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Practical Wireless

3D.

Published every Wednesday by
GEORGE NEWNES LTD.
Vol. 3.—No. 53.
SEPTEMBER 23rd, 1933.
Registered at the G.P.O. as a Newspaper.

EDITED BY F. J. CAMM.

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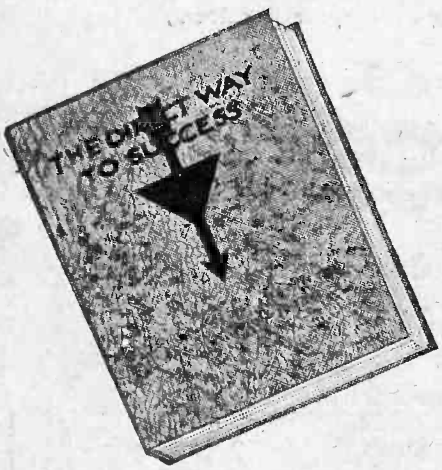

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THE "PREMIER SUPER"—THE BEST "HET" YET

See Page 7

Practical Wireless

EDITOR:
Vol. III. No. 53 || F. J. CAMM || Sept. 23rd, 1933.
Technical Staff:
W. J. Delaney,
H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.M.I.E.E.,
Frank Preston, F.R.A., W. B. Richardson.

ROUND *the* WORLD *of* WIRELESS

Birthday Greetings

SINCERE thanks to all those readers who have taken the trouble to wish us Many Happy Returns on the occasion of our Birthday! We are quite sure that these good wishes are echoed by our contemporaries with perhaps a slight accent on the "*returns*."

It is a source of great pleasure to us to learn that we have supplied what the home constructor has needed for the past twelve years. We shall do our best in the second year of our history even to surpass our past year's record. Again, many thanks.

Our Great Birthday Commemoration Scheme

TO commemorate our first year we have had specially designed and made the ingenious and handy Pocket Tool Kit which you see illustrated on the cover and on pages 31 to 33 of this week's issue, as well as in the centre of this page. You cannot obtain these tools in any other way, and they are all soundly made, accurate, and smoothly finished. They could not be purchased in the ordinary way for less than 12s. 6d. Those readers who care to avail themselves of this special Birthday offer should comply with the simple conditions given on pages 31 to 33 *without delay*, for, owing to the time taken to manufacture the tools, this offer cannot remain open for long. Notice that we have provided a recess beneath the Set Square for our Free Gift Spanners.

Our Free Gift Spanners

THE two spanners given this week form the first two of a set of three. The largest spanner completing the set will be given next week. These spanners are made of steel, and are correctly proportioned according to the Engineering Standard Committee's recommendation. Additionally, they are *accurate*. Real reliable and unrivalled reader service again, you see!

The World's Broadcasters

STATISTICS recently published by the U.I.R. (*Union Internationale de Radiodiffusion*), Geneva, show that whereas there were 1,323 broadcasting transmitters operating in the world in 1931, the number had increased to 1,444 by the following year. In the first half of 1933 roughly 50 transmitters were added to the list, thus bringing up the number to a grand total approaching 1,500 stations.

OUR GREAT BIRTHDAY OFFER!
RESERVE YOURS TO-DAY!

See pages 31—33

THE HANDIEST POCKET KIT OF TOOLS

This illustration shows the handy size and form of our Birthday Offer Tool Kit. It contains one four-inch Chesterman rule; one steel pocket scriber with chuck; one accurate 60-degree steel set square; a pair of ebonite test prods; one reflecting mirror for viewing obscure parts of the set; one set of trammels, with heads, for scribing, cutting holes in ebonite, etc.; one steel centre punch, and one handled screwdriver. The case is of metal finished in blue, and is specially reinforced with a metal-recessed bed into which the tools snugly fit. Owing to the extreme care used in manufacture and the length of time taken to produce these Kits, *it is necessary for every reader to reserve without delay, as the offer is only available for a short time. Turn to pages 31 to 33 and comply with the conditions now!*

Farthest North?

THE Norwegian wireless telegraphy station LGV, at Vardö, has been equipped with broadcasting apparatus and is now testing on relays of the Oslo programmes on 800 metres (375 kilocycles). Vardö lies to the north of Varanger fjord, 137 miles east-south-east of North Cape; it is well within the arctic circle and in consequence the station may claim to be the "farthest north" transmitter in Europe.

Overhauling the Short-Wavers

WITH a view to an improvement in the quality of transmissions from the Poznań (Poland) short-wave station on 31.6 m., broadcasts have been suspended until September 30th. In the same way UOR 2 Vienna, which for many months has been working on 49.4 m., has temporarily closed down. It is to be completely re-equipped with new plant to obtain increased power. No date for its re-opening has so far been fixed.

Mexico's Fifty-ninth Station

WITH the re-opening of XEB, Mexico City—now a 10 kilowatter—the number of transmitters in the State of Mexico has almost reached the "60" mark. The new station, now operating on 291.3 m. (1,030 kc/s), is owned by a cigarette manufacturer and will devote the greater part of its daily programmes to publicity.

Relays of Casino Concerts

LISTENERS to the Belgian and French studios may now hear programmes from kursaals and casinos in popular foreign seaside and watering places. By tuning to one or other of the Brussels transmitters on most evenings it is possible to pick up entertainments given at Ostend or at the Knocke-le-Zoute Casino. Radio Toulouse has also made arrangements to relay concerts from Biarritz on several dates in September at 9.0 p.m. B.S.T. Poste Parisien (Paris) in its turn takes you regularly over to Deauville, one of the most fashionable of French coastal resorts, and the French P.T.T. stations, including Eiffel Tower and Radio Strasbourg, frequently broadcast operatic works performed at Vichy-les-Bains.

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

Broadcasting on Ultra-Short Waves

EXPERIMENTS carried out at Amsterdam over a period of several months have clearly demonstrated the utility of short waves of the nature of seven to eight metres for the establishment of local broadcasting services. Tests proved that only a power of 300 watts was required for a good reception over small areas. Moreover, on these channels, it was found that static interference was almost non-existent. As the working range of these transmitters is strictly limited, neighbouring cities could use the same wavelength without any risk of mutual interference. In a band of frequencies from 40,000 (7.50 m.) to 38,460 kilocycles (7.80 m.) there is a difference of 1,540 kc/s, which is greater than the separation existing between 200 m. and 2,000 m. (actually only 1,350 kilocycles) or somewhat more than the entire broadcasting band. In effect, this would mean that the band would be sufficient to house with ease all the European transmitters provided for by the new Lucerne plan. The utilization of these short waves may result in the solution of many knotty problems in the development of wireless communications. In Holland, a scheme is being considered to link up Java with the neighbouring island of Bali in the Dutch East Indies by 7-metre transmissions. The depth of the sea in those districts is such that the laying of a special submarine cable for the purpose would be a much more expensive item than the installation of the necessary wireless transmitting and receiving plant.

Lugano *via* Sottens

DURING the temporary suspension of the Monte Ceneri transmission concerts from the Lugano (Switzerland) studio will be broadcast through the Sottens station on 403.8 metres.

America Calling

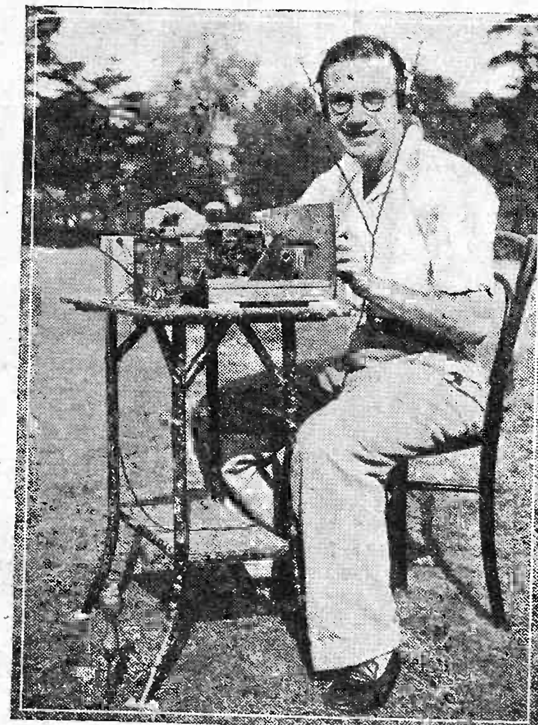
THE success of the burlesque American programme recently presented by the B.B.C. has induced the organizers to offer another edition in November. In this instance it will take off a number of radio stars like the Mills Brothers and Ted Lewis, for which room could not be found in the original programme. The first broadcast was relayed to America through the Columbia system, and so amused were listeners on the other side that in their turn they are planning retaliation with a special entertainment which will include their impersonations of well-known British microphone artists. It is hoped that we shall be given an opportunity of hearing this version when it is presented.

New Interval Signals

BOTH Brussels stations have adopted new and distinctive musical signals between items to identify themselves to their listeners. From Brussels No. 1 you now hear a short phrase (three bars only) of a melody by Grétry, a famous Walloon composer; Brussels No. 2, on the other hand, utilizes chimes giving an excerpt of an old song by Peter Benoit, the founder of the Flemish school of music. Whereas the 509-metre transmitter usually closes down with the playing of *La Brabançonne* (the Belgian National anthem), the 337.8-metre station plays an old Flemish patriotic song: *De Vlaamsche Leeuw.*

INTERESTING and TOPICAL PARAGRAPHS

A RADIO RECORD.



Two ultra-short-wave experimenters, Mr. Hilton O'Hefferman and Mr. T. E. Myatt, have broken the world's record for ultra-short-wave transmission. Mr. Myatt, at Hoddesdon, Herts, picked up the five-metre transmissions of Mr. O'Hefferman from Mount Snowdon, 200 miles away. The record distance for such transmission has previously been 160 miles. The photograph shows Mr. T. E. Myatt with his five-metre set.

SOLVE THIS!

Problem No. 53.

Blenkinsop wished to make up an output transformer to suit his particular valve and speaker, and, using the Data Sheets presented in various issues of PRACTICAL WIRELESS, he found the gauge of wire, transformer stampings, etc. He ascertained the ratio of the transformer required by taking the square root of the valve impedance divided by the speaker impedance, and built up quite a good transformer. When tested, results were not up to his expectations. The windings were found intact, correct according to all his figures, and no shorts or other faults appeared to exist. What was wrong? Three books will be awarded for the first three correct solutions opened. Address your attempt to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. All entries must be received not later than September 25th, and envelopes must be marked Problem No. 53.

SOLUTION TO PROBLEM No. 52.

The trouble with Arnolds' set was due to the smoothing condenser in the mains equipment breaking down. A short circuit was accordingly introduced across the secondary windings of the mains transformer, resulting in overloading of the rectifier valve and the consequent lack of H.T. voltage to the receiver proper.

The following three readers gave correct solutions to this Problem, and books have accordingly been forwarded to them:—

A. L. Beedle, 15a, Fontenoy Road, Balham, S.W.12; C. L. Philps, Runnymede, Hawkwell Chase, Hockley, Essex; G. Day, 24, Collindale Avenue, Erith, Kent.

German Television Development

ONE of the most remarkable exhibits at the Berlin Radio Show was a new television projector exhibited by the *Fernseh A.G.* with which Baird Television (London) is associated. The picture produced by the instrument may be compared in quality to that of the average home cinematograph projector. The instrument uses a sensitive coated film on which the televised object has been photographed, and projects the picture on to a large screen. In this system the exposed film can be cleaned off and the celluloid used again for a different subject.

