclanché type—which attacks the zinc and sets up an "electro motive force" or E.M.F. In the centre of the cell, at C, is the carbon rod surrounded by crushed carbon and manganese dioxide much in the same way as in the old Leclanché cell.

At D, is an insulator to avoid short-circuiting the zinc and carbon elements, which are, of course, at opposite potentials, *viz.*, negative and positive.

The top of the container is sealed in by a pitch compound through which is passed a vent tube for the release of the gases evolved during the chemical action. The same vent also allows the entrance of air, the oxygen of which assists in the process of depolarization. Apart from its convenience and unspillability, the dry battery has a much lower internal resistance than the older Leclanché cell. This means that it can supply much larger currents. In fact, a large dry cell can yield 20 amperes or more on a momentary discharge, on short circuit.

A single cell gives an average voltage of 1.5 volts, so that a 120 volt high-tension battery will contain no fewer than 80 cells. These are connected in "series," *i.e.*, carbon to zinc, which gives a total voltage of 1.5 times the number of cells, *e.g.*, 80 x 1.5=120 volts. This being a considerable electrical pressure, it is obvious that no leakage must be permitted, as not only would the cells soon become useless, but excessively noisy in working even over their very short life. It is, therefore, the practice of the battery manufacturer to make the outer container in the form of a crate, or "egg box," made of waxed cardboard, and filled in with paraffin wax. In some of the higher class high-tension batteries, several of the units are further enclosed in insulating capsules to "break" the leakage path at certain critical points.

Proper Care of Batteries

Having now gained some idea of the make-up, also the "whys and wherefores" of our dry battery we can apply the knowledge to useful effect. In the first place we must carefully guard against excessive discharge, and this entails two precautions. Firstly, we must not employ *too small* a battery for our radio receiver, and secondly, we must neither short-circuit the cells nor subject them to an excessive drain when testing their condition. Batteries of "standard," or small, capacity should not be used for sets of more than two or three valves, and taking over 10 milliamperes.

In fact, in practically every case it is a distinct economy to employ batteries of "double" capacity, as the additional life more than compensates for the extra cost. Very cheap batteries of little-known make are dear at any price. These often show a high initial voltage, which falls rapidly and does not recuperate readily on open circuit.

Such a battery has the additional fault of becoming very noisy in action, quite apart from its proneness to cause back coupling where the receiver is not particularly well decoupled.

A good battery will work well right down to nearly half its rated voltage, at which point, say, .8 to .9 volt per cell, its useful life is about ended.

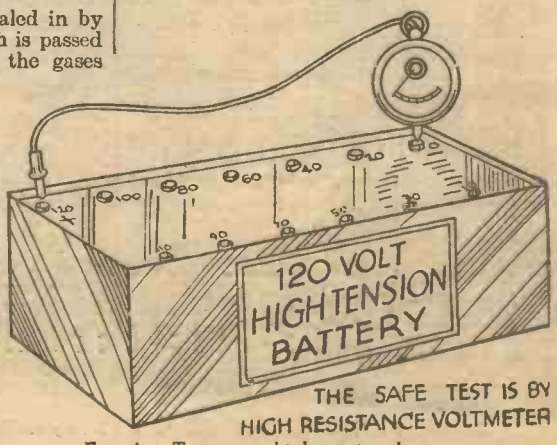


Fig. 4.—Testing a high-tension battery.

Fig. 1A.—*Illustrating an image out of phase.*

PART 7

WHAT IS TELEVISION?

A Short Series Explaining Fundamental Principles.

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

IN a short series of articles such as these it is impossible to give more than a brief résumé of television, and such ramifications as Noctovision, Phonovision, Screen Television, Daylight Television, Zone Television, Colour Television, Ultra Short-wave Television, etc., cannot be touched at all. In the previous six articles, however, I have endeavoured to cover the most important points dealing with the working parts of the transmitting and receiving apparatus, in so far as it affects the reader or experimenter. In the concluding one, therefore, I thought it would be interesting to touch on the procedure to be followed when preparing to "look in" at a transmission and using a disc type machine.

"Looker"

By the way, there has been a good deal of controversy concerning the correct term to describe the individual who looks in at a television transmission so that matters will be on a par with "listener," the generally accepted term for the man who sits at home and listens to the programmes provided for him *via* broadcasting. The word that finds the greatest favour, as far as the B.B.C. is concerned, is "looker." I wonder what readers of PRACTICAL WIRELESS think of this?

Fig. 2.—*Adjusting the speed control of the motor driving the television receiver disc while looking in.*

Obviously, the first thing to do is to tune in the London National Station on 261 metres, as this is the transmitter at present furnishing the B.B.C. television signals. These signals should be heard on the loudspeaker, and can be recognized easily as what may be described as a high-pitched steady note, with another high-pitched chirrup superimposed upon it. Once tuned in, change over the output connections on the set so that they feed the vision apparatus—neon lamp and synchronizing mechanism, if this latter has been included.

Fig. 3.—*Showing how an image will look when correctly phased and framed.*

Fig. 1B.—*Illustrating an image out of frame.*

Starting Up

It is not felt advisable to deal with the several methods by which the wiring between the vision apparatus and wireless receiver can be affected. Everything depends upon the type of output circuit in the set, that is, whether it is direct, choke, or transformer-coupled, together with the amount of voltage available from the source of high tension. This can be dealt with at a later date, when it is hoped to describe practical apparatus for the home constructor.

Start up the vision apparatus motor, noting first of all that the neon lamp is glowing at its normal brilliancy. As the disc gathers in speed a glance into the magnifying lens will reveal a number of oblique black lines and streaks intermingled with red patches. This is the image gradually taking shape, and as the disc speed more nearly approaches its correct value of 750 revolutions per minute, a succession of images can then be seen to be moving *downwards* rather rapidly and it is necessary to adjust the motor speed until the black lines which appear normally at the top and bottom of the picture are horizontal. It is a great help, in working the apparatus to remember that the lines, when sweeping downwards, signify that the motor is running too slow, while when the lines sweep upwards, this will indicate that the motor is running too fast. In either case, the procedure to rectify matters is quite obvious, that is, increase or decrease motor speed by means of the knob provided.

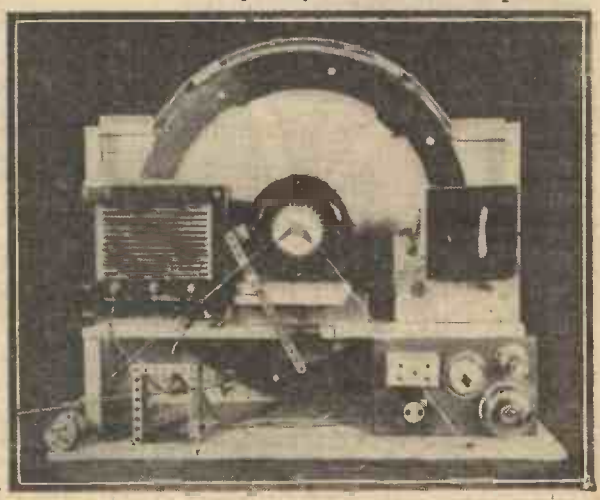


Fig. 4.—*A home-made version of vision apparatus having an ingenious method of friction brake speed control.*

Curious Effects

When the speed has been correctly adjusted, the synchronizing mechanism will come into play and hold the image steady, but if the adjustments are not correct, the image will "hunt" vertically, that is, move up and down and give one the impression of watching a scene through the porthole of a ship as it gently rides the waves. Correctly operated, however, the image can be kept steady, but the image may, when it first comes to rest, be "split vertically," somewhat in the manner indicated in Fig. 1, where two portions of a picture can be seen side by side. This is explained quite simply, and arises from the fact that the disc has been pulled into a state of isochronism (see last week's article), and true synchronism is not established, since corresponding disc holes or scanning areas at the transmitting and receiving ends are not in phase. The image is, in effect, moved bodily along to the left or to the right by the number of holes it is out of phase.

Rectifying Matters

To rectify matters with the ordinary apparatus, *gently* bring the disc from its correct speed by adjusting the resistance control. The image will drift slowly upwards or downwards, and as soon as the double image has resolved itself into a single one, the motor speed must be readjusted to normal again. These synchronizing adjustments have to be done intelligently, but a little practice will soon put this right, just as is the case when tuning a new set.

In Fig. 1 is shown another possible occurrence, this being known technically as an image "out of frame." It arises when automatic synchronizing or synchronous motors are employed, and is due to the mechanism being set incorrectly with reference to the disc holes. If no other device is available, it will be necessary to move round slightly the disc on the shaft, but the better and simpler alternative is to rotate either the whole carcase of the motor or adjust the position of the field coils by moving them a little round the motor carcase.

Interesting Records

The photograph indicated as Fig. 2 is interesting, inasmuch as it shows a "looker" making adjustments to the speed control of an experimental Baird "televisor" used in Germany in 1929. The image here was quite small, and appeared in the aperture seen on the right of the square front cabinet. In addition, Fig. 3 will show the reader how the image will appear in his apparatus when properly phased and framed. The machine shown is one which was built by the German company, Fernseh A.G., and is designed for horizontal scanning, with a resultant picture shape differing from the English standard.

Fig. 4 records an amateur effort at building disc television receiving apparatus and is included to show the ingenuity displayed by constructors to obtain correct speed regulation. A remote control friction brake will be noticed, this apparently being preferred to the more usual electrical methods, but by all accounts it functioned to the satisfaction of the user, and after all, that is the main criterion.

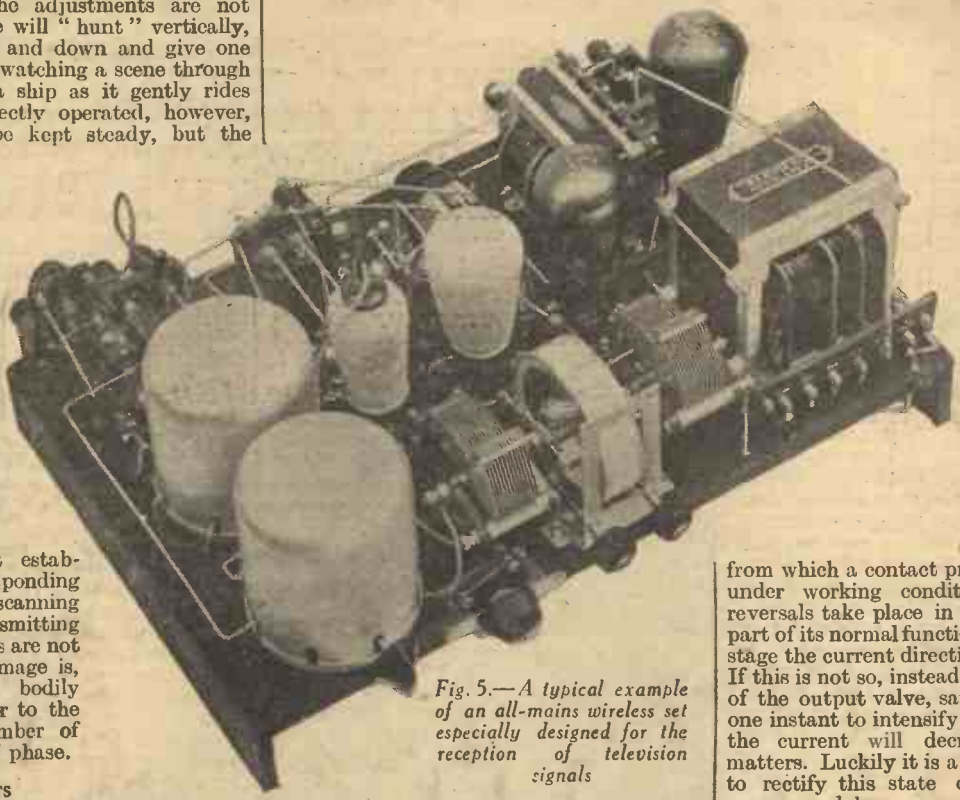


Fig. 5.—A typical example of an all-mains wireless set especially designed for the reception of television signals

The Television Wireless Set

Just a word now in connection with a wireless set to be used for the reception of the television signals. Here again is a case where individual taste can be exploited provided one or two points are borne in mind. First of all, do not forget that the absence or over accentuation of certain frequencies as a result of suppression or resonance in the wireless set, will quite easily spoil the image. The lower frequencies are responsible for the pictorial or pleasing effects, and if the set fails to go down to the "bass" notes it will no doubt be found that there is a kind of white light thrown up behind a person's head in the case of a close up image. In addition, the white background becomes almost black on the top of the image on either side, while the observer will notice beard-like shadows which have the effect of making the image look dirty.

On the other hand, if the higher frequencies are cut off there will be an absence of detail. The eye, for example, will look somewhat blurred or out of focus and too much imagination is required to get a true mental picture of the subject being transmitted.

From these remarks it will be gathered that the wireless set must be as free from distortion as possible. Tuning circuits, in consequence, must not be too sharp or ultra selective, otherwise we can say goodbye to the high frequencies, while at the other end of the scale do not have a rapidly falling response curve in the low frequency amplifier, or there will be a feeling of disappointment with the results obtained.

Negative Images

Another point to watch comes about from current direction. In aural reception no account has to be taken of this as far as the operation of the loud-speaker is concerned. A reversal of current direction in television reception will change a positive image (that is, one in which there are the true light and shade relationships as in an ordinary photograph) into a negative one (that is, an image which resembles the photographic plate from which a contact print is made). Since under working conditions these current reversals take place in the wireless set as part of its normal functioning, at the output stage the current direction must be correct. If this is not so, instead of the plate current of the output valve, say, increasing at any one instant to intensify the neon lamp glow, the current will decrease and reverse matters. Luckily it is a relatively easy task to rectify this state of affairs when it occurs, and here are one or two ways of doing it.

If a transformer precedes the last valve, reverse *either* the primary or secondary connections to the windings. In many cases it is quite sufficient to reverse or interchange the connections on the output terminals of the set, while another stage of low-frequency coupling can be added, or a change effected in the method of rectification, that is, anode bend to leaky grid or *vice versa*.

A Big Future

As an example of a well-made all mains wireless set for the reception of the television signals, readers should refer to Fig. 5. This is a three valver of medium range and represents quite good practice for this class of work. No doubt at some future date it will be possible to describe to PRACTICAL WIRELESS readers the complete designs of both a television wireless set and also the vision apparatus itself, but in the meantime may I enjoin every one of you to study carefully the facts which I have endeavoured to present to you in this series as succinctly as possible.

No one can gainsay that television has a big future and in this connection the amateur is an important person. He is the man (and in these enlightened days we can justifiably say woman) who studies every new development, and just as in the early days of wireless he contributed his quota which materially assisted progress, so history can repeat itself as far as the science of television is concerned.

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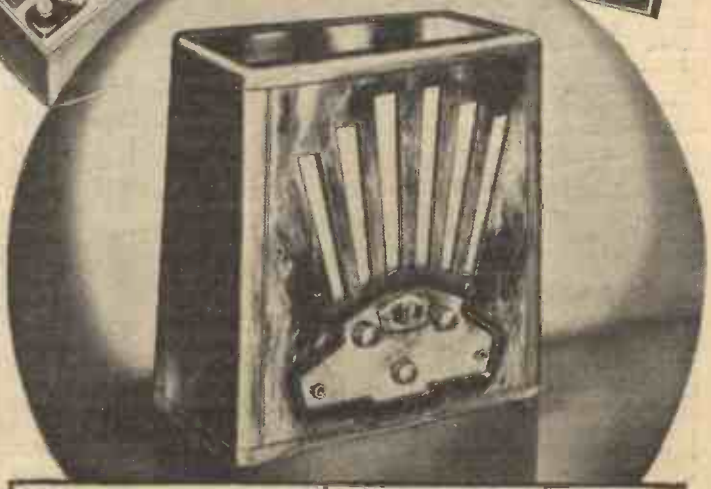

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A FEW WORDS TO THE MANUFACTURER

Little Improvements which are Long Overdue

By W. B. RICHARDSON

Modern Components have Reached a Very High Standard of Performance, but Many Still Suffer from Minor Defects Connected with their Fitting or Operation. The Writer Enumerates Some of These and Suggests How They Might be Remedied.

THERE is no doubt that on the whole home constructors are very well catered for by the trade. There is scarcely a single component or accessory which the amateur is likely to need which cannot be supplied in a variety of makes and styles. However, in spite of this there are still many little grouses to be laid at the feet of manufacturers. These are not grouses about the efficiency of components or their adaptability to modern circuits, for manufacturers have done marvels in these directions, but rather are they complaints which arise from the practical difficulties met with in assembling.

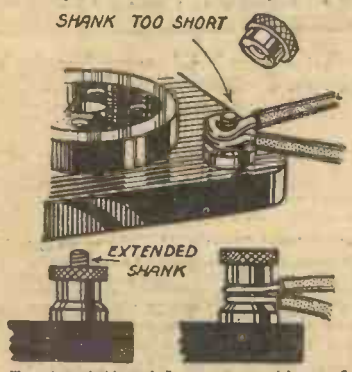


Fig. 1.—(Above) It is impossible to fit more than one wire under some terminals. (Below) A longer shank is all that is required.

Amateur construction or assembly is, of course, fundamentally different from professional construction. For example, a component used in a factory-made receiver can be designed for the one particular set in which it is to be used. The designer knows beforehand the exact characteristics required, so that there is no need to arrange for alternative values, extra tappings, and so on. Moreover, it can be designed to fit in nicely with the other parts so that there is no wasted space, and the connecting tags can be arranged in just the right position to give short and neat wiring.

With home construction, on the other hand, components have to be adaptable to many different circuits and layouts. This means that the general shape, position of terminals, etc., must be such as to suit average needs. We must not therefore be too ready in condemning the manufacturer if a certain part does not happen to fit in with a particular layout, or is a little difficult to connect up. It may be that in a different set it would be ideal. However, in spite of this acknowledged difficulty in meeting *all* requirements, we still have, as I say, several legitimate causes for grousing.

Why Not Standard Screw Threads?

Take terminals, for example. Constructors do not complain for fun. Terminals on many coils, valve holders, etc., are really too miserably inadequate for words. They are small and difficult to get at, and have no locking devices, so that when you attempt to tighten them up they merely go "round and round." All this has been pointed out before, but there are some other difficulties in connection with terminals which I have not seen mentioned before, but which most constructors must have come across at one time or another.

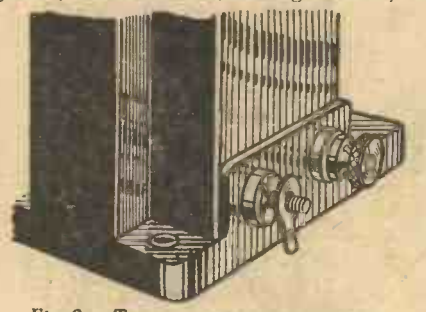


Fig. 2.—Type of soldering tag which is nothing more than a spade terminal. It is not a proper soldering lug.

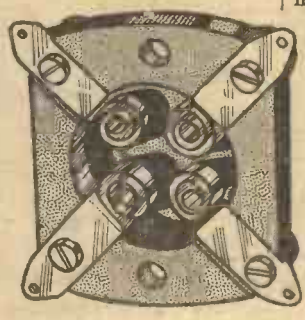


Fig. 3.—An example of a genuine soldering lug. They are made in one piece with the valve sockets.

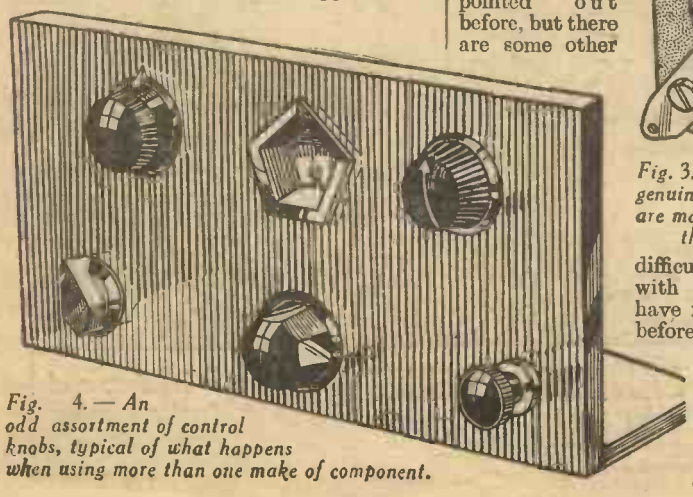


Fig. 4.—An odd assortment of control knobs, typical of what happens when using more than one make of component.

First of all there seems to be no co-ordination amongst manufacturers regarding the screw threads used; in fact, many seem to delight in producing a thread which is slightly different from any other. The result is that, if a terminal nut is accidentally lost, it is ten to one against our being able to replace it with one from off an old component. No retailer seems to stock replacement nuts, and so we either have to use one which is of the wrong thread, but can be made to "hold," or else do without one—a very unsatisfactory state of affairs.

I suggest that it would be quite simple to use standard threads and to limit them to two sizes, say 4 B.A. as the general size, with 2 B.A. for special purposes such as large aerial and earth or speaker terminals.

Another difficulty with some terminals is that there is not room under the nut for more than one connecting wire. If two wires are joined to the same terminal it is impossible to get the nut on. Of course it only means making the threaded shank a little longer and the problem would be solved. See Fig. 1.

Soldering Lugs

One thing regarding terminals which has always puzzled me is the little spade connector or soldering lugs which some manufacturers slip on to each terminal before putting on the nut. (See Fig. 2.) I have never quite understood whether these are to be considered merely as spade terminals to be soldered to the end of each connecting wire to save making a loop in the wire itself, or whether they are really intended to take the place of soldering lugs. If they are spade terminals, then there should be more than one under each nut, for it often happens that more than one wire has to be connected to one terminal. Anyway, they are certainly not much advantage over the ordinary method of making a loop in the wire since the time saved in making a loop is offset by the necessity for soldering. For this reason most constructors discard them. If on the other hand, they are supposed to be soldering lugs in the ordinary sense of the word, surely they lack the one essential of such a device, namely, the provision of an unbroken metallic contact from the component to the connecting wire. After all, we only solder a wire to a piece of apparatus so as to get direct contact and avoid the possibility of its ever coming loose. This is why the lug on a valve holder,

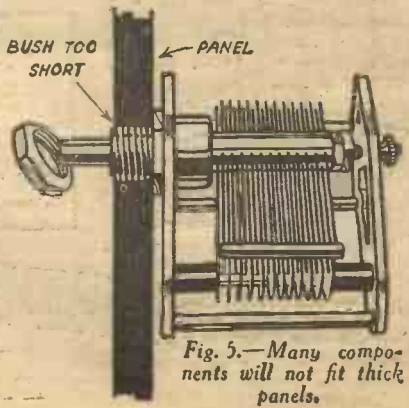


Fig. 5.—Many components will not fit thick panels.

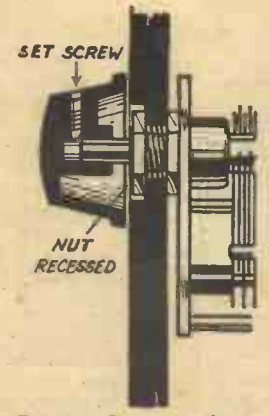


Fig. 6.—Recessing the panel may overcome the difficulty, but sometimes the control knob will not go in far enough for the set screw to hold.

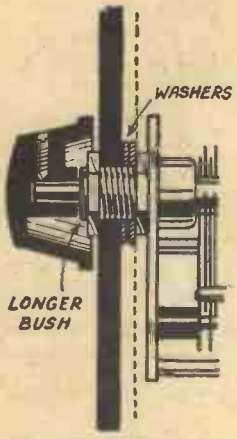


Fig. 7.—A longer bush is all that is needed. Washers could be used with thin panels.

for instance, is often an extension of the metal valve-pin socket itself.

A wire soldered to such a lug is bound to make contact with the valve-pin socket since it is part of it. However, with these soldering tags which fit under the terminal there is no such continuity. They are dependent for their excellence of contact on the tightness of the terminal in the same way as is a looped wire.

Position of Terminals

Regarding the positioning of terminals, most designers make an effort to keep them near the base of components. This is all to the good and makes for neater wiring, especially in the case of chassis-mounting and under-baseboard wiring. There is one little complaint I have to make, however, and that is that some makers put them rather *too* close, so that they almost scrape the baseboard or panel and make it very awkward when wiring up.

With variable resistances and potentiometers of the circular panel mounting type the terminals are usually placed round the edge, as in Fig. 11. This is often done for technical reasons, but one or two makes have them on the face of the instrument. This latter is certainly the most get-at-able position, and I suggest more makers might try to adopt this arrangement in their next designs.

Odd Control Knobs

One way in which home-constructed receivers are often not up to the standard of bought sets is in the appearance of the panel. Whereas the professional set usually has a neat and symmetrical layout with control knobs to match one another, the amateur receiver very often has an odd assortment of knobs. One reader pointed this out in the correspondence columns of this paper only a short while ago, and suggested that there should be greater co-operation between manufacturers, presumably to effect some sort of standardization.

It seems to me that the solution to the problem is very simple. Why not supply components *without* knobs and market the knobs themselves as separate parts? The idea would be to standardize not the pattern of the knobs, but the size of the spindles on which they fit. In this way a number of knobs of the same pattern could be fitted to all the various control spindles on a receiver. When building a set one would first purchase the necessary components and then choose a number of knobs. These would be obtainable in a variety of designs and colours, and all one would have to do would be to choose a complete set all of the same pattern. This might include, say, 2 large tuning dials, 2 smaller ones for volume and reaction controls and 2 knobs for switches.

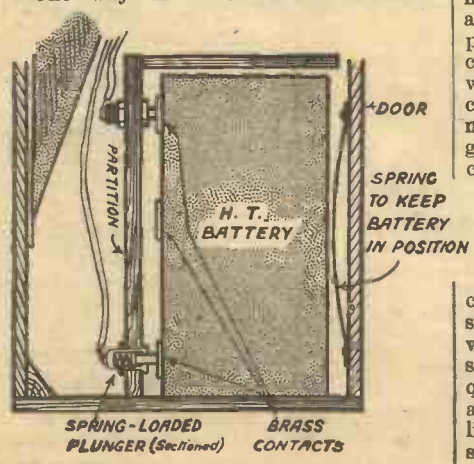


Fig. 10.—How the battery would be used.

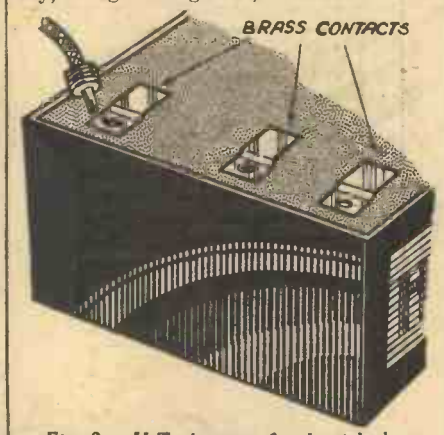


Fig. 9.—H.T. battery fitted with brass contacts as well as sockets (see text).

Stiff Controls

The question of control knobs reminds me that many variable condenser controls are anything but silky in action. This is particularly noticeable with some ganged condensers worked with a disc drive. One would think that any little stiffness in the condenser itself would be reduced to a negligible amount through the reduction gear of the drive; but nevertheless the control is often very heavy and jerky in operation.

On examining one or two models which suffered from this drawback, it appeared that the trouble was primarily due to the main spindle being very stiff. This necessitated the disc drive being very heavily spring loaded in order to turn the dial without slipping. Had the condenser spindle been easy to turn in the first place, quite a light drive would have beensufficient, and so the whole operation would have been lighter and smoother. The cause of the stiffness of the condenser spindle was chiefly the springs which were used to ensure good electrical contact between the spindle and the body of the condenser.

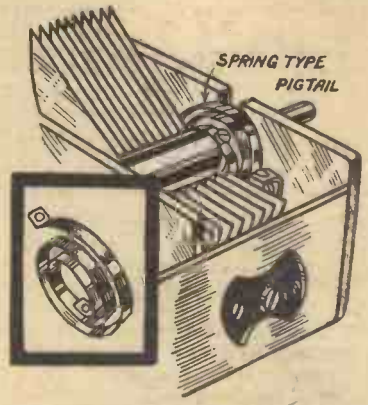


Fig. 8.—Watch spring type of pigtail connector has advantages over the ordinary type. Inset: Details of the spring.

No doubt pigtail connections would solve the problem. If the ordinary type were considered unsatisfactory owing to the possibility of their breaking, scraping on the plates, or varying their positions and so upsetting the ganging, I suggest that pigtails made like watch springs might answer the purpose. I had an old watch spring functioning in this capacity on a reactive tuning unit for many years and it worked admirably. Fig. 8 illustrates the idea as applied to a condenser.

Panel Mounting Difficulties

When it comes to the mounting of variable condensers and similar components on the panels of many home-built receivers another difficulty often crops up—the panel is too thick to allow the nut to go on the threaded bush. See Fig. 5. It seems to be the exception rather than the rule to find a component of the one-hole-fixing type which will fit a panel more than ¼in. thick, and many appear only suitable for 3/16in. panels. The result is that if a thicker panel is used the fixing nut has to be recessed in the panel as in Fig. 6. Even then it is often found that the control knob cannot be secured in position,

All this could be overcome by supplying slightly longer bushes and providing spare washers for use with thin panels. The washers would, of course, be placed behind the panel. This is shown in Fig. 7.

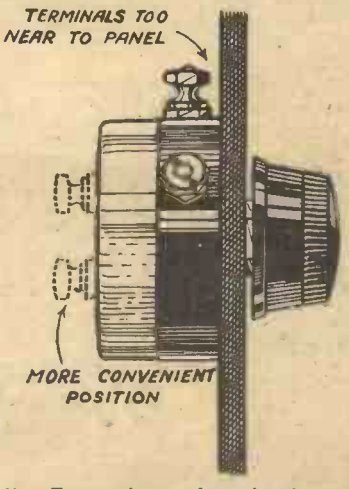


Fig. 11.—Terminals are often placed too near the panel for accessibility. Dotted outline shows a better position for them.

THE NEW RECEIVER WHICH WILL MAKE RADIO HISTORY.

Free 1/- Blueprint will be given with our Issue Dated Feb. 11th, on Sale Feb. 8th.

The Fury

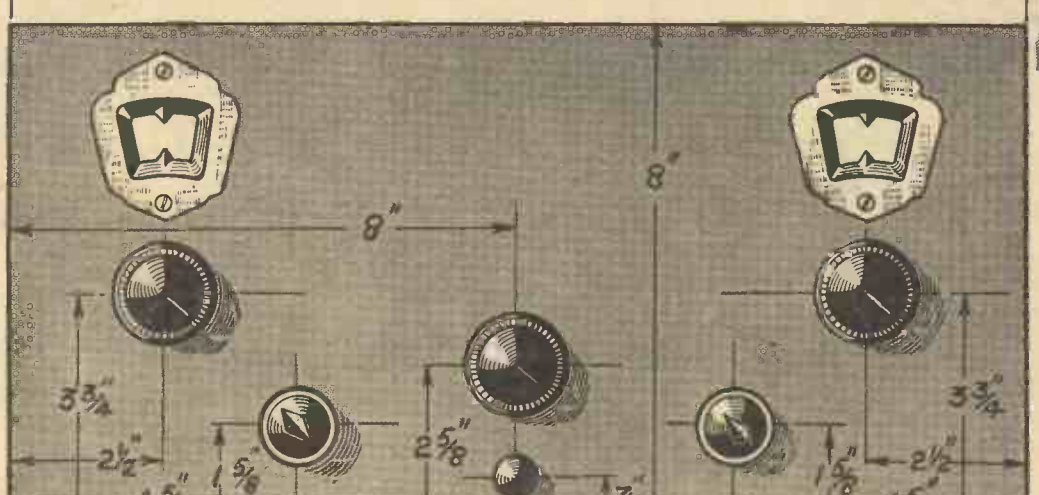
A most remarkable receiver, with a Personal Guarantee of Performance.

LAST week I made an important announcement on page 833 concerning my new four-valve receiver, the "Fury Four." I should like briefly to reiterate for the benefit of those readers who are reading PRACTICAL WIRELESS for the first time that I have specially designed this receiver for the readers of this paper as a result of the hundreds of letters I daily receive concerning the drawbacks and the deficiences of the average home-constructed set. So certain am I of the "Fury Four," that I recommend with every confidence and great enthusiasm, every reader of this paper to make it. Realizing as I did that this is the season when a reader might be tempted to make up a set which would fail to give him the satisfaction and service he requires, my tests of the "Fury Four" have been accelerated by the use of aircraft. I do not wish to use valuable space by reiterating *in extenso* all of the preliminary announcements I made last week, and I will therefore confine my claims to a sentence. They are these: the "Fury Four" is extremely selective; provides ample volume; receives at least one hundred stations on the medium and long wave bands; it is very simple to operate; cheap to build; free from background; economical to run; it is stable; easy to construct; no jamming of stations; most important of all, it is backed by my personal guarantee of satisfaction. Any reader, therefore, who fails to obtain the results of which I know the "Fury Four" to be capable, may avail himself of my personal advice free of charge on any difficulty he may encounter in its construction (excepting queries relating to alterations to suit reader's own components, which in no case can I answer) until the set functions to the satisfaction of the reader. It is necessary for the reader rigidly to adhere to my building and operating instructions. Let us now proceed to an examination of the circuit which is shown at the right-hand corner of this page. As stated above, a full-size wiring diagram of the Fury Four will be given with our issue dated February 11th.

The Circuit

It will be noted from the circuit diagram on this page that I have made use of two screened grid valves to render foreign reception certain. The pre-set aerial condenser C1 ensures that irrespective of the aerial used, the tuning range of the variable condensers will be fairly constant. A point which the reader will appreciate is that only one H.T. tapping is used. You merely plug in the negative wander plug into the negative socket and the single positive H.T. lead into maximum H.T. voltage. I have used voltage dropping resistances to ensure that each valve has the correct voltage applied to its plate. The great advantage of this arrangement is that the varying current-consumption of each valve does not cause high resistance patches to develop in the H.T. battery, which is the common cause of motor boating, instability, and poor reception when multiple H.T. tappings are used.

This illustration shows the extreme simplicity of the Fury Four. Tested in numerous zones noted for their reception difficulties, by many independent radio experts, this receiver has yielded remarkably uniform results.



PANEL LAY-OUT OF THE FURY FOUR.

Here is a r... "Fury Four," ... all sets. ... plicity of the ... wiring ...

MY GU...

I give a personal guarantee of satisf... I claim for it, and every reader ma... my personal advice *free of charge* co... any difficulties which may arise, unt... functions in the same manner as m...

Four

By F. J. CAMM

Every Reader of this Paper should make up this Amazing Receiver, which will easily receive OVER 100 Stations on the Medium and Long Wave-bands.