Ici Bordeaux Lafayette

THE French station you hear almost nightly on 304.9 metres immediately above North National is the PTT transmitter at Bordeaux. Although it frequently broadcasts its own studio programmes the bulk of its radio entertainment is relayed from *Ecóle Supérieure*, Paris. There is no interval signal, but at times a gong is struck at the end of an item. The full opening call is: *Ici la station du reseau français de radiodiffusion des Postes et Telegraphes de Bordeaux-Lafayette.* Fortunately for listeners who do not understand the French language the last two words are pronounced almost as written.

Another Television System

ACCORDING to a report from New York, a San Francisco scientist, Philo Farnsworth, is said to have invented a new television system. The test transmissions would appear to have been perfectly successful, and in statements made by the inventor it is claimed that the means adopted make of the system a commercial proposition of high value.

Notice to Short-Wave Fans

FROM January 1st, 1934, as its call-sign, Austria will take the International prefix OE instead of UO as hitherto. As an example, an amateur in that country now calling UOIDA would from that date take the call-letters OEIDA and UOR 2, Vienna, will be known as OER 2.

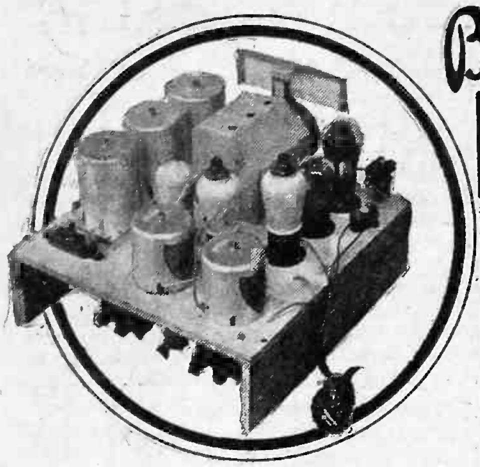
Alteration in German Wavelength

THE new 1½ kilowatt Hanover relay station was formally opened on August 13th last; it now works on a common wavelength with Flensberg, namely, 227.4 m. (1,319 kc/s). With the closing down of the old station operating on 566 metres it is now possible to pick up broadcasts from Wilnö (Poland) on 563 m. without any interference.

Berlin's New High-Power Station

THE 100 kilowatt transmitter now in course of construction at Berlin and which is destined to replace the weaker Witzleben station may possibly be ready by the Christmas holidays. According to the new wavelength plan it will work on 356.7 metres (841 kilocycles) thus displacing from this position London Regional, which will drop to 342.1 metres (877 kc/s). With a separation of 36 kilocycles between them there should be no mutual interference.

A ★ SET AND THE BEST SUPER-HET EVER PLACED BEFORE HOME CONSTRUCTORS.



Building the PREMIER SUPER

An Entirely New Five-valve Superheterodyne of High Efficiency and Low Cost. Specially Designed for Our Birthday Number.

By The Technical Staff.

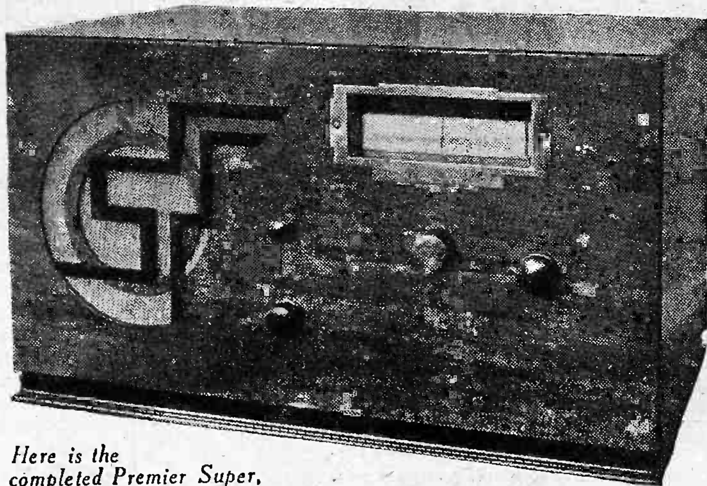
THE Wireless Exhibitions at Olympia and Glasgow have given us a unique opportunity of meeting a very large number of our readers and learning what kinds of receiver appeal to them most strongly. At both Exhibitions we have been asked many times if we would publish details of a really efficient battery-operated superheterodyne of a type suited for use with an outside aerial. To these inquirers we have said that we had such a receiver on our test bench, and that as soon as we were satisfied that it was better than any other similar instrument which had previously been described we should publish full details. Our tests are now completed, and we offer the results to our readers in the form of a five-valve superheterodyne, which we feel is worthy of the seal of perfection which the PRACTICAL WIRELESS guarantee automatically bestows upon it.

The "Premier Super" is entirely free from those defects which have been responsible for our not describing a superheterodyne of this type previously. It is tuned by means of a single knob; requires no difficult preliminary "trimming" and "balancing" adjustments; is free from heterodyne whistles; gives real "quality" reproduction; is delightfully easy to build; is economical in the way of battery current, and can be built very cheaply. It need scarcely be mentioned that the degree of selectivity is as good as it is possible to obtain with any type of receiver when good quality reproduction is insisted upon. Combined with these advantages are those of excellent appearance and compactness.

Extreme Simplicity

It will be evident from the photographs on this page that simplicity and ease of construction have been carefully considered, for it was realized that the set would appeal not only to the experienced amateur, but also to hundreds of new readers who have perhaps never before built a receiver of their own. Nevertheless, this simplicity has not been secured at the expense of efficiency, but, instead, the two qualities have been combined.

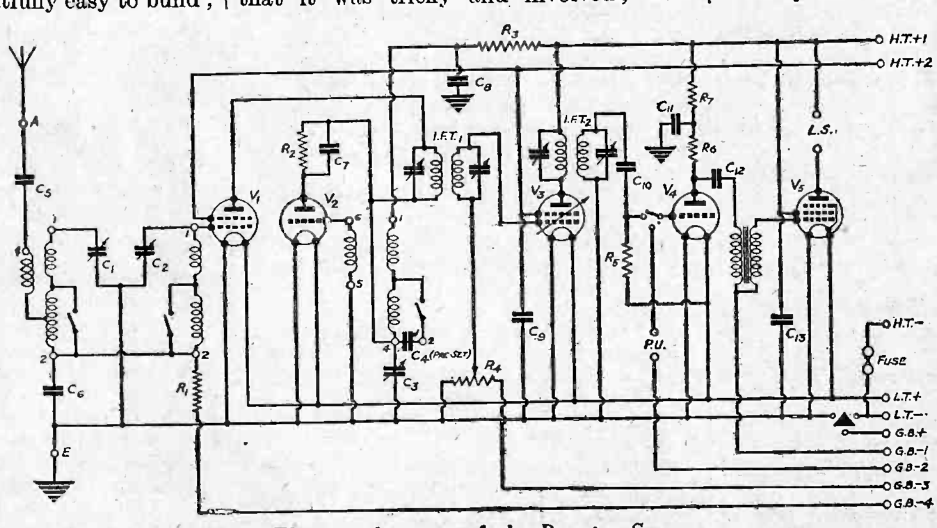
We know that many readers have in the past avoided the superheterodyne receiver because they were under the impression that it was tricky and involved; the "Premier Super" demonstrates in a practical manner that it is neither. Some have always regarded the superheterodyne as an expensive piece of apparatus; the fact that this new PRACTICAL WIRELESS receiver can be built for just over £14 0 0, including cabinet, batteries, valves, and moving-coil loud-speaker, or for £6 12 6 for the bare receiver, proves the fallacy of that idea.



Here is the completed Premier Super, in its modern Peto-Scott Cabinet.

Special Features

Before proceeding with the practical constructional details it will be well briefly to mention some of the practical features that have been incorporated in the set. Perhaps the most important of these concerns the use of a metallized chassis. All PRACTICAL WIRELESS sets, right from Number I, have been built on the chassis principle, since this has proved to show innumerable advantages over the use of a flat baseboard. The set can be made more compact, a much "cleaner" appearance is secured and the utmost efficiency can be obtained because the wiring is reduced in length whilst the components can be better disposed. Just as PRACTICAL WIRELESS set the fashion a year ago by adopting chassis construction as standard, so have we more recently made our receivers still better by being the first to use the "Metaplex" chassis. This latter has but recently been available, and although it is made of wood and thus has all the advantages of easy working, it is specially sprayed with metal, under high pressure, so that it also has the advantages of metal, being a perfect conductor. Not only does the metallized chassis act as a screen, therefore, but it can also be used for "earth return" leads, thus considerably simplifying the task of wiring.

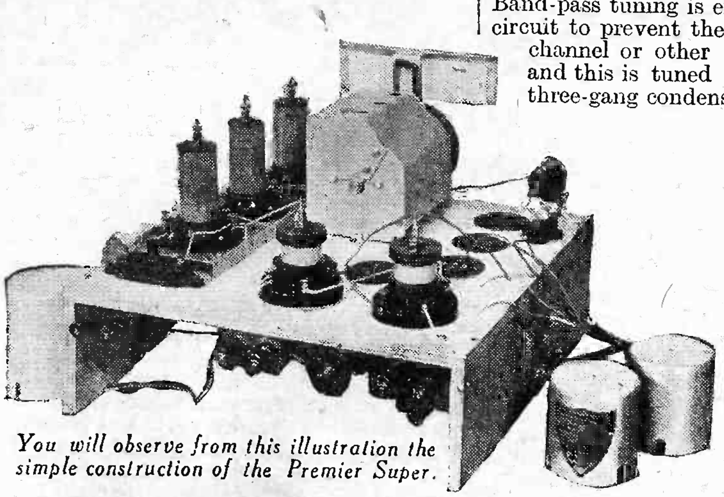


Theoretical circuit of the Premier Super.

(Continued overleaf)

HIGHLY SELECTIVE—LOW PRICED—SINGLE-KNOB TUNING

Some readers will perhaps question the use of air-core coils, now that iron-core ones are available in nearly every make. The point is that iron-core coils are not necessary in a superheterodyne, because an ample degree of selectivity can be obtained without them, and we have found that they do not confer any advantages whatever. In fact, our experiments have shown that air-core coils are slightly better in a band-pass circuit, due to the fact that they can be "matched" more easily, and with a better degree of accuracy. There is also another point which is too important to overlook; that is that air-core coils are appreciably cheaper.



You will observe from this illustration the simple construction of the Premier Super.

A Tested and Reliable Circuit

It will be obvious from a cursory examination of the circuit diagram that there are no "stunt" arrangements, or, in fact, any items which have not been fully proved in practice. Of the five valves, the first is a screened-grid first detector working on the anode bend principle, the second is the oscillator, whilst the single variable-mu intermediate frequency amplifier comes next. This is followed by a three-electrode second detector acting as leaky-grid rectifier, and this feeds into the pentode output valve. Band-pass tuning is employed in the aerial circuit to prevent the possibility of second channel or other form of interference, and this is tuned by two sections of a three-gang condenser of which the third (which has specially-shaped vanes to ensure proper "tracking"), tunes the oscillator coil. Two band-pass intermediate frequency transformers are used to couple together the first detector and I.F. valve, and the I.F. and second detector respectively. These transformers have a pre-set condenser connected across each winding, but as this is accurately adjusted by the makers before leaving the factory it does not need to be touched by the constructor.