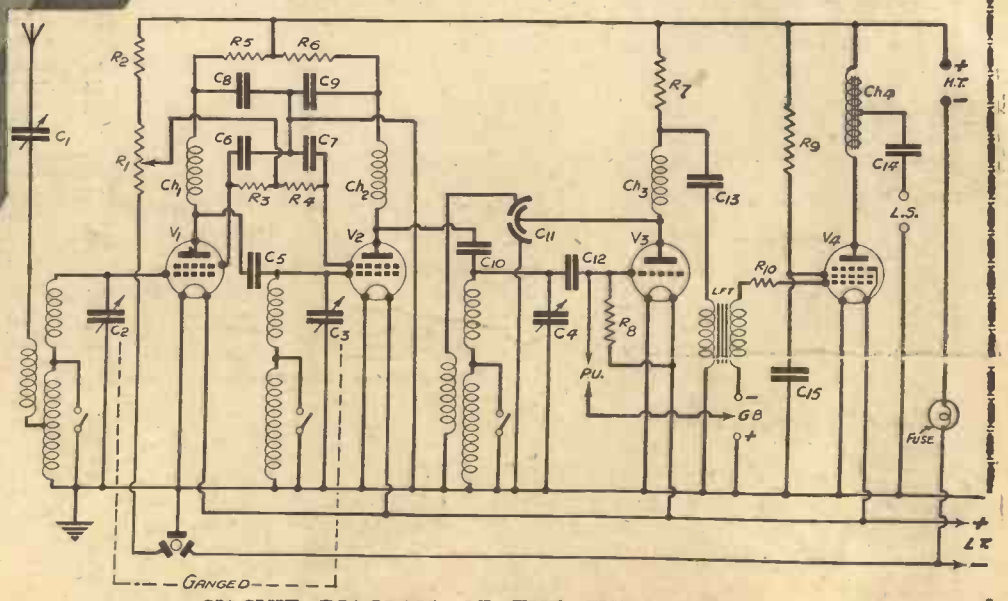
w of the amazing most modern of the extreme sim- out and the easy ngements.

arrangements to save him not only trouble in adjustment, but also money. My main object has been to provide a thoroughly reliable receiver with none of the drawbacks to which the reader has normally become accustomed, and with all of the snags anticipated and remedied, instead of, as is usually the case, the reader being left to do so. I feel that I should explain why I have not used a three-gang condenser in conjunction with the triple-gang coils. The reason is that there is a certain amount of difficulty in accurately balancing three condensers. I have, therefore, saved the constructor the trouble of doing this by tuning the detector grid-coil by a separate .0005 mfd. variable condenser. Therefore, the aerial and first grid circuit are ganged because, as the aerial is always flatly tuned, an accurate ganging does not, as a result, matter. In point of fact, this arrangement in the "Fury Four" yields far better results than the triple-gang condensers which I originally tried. I found that it was possible to facilitate the tuning considerably in this way. It is obvious that the detector grid-circuit is damped by the grid-leak; therefore this circuit is "flat," and a separate tuning condenser may be used here. You need to operate the "Fury Four" to realize the great value of this arrangement. You will notice that all components except one H.F. choke are screened. There is really no need to screen this as all risk of interaction is, of course, removed by the screening of the other components. Quite naturally I have adopted sub-baseboard wiring. Not only does this make for a neater layout and greatly simplify the wiring, but it also enables the condensers, the fuse, the resistances, etc., to be tucked away and hence actually reduces the size of the baseboard which otherwise would be necessary. I have considered the reader's pocket by using special mains condensers for screen grid decoupling purposes, for they are much cheaper than

(Continued on page 896.)

Full logging charts of the Fury Four will be given in later issues, together with independent reports by radio experts. Their reports agree in striking manner.

It will be noted that the detector valve is parallel-fed to the pentode, the one micro-farad condenser being fitted to provide a slight bass resonance to assist in balancing out the shrillness which generally accompanies the use of pentode valves. For the same reason a pentode output-filter is used with a similar value condenser. A point the reader will note in checking over the circuit is the extreme care exercised in choosing values and



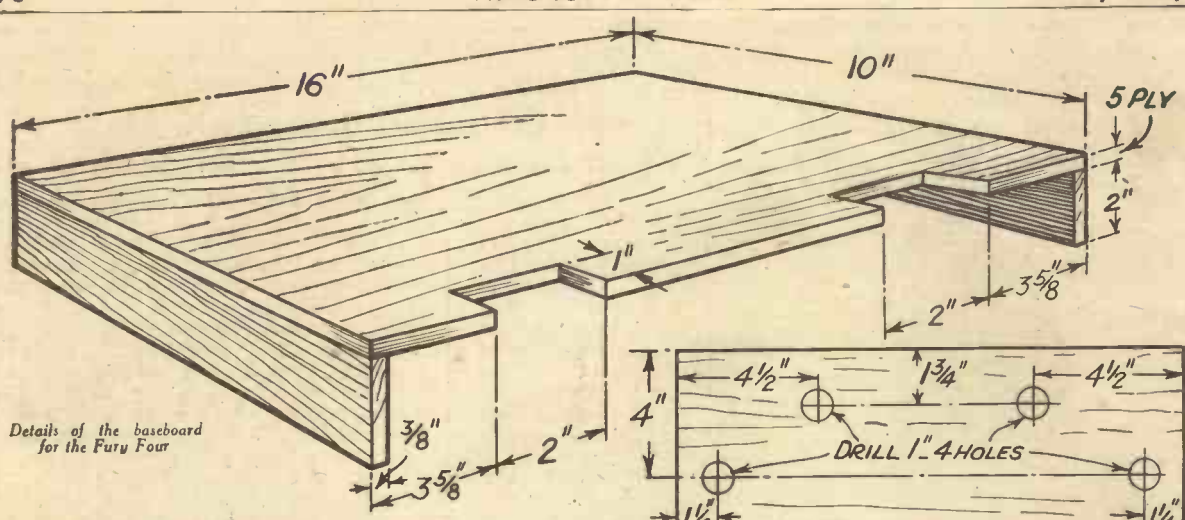
CIRCUIT DIAGRAM OF THE FURY FOUR.

C1, C5, C10—.0003 mfd. C2, C3, C4—.0005 mfd. C6, C7, C8, C9—.1 mfd. C11—.0003 Differential. C12—.0002 mfd. C13, C14, C15—1 mfd. R1—50,000 ohm. Potentiometer. R2, R7—30,000 ohms. R3, R4, R5, R6—1,000 ohms. R8—2 megohms. R9—5,000 ohms. R10—100,000 ohms. Ch1—Screened S.G. Choke. Ch2—Unscreened S.G. Choke. Ch3—Screened Standard H.F. Choke. V1, V2—Metallised 220 S.G. (Cossor). V3—Metallised 210 H.F. (Cossor). V4—220 PT (Cossor).

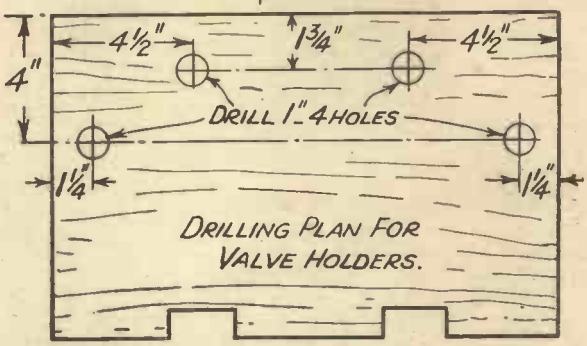
ARANTEE!

faction that the Fury Four will do what y obtain ncerning il the set ine.

F. J. Camm

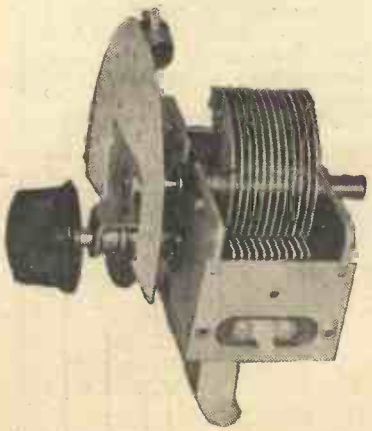


Details of the baseboard for the Fury Four



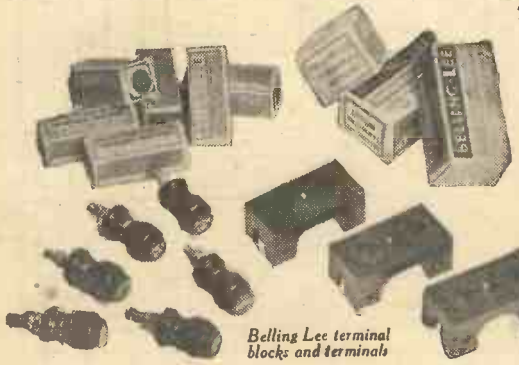
LIST OF COMPONENTS FOR THE FURY FOUR

(See Page 897 and below for illustrations of these Components)
One Three Gang LISSEN Coil Assembly (L.N.5162).
One LOTUS Two-gang Condenser with Disc Drive.
One LOTUS .0005 mfd. single Condenser with Disc Drive.
One SOVEREIGN Compression Type Condenser, Type J.
One WEARITE S.G. Choke, Type H.F.P.A.
One BULGIN S.G. Choke, Type H.F.4.
One PETO-SCOTT Screened H.F. Choke.
One READY RADIO L.F. Transformer, Ratio 3 to 1.
One TELSEN Pentode Output Choke, Type W.72.
Three DUBILIER 1 mfd. Fixed Condensers, Type BB.
Two DUBILIER .0003 mfd. Fixed Condensers, Type 665.
One DUBILIER .0002 mfd. Fixed Condenser, Type 665.
Two DUBILIER .1+.1 C mfd. Fixed Condensers, Type BE 31.
Four CLIX Chassis Mounting Valve-holders, Three 4-pin and one 5-pin.
Four 1,000 ohm. ERIE Resistors, 1 Watt Type.
Two 30,000 ohm. ERIE Resistors, 1 Watt Type.
One 100,000 ohm. ERIE Resistors, 1 Watt Type.
One 5,000 ohm. ERIE Resistor, 1 Watt type.
One LISSEN 2 meg. Grid Leak with Wire Ends.
Three BELLING-LEE Terminal Blocks.
One BELLING-LEE 4-way Battery Cord.
Six BELLING-LEE Terminals, marked Aerial, Earth, Pick-up, Pick-up, L.S. and L.S. (Type B).
One BULGIN Fuse-holder, Type F.5 with Fuse.
One LEWCOS 50,000 ohm. Potentiometer.
One TELSEN .0003 mfd. Differential Reaction Condenser, Type W.185.
One WEARITE Three Point Switch, Type GWC.
One Ebonite Panel, 16in. by 8in.—BECOL.
Three CLIX Wander Plugs, GB+ GB 1 and GB 2.
Two COSSOR Valves, Type 220 S.G. (Metallised).
One COSSOR Valve, Type 210H.F. (Metallised).
One COSSOR Valve, Type 220 PT.
One EDISWAN 2-volt Accumulator.
One EDISWAN 9-volt Grid Bias Battery.
One EDISWAN 120-volt Super Capacity H.T. Battery.
One W.B. Loud Speaker, Type P.M.4.
One CARRINGTON Fury Four Cabinet.
Two coils of GLAZITE Connecting Wire.
Sundry Screws, soldering tags, etc.

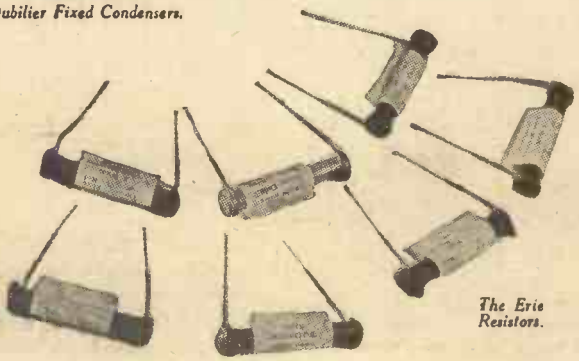


The Lotus single .0005 mfd. Condenser with Disc Drive

The Dubilier Fixed Condensers.



Belling Lee terminal blocks and terminals



The Erie Resistors.

(Continued from page 895.)

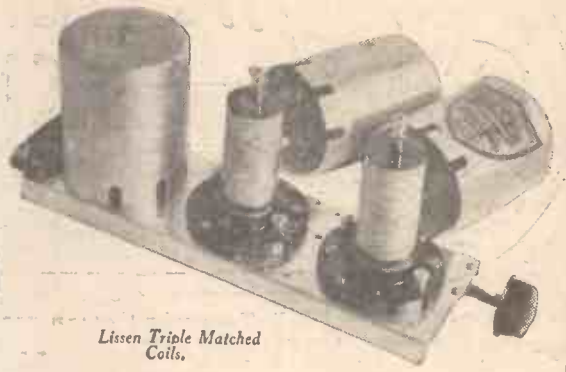
buying separate condensers, and possess the additional advantage that they are mounted two in one case, and, therefore, take up much less room. Another advantage which the home-constructer will appreciate is that the special condensers employed are fitted with flexible leads instead of terminals. They are, therefore, more conveniently wired into the circuit.

The potentiometer for the screen grid voltage adjustment is disconnected from the H.T. circuit when the set is switched off owing to the use of the three-pole switch, hence there is no drain on the H.T. battery when not using the set, and this control may be left in its usual position—which will, of course, be found in operation. The illustrations on this and the next page show the actual components I have used. Take this list to your dealer to make absolutely certain that the goods supplied agree with the list of components given above.

The Actual Components Required for the "Fury Four."

The Ready Radio Low-frequency Transformer

Telsen Tapped Pentode Output Choke.

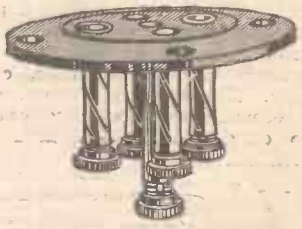


Lissen Triple Matched Coils.

The Peto-Scott Screened Choke.

The Wearite Screened H.F. Choke.

Bulgin H.F. Choke.



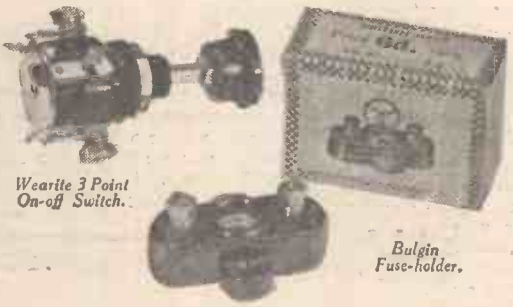
The Clix chassis mounting valve-holder you require.

Lewcos Potentiometer.

Telsen .0003 Reaction Condenser

The Lotus Double Gang Condenser with Disc Drive.

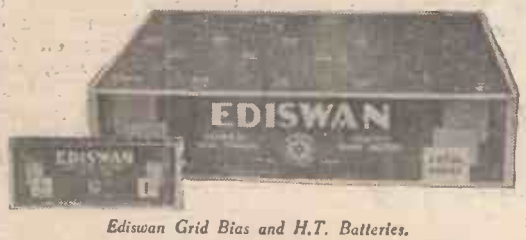
The Cossor Valves.



Wearite 3 Point On-off Switch.

Bulgin Fuse-holder.

The Ediswan Accumulator.



Ediswan Grid Bias and H.T. Batteries.

Sovereign Pre-set Aerial Condenser.

The BEGINNER'S SUPPLEMENT

Conducted by
F. J. CAMM

METHODS OF DETECTION.

SINCE the discovery of Radio Telegraphy and Telephony, many means have been devised for converting the high-frequency impulses into low-frequency or sound impulses. This process is known as rectification or detection. Of the various ingenious arrangements which have been used in broad outline, two only have survived the test of time, crystal and valve. The former is now well on the way to becoming obsolete, and valve detection is the only method that need claim our attention.

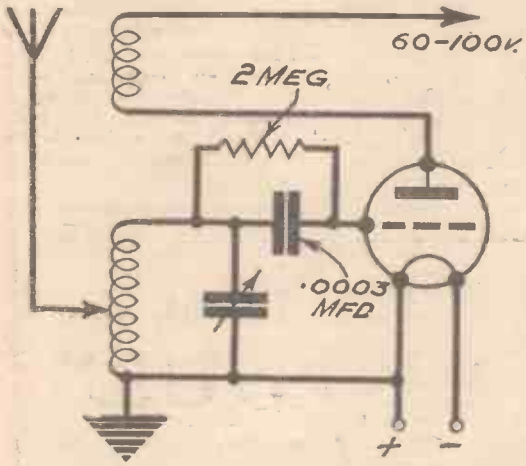


Fig. 1.—The familiar "leaky-grid" detector circuit.

"Leaky-grid" Detection

There are some four systems in general vogue to-day, all of which receive varying support. Each one has its merits and drawbacks, and it will repay us to examine these points in detail. Probably 75 per cent. of receiving sets used to-day embody a valve as a "leaky-grid" detector. The familiar circuit is shown in Fig. 1. This arrangement owes its popularity mainly to sensitivity, and in this direction it scores heavily over all other methods. As a rule quality is satisfactory enough for general purposes. Owing, however, to the comparatively high value of leak and condenser, the "time-constant" of the circuit is high. This means that the condenser retains its charge for a longer period, perhaps, than the interval between two successive cycles. Obviously, the shorter this interval the less chance the condenser has of returning to an uncharged condition. A short interval between cycles means a high frequency. Therefore, treble notes will suffer a certain amount of distortion, and, in fact, the higher we go the more apparent is the distortion. Harmonics will receive the worst treatment, and as a musical instrument owes its timbre largely to the presence of these, individuality is liable to be impaired. Another drawback of "leaky-grid" detection is the presence of grid current owing to the positive bias. This means a load on the tuned circuit, which is reflected as flat tuning; matters can sometimes be improved in this direction by tapping down on the coil as shown in Fig. 2.

Anode Bend Detection

Until quite recently, "anode-bend" detection was very popular; rectification depended on the bottom bend curvature of the valve characteristic and was, in fact, similar in principle to a crystal rectifier with the added advantage of amplification. In order to work on the proper part of the curve it was necessary to bias the valve negatively. One important benefit accrued from this; there was no grid current flowing and therefore no appreciable load on to the tuned circuit. Selectivity was much better than when using "leaky-grid" rectification, and providing the transmission was not modulated too deeply, quality was good. An additional advantage to battery users was the very low H.T. consumption. Nowadays, however, transmissions are modulated very deeply, and it is found that with anode bend detection reproduction is liable to be rough with large inputs as one is accustomed to receive from regional stations.

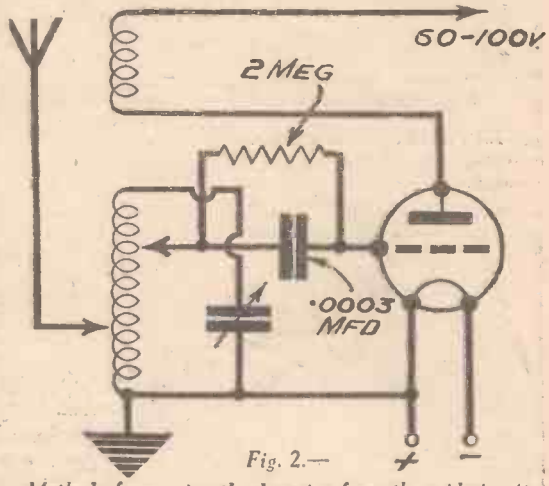


Fig. 2.—Method of removing the damping from the grid circuit.