Perfect volume control is obtained by adjusting the grid-bias to the variable-mu intermediate frequency amplifier by means of a 50,000 ohm potentiometer. A radiogram change-over switch is included in the grid circuit of the second detector so that a pick-up can easily be brought into circuit when required. To ensure an ample bass response and to obtain the maximum amount of amplification between the second detector and the pentode the L.F. transformer is resistance coupled.

NO TRICKY ADJUSTMENTS OF ANY KIND AND— IT'S GUARANTEED!

Battery or Eliminator Operation

Ample decoupling is provided throughout the receiver and only two H.T. positive leads are required. Thus the set can be operated from batteries in the ordinary way, or from practically any type of eliminator giving an output of about 15 milliamps at 120 volts. Actually, the anode current consumption varies between about 11 and 15 milliamps, according to the setting of the volume control.

Assembling the Components

A complete list of components is given below, and the first step is to obtain all the parts listed. Please do not think that any other similar components will serve; in rare instances they might, but it is unlikely that they will be so good as those around which the circuit was designed, and in any case our guarantee would not apply. The metallized chassis is supplied all ready drilled to receive the valve-holders and other parts, so all you have to do is to mount them in the positions indicated in the wiring plans. It will be found best to carry out the work in a systematical manner by first screwing down the valve-holders, then mounting the components on the under side of the chassis and leaving until last the coil assembly, intermediate frequency transformers, and three-gang tuning condenser. No special instructions are necessary in regard to the method of mounting, since every component is attached in a straightforward manner by means of suitable screws. These latter are supplied with the kits of parts advertised on other pages of this issue, but for those who prefer to buy separate parts locally it might be mentioned that about one and a half dozen ⅜in. screws are needed and approximately two dozen ⅛in. ones. It will be noticed that the two grid-bias battery clips are attached to one of the chassis side members; they can be dealt with without dismantling the chassis, but it will be found somewhat easier to remove the side member by taking out the three screws by means of which it is attached to the baseboard.

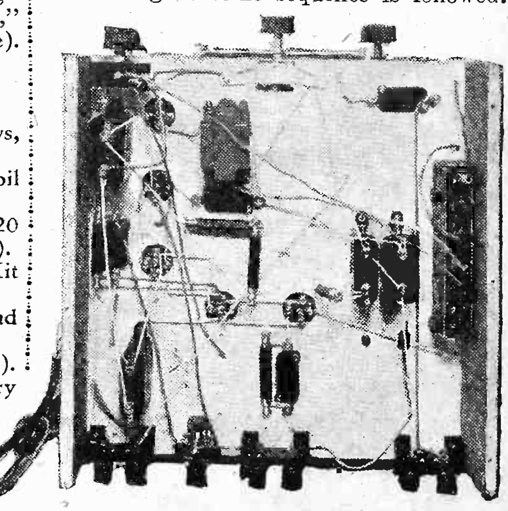
The Wiring

The wiring need present no difficulty at all so long as some sequence is followed.

LIST OF PARTS FOR THE PREMIER SUPER.

Don't depart from these specially selected components.

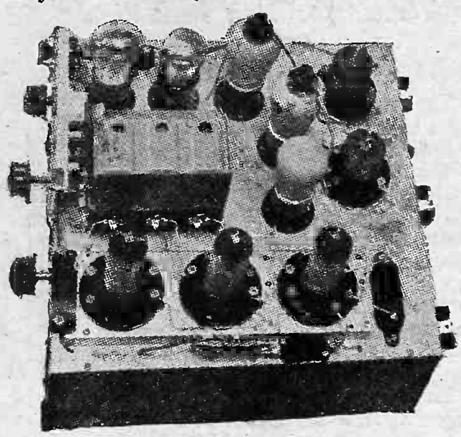
- One Superhet 3-gang Midget Variable Condenser, Type 693, with Straight Line Dial (British Radiophone).
- One Set Matched Superheterodyne Coils (2 Bandpass and Oscillator) (Lissen).
- Two Intermediate Frequency Transformers (Lissen).
- One 50,000 ohm Volume Control Potentiometer, Type V.C.36 (Bulgin).
- One 3-point Switch, Type 48 (British Radiogram).
- One Push-Pull Radio Gram. Switch, Type 50 (British Radiogram).
- Three Chassis Brackets, Type 21 (British Radiogram).
- One "Pip" 3/1 L.F. Transformer (Graham Farish).
- Six "Ohmite" Resistances—2,000 ohms, 10,000 ohms, 20,000 ohms, 30,000 ohms, 100,000 ohms, and 2 megohms (Graham Farish).
- Two .1 mfd. Condensers, Type B.B. (Dubilier).
- Two 2 mfd. Condensers, Type B.B. (Dubilier).
- One .0001 mfd. Condenser, Type 670 (Dubilier).
- One .0002 mfd. Condenser, Type 670 (Dubilier).
- Two .01 mfd. Condensers, Type 670 (Dubilier).
- One .002 mfd. Pre-Set Condenser (Polar).
- Four 4-pin Chassis Mounting Valveholders (Clix).
- One 5-pin Chassis Mounting Valveholder (Clix).
- Three Terminal Mounts (Belling-Lee).
- Six Terminals, Type "R," marked "A," "E," "L.S—," "L.S.+," and two marked "Pick Up" (Belling-Lee).
- Six Wander Plugs (marked "G.B.+," "G.B.—1," "G.B.—2," "G.B.—3," "G.B.—4," and "G.B.—5" (Belling-Lee).
- One "Metaplex" Chassis (Peto-Scott).
- One Premier Super Cabinet (Peto-Scott).
- One Fuse Holder and Fuse (Bulgin).
- Two Coils Quickwire, length of Flex, Screws, etc. (Bulgin).
- One P.M.6 "Microlode" Moving Coil Speaker (W.B.).
- Five Valves Types 215 S.G., 210 H.L., 220 V.S., 210 Det., and 220 H.P.T. (Cossor).
- One "Aeroficient" Aerial Earth Kit (Graham Farish).
- One Length Metal Screened Down Lead (Goltone).
- One 2-volt 40 amp. Accumulator (Smiths).
- One 9-volt G.B. "Anodex" Battery (Smiths).
- One 120 volt Triple "Anodex" H.T. Battery (Smiths).
- One Baffle Baseboard Assembly (Peto-Scott).



The simplicity of wiring is evident from this illustration.

SUPERB QUALITY—LONG RANGE—ONLY 5 VALVES

Thus you should commence by joining together the filament pins of all the valve-holders. After that, start at the aerial "end" and work right through the set to the loud-speaker terminals. If you are new to set construction you will probably find it a good plan to cross off, or mark in some way, every wire on the wiring plan as you put it into the set. Practically all the connections are made by looping the bared end of the wire to fit over the terminal, but in one case a soldered contact is used to prevent the use of an unduly long lead. If you cannot lay hands on a soldering



Note the clean layout of the Premier Super.

iron, this connection can be made by looping the wire and nipping the joint up tightly with a pair of pliers. You will notice that several wires are secured under the heads of screws attached to the chassis; these are "earth return" leads and by connecting them in this way a good deal of extra wiring is avoided. A few other similar connections are made to the foot of the tuning dial underneath the chassis. The ends of wire are simply bared for a short distance and slipped under the metal strip forming the foot before the securing screws are finally tightened down. Notice carefully the connections to the push-pull radio-gram switch attached to a component bracket at the rear of the chassis. There are three terminals on this component, and they are in contact with three flat springs of different lengths. The terminal on the shortest spring is joined to the pick-up terminal; the next one connects up with the grid terminal on the second detector valve-holder, whilst the terminal on the longest spring is connected to the grid condenser. Short lengths of flex are used for the grid-bias battery tappings and also for the anode terminal connections to the screened-grid and variable-mu valves; all these should be just long enough to connect up to the appropriate points and should not be allowed to stray about among the other wiring.

The special cabinet specified is supplied ready drilled to receive all the controls and also the tuning condenser escutcheon, so that there will be no difficulty whatever in fitting the set provided that care has been taken in following the dimensions given in the wiring plans. The loud-speaker is first screwed to the baffle board and then attached to the base of the cabinet by means of four ½in. screws, making sure that the baffle fits closely against the fret in the front of the cabinet.

You can now get along with the construction of the "Premier Super."

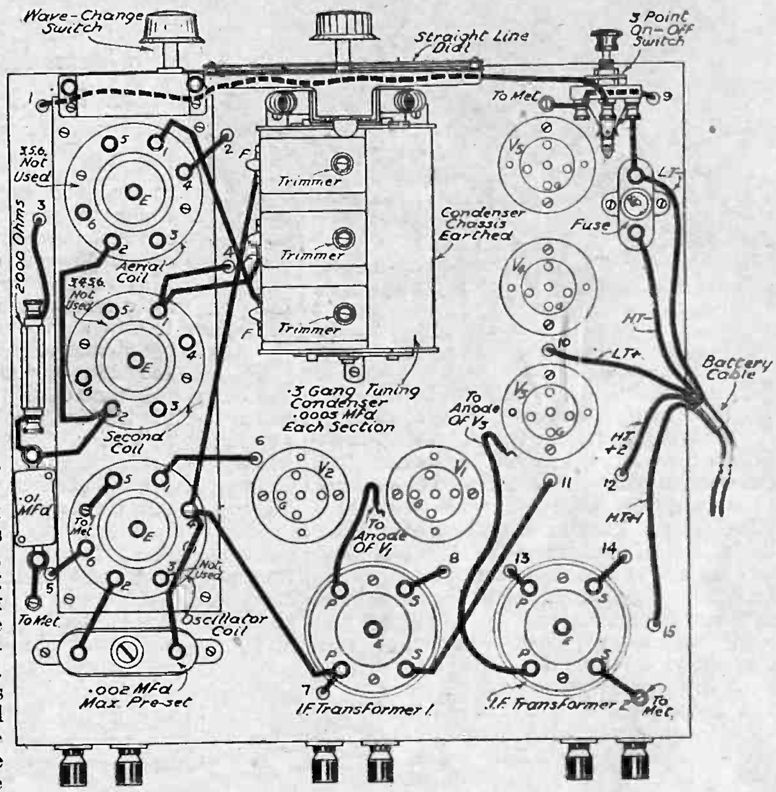
CAREFULLY DESIGNED FOR YOUR BENEFIT AND BACKED BY OUR GUARANTEE.

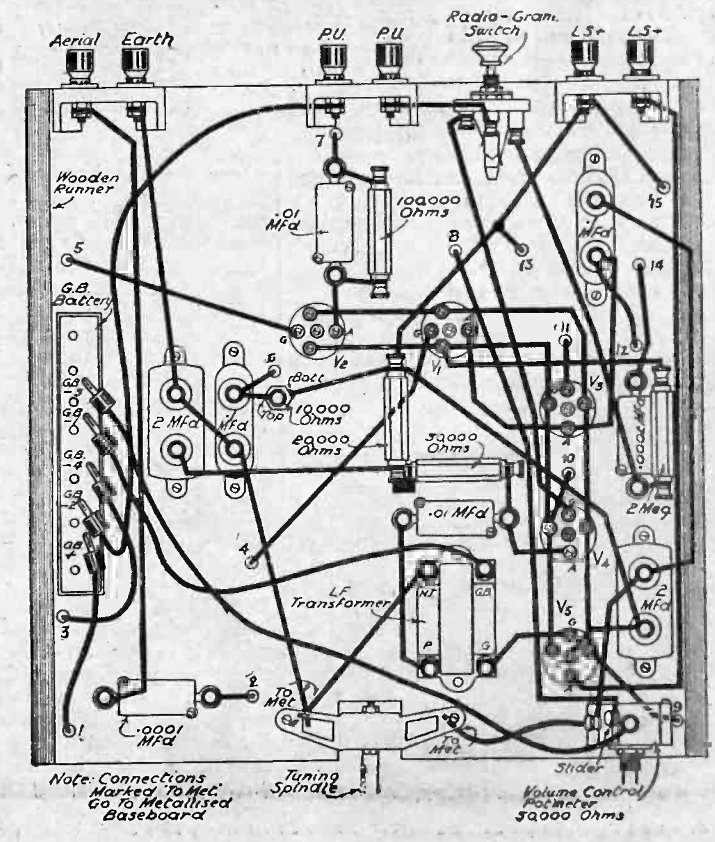
Connecting and Adjusting.

Next week we shall give you full particulars in regard to the method of making the few simple preliminary adjustments which are required and will describe in detail just how the best results can be obtained. For the benefit of those readers who are more experienced, however, and who finish the constructional work before next week's issue is available, the following notes respecting the most suitable voltages will perhaps prove useful. The grid bias battery should first of all be fitted into the clips which are mounted on the underside of the chassis, when the "G.B.+" plug should be inserted in the corresponding socket. Put plug "G.B.—1" (which is that supplying the pentode) into the 4½ volt socket; put the "G.B.-2" plug (that for the pick-up) into the 1½ volt socket; insert plug "G.B.—3," which is that for the variable-mu intermediate frequency amplifier, into the maximum (9 volt) socket and try the fourth "G.B.—" plug first of all in the 3-volt socket. After trying out the receiver it might be found that better results can be obtained by applying 1½ volts negative to the grid of the first detector (through plug "G.B.—4"), but the optimum voltage is best found by trial.

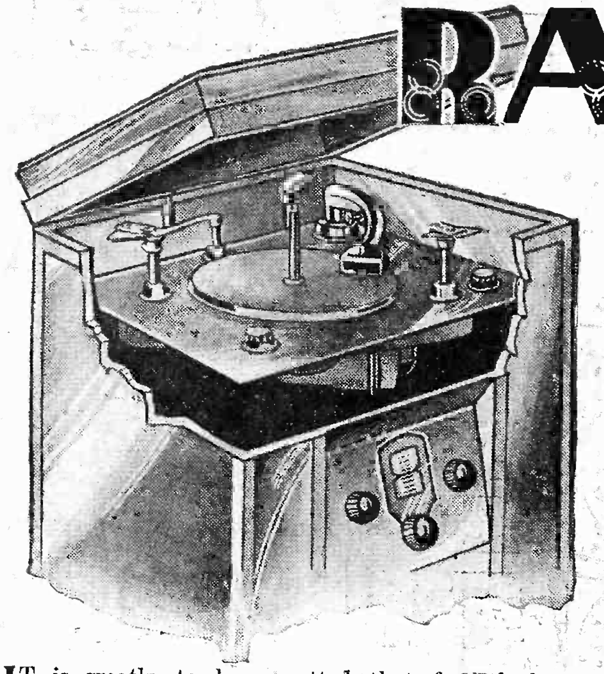
Should it be decided that 1½ volts gives best results, the two flexible leads to plugs 2 and 4 can be joined to the same wander plug.

TOP AND SUB-BASEBOARD WIRING DIAGRAM OF THE PREMIER SUPER.





RADIO-GRAM MOTORS



The Purpose of This Article is to Help Readers in Their Choice of a Motor for Radiogram Work and, After They Have Obtained the Motor Best Suited to Their Requirements, to Give Some Hints on Its Proper Maintenance.

By ALFRED J. POTTS

IT is greatly to be regretted that far too many owners of gramophone motors, particularly of the spring-driven type, have the fixed impression that once put in place the motor needs no attention whatever. Not only this, but they blissfully continue to use the motor after it is out of condition until the spring breaks, when, of course, something has to be done. Would you, on having bought a new car, keep on using it until it would not work satisfactorily and would not run smoothly? Why, then, do this with your gramophone motor?

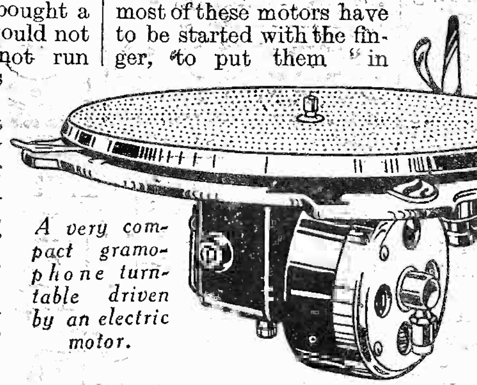
A further point that is of great importance but which is frequently overlooked is that if the motor does not carry out its required work smoothly and efficiently, then the best pick-up and amplifier ever designed cannot give good, clear and undistorted reproduction. This point will become obvious when the explanations given later in this article have been considered.

First to choose the type of motor to be used. Those with electric light are in the fortunate position of having an enormous choice of really good motors, but great care has to be used if a satisfactory choice is to be made.

As it would take a great deal of space to explain all the advantages and disadvantages of the various types of motors, I will give just a short description of each which will aid the reader in his choice of type.

The Synchronous Motor

The simplest and, incidentally, cheapest form of electric gramophone motor is, of course, the synchronous type which makes use of the frequency of the A.C. mains to keep it at a constant speed of seventy-eight. This is, of course, very useful, since many people seem unable to run a record at its proper speed and always run it either too slow or too fast, generally the latter, owing, no doubt, to the fact that when the pitch rises the output volume appears to be louder. It should be remembered, however, that this type of motor has only the flywheel effect of the turntable to keep it at a constant speed and that it depends very much upon its design to be efficient for satisfactory results. In addition to this, it must be remembered that most of these motors have to be started with the finger, to put them "in phase" with the electricity supply before they will go at all. This motor is only suitable for A.C. mains.



A very compact gramophone turntable driven by an electric motor.

There is then the universal motor, which can be used on either A.C. or D.C. mains, and which, if of good design, can be very efficient. These motors have a speed regulation of similar nature to a spring-driven motor. Some hints on regulating the speed of all these types of motors being described will be given later in this article. The great trouble in this type of motor which has to be looked out for is sparking, but most motors made by good reliable firms are free from this trouble.

The Induction Motor

The only other type of motor which is in demand is the induction type, which again often has a speed regulation and was mainly designed to overcome the commutator sparking which is sometimes troublesome in the universal type. This type of motor can, of course, only be used on A.C. mains.

Various other types of electric motors have been brought out, but the three types described above are among the best available and are the most popular types.

Many of us are not fortunate enough to have electric light and many, whose pockets are not very deep, cannot afford the extra expense of the mains-driven motor. It should always be kept in mind, too, that even if you are in the happy position of having the mains, a good spring-driven motor is far better than a cheap electrical one.

The choice of a spring motor is just as important as an electric one, and since there is rather more liability in the spring motor for mechanical faults, cheap motors should be definitely put aside. When possible, a double spring motor, or even a triple spring one, should always be used for the following reasons. Many people are under the impression that the governor keeps the speed of the motor *absolutely* constant. This is not *quite* true, for this reason.

The governor's duty in the motor is to take the main load of the driving spring. Therefore it is quite easy to see that even if no record is being played, when the motor is fully wound up the pressure on the governor is considerably greater than when it is nearly run down. Thus when a record is being played this fault is emphasized considerably owing to the extra pull on loud passages. Since this fault is more noticeable when the motor is nearly run down, it will be seen that it is better for this reason to purchase a double or triple spring motor as, of course, the period in which it is "nearly run down" is lessened to a half and third respectively. A further important reason for the use of the more powerful types of motor is that the tendency

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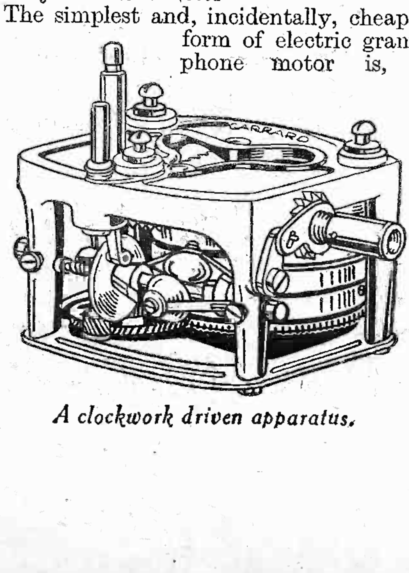
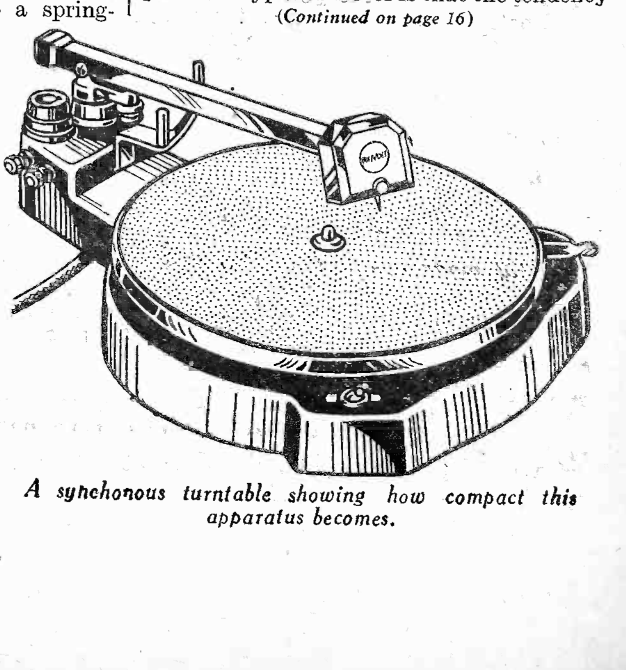


A clockwork driven apparatus.



A synchonous turntable showing how compact this apparatus becomes.

FIRST DETAILS OF A NEW OUTPUT VALVE

By LAMBDA

THE subject under discussion was valves and valve progress—opinions were divided—finality had definitely been reached and no further developments were possible was the opinion of the majority. There could not be any revolutionary designs for some time to come, they said. The Radio Exhibition at Olympia had not produced any surprises. Class B and H.F. Pentodes were in evidence and the Pentagrid or Hexode would shortly be available for the constructor.

Apart from these valves with which we are fairly familiar, there did not seem to be any further developments forthcoming. However, history tells us that the opinions of the majority are not always correct, and now still further valve improvements have once again proved them to be mistaken.

It is a rather interesting fact that the recent valve developments seem to alternate between this country and America. The Q.P.P. system and the Catkin valve were developed in the laboratories of this country, whilst Class B and the Pentagrid valve were originally American inventions.

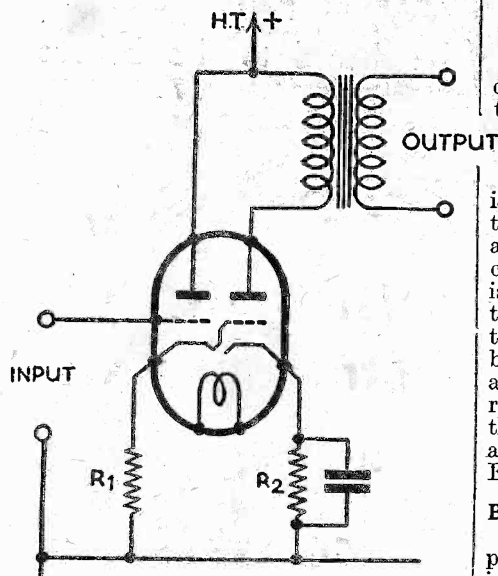


Fig. 2.—Connections for the new valve in a single output stage.