"Power-grid" Rectification

The system which seems likely to oust all others in the near future is that known as "power-grid" rectification. The circuit as shown in Fig. 3 bears a close resemblance to "leaky-grid" detection, but it will be seen that a much lower grid-leak value is used, together with a smaller grid condenser. The effect of this is to make the time-constant much shorter. Our treble, therefore, does not receive such rough treatment. Also, a much higher anode voltage is employed, 120-150 volts being quite common. Large inputs may be handled with very little distortion; as a point of fact, it is actually necessary to feed a high input in order to ensure a minimum of distortion. With this method of rectification, the loading on the tuned circuitis rather severe, and tuning is comparatively flat. Once again we may attempt to improve matters by tapping down on the grid coil. It should be noted in passing that sensitivity will thereby be reduced, but there will be an optimum point where the loss of volume is more than outweighed

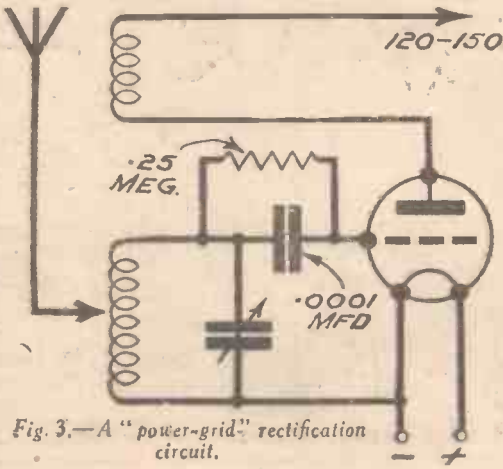


Fig. 3.—A "power-grid" rectification circuit.

by the gain in selectivity. These remarks apply more especially to receivers which do not incorporate an H.F. stage as such sets are naturally unselective, and one cannot afford to overlook any point which may lead to an improvement in this direction. One difference between the circuits in Figs. 2 and 3 is often missed. With "leaky-grid" detection the grid return lead is connected to L.T. positive, but with the "power-grid" arrangement is returned to L.T. negative. This does not mean, of course, that the grid is biased negatively; as grid voltage is calculated with respect to the cathode (negative end of filament in battery valves), the grid potential is actually zero.

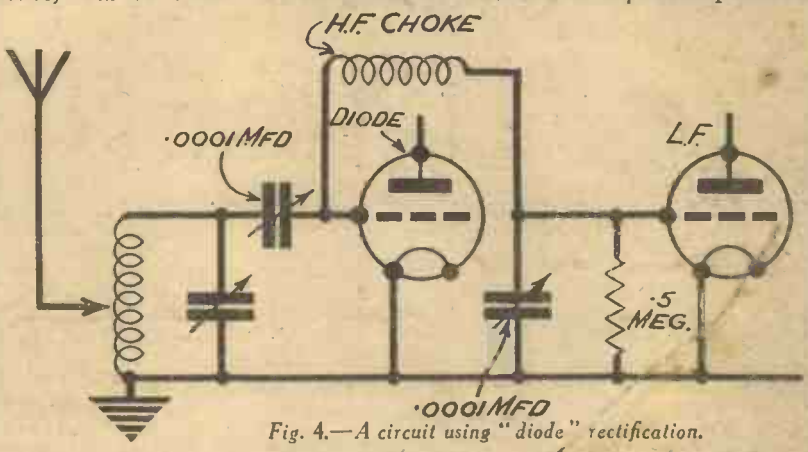


Fig. 4.—A circuit using "diode" rectification.

Diode Rectification

The final method of detection to receive our consideration is shown in Fig. 4. It is not a very popular one, but fully deserves to be. It is known as "diode" rectification. The reason for the name will be perfectly obvious as only two electrodes of the valve are used, the anode connection being left free. In this scheme the valve is a valve in the true sense of the word. Detection depends on the unilateral conductivity of the diode. It is absolutely distortion free and it is virtually impossible to overload it. Furthermore, there is little or no loading effect on the preceding tuned circuit, and tuning is therefore sharpened. For battery users an added attraction is the non-consumption of anode current. We now come to the one snag which has restricted its popularity. Used as a diode we obtain absolutely no amplification from the valve. It is therefore necessary to use an extra L.F. stage. It is possible to incorporate reaction, but the writer thinks that anyone who is sufficiently out for quality to use a diode, will not tolerate this. In the normal triode detector two jobs are combined, rectification and amplification. It must be perfectly obvious that the valve cannot handle both absolutely successfully. This is the great virtue of the diode; it does one job properly and we can then follow it by a well-designed L.F. stage. It is true that two valves are necessary to replace the usual one, but the results fully justify the extra complication.

ROUND THE WORLD OF WIRELESS.

ON the 14th, 15th and 16th day of each month, except in cases where the date coincides with a Sunday or holiday, Königs Wusterhausen (Germany) transmits a series of signals according to the following schedule:—

USEFUL CALIBRATION SIGNALS.

1st Day.	2nd Day.	3rd Day.	Time. (G.M.T.)	Signal.
549.4 m., 546 kcs.	579.1 m., 518 kcs.	869.6 m., 345 kcs.	05.00–05.05	a (·—)
553.5 m., 542 kcs.	840.3 m., 357 kcs.	900.9 m., 333 kcs.	05.15–05.20	b (—···)
557.6 m., 538 kcs.	849.8 m., 535 kcs.	1,096.9 m., 273.5 kcs.	05.30–05.35	c (—·—·)
566 m., 530 kcs.	1,055.2 m., 284.3 kcs.	1,123.6 m., 267 kcs.	05.45–05.50	f (··—·)
570.3 m., 526 kcs.	1,069.9 m., 280.4 kcs.	1,200 m., 250 kcs.	06.00–06.05	g (——·)
574.7 m., 522 kcs.	1,464.8 m., 204.8 kcs.	1,339.3 m., 224 kcs.	06.15–06.20	j (·———)

Such signals, transmitted from this high-power station, will be found very useful for calibrating a wireless receiver by plotting a graph, showing the individual wavelengths with their respective condenser readings.

Donald P. Marcus, Managing Director of Direct Radio Ltd., recognised by "Practical Wireless" as Official Kit Distributors for the "Fury Four."
"Mr. Camm and I know you will not be disappointed with the "Fury Four"—if built with the Official Direct Radio Kit—so order with confidence.

The Editor of PRACTICAL WIRELESS

and the Managing Director of

DIRECT RADIO

PERSONALLY GUARANTEE THE

'FURY FOUR'

F. J. Camm, Editor, "Practical Wireless."
"It is with extreme confidence that I place the Direct Radio "Fury Four" before readers of "Practical Wireless." This is the first time any circuit has carried the personal guarantee of the Editor. You can build the "Fury Four" with complete confidence."

if built with a DIRECT RADIO guaranteed and tested kit . . . .

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	£	s.	d.
1 Lissen Three-gang Coil Unit type LN5162	1	6	0
1 Erie 2-megohm Grid Leak with wire ends	0	1	0
1 J.B. Unitone two-gang screened condenser .0005 mfd., with disc drive	0	18	6
1 J.B. Dual Nugang Single screened condenser with disc drive	0	9	6
1 Ready-Radio .0003-mfd. Differential Reaction Condenser	0	3	0
1 Varley Pentode Nichoke	0	12	6
1 Erie 100,000 ohms resistance	0	1	0
2 Erie 30,000 ohm resistances	0	2	0
1 Erie 5,000 ohms resistance	0	1	0
4 Erie 1,000 ohms resistance	0	4	0
1 Set of 8 Erie Resistor coupling links	0	1	0
1 pair Panel Brackets	0	0	6
1 Ready Radio fuse holder and fuse	0	1	0
1 Ready Radio Standard S.G. Choke	0	4	6
1 Ready Radio 3-pt. switch	0	1	6
1 Ready Radio S.G. H.F. Choke	0	5	6
1 Kinva standard screened H.F. Choke	0	2	9
2 Dubilier .1-mfd. C.T. Condenser type B.E.31	0	6	0
3 Dubilier 1-mfd. Condenser type B.S.	0	6	0
2 Dubilier .0003-mfd. Condensers type 665	0	1	0
1 Dubilier .0002-mfd. Condenser type 665	0	0	6
1 Lewcos 50,000 ohm Potentiometer	0	3	0
1 Sovereign .0003-mfd. Preset condenser	0	1	3
1 Ready Radio 3/1 ratio L.F. Transformer	0	8	6
2 Belling Lee Wander plugs G.B.—, G.B.+	0	0	4
3 Clix sub-baseboard valve holders 4-pin	0	2	0
1 Clix sub-baseboard valve holder, 5-pin	0	0	9
1 Belling Lee 4-way Battery Cord	0	1	9
3 Belling Lee terminal mounts	0	1	6
6 Belling Lee terminals A.E.P.U., L.S.+, L.S.—	0	1	3
1 Permcol Panel 16" x 8" drilled to specification	0	5	6
1 Drilled and foil covered baseboard 16" x 10" x ⅜", and 2 side Strips 10" x 2"	0	4	0
1 Direct Radio "159" "Fury Four" Cabinet in Walnut	1	1	0
4 Valves to specification	2	17	6
Connecting Wire, Screws, Flex, etc.	0	0	8
	£10	17	9

So confident are we that the Direct Radio "FURY FOUR" is the ideal set for your Family's entertainment that we give this unconditional Guarantee—Build the "FURY FOUR" with a Direct Radio Kit and if you find the slightest cause for complaint, we, in conjunction with "Practical Wireless," will not consider the purchase completed until we have made your "FURY FOUR" operate to your absolute satisfaction free of charge.

DONALD P. MARCUS, Managing Director, Direct Radio Ltd.
F. J. CAMM, Editor, "Practical Wireless."

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or twelve monthly payments of **12/9.**

KIT Model 2

(with valves less cabinet) **£9:16:9**
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Siemens 9 Volt G.B. Battery	0	1	0
Block L.T. Accumulators 80 amp/hrs.	0	11	0
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W.B. PM4 permanent magnet moving coil speaker with Input Transformer	2	2	0
Epoch Twentieth Century permanent magnet moving coil speaker with Input Transformer	1	15	0
Bluespot 99PM permanent magnet moving coil speaker with Input Transformer	2	19	6
W.B. PM2 Permanent Magnet Moving Coil Speaker with Input Transformer, or 12 monthly payments of 8/-	4	5	0
R & A Victor Permanent Magnet Moving Coil Speaker with Input Transformer, or 10 monthly payments of 8/-	3	10	0
R & A Bantam Permanent Magnet Coil Speaker with Input Transformer	1	7	6
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Pifco Set Tester De-luxe Model	2	2	0
New R.I Quiescent Push Pull Transformer	0	16	6
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Bowyer Lowe A.E.D Mark III Pickup	1	10	0
Volume Control	0	3	0
Collaro Double Spring Gramo Motor Automatic Stop	1	13	0
Collaro A.C. Induction Gramo Motor	2	10	0
Collaro Complete to A.C. Gramo playing Unit with Induction Motor Pickup and Volume Control. Or 12 monthly payments of 7/6	4	10	0
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(The original unsolicited testimonials may be inspected at our offices.)

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Kit 1.	£4 2 0	12 monthly payments of 8/-
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Kit 3.	£6 4 9	12 monthly payments of 11/6
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Why deny your family the pleasure of listening to the World's Radio programmes until father or the family wireless expert comes home? Let them choose the programmes themselves all day. Give them the Direct Radio Fury Four—simple to build—simple to tune,—no freakish controls. Foreign programmes galore—one at a time without interference or distortion—inexpensive—in fact, the ideal set. Backed by the Editor of "Practical Wireless" and the famous reputation of Direct Radio of the Borough.

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OFFICIAL DEMONSTRATION

The "FURY FOUR," in conjunction with "Practical Wireless," will be demonstrated daily at 159, Borough High Street, London Bridge, S.E.1. Come and hear the amazing results for yourself.

SENSATIONAL KIT BARGAINS!

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BRITAIN'S SUPER KIT. Complete kit of all specified components. £4/12/6. A five-valve, super-heterodyne receiver, best super-het ever designed, full instructions and blue-print with each kit.

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EXTENSER CONDENSER, .0005 mfd., slow motion. List price 14/6. **Sale Price 9/11.**

COSSOR THREE-VALVE BATTERY MODEL KITS without valves £4/16/0. **Sale Price £3/3/0**

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COMMENTS ON COMPONENTS

What we Found..

"BROADCASTER" TRADE ANNUAL

THE service man, wireless set repairer, or keen experimenter will find this book a most handy reference volume to keep on the bookshelves. In addition to a complete Directory divided into classes of components and sets, there is a list of Trade Names, list of products, supplies, and a list of wholesalers. The technical section contains a list of the supply voltages for the majority of the towns in England, and complete formula for all wireless purposes. Radio servicing receives over a dozen pages, explaining methods of fault finding and testing. At 5s., this is a valuable volume which should and undoubtedly will find a ready market.

LEWCOS CONDENSERS

WE are advised that the well-known Lewcondensers, Type O and W, have been reduced in price from 2s. to 1s. 6d.

IGRANIC TRANSFORMER

WHERE space is a consideration, a small transformer becomes an essential item in the receiver. There are several difficulties, however, in the design of an efficient transformer of small dimensions, but the Igranic is certainly a miniature masterpiece. The dimensions are 2⅞in. by 1¾in. by 1⅝in., and the weight only 6½oz. In spite of this, however, the primary inductance is over 60 henries. It is stated that the core is of a new material, and that the iron circuit is so small that the stray field round the transformer is almost negligible. The result of this is that two of these transformers may be mounted close together without interaction. It is also stated that no earthing of the core is necessary. Fitted with a brown moulded bakelite case, this transformer is obtainable in two ratios, 3 to 1 or 5 to 1, and the price is in each case the same, namely, 10s. 6d. A really excellent product.

WATES DISTANCE SWITCH

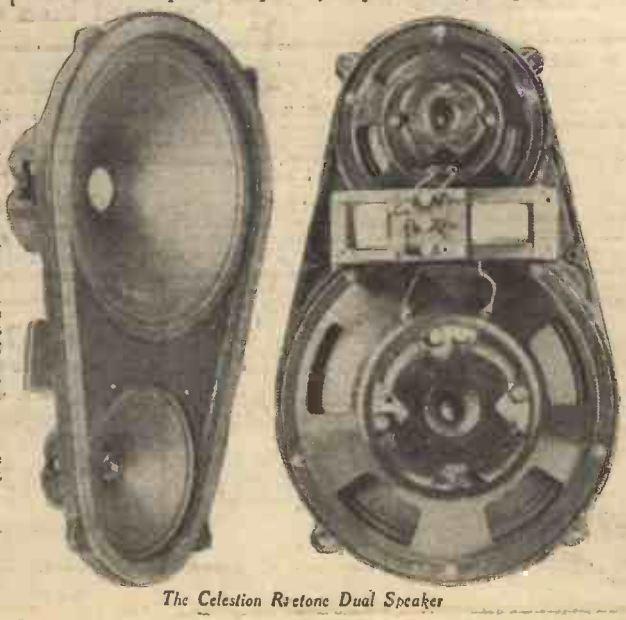
AN article has already been written in these pages explaining the advantages of remote control, and the Wates switch was illustrated therein. This works by means of a solenoid and a toothed wheel. An armature is disposed inside the solenoid, and a small finger is held by a weak spring against the toothed wheel. This is provided with a small commutator having four brass segments and four ebonite segments. Two spring contacts bear against this commutator, and when a current is passed through the solenoid the armature is drawn up and thereby causes the finger to engage behind one tooth of the toothed wheel. This rotates the commutator a quarter of a revolution and alternately brings the brass segment or the ebonite segment against the spring contacts. The contacts are provided with two terminals, and two additional terminals are provided for the battery to operate the solenoid. By employing an extended lead from these latter terminals, and connecting push switches in these leads, the solenoid may be operated from a distance. The current taken was found to be about .8 of an amp, but as it is only necessary to press the button for an instant to make the commutator make the necessary connection, a dry battery may be used for the purpose, and will last quite a long time. This point must be borne in mind when using the switch, and the button must only be pushed for an instant, just sufficient to bring the relay into operation. The switch is inserted in either the low-tension lead or one of the mains leads, and the two terminals are completely isolated from the terminals used for the distant switches, so that the apparatus may be employed with a mains set in perfect safety. The price of the switch is 9s. 6d., and it will be found a very useful device for remote control, an article on which appeared in a recent issue of PRACTICAL WIRELESS.

S.G. ANODE CONNECTOR

WHEN a metallized S.G. valve is employed, the metal coating is joined to H.T. negative (earth). The flexible lead which is joined to the terminal on the valve is joined to H.T. positive, and therefore, if this lead comes into contact with the metal coating, the H.T. supply is short-circuited. The usual method of employing a metal spade at the end of the flexible lead for connection often leads to this trouble, but the Belling-Lee special connector avoids the difficulty, and also enables the connection to be made very easily. It consists of two parts, a socket and a plug, all ebonite coated. The socket portion is attached to the screw of the S.G. anode terminal, and the socket is attached to the flex. All that is necessary to make connection is to fit the socket over the plug. This ingenious and useful accessory only costs 4d., and for those who object to even this expense, a cheaper model is made at 2d. This has the socket part screwed under the S.G. terminal and plugs in sideways. The ingenious experimenter will find many other uses for this little component.

CELESTION REETONE SPEAKERS

WHEN it is desired to get a really ideal output, with correctly balanced reproduction of the highest and the lowest note, the new type of dual speakers will be found invaluable. It is asking rather a lot of one diaphragm to respond to, say, a 30 cycle organ note with the same accuracy as a 4,000 cycle note. The dual-matched speaker has, therefore, been introduced, and consists of a large metal chassis carrying two loud-speakers of different sizes. The illustration below shows the Celestion assembly, with the small speaker at one end and the large one occupying the remainder of the chassis. Each speaker is of the permanent magnet type, and has its own input transformer. In addition, a set of sockets and plugs enables varying degrees of tone to be obtained. The small speaker deals with the higher notes in the musical scale, and the large speaker handles the bass notes, and with the addition of the plug and socket arrangement it is possible to get a wonderfully realistic tone. Of course, a baffle is essential with the assembly, and this should be cut to take the complete assembly, and a larger fretted front may then be attached over the baffle to hide the rather odd-shaped cut-out. On test, it was found that the speaker would handle a really heavy signal (of the order of 3 to 4 watts) and was just as satisfactory on a small input of 800 milli-watts. The complete absence of boom was one of the principal features which was noticed, and the brilliance on violins, speech, and such items as cymbals and similar noises was very pleasing. Although there are two complete loud-speakers, the price of the complete assembly is only £4 5s., and there are three distinct models available. One employs two permanent magnets, one consists of two energized field windings, and the remaining model utilizes one of each type. The price is the same in each case. The makers are Celestion, Ltd.



The Celestion Reetone Dual Speaker

MELBOURNE SWITCHES

THE switch illustrated is one of the novel components manufactured by the Melbourne Radio Supply Company. The illustration shows the internal construction of this rotary switch, from which the mechanism is clearly seen. The outer casing of the switch consists of an ebonite box with terminals attached to the sides. The end of the terminal inside the box is recessed with a small hollow, and the operating knob of the switch is attached to a solid piece of ebonite, which just makes a nice fit inside the box. A hole is drilled through this solid piece, and through this is fitted a spring with a solid brass pin at each end of the spring. When the assembly is put together, the small brass pins are forced against the inner wall of the switch by the spring and engage in the recessed base of the terminals. There is thus a definite position for the switch in each position, and this may be felt when rotating the switch knob and a definite click may also be heard. A fan-shaped indicating plate is provided, and the switch is obtainable in either "On-Off," or "Radio-Gram" lettering.

The Melbourne Rotary on-off switch.

The On-Off switch costs 1s. 6d., and the Radio-Gram switch costs 1s. 9d., in either black or brown.

SOVEREIGN SKYHAWK S.G.3.

IN a leaflet just to hand from Sovereign Products, Ltd., a blueprint is given of the Sovereign Skyhawk S.G.3, an efficient and economical three-valver (S.G., Detector, and Power valve). The cost of building this useful set, chiefly using Sovereign Components is a little over £2, exclusive of valves and batteries. Hints on building the set are given in the leaflet, a copy of which can be had free on application to Sovereign Products, Ltd., Sovereign House, Rosebery Avenue, London, E.C.1.

TWO SPLENDID SIXPENNY HANDBOOKS

READERS who wish to obtain a reliable source of information regarding the construction of all types of wireless receivers, from a crystal set upwards, should obtain "Make Your Own Wireless Set" and "Modern Wireless Sets and How to Make Them," each costing 6d. and containing 80 pages of wiring diagrams and lucid text relating to the construction of the very latest receivers. Full lists of components are given in every case. Both volumes are by F. J. Camm, and are obtainable for 7½d. each post free from Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2.

TESTING LOUD-SPEAKERS

THE majority of beginners usually have a loud-speaker of the moving-iron variety, and there are several quite simple tests which may be carried out to test the frequency response, sensitivity and other features of this type of speaker. The most important feature of any speaker is its frequency response curve, and this can really only be satisfactorily tested by connecting the speaker to a first-class amplifier which is joined to a gramophone pick-up, the whole used in conjunction with constant frequency records. Of course, it is of no use testing the really low notes on this type of speaker, as the radiation falls off appreciably when below 80 cycles.

Faults

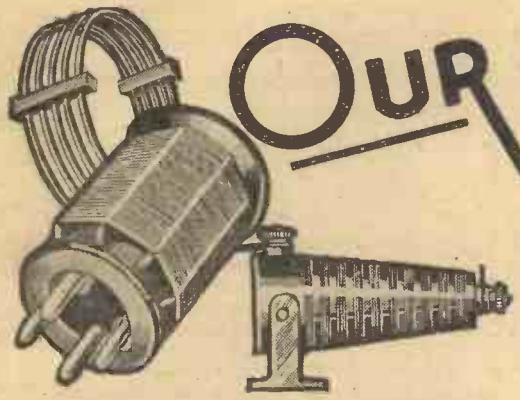
There are two principal faults which can arise in the moving-iron type of speaker, and these are electrical or mechanical. As the operating mechanism of this type of speaker is a magnet and armature, the obvious faults are short-circuits due to the insulation becoming worn away from the connecting leads, or metal filings, or similar material across the input terminals. This will result in complete cessation of signals. Leakage from the coil windings to the frame will result in a greatly decreased output, the strength depending upon the actual leakage. If the windings are only partially shorting, due to faulty insulation, scraping and scratching noises will be caused when the speaker is in operation, and by gripping the unit tightly in the hand this will be decreased. The impedance of the loud-speaker (as distinct from the D.C. resistance) will also vary the strength of the reproduced signals, and this factor should be borne in mind when a speaker is first connected up and fails to give complete satisfaction. Especially is this the case when a pentode is employed in the last stage of the receiver, with no compensating output circuit.

Mechanical Faults

Under this heading there are quite a number of troubles which can mar the reproduction. First and foremost is the rattle caused by loose nuts. The cone attachment in the apex of the cone may work loose after constant use, and this results in a peculiar form of "dither" which stops if the cone is lightly pressed with the finger tips just round the cone attachment. Looseness of the clamping nuts of the speaker casing results in a metallic rattle which is most noticeable when loud signals are being handled, or very low notes are being reproduced. Sometimes the material which surrounds the periphery of the cone becomes distorted, due to atmospheric conditions, and this results in the cone twisting as it is driven backwards and forwards by the armature. The only cure for trouble of this sort is, of course, a new diaphragm surround, and this should preferably be of leather and not rubber. Special thin leather is obtainable for the purpose and this lasts much longer than rubber, and is not so susceptible to rotting.

Cabinet and Baffle Troubles

Very often rattling and other noises may be caused by sources outside the actual speaker. These are due principally to insecure mounting to baffle boards, or loose joints or screws in the speaker cabinet.



Our Short-Wave Section

CONSEQUENT upon the opening of the new Empire Transmitter at Daventry, short-wave reception is becoming increasingly popular. Many amateurs are building short-wave sets, and it is not unlikely that in the near future even domestic receivers will be designed to work on wavelengths down to 15 metres or so. In the past a short-wave set has been looked upon as rather a special instrument intended only for the more advanced experimenter. As a result, sets of this type were made in somewhat "rakish" form and were fitted with numerous "gadgets" and controls which, in themselves, were sufficient to scare the average listener away from short waves. But these things are rapidly changing, and a short-wave receiver is beginning to look more and more like the broadcast set. Partly as a result of this, and partly because the number of S.W. stations giving out interesting programmes is quickly growing, the ordinary constructor is giving more attention to short-wave work. This is all to the good and the change will lead to greater simplicity of design and operation. Already the use of plug-in coils is becoming a thing of the past just as it did in respect to broadcast receivers a few years ago. Thus two or three manufacturers have put on the market dual—and triple—range S.W. tuners which are very efficient and help to simplify construction very considerably. But up to now (so far as I am aware) no constructional details have been given in the Press regarding tuners of the latter type and it is for this reason that I am writing the present article.

12—70 Metres

The three-range tuner of which particulars are given in Fig. 1 will cover the wavelengths of from approximately 12 to 70 metres when tuned by a .0002 mfd. condenser. This range is a very wide one, of course, representing a frequency range of from 25,000 kilocycles to 4,250 kilocycles, and so it is divided into three portions, which give approximately 12 to 20, 18 to 38 and 35 to 70 metres respectively. It will be seen that the bands overlap slightly and thus permit of an unbroken tuning range from the lowest to the highest wavelength.

The change-over from one wavelength to another is effected by means of two ordinary push-pull switches which each short-circuit a portion of the tuned winding. Reaction is provided, and by dividing the reaction winding into two parts, situated one at each end of the tuned winding, a more or less uniform degree of reaction coupling is obtained over the full tuning range.

Making a Triple-range Short-wave Tuner

Parts Required

The few materials required to make the tuner are:—

One, 3½ inch length of six-ribbed ebonite coil former, 1½ins. diameter. (The diameter is measured *outside* the ribs.)
Six, 6 B.A. terminals.
Six feet, 18 gauge enamelled wire.
Six feet, 26 gauge enamelled wire.

Construction

First of all drill six ⅛in. holes around one end of the ebonite former and securely fix the terminals into them. Next make a pair of 1/16in. holes about ⅛in. away from the "terminal" end of the former, and anchor one end of the thinner wire in these, leaving a couple of inches of wire projecting inside the tube for later connection. The method of anchoring the wire is to pass the end through one hole, back through the other and back to the inside again through the first. Now wind on four turns, cut off the wire and secure the end by passing it through another pair of holes made in a suitable position.

Leave a space of about 3/16in., and then make another pair of holes (about ⅛in. this time) for securing the end of the thicker wire. Fix the end of the 18 gauge wire in these and wind on two turns before making a looped tapping as shown in a detail on Fig. 1. Pass the loop through a ⅛in. hole in the former and continue to wind on another three turns; make another loop and then put on the remaining seven turns. Terminate the winding by passing the wire through another pair of holes as at the beginning. It will be seen from Fig. 1 that all the turns of thicker wire are spaced by about the thickness of the wire; the spacing increases the tuner's

(Continued on page 908.)

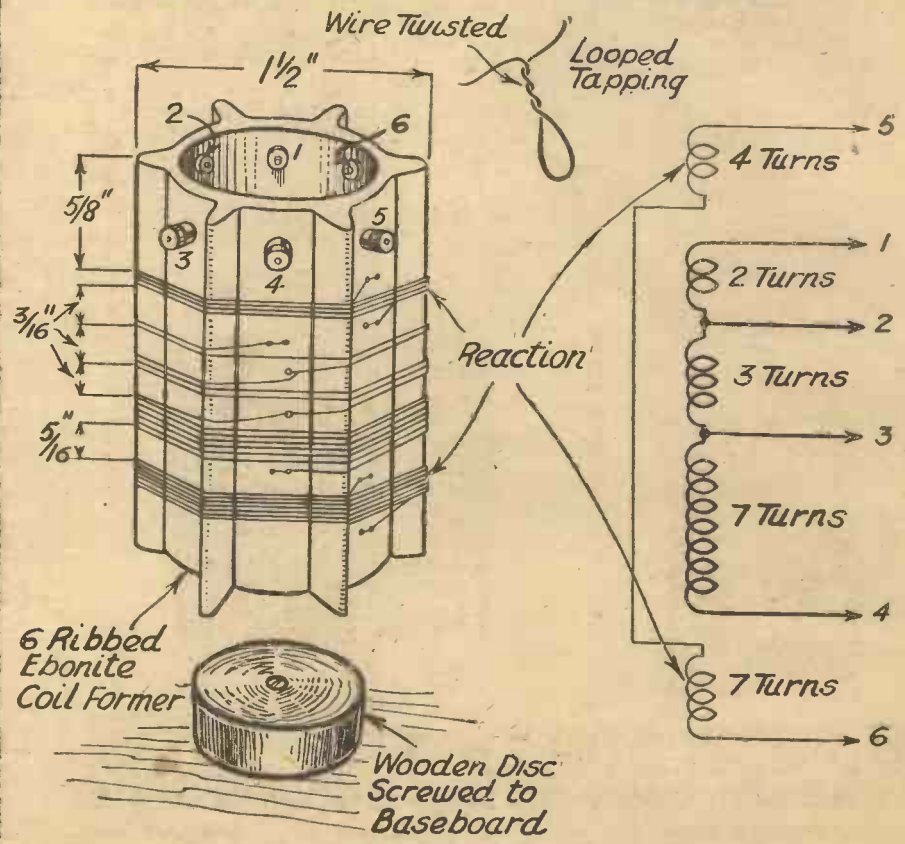


Fig. 1.—Constructional details of the short-wave tuner

OTHER LOTUS COMPONENTS

SUITABLE FOR INCLUSION IN THE "FURY 4"

.0003 Direct Drive Condenser, Type KC3, Price 3/6.

Output Choke 20 Henri type D.C.1. Price 5/6.

Universal Switch U.S.3. Price 1/6.

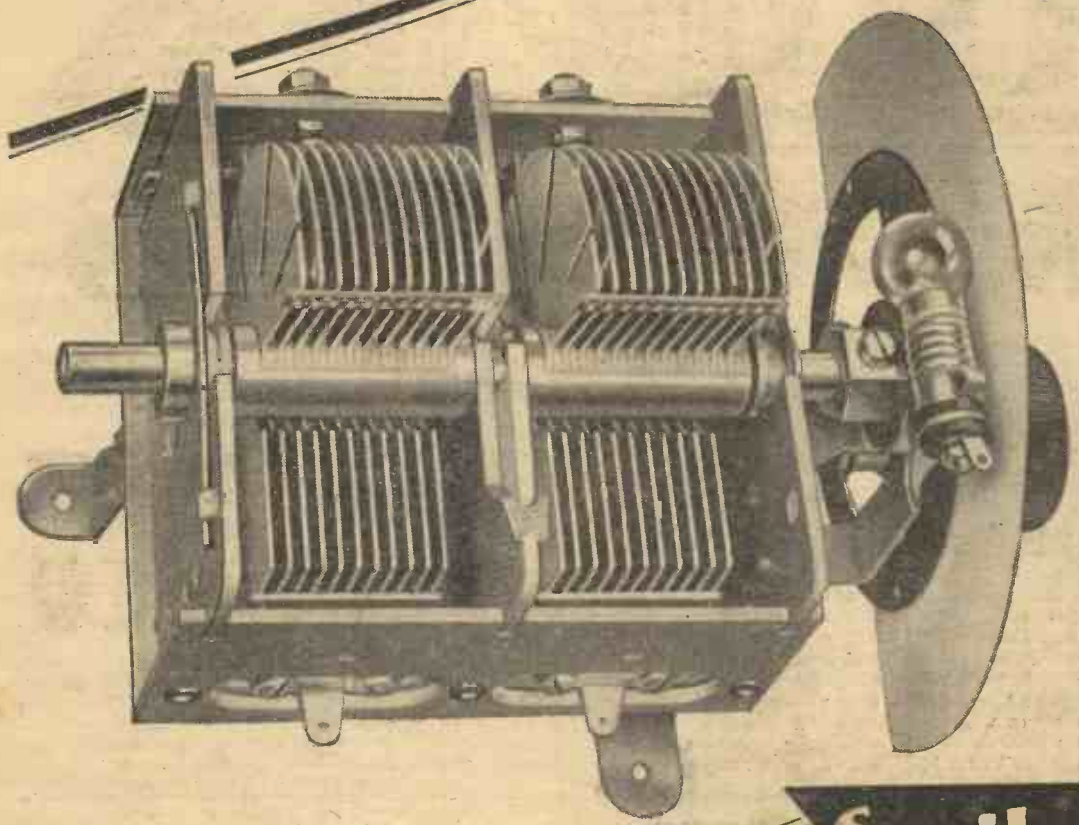
R.F. Choke designed to work on 1500/2000 metre wave band type R.F.C.1. Price 2/6.

L.F. Transformer No. 1. A.T. 13, ratio 3-1. Price 5/6.

2 GANG CONDENSER

with similar specification to the Single Unit Condenser.

WITH DISC DRIVE TYPE P.C.2



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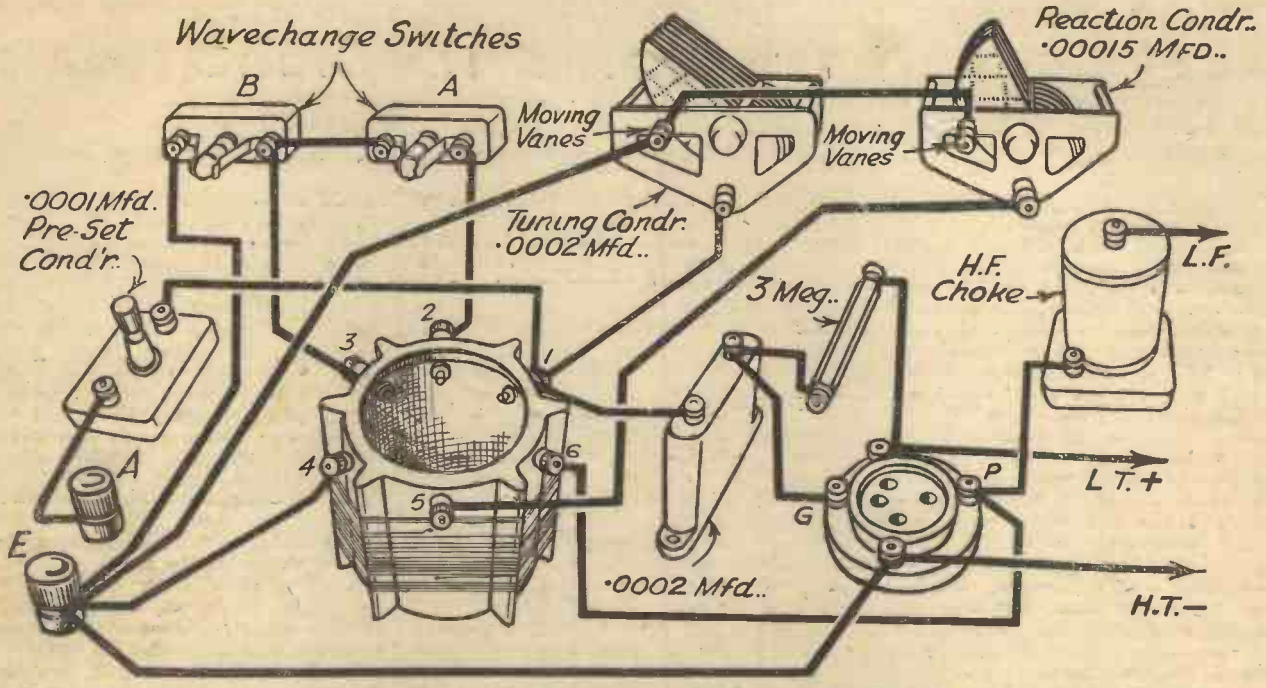


Fig. 2.—Diagram showing how the tuner should be connected up.

(Continued from page 905.)

efficiency by lowering its self capacity. To prevent the turns from slipping, a good tension should be kept on the wire whilst winding. Lastly put on the other portion (seven turns) of the reaction winding, leaving a space of 5/16in. between it and the lower end of the tuned winding. To fix the turns more securely in position they should be given a coat of shellac varnish.

And now all the tappings must be soldered to their proper terminals. Before doing this cut them to such lengths that they will just reach the terminals, and scrape the ends bare. If it is necessary to cut any wire off the loops make sure that both sides are soldered to the terminal, because if this is not done the continuity of the winding will be broken. The proper terminal connections are shown diagrammatically in Fig. 1 and the relative positions of the terminals are clearly shown in Fig. 2. Notice that the two halves of the reaction winding are joined in series by soldering the end of the upper winding to the beginning of the lower one.