Mains Receivers

Now a new output valve for mains sets has been designed which appears to be quite revolutionary. With it excellent quality is obtainable without excessively high anode voltages, and with an output of about 4 watts. It is claimed that this new valve can be substituted for many of the existing output valves at present employed in mains receivers, where only relatively low anode voltages of about 250 to 300 are available.

Triodes and Class B

It is generally conceded that the triode output valve provides the best quality, so long as high anode voltages can be obtained. In order to provide an undistorted output of, say, 5 watts, an anode voltage of at least 400 is usually necessary. The introduction of Class B valves for battery sets enabled $1\frac{1}{2}$ to 2 watts output to be obtained with a minimum of H.T. current and voltage. This new valve will, to some extent, perform the same service for the owner of small mains sets, but with the added advantage that it will not be necessary to employ a driver valve or special input transformer.

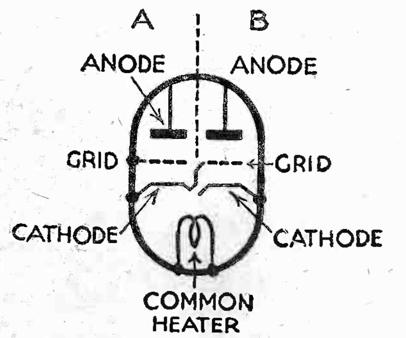


Fig. 1.—The electrode connections of the new valve.

Two in One

The theoretical circuit of the new valve is shown in Fig. 1, notice the two sets of triode elements mounted side by side using a common heater, but electrically separate cathodes. An unusual feature of this valve is the tying of the cathode of the first portion to the grid of the second portion. In order to understand its functions the diagram has been divided by means of the dotted line and the sections have been marked A and B respectively. The elements marked A are the input and those marked B the output, and the circuit arrangements are shown in Fig. 2.

Biasing Arrangements

The bias for the first portion is provided by the resistance R_1, which is also part of the load for the triode A. We have already mentioned that the cathode was tied to the grid of the output triode B, therefore the voltage drop across this resistance puts the output section at a rather high positive bias, in fact much too high. This high bias is necessary for the triode A but not for triode B. To remedy this state of affairs the output portion is also biased by a resistance in the cathode lead. In calculating the value of this resistance, however, it is necessary to take into consideration the bias on the input section. The output bias is therefore arranged so that there is a difference between the voltage drop across R_1 and R_2 actually $2\frac{1}{2}$ volts. Let us re-state this as it is rather unusual.

Positive and Negative Bias

Triode A is biased 24 volts negative but tied to grid of triode B, therefore the latter will be 24 volts positive as it is 24 volts above H.T. negative. The biasing arrangements of triode A are quite orthodox; that is if the cathode is made 24 volts positive with respect to earth, the grid will be 24 volts negative.

Now the next step. Triode B is 24 volts positive, quite obviously considerably too much. To make it negative we adopt the usual procedure—a resistance in the cathode lead. But we do not want it negative, but $2\frac{1}{2}$ volts positive. So subtract $2\frac{1}{2}$ volts from 24, leaving us $22\frac{1}{2}$, and calculate our biasing resistance for $22\frac{1}{2}$ volts, which when placed in the cathode lead will make the grid less positive, thus leaving us the $2\frac{1}{2}$ volts we require. It is quite simple if each triode of the complete valve is taken separately.

It is really worth while understanding the principle involved in the calculation of the biasing arrangements, because when this valve becomes available in this country it will be essential for you to be able to make the necessary calculations if you wish to fit one of them in the output stage of your receiver. With this valve the first triode A is biased negatively and the second triode B is biased positively, rather a unique arrangement.

Output Power

Output power is delivered by triode B, which operates at the middle point of its Eg Ip characteristic. The input section performs a function somewhat analogous to that of the driver valve in Class B circuits, but a step-down transformer is unnecessary.

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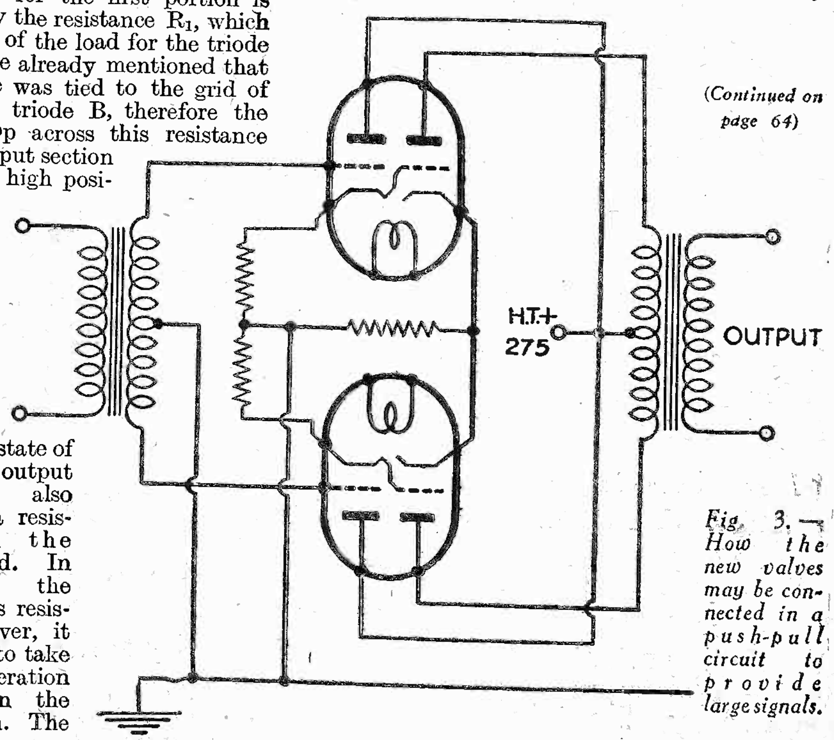
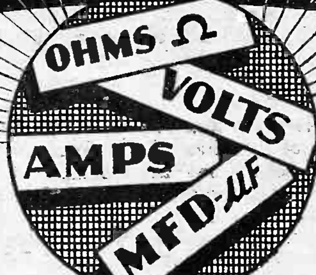


Fig. 3.—How the new valves may be connected in a push-pull circuit to provide large signals.

How Electrical Units are Derived



AN ARTICLE GIVING SOME INTERESTING FACTS ABOUT—VOLTS, AMPS, AND WATTS.

By W. B. RICHARDSON.

MOST of us are, of course, quite at home with volts, amps, and watts. We talk quite glibly of kilowatts and amp-hours and show a condescending familiarity with Ohm's law ; but I wonder how many radio enthusiasts when tackled could give a satisfactory answer to such a simple question as "What is a volt ?" or "What is meant by power ?" I am afraid quite a number would find such blunt inquiries rather embarrassing. "Oh, hang it all," they would say, "a volt is a volt, just the same as a pound is a pound, or an inch an inch" ; or they might answer brightly that a volt was the product of amps and ohms, at the same time fervently hoping they would not be asked for a definition of either an amp or an ohm. Of course, to define a unit in terms of other units without really knowing what the others are derived from is only begging the question.

Now units may not appear to be particularly interesting things in themselves, but to those who like to know the "whys and wherefores" of things a study of their derivations is most illuminating.

Mechanical Units

To get an idea of how the familiar units used by electricians are arrived at, we must have some knowledge of the simple mechanical units which were in use long before electricity was thought of.

The unchanging fundamentals from which other units are derived are :—Time, Length, and Mass. These hardly need any explanation, except perhaps the last one, which means the amount of matter or substance in a body. It must not be confused with *weight*, which is measured by units of the same name, but which is the force exerted by gravity, although for practical purposes they may often be considered synonymous. Thus a body weighing a pound may be taken as containing a mass of one pound, and a gramme weight as the same as one gramme mass. The slight discrepancies which sometimes exists between the two measurements is due to the fact that weight varies on different parts of the earth's surface. A pound mass, for instance, may weigh just over a pound in one place and just under in another. It is due to this that mass is used instead of weight as the fundamental measure.

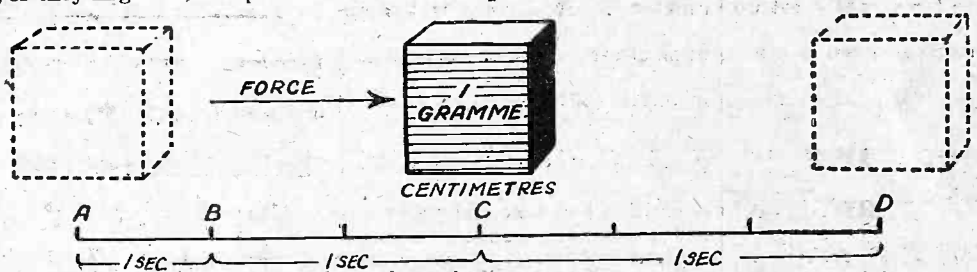


Fig. 1.—Diagram illustrating the derivation of the dyne, a mechanical unit of force.

Force

One of the most important units apart from time, length, and mass is *force*. A force is defined as that which tends to produce movement in a body. For instance, a man pushing a truck along uses force. "Yes, very obvious," you may say, "but how do we measure a force ?" Well, there are several different units in use. There is what is called the *absolute unit*, that is a unit which is independent of any varying factor—a sort of rock bottom unit, and there are several *practical units*. The absolute unit of force under the metric system is the *dyne*, and is that force which, acting for one second on a mass of one gramme, produces an acceleration of one centimetre per second, per second. This may sound rather technical, but a study of Fig. 1, will no doubt help to make it clear. Here the mass of one gramme is shown as a cube composed of just one gramme of matter. This is being pushed from left to right by the force. In one second it moves from A to B, that is one centimetre. However, it is gradually increasing in speed due to the force and in the next second travels two centimetres—from B to C. During the third second it is going so fast as to cover three centimetres, and so on. Actually, a force of one dyne is very small, and for practical purposes units of a gramme weight or a pound are used. The gramme is the metric unit and the pound the English unit. The former is equal to 981 dynes and the latter to 445,000 dynes.

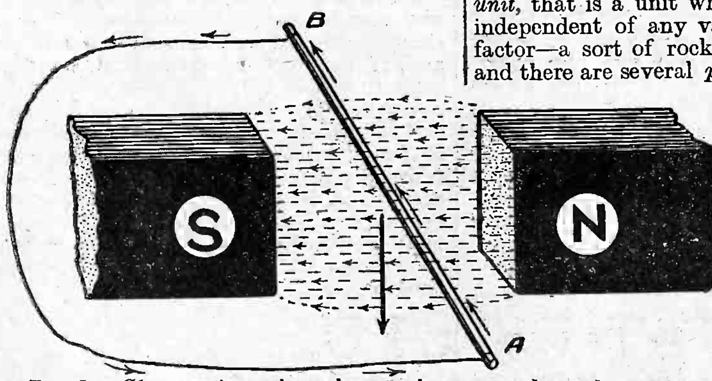


Fig. 2.—Showing how the volt may be expressed in the pressure created in a conductor cutting a certain number of magnetic lines of force.

Electro-Motive Force

Well, so much for the mechanical units of force. Now what of the electrical equivalents ? Electrical force or pressure is known as the *electro-motive force*, abbreviated to E.M.F., and is the "push" that moves or tends to move electrons from one place to another, in other words causes electricity to flow.

Just in the same way that pressure in pounds or grammes is required to force water through a pipe, so an electro-motive force or "voltage" is necessary to make electricity move in a wire. The unit

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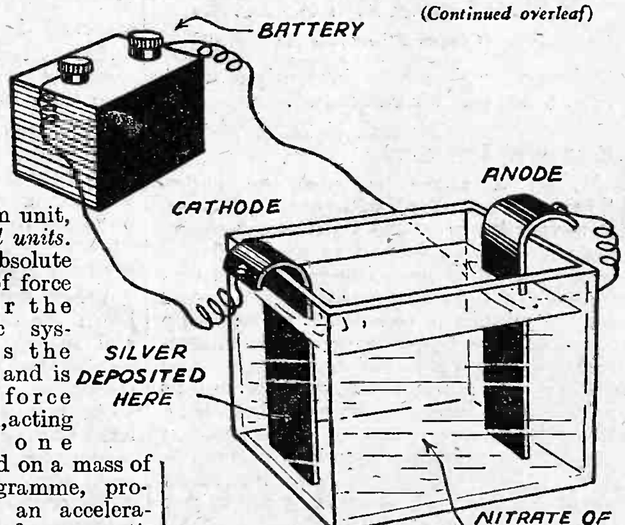

Fig. 3.—Diagram explaining the definition of the ampere.

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used is the *volt*. The volt is not so easy to define as a mechanical unit since we cannot give it directly in terms of time, length, and mass. One definition states that it is

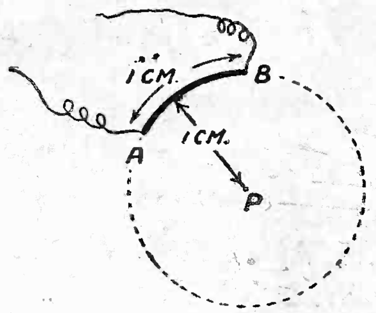


Fig. 4.—How the absolute unit of current is measured.

the electro-motive force or electrical pressure produced when a conductor is cut by magnetic lines of force at the rate of 100,000,000 per second. It is well known that when a wire or other conductor is moved about near the poles of a magnet that electricity is generated in it. Look at Fig. 2, for example. Suppose the conductor A B to be moved up and down through the magnetic field between the poles N and S, of a permanent magnet. Whenever it is moved it will cut through lines of force, and an electro-motive force will be set up in it so that current will flow. If as many as 100,000,000 lines of force are cut per second, then the pressure created will be one volt.

Definition of an Ampere

Let us now consider how current is measured. Current is the rate of flow of electricity. The practical unit is, of course, the *ampere*. It is the constant electrical current which, when passed through a neutral solution of silver nitrate, deposits on the negative pole or cathode .001118 grammes of silver in one second. The process employed for this measurement is the same kind as is used in electro-plating, namely electrolysis. An electric current is passed through a cell, shown diagrammatically in Fig. 3, consisting of two electrodes dipping in an electrolyte consisting of a solution of silver nitrate. The passage of the current causes silver to be deposited on the cathode, and it is the weight of silver deposited per second by which the amount of current flowing is measured.

As with mechanical units there is often more than one unit for the measurement of the same force or property, so it is with electrical units. For instance, there is the absolute unit of electric current and also the practical, the latter being the ampere which I have just defined. The absolute unit is equal to one tenth of an amp, and is that current which, flowing in a circuit, part of which is formed into a circular arc one centimetre long, and one centimetre radius, will act upon a unit magnetic pole at the centre of that arc with a force of 1 dyne. Fig. 4 shows what this means. A B is the conductor of the current. It is 1 centimetre long, and curved to form the arc of a circle 1 centimetre in radius. The centre of the circle P is the point where the magnetic field surrounding the wire, and due to the current through it, will act on a magnet of unit strength with a force of 1 dyne. Naturally this definition will not convey much unless we know what a "unit magnetic pole" is. This again is another absolute unit, and means a magnetic pole of such strength that if placed one centimetre from a similar pole, as in Fig. 5, would exert a force of repulsion of one dyne.

Resistance and the Ohm

Of equal importance with the volt and amp is the *ohm*—the practical unit of *resistance*. Resistance is the opposition a body offers to the passage of an electric current. It may also be described as the property of converting the energy of the swiftly moving electrons (which constitute an electric current) into heat. In this connection it is analogous to mechanical friction, which is the opposition encountered by all moving bodies, and which also manifests itself as heat.

The ohm is described as the resistance of a column of mercury 106.3 cms. long and 1 sq. mm. in cross section, and of a mass of 14.4521 grammes at a temperature of 0 degrees Centigrade. Again there is also an absolute or electro-magnetic unit based on unvarying factors. There is scarcely need to go into details as to how this unit was evolved, but I mention it, as I have done the other absolute units, to show that it is possible to define such an apparently evanescent thing as electricity in terms of such tangible factors as time, length and mass. In fact, electro-motive force (E.M.F.) current, resistance, and inductance, etc., can all be expressed in terms of T, L, and M, and from this the absolute units have been derived. As we have seen, they are not always of a convenient size for ordinary use, and this has led to the introduction of the practical units. In the case of resistance the practical unit, namely the ohm, is equal to 1,000,000,000 (one thousand million or 10^9) absolute units.

Power

Volts multiplied by amps gives *watts*. A watt is the electrical unit of *power*. Power is the rate of doing work. Perhaps this needs a little explanation. "Work" is here used in the restricted sense, not in the general. When a force overcomes a resistance and so moves something, work is said to be done; for instance, when a man lifts a pound weight one foot from the ground he does work. In such a case the work done would equal one *foot-pound*. If he raised it two feet he would do two foot-pounds of work. Of course time does not enter into the matter. However, if he does the work quickly, he uses more *power* than if he does it slowly. The English unit of a horse-power is equal to 550 foot-pounds of work performed in one second.

The electrical unit of power—the watt, is

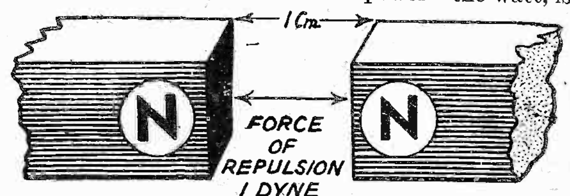


Fig. 5.—A unit magnetic pole is one which will repel a similar pole 1 centimetre away with a force of 1 dyne.

equal to $\frac{1}{746}$ horse-power and is the power developed when one volt produces a current flow of one coulomb per second (one ampere).

If an electric lamp takes a current of, say, $\frac{1}{4}$ amp at 240 volts, then the power used is 60 watts ($\frac{1}{4}$ x 240). Similarly a lamp taking $\frac{1}{2}$ amp at 120 volts also consumes 60 watts. From these two examples you will see that voltage or amperage alone is no indication of the power expended in a circuit. Power is dependent on both current *and* voltage.

RADIO-GRAM MOTORS

(*Continued from page 10*)

to drag on loud passages is greatly reduced, even if not entirely eliminated.

Keep Well Lubricated

When a motor is new the spring "barrels" are filled with a thick grease. It is very important to see that this grease does not get exhausted in any way and cause "sticking" or undue friction between the coils of the springs, as the force applied by the springs is sometimes momentarily arrested, thereby giving very erratic movement to the turntable and causing bad quality and reproduction. An important point should, perhaps, be mentioned here. If for the above reason, or any other, you are taking out the barrels holding the springs, be very careful indeed not to let the spring come out in any way unless you have experience with these springs. To those who have not had experience with motor springs, let me remind them that these springs are very powerful, and if they spring out suddenly are liable to do considerable damage.

In addition to this, of course, it would be extremely difficult to get them back again into the case.

The gears of the motor should be kept well oiled but not over-oiled. The friction pad of the governor should not be oiled if it is running smoothly, otherwise it will be anything but a friction pad and consequently will not carry out its proper operations in the motor.

When buying a spring motor, always listen for sounds such as gear humming and rattles very carefully indeed, as it should be remembered that when this motor is mounted on the motor-board these sounds are frequently very much louder owing to the motor-board becoming a kind of diaphragm and baffleboard. A good rough and ready test is to lay the motor on the shop counter when examining before purchasing. The motor should, of course, be going when this is done, and the counter will act in a similar way to the motor-board.

Hints on All Types of Motor

To conclude this article some general hints of use for all types of motors may be appreciated. The regulator indicating table should not be relied on too blindly, but should be tested in one of the following ways.

Chalk a mark on the edge of a record and play it, counting the times the chalk-mark passes a given spot over a minute, and, if incorrect, regulate until seventy-eight turns per minute is obtained. Make a note of where this comes on the indicator and set there in future. Another method of similar nature is to slip a small piece of white paper under the record so that it just shows and count the times this revolves in a similar way. There are many other methods of obtaining the speed, but two should be quite sufficient, and these two are very simple.

As a final note, may I remind you that you are far less likely to damage or break your springs if you keep the motor running when winding, as the motor does not have to take the sudden jerk when fully wound as it often does when the turntable is stopped.

CLASS B—AND YOUR SET

Some Useful Notes explaining How a Class B Stage can be Added to any Battery Receiver, and also How Optimum Results can be Obtained from it.

By FRANK PRESTON, F.R.A.

CLASS B amplification has formed the subject of several articles previously given in PRACTICAL WIRELESS, whilst a complete Class B amplifier and a number of receivers incorporating this wonderful system of amplification have been described in these pages. But despite these facts the numerous inquiries relating to Class B which we received at Olympia and which continue to pour in by post make it perfectly clear that there are many readers who would welcome some additional practical information on the subject. It is therefore proposed to deal in general terms with the methods of adding Class B, as well as with the choice of components for building an amplifier. Some information on how to obtain the best results from Class B will also be given. In short, an attempt will be made to cover, as briefly as possible, all the queries that are most frequently addressed to us.

Although Class B is now well established, there are not a few readers who find it hard to believe that it can give the tremendous volume of output which is claimed with such a modest consumption of H.T. current. As a matter of fact, the claims made—that the undistorted output of a battery set with "B" output is equal to that given by a mains set consuming considerably more power—are entirely borne out in practice and I have no hesitation in saying that the new system of amplification has come to stay and is well worth adopting by every battery set user.

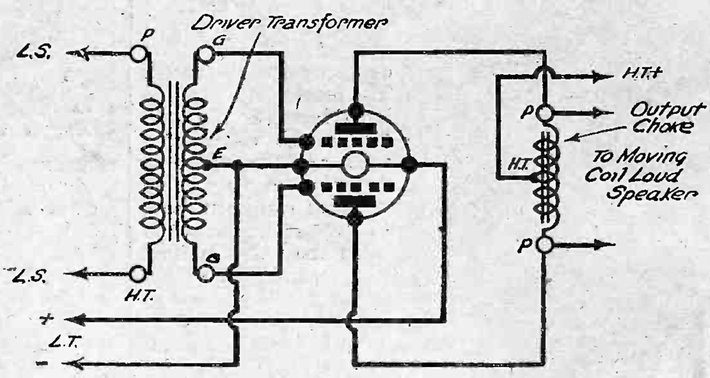


Fig. 1.—The circuit of a Class B amplifier suitable for use with any type of battery receiver having a single L.F. stage.

Adding a Class B Amplifier

Having decided to fit Class B, the constructor next wants to know the best way of doing it. This, of course, depends upon the design of the existing set and upon personal inclinations. If the set has a single low-frequency stage a Class B amplifier can be added without altering the set in any way, by simply connecting it to the loud-speaker terminals. The normal L.F. valve (generally of the small power type) then performs the duties of the "driver" which is necessary to feed the new output valve. When there are two L.F. stages, one of them should be removed because it will no longer be required; as a matter of fact, it could be kept, but it would serve no good purpose and would naturally add to the battery consumption. A pentode can be used as "driver," but an ordinary triode is better. The reason is that both pentodes and Class B valves tend to give emphasis to the higher musical notes, and thus when the two are combined there is some danger of making reproduction "screetchy."