The simplest way to attach the tuner to the baseboard of the set is shown in Fig. 1; a wooden disc is made to fit tightly into the ebonite former and is secured to the baseboard by means of a screw.

Using the Tuner

The tuner is very suitable for use in the aerial circuit of any short-wave set, adaptor or converter, and in each case the connections will be as shown in Fig. 2. Suitable values for the more important components are also shown in the latter figure, and these should be adhered to with fair accuracy. The .0001 mfd. pre-set series aerial condenser is a necessity and prevents damping of the tuned circuit by the aerial load. If it were omitted it would in most cases be impossible to obtain oscillation. Its optimum setting will depend to some extent upon the length and capacity of the aerial employed as well as the wavelength range in use. I do not say that it will have to be adjusted each time a change is made from one wavelength range to another, but very often it will be found that improved reception of certain stations will result from a slight and careful adjustment.

Both wavechange switches are of the normal two-spring push-pull type, but it is important that good ones should be used because if the contacts are not perfect they will give rise to crackling sounds.

When both switch knobs are pushed in the highest wavelength range (35 to 70 metres) is obtained; by pulling out switch "B" the range is from 18 to 38 metres, and when both switches are pulled out the tuner works on the very lowest range. The capacities of tuning and reaction condensers are shown to be .0002 mfd. and .00015 mfd. respectively. These values are most suitable, but they might be increased to .0003 mfd. and .0002 mfd., or reduced to .00015 mfd. and .0001 mfd. without affecting efficiency to any marked extent. Both condensers should be good ones designed especially for short-wave work, and it is desirable (from the point of view of easy tuning) that the tuning condenser at least should be provided with a vernier control. The H.F. Choke should, of course, be a special short-wave one and not of the ordinary type intended for a broadcast receiver.

THE NEED FOR DE-COUPLING.

AN enthusiastic listener who lives near me complained recently of the high cost of running his set, a statement I could not understand, as it was an ordinary three valver, S.G., det. L.F., battery operated, and commercially built. The trouble appeared to be in the high tension supply. My friend hadn't the mains in his house, and it seems he found it necessary to buy a new high tension battery every month or so. Granted he used the set considerably, say, four or more hours every night, he still felt his high tension was costing him too much, and when I went round one evening he happened to be in the act of fitting a new battery. It is true his grid bias battery was not above reproach, and he had no idea that the plug had to be changed to different value according to the state of the H.T., but the real trouble was in the set itself. It was one of those cheap sets sold at barely the price of the parts, and I found that when the old H.T. battery was connected to the set low-frequency instability was taking place and setting up the usual howls due to the back-coupling of the battery which obviously had developed a high internal resistance. On testing with the voltmeter, however, I found that the voltage drop was at the very outside not more than 20 per cent., so that my friend had been throwing away more or less good batteries on account of these howls. To cut a long story short I took around a 2 mfd. fixed condenser, and placed this across the H.T. terminals, when the set worked perfectly.

This brings me to what I set out to say, that certain manufacturers who think in terms of price only—and perhaps the customer is partly to blame also—too frequently omit any de-coupling arrangements on battery sets on a price basis. It is as penny-wise-and-pound-foolish as buying H.T. batteries of too small a capacity, and does radio harm through making it a more expensive pursuit than it actually is. A few shillings spent on a fixed condenser or two will often save the set-owner much more than this in battery replacements, and if you know of any non-technical listeners who are in similar difficulties, or at all likely to be on account of the design of their set, I should like you to feel it your duty to help them all you can. Only by people getting the very best results will radio become even more popular, and it is the duty of all of us who have the technical knowledge to help the novices understand the working of their sets.—DETECTOR.

IDENTIFYING THE FOREIGNERS

WAS IT A DUTCHMAN, CZECH, FRENCHMAN OR SWEDE?

By J. GODCHAUX ABRAHAMS

IN Europe alone to-day there are roughly 230 broadcasting transmitters operating in twenty-eight different countries. You may take it that the average listener, sitting at his receiver, even only a modest three-valver of modern construction—may easily tune in from *forty* to *fifty* transmissions in the course of an evening's tour of the ether, and during this period he may hear a dozen different languages—if not more. In the course of a week, I receive a number of inquiries in which correspondents anxious to identify a transmission state very vaguely that "*the announcer spoke in French or Spanish; possibly German or Czech.*" To the British listener who only knows his Mother tongue, all other languages are classed under one heading, namely, *foreign*—a delightfully vague term. Admittedly, it is not easy to identify your captures unless you have some idea of French, German, Spanish, Danish, Czech, and so on, but the problem is not so difficult to solve as might appear at the outset. It is to assist listeners so puzzled that this article has been written. The first step to take if, when twirling the condenser dial, you happen to pick up one of these mystery broadcasts is to ascertain roughly—or better still, accurately, if you can do so—the wavelength on which the transmission is made. Little experience will be required to know in which waveband the broadcast falls, namely, whether between 200 and 550 metres, or whether above 1,000 metres. As there is a much greater number of transmitters in the medium waveband, a more precise estimate of wavelength will be required. It is to be presumed that you have already logged some stations—perhaps B.B.C. broadcasters—with their respective condenser readings; if so they will supply the necessary landmarks to establish this valuation.

Establishing the Wavelength

Is the mystery station tuned in at a point somewhere between two such known transmitters as, say, above London National and below London Regional, or roughly midway between Midland Regional and Brussels? The reply to such a question will give you to some extent the data required, it will tell you that the station you are trying to identify is operating between so-and-so and so-and-so metres. By this method you have narrowed down your search to a definite portion of the waveband. Another and more accurate way of establishing the wavelength is by plotting a graph; it is quite an easy matter, but space will not permit me to describe the method in this article. Now, for the question of language, interval signal or other peculiarity by which the broadcast may be definitely recognized. You must, however, bear in mind one important point; it is that, as in Great Britain, most of the main continental stations relay their programmes to smaller transmitters for local re-broadcast and, consequently, when such an interchange is taking place you may not receive the actual call of the station heard, but that of the *main* studio which is feeding it. As an example, take Nurnberg (239 m.) from which, at most hours of the day, you will pick up the call of Munich (532 metres). You could not mistake the former for the latter in view of their difference in wavelength. In the same way, on international nights, a concert emanating from, say, Vienna or Berlin, might be received through Warsaw, Prague, Beromunster, Brussels, and a number of other cities taking the relay. Switzerland, for instance, frequently links up with Vienna or Munich, Oslo with Copenhagen, and so on, but this will not mislead you if you narrow down your search, as already explained, to a relatively small portion of the waveband. Moreover, the published programmes in such a paper as *World-Radio* will give you the information as to the

(*Continued on page 910.*)

Was it a Dutchman?

(Continued from page 909.)

class of entertainment heard and its actual origin.

Identifying the Station Calls

It is essential that you should know how the stations work in groups, that, say, Milan, Turin, Trieste, Genoa, and Florence frequently radiate the same programme, that *Ecole Supérieure*, Paris, feeds a number of provincial stations, that Frankfurt-am-Main and Stuttgart (*via* Muhlacker) exchange broadcasts throughout the day, and other information of this tenor. In most instances, the actual call will tell you from which studio the transmission emanates, as most of the relays remain connected to the mother station for a long period, and thus between items the original call will be heard. The question of language is a more difficult one to tackle, but here are a few pointers. Without exception all German stations precede the name of the city in the call by the word *Achtung!* (pronounced: *ach-toong*). The French and Belgians (with the exception of Brussels No. 2, which announces in Flemish only) by a double-barrelled *Allo!* The Italians have coined a word sounding like *Eh-yah*, which represents the initial letters of the Broadcasting Corporation, E.I.A.R. Vienna, although speaking the German language, does not use the word *Achtung;* you will hear *Hallo Radio Veen*, the native name of the Austrian capital being *Wien*. Beromunster, relaying Berne, Zurich, and Basle, all cities of the German-speaking districts of Switzerland, uses both *Achtung* and *Hallo*. Here, however, it is necessary to explain in conjunction with the calls that the native names of foreign cities unfortunately do not necessarily correspond with those we have given them in English. It is not always merely a question of pronunciation such as *Paree* for Paris, but in many instances the difference is much greater. Munich will not advertise itself as Munich, but as *Muenchen;* from one of the Italian transmitters you may pick up a call which includes *Milano, Torino, Genova, Trieste* (pronounced: *Tree-ess-tay*) and *Firenze*. From it you must understand that you are listening to a programme common to Milan, Turin, Genoa, Trieste, and Florence. *Napoli* is the true appellation of Naples; *Roma* needs no translation. When it comes to the Polish studios the differences are still more marked, as Warsaw will be heard as *Warszawa* (*Varschavva*), Lwow as *Lvoof*, Lodz as *Woodsh*, and Katowice as *Katow-vee-tzee* or Posen as *Poz-narn*. Prague reveals its identity as *Praha*, Kovno as *Kow-nass*, Belgrade becomes *Bay-o-grad*, Berne (*Bairn*), Copenhagen (*Key-ob-en-harvn*), Algiers (*Al-jay*), and others too numerous to mention. But you will be surprised how soon you will recognize and mentally translate these sounds into more familiar names after you have heard them from time to time. Most stations have realized that their broadcasts are heard, not only by their local subscribers, but by listeners in foreign lands, and also that the recognition of a transmission with the consequent knowledge of its origin greatly adds to the interest of the broadcast. In consequence, to facilitate this identification they have devised various mechanical means by which distinctive signals can be trans-

(Continued on page 911.)

Was it a Dutchman?

(*Continued from page 910.*)

mitted during intervals in the programme. In some cases they are self-explanatory, in others they require memorizing for a future occasion. As examples of the former, take Hamburg, with its morse signal HA, or Kiel (KL), Hanover (HR), Flensburg (FL). Vienna when opening up usually puts out a series of morse v's, and Graz, as an alternative to the monotonous metronome *tick-tock*, sometimes uses the letter K (—.—).

Metronome Interval Signals

It is a pity that the metronome, as an interval signal, should still be so widely adopted, as obviously nothing is so much like a metronome as another metronome! Some stations have had the happy thought, when they could not think of a better method, of taking a different number of beats from others. You might make a note of the following which may assist you in logging the actual transmitter:—

Belgrade (60 beats per minute), Berlin and Königswusterhausen (210 beats), Breslau (240 beats), Bucarest (160 beats), Frankfurt-am-Main (190 beats), Kosice and Riga (80 beats), Radio Maroc (Rabat) (60 beats), Vienna (270 beats), Zagreb (106).

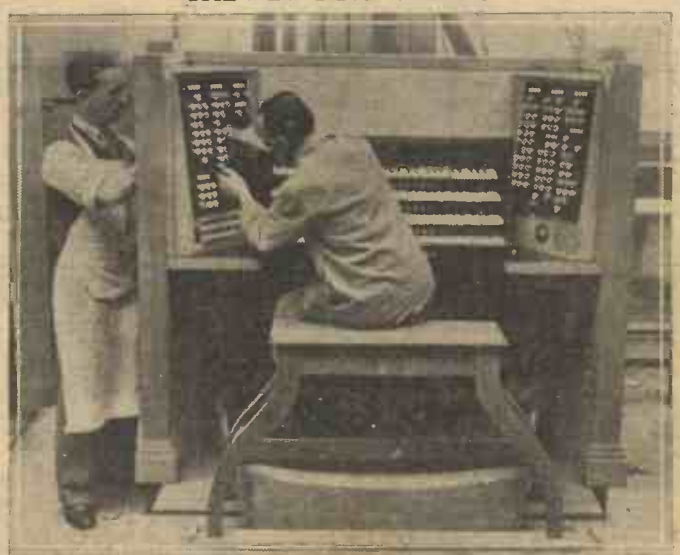
Apart from the frequency of the ticking, it is possible to note differences in tone or pitch, and you will soon differentiate between the metallic *ping* of Radio Maroc and the dual *Tock-tock* of, say, Vienna. Stations such as Strasbourg and Radio Toulouse are already known to most listeners in the British Isles, the former with its incessant bell, and the latter with its series of deep booming notes. But bells in some form or other have been adopted by many studios, either singly or in combinations of two, three or more notes, and also in short musical phrases of which the melodies are associated with the individual country or city.

Of single bells the following should be noted: Istanbul and Tallinn (60 per minute), Stockholm (about 80), Radio Strasbourg (about 16); at the following studios bell-like notes produced by oscillating valves are used: Heilsberg (Konigsberg and Danzig), just two notes (D flat, A flat), Leipzig, four notes (B A C B), Stuttgart (heard through Muhlacker and Frankfurt), 3 notes, (C D G). From Langenberg you will hear chimes (5 notes). In the matter of short musical-box melodies, there is a wide selection, as this permits a highly distinctive signal. You will pick up different tunes from Copenhagen, Oslo, Munich, Budapest, Warsaw, Beromunster (with a distinctive phrase allotted to Berne, Basle or Zurich, according to whichever city is relayed), Madrid, Naples, etc. Again, breaking away from the conventional, some stations have adopted such signals as a trumpet call. Algiers opens its broadcasts in this way, as does Wilno, or the song of a bird, such as the nightingale, imitated by Turin, Milan and the other North Italian studios. A cuckoo call may be picked up from Llubljana, Wilno, and Radio Beziers, but their wavelengths will prevent confusion. Radio Vitus (Paris) gives you the crowing of a cockerel; Prague also opens its early morning transmission in this manner.

Women Announcers

For some time it was possible to state definitely that announcements heard in a feminine voice stamped the broadcast as of Italian origin; to-day you cannot rely on this fact, for many studios in other countries have entrusted these duties to women. Strasbourg, however, possesses the peculiarity of giving out its announcements in two languages, in French by a woman and in German by a man. Female announcers also officiate during certain periods of the day at Copenhagen, Stockholm, Algiers, Sottens, Katowice, Warsaw, Fécamp and at a number of German studios. In the space at my disposal it is obviously impossible to give you any idea as to the different languages spoken in Europe; they are too numerous. You must, however, bear in mind that most of them belong to one of three groups, namely, Teutonic, Latin or Slav. In the first we class German, Dutch, Danish, Swedish, Norwegian, and Flemish; in the second, French, Italian, Spanish, Portuguese; and in the third Russian, Polish, and, to facilitate matters, we associate with them Czech, Finnish, and Magyar. There are, of course, strong differences in languages of the same group, but it requires little experience when listening to differentiate between, say, a Teutonic and a Slav. tongue. In the same way, you will find that you will soon detect whether you are listening to a German or a Dutch broadcast, or whether an announcement was made in Polish, Czech or Magyar (Hungarian).

THE NEW B.B.C. ORGAN.



The new £10,000 organ which is being built for the British Broadcasting Corporation will be ready for use early in February. It has 150 electrical stops and 2,326 pipes divided into 31 tones. It has been built by the John Compton Organ Co., Harlesden, London, N.W. The photo shows an expert adjusting the draw stop action on the new organ.

RADIO RAMBLINGS

Metal versus Wood Panels

IN radio, as in most other things, fashion changes rapidly and there is a tendency for the order of things to repeat itself occasionally. That this is so struck me the other day when handling a set with a wooden panel and wooden knobs. Was not our very first ventures in the world of wireless carried out by means of a wooden panel which we sometimes shellaced and sometimes didn't? Then we tried ebonite, rough, dirty stuff that had to be sand-papered before use to remove the particles of tin-foil which adhered to the surface as a residue from a manufacturing process. Do you remember doing this?—and do you remember the result after some 30 minutes hard scrubbing with sand-paper and the subsequent light coating of oil that we were instructed to rub in? Well, I do, and I also remember parting with a small fortune in the purchase of a piece of the first highly-polished ebonite that appeared on the market, guaranteed free from surface leakage and complete with a test certificate as to the voltage it would stand. Ebonite then took great strides and we were soon able to obtain it in many varied and beautiful colours. Mahogany-coloured ebonite found favour for a while and some really beautiful panels resulted, but quite a simple thing caused this material to fall from favour. This was the real difficulty in getting knobs to match the panel. Knobs and dials could be obtained for some components but not for all, as lack of standardisation of threads and diameters of spindles of condensers, rheostats, reaction condensers, volume controls and other variable resistances then the order of the day sounded the death-knell of the amateur's use of figured ebonite. These panels therefore soon became the prerogative of the commercial set builder who was able to design his knobs to suit his panel. Soon after this came a rage for aluminium panels with their peculiar mottled surfaces. They tarnished quickly, however, despite generous coats of lacquer that were applied, and many a valve met an untimely end through the shorting of the H.T. across the filament *via* the metal panel due to a large extent through further lack of uniformity in components. You see, some of them required insulating bushes when used with metal panels, and some did not, and it is easy to see that confusion too often arose with most disastrous results to our long-suffering valves. In any case the metal screen and base board possessed many advantages both in practice and in theory that far outweighed those of the metal panel. Now we come back to the beginning, and wood is once more coming into its own as panel material. Of course, the loss due to really dry wood is not very high, but when it becomes moist quite an appreciable loss can be traced to surface leakage. Why then is it again being used in these days of super efficiency? Well, I think the reason is that it is cheap, easily worked, and as most sets are now constructed on the unit system—that is, built on to a chassis with all the components firmly secured thereon—the holes in the panel are really only clearance holes and are not in actual contact with the one or two spindles that pass through.

JOTTINGS FROM MY NOTEBOOK
By "DETECTOR"

That Old Set!

THEY say that it is a sign of old age creeping on when one becomes over reminiscent. This is as maybe, but talking of the old fashions in radio brings to my mind a set of my own building that came once more into my hand in a peculiar manner, a week or so ago. I made the set, a small two-valver, some years ago for a friend who went to live in the North of England. I hadn't seen him for years until this Christmas, when he once more came South for a few weeks. He brought the set for me to look at as it was not going so well as it had! He had only used it occasionally to get the news, and any other really important broadcasting—events like the King's speech and so on—so that the original valves had been used till recently. Then he went to a local dealer, who, acting on the description of the set that my friend gave, sold him two new valves and a high-tension battery. Of course, you know the rest. With two new efficient valves the result was much worse. The set went up all in the air and nearly jumped at him as soon as he approached the dials. Howls and squeals were emitted from the speaker all round the dial until my friend decided to wait until the holidays and bring the set to me. Well, I persuaded him to scrap the set, as you may imagine, but I should like to tell you about its design. First of all the original valves which, by the way, would still work the set at good headphone strength, were two-volt dull emitters of the old 0.06 type, both general purpose. The set was the panel, and the panel was the set, for every component was fixed on to the panel, either on the inside or the outside. Of course, there was much to be said for this form of construction, it was at least easy to wire up, and all the terminals were well in sight!—but the danger to the valves and coils sticking out on the panel was high, and the appearance was, well, terrible. Anyhow, that's that, but I feel there is a moral to this little yarn somewhere. Something about not buying new tyres for an old bus, but please humour me to the extent of remembering that when you treat your set to a new fit-out of valves the results might not be as good until you adjust the set generally to work with the new highly-efficient "toobs." In the case of sets like my friend's, the adjustments are best carried out with a coal hammer!