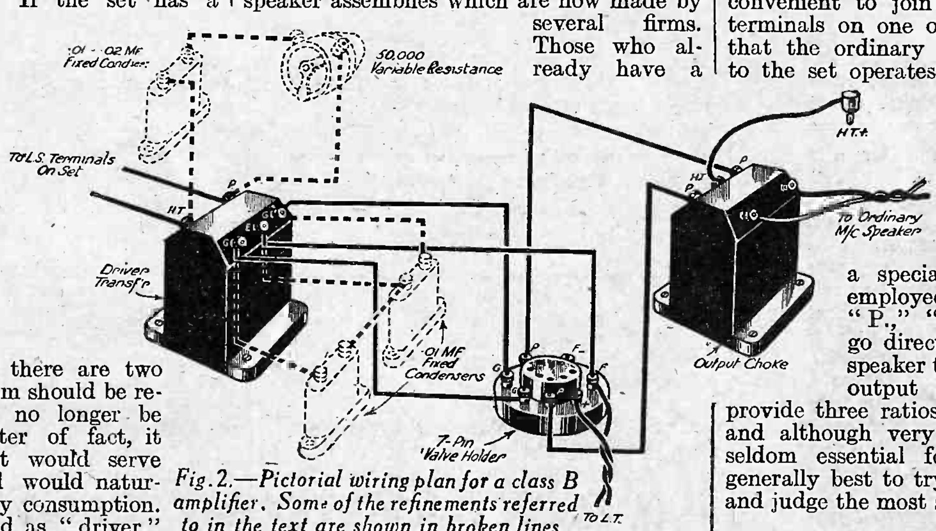


Fig. 2.—Pictorial wiring plan for a class B amplifier. Some of the refinements referred to in the text are shown in broken lines.

Choosing the Loud-Speaker

Complete Class B amplifiers, which may be connected direct to the set with a minimum of trouble, can be obtained, but most readers will prefer to make their own. Particulars relating to the construction of an amplifier will be given later. A loud-speaker of the balanced armature or moving iron type is useless with Class B since it is incapable of handling the full output, which is anything from ten to twenty times as great as that given by an ordinary power valve. For this reason those who contemplate changing over to Class B are recommended to buy a new moving-coil speaker already fitted with a special Class B transformer, or even to buy one of the amplifier-speaker assemblies which are now made by several firms. Those who already have a moving-coil speaker of normal type can use this on Class B by feeding it through a centre-tapped choke.

The Essential Components

Fig. 1 shows the circuit of a Class B amplifier suitable for connection to any single L.F. receiver, whilst the practical wiring connections are given in Fig. 2. It will be seen from these drawings that the only essential components are: one "driver" transformer, one seven-pin valve-holder and an output choke (unless a Class B speaker is used, in which case the choke is not required). A Class B valve is, of course, needed in addition, and it is mainly upon this that the choice of "driver" transformer ratio depends. In any case the ratio will be either 1 : 1 or 1.5 : 1, and as several transformers are available with tappings to provide either ratio, it is suggested that one of these should be used, and the better ratio found by trial. At the same time it will be helpful to know the correct ratio for different Class B valves used after a small power "driver"; they are as follow: For the Cossor 240B valve the ratio should be 1 : 1; for the Cossor 220B, Marconi or Osram B21 the ratio may be either 1 : 1 or 1.5 : 1; for the Mazda PD 220 and Mullard PM2B the optimum ratio is 1.5 : 1.

It is not anticipated that any reader would find any difficulty in constructing a Class B eliminator by following the connections shown in Fig. 2, but a few words of explanation might be of use. The two leads from the primary of the "driver" transformer marked "L.S." go to the speaker terminals on the existing set; the lead with wander plug marked "H.T.+" is taken to the socket on the H.T. battery giving maximum voltage; the two "L.T." leads can be joined directly to the accumulator, but in that case it would be necessary to disconnect one of them when the set was switched off, so it is much more convenient to join them to the filament terminals on one of the valve-holders so that the ordinary on-off switch attached to the set operates on the Class B valve also. An output choke (of special Class B type, having a low D.C. resistance) is shown, and is required when using an ordinary loud-speaker, but when a special Class B speaker is employed the three leads marked "P.," "H.T." and "P." will go direct to the corresponding speaker terminals. Most Class B output chokes are tapped to provide three ratios of from 1 : 1 to 3 : 1, and although very accurate matching is seldom essential for good results it is generally best to try the alternative ratios and judge the most suitable by ear.

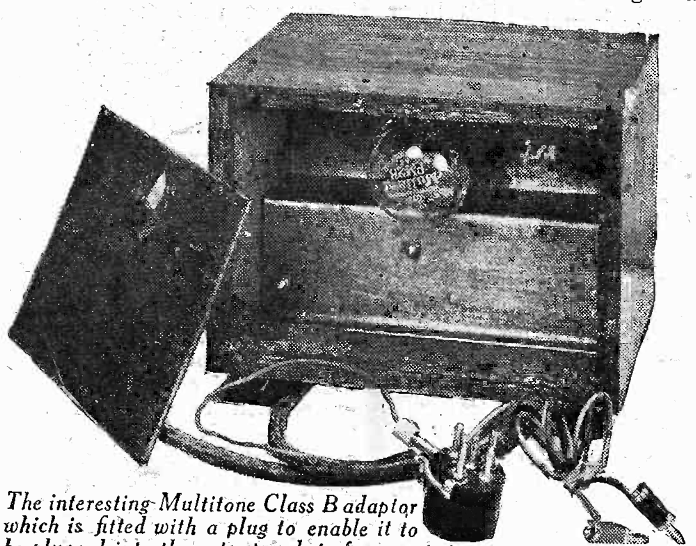
Curing Distortion

Actually, Class B amplification gives particularly good "quality," but for various reasons many users find the reproduction far from good. Distortion is generally traceable to a lack of sufficient decoupling of the detector valve or to the leakage of H.F. currents into the amplifying stages. The cure in the first instance is obvious, and a larger decoupling resistance will generally do the trick. When the second cause of trouble is suspected it can be checked by seeing if hand-capacity in the region of the Class B valve has any effect; if it has, a "stopper" resistance of about 100,000 ohms should be connected between the first L.F. transformer and the grid of the "driver" valve. Alternatively—or in really severe cases, additionally—a .01 mfd. condenser should be connected between each "Grid" terminal of the "driver" transformer and the centre tap, as shown in broken lines in Fig. 2. Very often the same result can be obtained by connecting a .005 mfd. condenser across each half of the output choke or transformer.

Tone Correction

It is by now well known that all Class B valves, like pentodes, tend to give too great a degree of amplification to the higher notes, with a result that reproduction is liable to sound rather "shrill." Because of this it is usual to fit some kind of tone control or tone compensating device. This consists of a variable resistance and fixed condenser connected in series, and may be inserted in the anode circuit of the "driver" valve or between the two anodes of the Class B valve. Although often used in practice, the latter position is not good from the point of view of economical working, which is, of course, one of the main features of Class B. The anode current consumption of a Class B valve is proportional to the signal voltages applied to its grids. It is therefore wasteful to allow the valve to amplify the high notes and then to "cut" them, but by suppressing these high frequencies prior to the output stage they do not pass to the grids of the Class B valve and thus do not "cost" anything in the way of high-tension current.

If a tone control transformer is used in the anode circuit of the detector valve this can be employed to reduce the high note response, but if not, the best position for the tone control components is between the primary terminals of the "driver" transformer, as shown in broken lines in Fig. 2. The variable resistance should have a maximum value of 50,000 ohms, whilst the condenser may have a value of between .01 and .02 mfd.

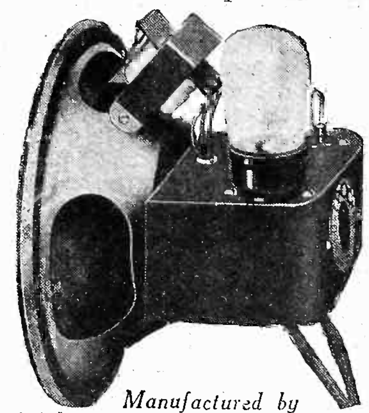


The interesting Multitone Class B adaptor which is fitted with a plug to enable it to be plugged into the output socket of any existing receiver.

The H.T. Supply

Even though Class B amplification is inherently economical there are two or three ways in which a still greater degree of economy can be secured. The most useful of these is to increase the grid bias on the valve being used as "driver"; in nearly every case the bias can be at least 1½ volts higher than when the valve is used as a normal L.F. amplifier. Another way, which is applicable when the maximum output of the Class B stage is not required, is to use a type L. or HL. valve as "driver." It need scarcely be mentioned that there are two general types of Class B valves, one of which gives an output of 2 watts, takes an average H.T. current of 9 milliamps and a filament current of .4 amp, whilst the other gives 1¼ watts output and requires H.T. and L.T. currents of approximately 6 milliamps and .2 amp respectively. The smaller valve is adequate for most purposes and the larger one is only actually required when the speaker is to be used out of doors or in a very large room.

Several readers who have H.T. eliminators ask if these can be used with a Class B set. If the eliminator is operated from D.C. mains it is almost invariably suitable, provided that it is a good quality instrument rated to give not less than 30 milliamps maximum. The reason for the latter proviso is that the "peak" anode current of a Class B valve often attains a figure of from 25 to 35 milliamps, even though the *average* consumption is less than 10 milliamps. With a cheap eliminator the resistance of the smoothing chokes is often fairly considerable, and in consequence the output voltage drops as the current drain is increased. When this happens distortion is immediately produced by the voltage fluctuation on the anodes of the detector and "driver" valves.



Manufactured by Epoch, this complete loud-speaker and Class B amplifying stage forms a valuable unit for adding to an existing low-powered receiver.

The same kind of ruling applies when an A.C. mains unit is employed, although there are now a number of units on the market specially designed for Class B work. An ordinary eliminator of the A.C. type, giving an output of not less than 25 milliamps at 180 volts, can nearly always be used with every satisfaction on a Class B outfit, by connecting a neon stabiliser of the kind specially produced by Messrs. Cossor between the positive and negative output terminals.

I would conclude these notes by emphasising that Class B is not only worth while but is indispensable to the battery user who requires a good volume of undistorted output in the most economical way. There are no "snags" or "catches" in the system and it is just as easy to deal with as is any ordinary low-frequency stage.