The Uses of Rubber

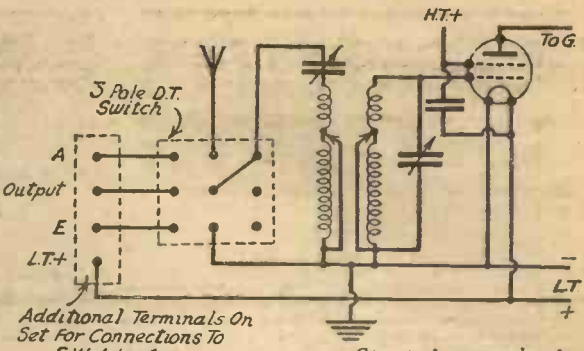
WHERE would the radio and electrical industry be without rubber? It is the basis of most insulating materials, apart from porcelain and glass, of course, and it has scores of other uses, from roads

Prague's new radio station is situated in the geographical centre of Europe some 35 kilometres east of Prague, in the vicinity of the small town of Cesky-Brod. This new high-power broadcasting station is rated at 200 kilo-watts and is the most powerful station operating in the medium-wave broadcast band. The photo shows a general view of the new Prague broadcasting station, with the aerial towers and buildings.

and tyres to clothing and hot-water bottles. It protects the tiny wires of our components, and it insulates mighty cables in the earth and under the sea. Its value to modern civilisation is unmeasurable, and yet it is cheaper now than ever it was. Those stern industrialists, the members of the Soviet Government of Russia, also realise its value, and in their efforts to make their country a self-supporting unit they have raised an objection to importing rubber from tropical countries. Accordingly they set to work to obtain rubber from their own vegetation, and the story of it reads like a fairy tale. They found plants from which latex, the sap-like substance from which rubber is made, is exuded, but in such quantities as to make the industry uneconomical; but they also found that by enlisting the aid of some little caterpillars the percentage of rubber could be increased. These grubs feed on the roots of the plants, and construct around their bodies a tube of condensed latex, which forms a kind of home for them. Only roots that are infested give nourishment to the grubs, so that the plants are artificially infested in order to rear the small insects on them. In some cases as many as thirty tubes, each containing a grub, has been found on a single plant, and as each tube is rich in latex, or unrefined rubber, it is expected that the industry will soon be profitable enough to warrant expansion. Surely the wonders of radio are not all electrical!

Wireless for Air Liners

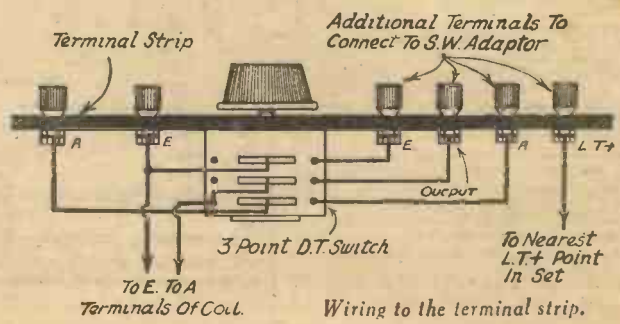
TWELVE fine new aeroplanes have been ordered by Imperial Airways for the London-Cairo-Capetown air route, and these of a type known as the Atlanta are fitted up with a luxury never yet approached in aeronautical design. The wireless equipment is far more complete than that of any other civil aeroplane, and is being furnished by the Marconi Co. The radio apparatus has been designed to suit the extremely difficult conditions that will be met with on the route over desert and jungle, and the set fitted to each plane is a combined transmitter and receiver. It will work on wavelengths of 40 to 80 metres and from 500 to 1,000 metres, and telegraphy and telephony can be transmitted and received at will on each waveband. When on the ground the set will derive its power from a light petrol engine, thus reserving the battery supply for when actually flying, and remote control of the frequency altering device is fitted. In addition a Marconi-Robertson direction-finding equipment is fitted to the receiver which will greatly assist the navigation officer.



Circuit diagram showing switching for super-het. adaptor to ordinary broadcast receiver.

Connecting a Super-Het. S.-W. Adaptor

THE accompanying circuit diagram shows a method of switching suitable for connecting a short-wave adaptor of the super-het. type to the ordinary broadcast receiver by means of a switch instead of the usual four or five temporary connections which have to be made. The components required are four terminals and a three-pole, double-throw switch. The writer uses a Wearite switch, which answers admirably. The switch may be mounted on the terminal strip of the broadcast receiver, in close proximity to the aerial terminal in order to keep the wiring as short as possible, and the four additional terminals may be mounted on a short strip above the existing one, or, if there is room, on the existing strip adjoining the switch. From these new terminals it is only necessary to take short leads to the adaptor, which can be left connected permanently. The wiring is as follows: To change the aerial from the broadcast receiver to the adaptor, and to connect the output of the adaptor to the aerial terminal of the set, connect aerial terminal of set to first centre contact on switch, one outside contact on switch to aerial terminal of adaptor, other outside contact to second centre contact and on to aerial series condenser or appropriate terminal of aerial coil in set. One of the outside contacts opposite the second centre contact is left free, and the other connected to the output terminal of the adaptor. The L.T.— and E are connected to the adaptor by extending this wire in the set to the third centre contact on the switch, one outside contact being left free and the other being connected to the L.T.— terminal of the adaptor. The L.T.+ of the set is connected to the adaptor by connecting a wire from the remaining terminal to the nearest L.T.+ point in the set, this wire not being connected to the change-over switch. Reference to the theoretical diagram and the sketch will elucidate the wiring. Separate H.T.+ connections are, of course, required for the short-wave adaptor.—E. A. COATES (Leek).



Wiring to the terminal strip.

RADIO CLUBS & SOCIETIES

SLADE RADIO

Anyone interested in wireless is cordially invited to attend the meetings of the above Society which are held every Thursday at 8.15 p.m. The appended programme gives a good idea of the interesting nature of the lectures which are regularly given. Full particulars are obtainable on request from the Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

Programme: February 2nd to March 30th, 1933.

Feb. 2nd Members' night.
„ 9th Lantern Lecture, "The Navy," by Lieut.-Commander Brewster.
„ 16th Lecture and Demonstration by Mr. Youle, B.Sc., A.C.G.I., A.M.I.E.E., of the Marconiphone Co., Ltd.
„ 23rd "Junk Sale."
Mar. 2nd Lecture and Demonstration by Mr. E. F. Handley, of the Radio Gramophone Development Co., Ltd.
„ 8th WHIST DRIVE AND DANCE.
„ 9th "Dual speaker equipment": Lecture and Demonstration by Mr. G. T. Peck.
„ 16th Lecture and Demonstration: Radio Instruments, Ltd.
„ 23rd Lecture and Demonstration: H. Clarke & Co., Ltd.
„ 30th How *you* can win the D.F. (Direction-Finding) Cup.

DENNISTOUN TRAMWAY DEPOT RADIO CLUB

The above Club, membership of which is confined to Depot Employees, meets every Wednesday at 8 p.m., in Depot Hall. Although recently founded, an attractive series of lectures, demonstrations, and visits have been arranged. On Wednesday, February 1st, 1933, J. L. Hunter will give an insight into Manufacture of batteries and accumulators, assisted by the aid of a Model Working Plant. The first Club outing takes place on April 19th, 1933, and Itinerary includes an inspection tour of "Scottish Regional Broadcasting Station" at Westerglen. Special high tea and theatre visit in the evening. It is hoped to arrange a series of lantern lectures in the near future, also television and short-wave talks. Radio manufacturers and dealers, etc., who are willing to give demonstrations, lectures, displays, etc., are invited to communicate with the Secretary. Membership Fee is 1/- per annum and all employees interested in the club should make application to Secretary or Committee, who will gladly furnish details.—Wm. McKenna, Secretary, 90, Paton Street, Glasgow.

LECTURE-DEMONSTRATION ON LOUD-SPEAKERS

A very interesting and instructive lecture-Demonstration was recently given by the Secretary to the Newcastle-upon-Tyne Radio Society. He is a well-known personality in the wireless world of the north-east coast. He has been associated with the Amateur Radio Society movement for many years, and he was, for many years, the Hon. Secretary of the Northern Group of Radio Societies. During that term of office he was responsible for many unique and interesting items and lectures for the societies over the whole of the North of England.

The lecture-demonstration to the Newcastle Radio Society was extremely interesting, as not only was the general principles given, but Mr. Fabian also explained and showed explicitly exactly how a moving-coil speaker is made at the works. He also gave a comprehensive demonstration on many types of the speakers that are made by his firm.—R. E. Fabian, 5, Egremont Drive, Sheriff Hill, Gateshead. Phone 76515.

THE SOUTHALL RADIO SOCIETY

Programme of Meetings up to end of February.

Jan. 31st Meters and Their Uses: Mr. W. Anerum.
Feb. 7th Mr. Parr, of Messrs. Ediswans: Demonstration of the Cathode Ray Tube in connection with Radio Circuits.
„ 14th Circuit Design: Mr. A. Stephens.
„ 21st Debate: That Pentode valves have more favourable characteristics than a Triode for Modern Set Design. Proposer: Mr. G. Lee; Seconder: Mr. L. Swan. Opposer: Mr. A. Stephens; Seconder: Mr. H. Rayner.
„ 28th Pick-up tests.
To be held at the White Hart Hotel, High Street, Southall, at 8.30 p.m. sharp, preceded on certain nights by Elementary Lectures at 8.0 p.m. as below.
Jan. 31st Detector Valves: Mr. A. Stephens.
Feb. 14th L. F. Coupling: Mr. H. L. Rayner.
„ 21st H.F. Coupling: Mr. A. Stephens.
„ 28th Output Circuits: Mr. G. Lee.

Morse Classes will be held if found desirable. The above programme is subject to modification if necessary.

For the benefit of interested readers, to whom a hearty welcome is extended, the session can be joined for 2s. 6d., as our year ends on March 31st.—H. Rayner, Hon. Sec., 114, North Road, Southall.

A SIMPLE VOLUME CONTROL DEVICE

By H. A. JONES

MANY listeners have relatives or friends who are unfortunately just too deaf to appreciate the programmes from a loud-speaker, and the necessary control of volume in a pair of earphones is not usually a simple method. This is primarily the use of the unit I am about to describe, and those dwellers in flats who are not permitted to have their sets going late at night can connect one or more pairs of 'phones and listen comfortably to a late programme. Lastly, the unit is invaluable to listeners to distant stations, as it is possible to select a moderately loud station on the 'phones, and with a snap of the switch transfer it to your loud-speaker. A front view of the complete unit is given in Fig. 1.

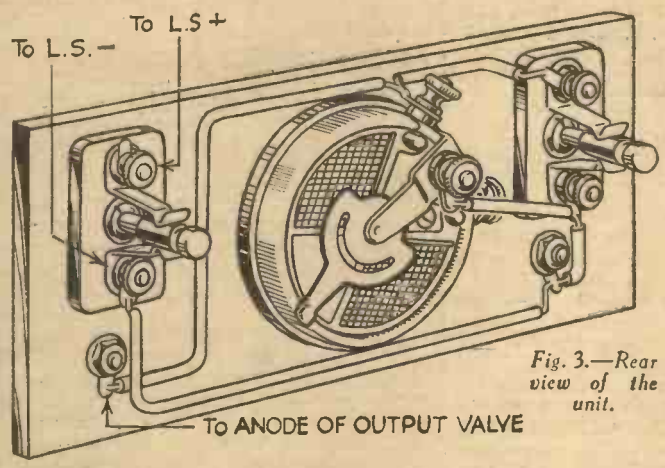


Fig. 3.—Rear view of the unit.

The components required are: one 400 ohm. potentiometer (panel mounting), two on-and-off switches, two phone terminals, small piece of scrap ebonite 5in. by 2½in., and a length of Glazite or sleeved wire.

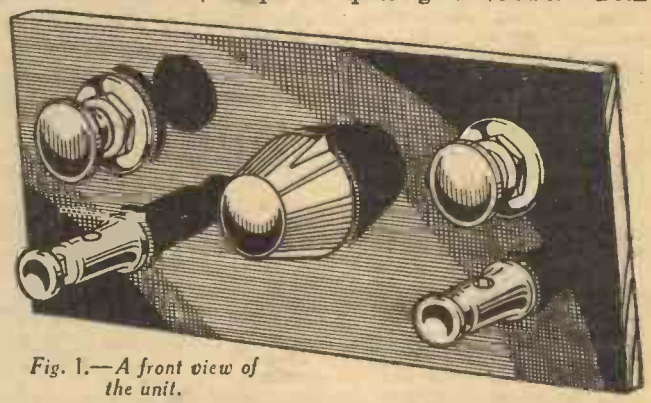


Fig. 1.—A front view of the unit.

Most constructors will have these articles in the junk box, but where this is not the case the whole can be purchased for about four shillings, or less.

Details of Construction

The construction is quite easy—soldered joints are preferable, but as all the components have terminals, tightly screwed-down joints will be quite as serviceable. A glance at the circuit diagram Fig. 2 will explain the principle of the unit, and it will be noted that one wire only has to be disconnected in the set. This is the lead from the anode of the last valve, which normally goes to the L.S. negative terminal. This lead is disconnected and taken to the negative phone terminal on the unit, and from there onwards the wiring is quite simple. Note that one terminal on the potentiometer is left free. The back of the unit, showing the wiring connections, is given in Fig. 3. The front of the panel (Fig. 1) shows the potentiometer centrally situated, with the switches above, and the phone terminals below. The top left-hand switch is for the 'phones, and the one on the right is for the loud-speaker. The positive 'phone terminal is the left-hand one. In operation, the potentiometer knob will give a fine control of volume to the 'phones from a whisper to quite good volume. Both switches can be *ON* at once (which in the case of this unit is *IN*) when both 'phones and speaker are in circuit, or alternatively, either 'phones or speaker may be used by pushing in the necessary switch.

Finally, the whole unit can be let into the side of the cabinet—used as a sub-panel—or even wired into the circuit of the existing panel if a little extra trouble is taken. Constructors will find the unit has possibilities in addition to those already mentioned.

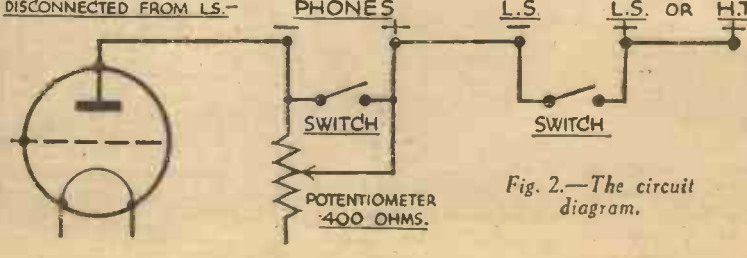


Fig. 2.—The circuit diagram.

Practical Letters from Readers.

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

What a Contributor Thinks of "The Encyclopædia"

SIR,—Allow me as a contributor and reader of PRACTICAL WIRELESS to congratulate you upon the production of "Newnes Wireless Constructor's Encyclopædia," which I have received under your gift scheme. A more concise, useful and accurate collection of data, circuits, and radio information I have never seen. The way in which it is written and compiled is to be commended. It will be of inestimable use to me in the pursuit of radio as a hobby, and in my business. The short-wave sections and circuits are really up-to-date, and will be very helpful to beginners and others, including old hands. In particular, the list of short-wave stations is comprehensive and accurate. I am pleased you did not include time schedules, as these would soon be out-of-date. Another point to be commended is that the pages are of strong, durable paper which, to my mind, is most desirable, next to clear type, if a book is to be used, and not just to fill a space on the bookshelf.—ALF W. MANN (Middlesbrough).

"Wireless Constructor's Encyclopædia": Readers' Congratulations

SIR,—May I admit surprise on receiving the "Wireless Constructor's Encyclopædia"? Surprise that such an excellent volume of most valuable information should be presented merely because I have continued to order my copy of PRACTICAL WIRELESS. I have always considered the paper itself to be far above the average, and for that reason alone shall I continue to read it. In one way and another, I must admit that you are making the finest contributions yet towards the help, guidance and pleasure of those who follow that most interesting hobby—wireless. I hope that you will put the Encyclopædia on the market for the benefit of those who were unfortunate not to qualify for its presentation. My best respects and wishes for your continued success.—GEO. E. DRIFFIELD (York).

SIR,—I thank you for your "Wireless Encyclopædia," which *I think is an admirable and comprehensive book.*—B. C. KERLOGUE (Catford).

SIR,—I have received my "Wireless Constructor's Encyclopædia," and must say I am very pleased to have such a book. —V. WEEDON (New Malden).

INDEX TO "PRACTICAL WIRELESS"

In response to the request of many readers for an index and binding case, we have pleasure in announcing that we shall issue a semi-annual index and binding case for a nominal sum. The first volume will be completed with No. 26 issue dated March 18th, 1933. A further announcement will be made later.

SIR,—In acknowledging, with thanks, the safe receipt of my "Wireless Constructor's Encyclopædia," may I take the opportunity of congratulating you upon the production of such a fine work of reference? When entering upon this Gift Scheme I must confess I had some misgivings, but I must say, however, that the book you have sent me is far beyond my expectations, and I am thoroughly satisfied with the same. The binding is perfect, the paper good, the printing flawless, and altogether it is a magnificent volume, of which I shall feel justly proud to be the owner. I sincerely hope that your paper will continue to supply the long-felt want of wireless "fans" for a journal which is really practical, and I would wish you every success for the year upon which we have just entered.—V. FOSTER (Earl Shilton).

SIR,—I thank you for your Encyclopædia, which I have just received. I have had a glance through it, and you are to be complimented on producing such a valuable work. It is well illustrated, and the circuit diagrams are, I think, a good addition to the book. —F. W. SEWELL (Sheffield).

SIR,—I am delighted with the "Wireless Constructor's Encyclopædia." It is a splendid book, full of information for everybody interested in wireless, and owing to its lack of padding, a boon to busy people. I have only been in possession of my first valve set a few months and the book is specially valuable to me. Many thanks for sending me the best New Year's gift I have received this year.—WILLIAM J. GRUNDLE (Glasgow).

Articles on One and Two Valve Sets Wanted

SIR,—I wish to congratulate you for the finest wireless magazine I have yet come across. In No. 12 issue J. Sheppard, of Taunton, wrote on a point I should also like to bring to your notice. Why can't we have more articles on small sets, such as one and two valves, with home-made coils? As he said, costly sets are all right for those who can afford them. Once again thanking you for your splendid paper and wishing you every success in the future. —A. CROSS (Tyseley).

Congratulations and a Suggestion

SIR,—Having purchased your paper, PRACTICAL WIRELESS, for the seventeenth time I feel I must congratulate you and wish you every success. Such a paper deserves the whole-hearted support of every wireless amateur in the country. I read with interest the weekly correspondence page, and have noticed of late two letters suggesting articles on studios and artists. Will these readers please understand that a practical wireless paper of necessity deals exclusively with the technicalities, operation, and construction of wireless instruments. And now a suggestion. Since some readers desire articles of special interest why not a few on the modern electric theory of matter? Such articles dealing with the electro-magnetic nature of matter would make entertaining reading, and at the same time be of vital importance to wireless amateurs, besides being of educational value.—A. P. WEST (Liverpool).

(Continued on page 918.)

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT instability in a mains or other powerful receiver may often be cured by screening the reaction coil leads.
—THAT the symbol for current in electrical calculations is not C but I.
—THAT H.F. chokes are a common source of H.F. instability and should therefore always be screened.
—THAT a new system of amplification enables the drain on the H.T. battery to be proportional to the strength of signals received.
—THAT experiments are now being carried out with transmission on wavelengths which are less than an inch long.
—THAT automatic volume control solves the problem of overloading and delicate reaction control.
—THAT the test voltage of a condenser for mains use should be three times the working voltage.
—THAT an A.C. receiver should on no account be tried out on D.C. mains.

NOTICE.

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

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

PRACTICAL LETTERS

(Continued from page 917.)

"Practical Experiments with Cone Diaphragms"

SIR,—May I draw your attention to a printing error in connection with the reproductions of my diagrams on page 815 of the January 14th issue? The printer has inadvertently transposed two of the blocks, so that the figure number and caption placed under the first diagram actually refers to the fourth one on the page, and *vice versa*. Most of your readers, of course, will guess what has occurred, on referring to the text of the article; but I thought it best to draw your attention to the mistake in case any beginner is confused by the transposition.—"RADIOMAN" (Wandsworth Common).

[*It really is too bad, but we do try.*—ED.]

A Reader's Requirements Supplied

SIR,—As an enthusiastic wireless amateur, what I personally require is plain instruction at each step, and I am pleased to say that I am finding almost all I require in your paper. I hope you will continue to publish such articles as will help those, like myself, whose means are strictly limited, and whose knowledge of "wireless" is also scanty.—J. BROWN (Liverpool).

Another Plea for Plug-in Coils

SIR,—As an enthusiastic wireless amateur, and a reader of your fine wireless journal, I would like to mention that in my opinion the fixed coil is not made yet that will beat the plug-in coil set. I agree with your reader, Mr. Collins, of Birmingham. If one is interested, coil changing is not a big job. I have a set consisting of 25, 35, 45, 50CT, 60X, 75CT, and a 100CT. These, I think you will agree, will not miss many stations on the medium-band with careful tuning, of course. The long-wave coils consist of a 250X, 100, and 150. The only thrill I have not had is a search around on the short waves. Here again I have just got a set of coils from two turns up to twenty turns, and am waiting for PRACTICAL WIRELESS to give us a suitable circuit. If Mr. Collins would care to write to me, c/o the Editor, I shall be pleased to give him a circuit that only employs eight pieces on the base, and three of them are valve-holders; on the panel there are only three controls, an on-and-off switch, reaction, and tuning condenser. I assure you I don't miss many stations when conditions are good. The components are the best I could get.—F. ARMSTRONG (London, S.W.).

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

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

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

SPECIAL NOTE

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

(1) Supply circuit diagrams of complete multi-valve receivers.
(2) Suggest alterations or modifications of receivers described in our contemporaries.
(3) Suggest alterations or modifications to commercial receivers.
(4) Answer queries over the telephone.

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

DUAL BALANCED SPEAKERS

"I have noticed one or two advertisements lately showing two loud-speakers mounted on one plate. One seems to be a small speaker, and the other a large one, and most extravagant claims seem to be made for them. Is there anything in this idea, or is it just an advertising stunt? If it is sound, could I make up anything on the lines of it? What should I gain? I hope I am not asking too much, but I am only a newcomer to wireless, and I should much appreciate your assistance."—(M. B., Clovelly.)

The idea of using two speakers is to endeavour to provide a more even response curve. The theory is that one speaker is designed to deal satisfactorily with the high notes, and the other is to deal well with the bass notes. Therefore, what one speaker lacks, the other deals with, and so there is, theoretically, a much straighter amplification curve. It is, of course, essential that the speakers should be well designed if there is to be no "peakiness" or other troubles, and we think you will find that the only people who are making these speakers are firms who have specialised in speakers, and are, therfore, well able to design a perfectly matched pair. You could try the idea at home, but you would no doubt find that you could only compromise, and would not get such good results as a commercial make of Dual Speaker would give.

MAINS INTERFERENCE

"I am living next door to a workshop, and every time they use their power lathe I get terrible cracklings and hum in my set which is mains driven. I should like to know how to stop this trouble, which spoils the programmes while it lasts. I have tried several ideas, even to using a frame aerial, but nothing seems to be much good. Could you help me, please?"—(S. V., Manchester.)

The trouble may be induced through the mains, or may simply be caused by pick up of the sparking at a commutator or other similar device, if the power lathe is very close to your set or aerial. The firm responsible for the machinery should be informed of the interference, and they should then take steps to remove it by fixing condensers across the brushes, or whatever is found necessary to reduce the trouble. If the firm prove unwilling to do this, you should communicate with the B.B.C., and they will take up the matter with them. If the trouble is caused by induction through the mains, you could try the effect of fixing two large chokes in series with the leads to the mains from the transformer primary. These should be of the type specially made for the purpose, or you could make up two for yourself by winding on a good quality ebonite former having a diameter of 2in., 60 to 100 turns of 22-gauge D.C.C. wire. Do not be tempted to use ordinary H.F. chokes, as these are not wound with wire sufficiently thick to carry the current.

COLOUR CODE RESISTANCE

"I have a factory-made receiver installed, and unfortunately it has met with an accident. Whilst it was being dusted the other week it was knocked on to the floor and upon inspection one of the valves was found to be broken and replaced. The set would not work, however, and I tried all leads and so on, and eventually found that a small pencil-shaped article was broken into two parts. I do not understand the circuit arrangement, but I believe this might be a resistance. It is coloured a chocolate tint, and one end is painted black. In addition there is a large yellow spot in the centre of it. Can you tell me what it is, and whether it is possible to replace it? Unfortunately, the firm who made the set is no longer in existence, or I would not have troubled you."—(Y. G., Hendon.)

The component you refer to is certainly a resistance, and the method of colouring denotes its value. The system of colour coding as it is called was first used in America and is now becoming popular in this country, and the industry has adopted a definite system which all makers adopt so as to provide uniformity. The particular value of the resistance which you have broken is 100,000 ohms, and you should therefore obtain one of that value for replacement purposes.

DATA SHEET No. 19

Cut this out each week and paste it in a notebook

TABLE OF ACCUMULATOR SOLUTIONS

No of parts of pure sulphuric acid (sp.g.= 1.842).	No. of parts of distilled water (sp.g. =1.0).	Approx. sp.g. of resultant mixture.
By volume—		
1	1	1.42
1	2	1.28
1	3	1.21
1	3½	1.19
1	4	1.17
1	5	1.14
By weight—		
1	1	1.30
1	2	1.18

INDOOR AERIAL

"My receiver is operated from a thin, flexible wire arrangement run round the upper part of my walls, and unfortunately there is only one place where it can be put. This runs very close to a lead which connects an electric bell and indicating board operated from each of the rooms in my house. Whenever one of the bells is rung there is a terrible rattle from the loud-speaker, and I should much appreciate your advice as to how this may be avoided. If it is not possible to effect a complete elimination, some reduction in the interference would be useful."—(F. T. B., Kensington.)

The most practicable solution of your difficulty is to affix a large condenser, say 2 mfd., across the contacts of the bell make-and-break. This is the point where a small screw touches a thin spring, and if you watch this point when the bell is rung you will no doubt see a small spark at the point of contact. This is what is causing your trouble, and by connecting one terminal of the condenser to the screw, and the other terminal to the small vibrating spring, you will find the spark will not take place. It will not therefore be heard through your loud-speaker. Have you tried the effect of utilising one of the bell leads as an aerial? This may prove more efficient than your present wire, as there will be a certain amount of screening with the existing arrangement.

BUYING A MAINS RECEIVER

"I have read your book since No. 1, and am feeling now that it is time I scrapped my present wireless set—which is a shop-made article dating from 1925. I have the electric light laid on, but have been told that it is just as expensive to use a mains set as to pay for accumulator charging and batteries. Can you confirm this, and give me an idea what a set costs to work off the mains? I should like a powerful set, one that brings in plenty of foreigners at a good volume, and I do not very much object to the price—say up to twenty guineas."—(C. M. N., Preston).

You have certainly been misinformed regarding the running costs of a mains receiver. At the most, it will only consume as much as an ordinary electric lamp, and in some cases it may consume very much less. You are on A.C., and therefore you can get a good commercial receiver employing four valves, which will give you forty or fifty stations, with a really powerful output, and which will consume about 30 watts. If you run this from a power point at say 1d. a unit, you will get thirty odd hours running for 1d., which is surely much cheaper than paying 1s. or so for charging an accumulator every week, and 10s. for new batteries every few months. In addition, you have the advantage of constant voltage all the time and not maximum voltage for a short period, and then a constantly falling voltage as the H.T. battery runs out.

ANOTHER MAINS PROBLEM

"Our house is fitted with D.C. power at 200 volts. I am going to build up a mains set, but feel that I shall not be able to get a really powerful kick out of the L.S. with such a low voltage. I am buying special D.C. valves, and should like to know what type of circuit you can recommend for my use. There does not seem to be a really good Power valve for D.C. users, the same as there is for A.C. sets, and I would like to get such results. What do you suggest please?"—(S. K., Twickenham.)

You need not despair, S.K., as you have quite a simple device which may be employed to help you to get a greater output than at first seems possible from 200 volts. We refer, of course, to Push-Pull output valves. The circuit we would recommend would be S.G., Detector, L.F. and two Power valves in Push-Pull. A volume control should be joined across the Secondary of the transformer of the first L.F. stage, and you will find that even allowing for a reduction below 200 volts, due to the employment of automatic Grid Bias, you will be able to get very nearly 2 watts undistorted output, which is more than enough for ordinary home use. We enclose a suitable circuit herewith.

AUTOMATIC VOLUME CONTROL

"Your recent article on automatically controlling volume, was most interesting, but I should greatly appreciate some definite values relative to my receiver, which is a Mains Three. I quite appreciate that the values will depend upon the particular components which I am using, but could you give me some starting-off point?"—(S. G., Newton Abbot.)

A detailed article appears in this issue, S.G., and this gives in addition to certain circuit considerations, some definite data which will no doubt be of great use to you. The values given in the circuit shown should be applicable to your own receiver, but you will no doubt be able to modify these if any modification is necessary.

DIAL MARKINGS

"Is there any reason for the difference in some dial markings? Some are marked from 0 to 100, whilst others are marked 180, and I would like to know whether it makes any difference to the tuning-in of foreigners."—(F. H., Balham.)

There is no difference in actual tuning, no matter how the dial is marked. Theoretically certain types of condenser should be marked in degrees from 0 to 100 in order that actual degrees may represent kilocycle separations, but beyond this there is no difference.

FREE ADVICE BUREAU

COUPON

This coupon is available until Feb. 4th, 1933, and must be attached to all letters containing queries.

PRACTICAL WIRELESS 28/1/33.

CATALOGUES RECEIVED

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

DUBILIER PRODUCTS

WE have received from the Dubilier Condenser Company, two booklets of special interest to home constructors. One deals with condensers and resistances and gives particulars of mica condensers, paper condensers, block condensers for use with mains receivers and battery eliminators, and high voltage electrolytic condensers. Resistance capacity coupling units and anti-interference filters are amongst the other components listed. The other booklet deals with Dubilier metallized resistances, designed especially for use in mains-operated receivers for voltage dropping and decoupling purposes. Useful tables giving maximum currents and voltages, and graphs showing the voltage and current ratings at a glance, are also included in the booklet. Interested readers should write for copies of these booklets to Dubilier Condenser Co., Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.

LOEWE RADIO COMPONENTS

THE latest list received from the Loewe Radio Company gives particulars of their paper condensers—with details of the various tests to which they are subjected; valves, both of the multiple type, and rectifying valves; receiver chassis; gramophone pick-up; volume control; loud-speaker and loud-speaker chassis, are well illustrated, and copious details are given. It is explained that the majority of the components are protected by Letters Patent.

TUNEWELL COMPONENTS

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

EDISWAN H.T. BATTERIES

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

COLVERN COILS

THE latest list issued by Colvern, Ltd., gives particulars of a new dual-range coil known as the T.D., as well as full particulars of their other numerous types. These new coils can be used in either a detector L.F. type of receiver or in a screen-grid circuit. The booklet can be obtained free on application to Colvern Ltd., Mawneys Road, Romford, Essex.

Broadcast Query Corner

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

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

Replies to Broadcast Queries

JANNOCK (Little Lever): (1) vague; possibly WBZ, Boston (Mass.) on 302.8 m.; (2) Leningrad; interval signal. E. SALTER (Essex): Shore-ship telephony; possibly on 177 m. BOX (S.S. Blackpool): (1) CTIAA, Lisbon on 31.25 m. (9,598 kc/s); (2) G2XO, is the call sign of Mr. A. Turner, 13, Elgin Avenue, Maida Vale, London, W.9. BRS 1038 (Herne Bay): Yes, WABC, New York (348.6 m.) direct. C-KER (Worksop): We cannot possibly trace station from details given as we cannot establish wavelength from your condenser degrees only; it would help if you gave the condenser dial readings of another station definitely identified by you on a nearby wavelength of the one heard. TALL POLE (St. Helens): WTIC, Hartford (Conn.) on 282.8 m.

THAT'S UP-TO-DATE — THAT WAS! By "PUSH-PUSH"

Radio is the best hobby in the world, but it has one big disadvantage in my eyes. No—I don't mind going to bed late o' nights. The disadvantage I refer to is the amazingly rapid progress which radio *keeps on making*. If only those incredibly ingenious engineers would pause awhile in their labours so that I could catch up with them! Of course, I keep up-to-date with modern ideas by diligently reading my copy of PRACTICAL WIRELESS every week—so do all of you. But what I mean by "catching up" is actually hooking up these new circuits for myself and passing my own judgment on them. And that costs money!

Two months ago, by limiting myself to sandwiches (without liquid refreshment!) for weeks on end, I managed to achieve at last "band-pass tuning."

But those gleaming aluminium coils which I carried home so proudly are now almost old-fashioned to my eyes. I promise myself a set of the new Ferrocart coils the minute they're put on the market. And I'm not going back to sandwiches for lunch. Neither am I going to try and pass off my unwanted coils to a friend.

I feel angry with myself for not tumbling to the solution before. *Part Exchange!* Obviously a firm such as Co-Radio Ltd., who are specialists in this part exchange business, know the second-hand market intimately and will say quickly and precisely what my apparatus is worth. Of course, I have a pretty good idea myself. I realise that components such as tuning coils which date quite quickly have not such a very good second-hand value as, for instance, transformers of well-known makes.

Now I read the constructional articles in PRACTICAL WIRELESS and know I can afford to try out any circuits that take my fancy.

So could you all. Why don't you write to Co-Radio Ltd. for a free Quotation on your surplus apparatus? Here is the address:—

ADVERTISEMENT INDEX

TIT-BITS GREAT SOUVENIR OFFER

VALUE 8/6

This illustration is from an actual photograph of the Tit-Bits "Souvenir" Camera. It is the latest-pattern "Coronet" Type Box Camera with Fixed Portrait Lens, British made and fully guaranteed by the Makers. The fixed Portrait Lens is an exclusive feature of this magnificent Camera.

WITHOUT question, the most sensational Souvenir offer ever made by a paper to its readers. Whether you are an old or a new reader of *Tit-Bits*, you are invited to avail yourself at once of this amazing offer. There are no "hidden conditions." You merely have to comply with a few simple rules, and this up-to-date, high-grade Camera with fixed Portrait Lens, complete with valuable handbook, "Prize-Winning Snapshots," and Instruction Booklet will be sent to you in time to take "Snaps" at Easter. So simple is this Camera, and so efficient, that even though you know nothing about photography, you will be able to take perfect "Snaps" right away.

WITH a Tit-Bits Camera you can not only secure a truly invaluable collection of photographic records of your Holidays, your week-end Rambles and Motor-runs, your Garden, your Friends, your Children, your Pets, etc., but can also obtain at very slight cost permanent enlargements which, suitably framed, will adorn your home with beautiful and intensely interesting pictures.

ALL CAMERAS WILL BE DESPATCHED IN TIME FOR THE EASTER HOLIDAYS

IMPORTANT! *Tit-Bits* "Souvenir" Camera is not a cheap article specially produced for the purpose of this advertising scheme, but is a British-made standard Camera of proved merit, used and recommended by thousands of enthusiastic amateur photographers in all parts of the country.

To make certain of your Souvenir Camera

Buy TIT-BITS

2d ON SALE TO-DAY

Geo. Newnes, Ltd.

P.W. Gift Stamp No. 18

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