THE FOURTH DIMENSION

By GRID LEAK

WILL you join me for a minute or two in the realms of "Might Be," or, if you would rather have it so, "Phantasy"? I have just been listening to an argument on the fourth dimension in which several promising students in the medical world were taking part. One gentleman, who had been paying careful attention to the opinions expressed, got up from his chair with a look of disgust on his face, and before leaving bent down and whispered in my ear: "Crackers." Now I expect many of you will know that theories have been advanced as to the fourth dimension, and the most interesting and easily understood theory is that it is a plane superimposed upon the one on which we live, so that countries, towns, and their peoples may be intermingled with ours without our being able to detect them, we not being able to perceive this fourth dimension, as it has neither length, breadth, nor thickness. Suppose I give you a slight illustration. Take a sheet of very thin paper and hold it edgewise between you and the light; when you get it in the correct position it will almost disappear from your sight, as it has almost the minimum of length, breadth, and thickness. If you could take away from it these three dimensions it would disappear, becoming a fourth-dimensional object, and if you could add these three dimensions to a fourth-dimensional object it would become visible to you and be on the material plane. We know we live in a three-dimensional world and that every material thing must have length, breadth, and thickness; in other words, that all matter must have solidity. Our scientific friends tell us that there is another dimension, and they have sought through the ages for real proof of its existence. Theoretical proof is provided to the students of mathematics, and accepted as proof by the scientist, through algebraic formulæ. Now, if this theory is correct, and such a dimension does really exist, the argument suggested a new line of thought to me as to whether radio might prove the key to this fourth dimension, and may offer us at last the means of finding and proving its existence, together with the possibility of communicating with its inhabitants. What a new field it would make for the radio experimenter! What type of coils, condensers, and power valves would be required to bolster up the undiscovered signals which may be flashing through the ambient ether? It may be that much of the strange phenomena heard by experimenters have an equally strange source of excitation which even a most discriminating ear may pass over as a crash of static, when it is really an authentic signal of another kind.

LEARNING THE MORSE CODE—II

By "SHORT-WAVER"

(Concluded from page 938, September 16th issue.)

Sending and Receiving

BECAUSE it seems easier, many people try to learn to send before they can receive, but this is very undesirable, and the two should go hand in hand, with the receiving getting the most attention; the ordinary listener will do more receiving in any case, and if he graduates to a transmitter it is of no use to be able to send at high speeds and not be equally expert at reading the code, in addition to which a bad receiving operator is certain to be a bad sending operator. Once the code is completely memorized and words of two or three letters can be read, however slow the speed, it is best to drop the buzzer practice and concentrate on listening only. Search round on the receiver for someone sending quite slowly; the most likely place to find such transmissions is in one of the amateur bands of wavelengths, particularly that from 41.1 to 42.9 metres, but some of the commercial stations are slow enough for this work. Having found a suitable transmission try to copy as many letters as possible; as soon as a letter is recognised write it down and *forget it*, passing on to the next at once. When learning morse code one of the hardest things to avoid is trying to think what the letter was that you just missed, instead of forgetting it and going straight on to the next; while you are searching your mind for the missed letter you are losing the next five as well! It must be frankly confessed that this listening and trying to copy letters is the most disheartening part of the whole process because so little is received and so much seems to be sent, but it is very well worth persevering because it is undoubtedly far and away the best way of learning. As soon as it is found that most of the transmitted matter can be copied, a search should be made for a station sending faster, always aiming to copy a few words a minute more than your maximum. When the stage is reached of being able to read at about eight words a minute the commercials should be used in preference to amateur transmissions, partly because they send faster and for longer uninterrupted stretches, and partly because most of their transmissions are in code, which is much better practice than plain language because it is impossible to guess the end of a word after the first few letters are copied! This is a point to be remembered when getting someone to give you buzzer practice; the best plan is for the sending operator to take as material for his transmissions a passage from a book or magazine and send it backwards, *i.e.*, from the end of the sentence to the beginning, so that the receiving operator cannot guess what is coming next.

Logging Call Signs

Once a speed of about eight words a minute has been attained a great deal of fun can be had on the amateur bands in logging call signs, while at the same time the operating ability will be improved. It will perhaps be as well, therefore, to give some idea of the type of transmissions that are likely to be heard. One of the first things to be noticed will be the great number of times the group CQ is heard, usually repeated three or four times in succession and sometimes more often. CQ is sent out by a station wishing to get into touch with any other station; it may be translated as meaning "will anyone who hears this please call me," and is sent three times followed once by DE (meaning from), and then by the call sign of the transmitting station repeated three or four times. At least, that is the correct procedure; unfortunately a regrettably large number of stations abuse the signal by sending CQ far too many times and signing their call far too little. The use of CQ, though permitted to all other countries, is forbidden to amateurs in this country and so they use the group TEST implying a desire to conduct some tests with the other station. After either of these groups comes the DE, and then the call sign of the sending station, which consists of one, two or three letters (which give the nationality) followed as a rule by a single figure and one, two or three more letters. Examples are:—

X9A—Mexican
G5EE—British
OZ7MI—Danish
HAF5H—Hungarian
W6GAT—American

When answering a CQ call the calling station sends the call sign of the CQ'ing station several times, followed by DE and his own call, repeated. Owing to the repetitions these transmissions are most likely to be picked up by the novice and quite a large bag of stations can soon be recorded, many of which may be a very great distance off, although DX is more likely to come when the listener is sufficiently familiar with the code to be able to read the call signs of very weak stations. The text of amateur transmissions, when contact has been established, is very largely interlarded with abbreviations, some merely compressions of ordinary words and some the Q signals, groups of three letters beginning with Q which were laid down in the International Radiotelegraph Convention, for the speeding up of ordinary ship to shore traffic, and which have been adopted, with occasional modifications of the literal translation, by amateurs for their own use. There is no room to give them here, but they are obtainable in several publications, notably the "Handbook for Wireless Telegraph Operators" published by His Majesty's Stationery Office at ninepence.

An Audio Frequency Oscillator

Another, somewhat aristocratic, method of providing morse signals for practice is the use of an audio frequency oscillator. This is simply a valve oscillator working at an audible frequency, and an excellent one can be rigged up with a low-frequency transformer in the circuit given last week, which it will be seen is simply an ordinary reaction circuit with the windings of an L.F. transformer in place of the usual coils and with the grid condenser and leak omitted. Such an oscillator will give a pure whistle whose pitch depends on the inductance of the transformer winding and the capacity across it, the addition of more capacity lowering the pitch. The strength of the oscillations depends chiefly on the H.T. voltage, sixty volts or so providing enough volume to work a loud-speaker, while reducing H.T. to the minimum required to maintain oscillations will permit headphones to be used and practice to be carried out without interfering with other people in the same room. If the short-wave receiver is provided with plug-in coils it can easily be converted for use as an audio oscillator without any permanent change by fitting an L.F. transformer with leads going to a plug mounting similar to that used for the ordinary coils, except that if the usual Reinartz control of reaction is used a separate lead will have to be brought out for the headphones and H.T. positive connection, the usual detector H.T. plus wander plug being removed; it is also necessary to short the grid condenser by means of a short piece of wire and two crocodile clips. Fig. 3 shows the arrangement; if no oscillations are obtained the leads to one of the transformer windings must be reversed. The advantage of using an audio oscillator is that it gives a note similar to the beat note of a C.W. station.

The code given in last week's issue is that usually referred to as the morse code, but it is more correctly the Continental morse code, morse code proper being used only in America on line telegraph circuits. In addition to the English alphabet there are

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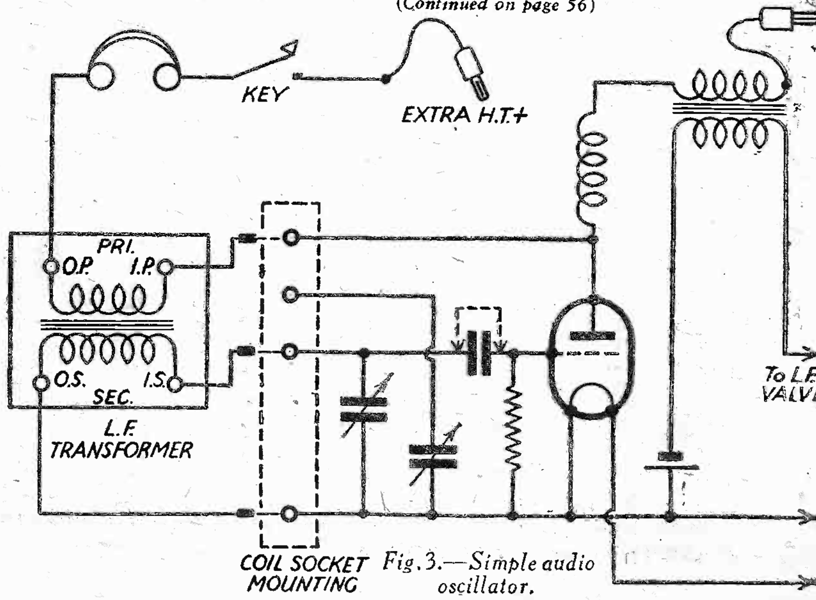
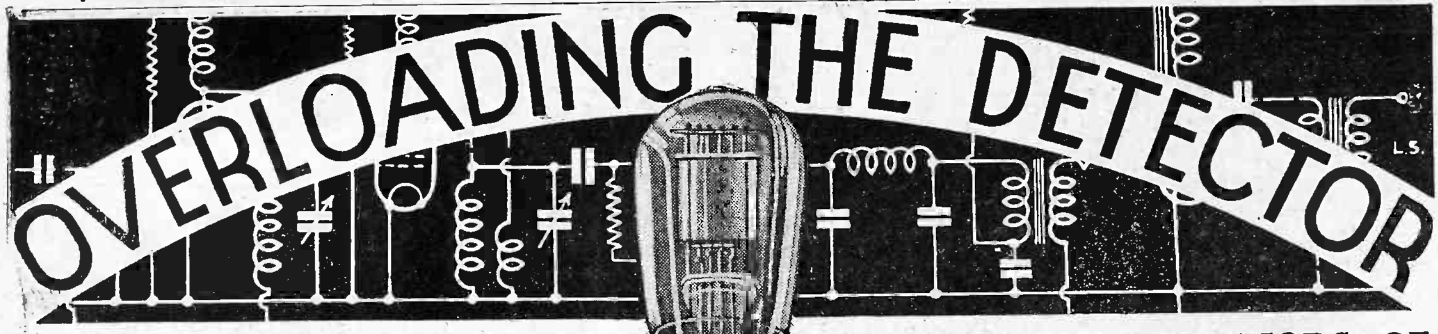


Fig. 3.—Simple audio oscillator.



OVERLOADING THE DETECTOR

A PRACTICAL ARTICLE DEALING WITH VARIOUS METHODS OF AVOIDING THE TROUBLE.

By ERIC JOHNSON

UNTIL the advent of the regional scheme the question of overloading of the detector valve rarely arose. Unless the listener actually lived under the aerial of the broadcasting station, so to speak, he was unlikely to experience this trouble. Nowadays, however, with super-power stations springing up all around us, this fault is becoming increasingly common. The popularity of one or more screened grid stages has also contributed in no small degree to this annoyance by reason of the very high stage gain.

Detector overloading manifests itself as a rather peculiar form of distortion which is somewhat dissimilar to overloading of the L.F. stages. To the inexperienced ear there is little difference—in both cases harshness and blasting are prominent; over-accentuation of sibilants, however, which are produced with a curious rasping sound, may be taken as a likely indication of detector overloading. A cure may be effected in a number of ways. Let us examine these in detail.

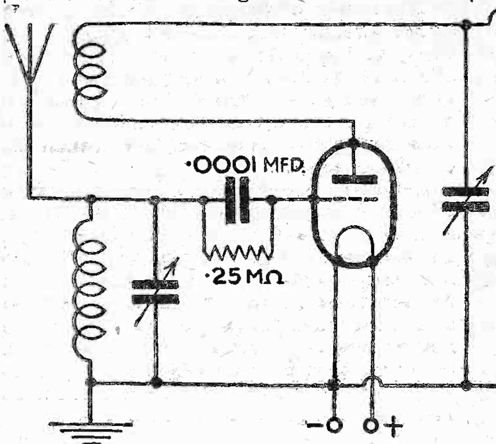


Fig. 1.—The circuit of a power grid detector.

Converting to Power Grid Detection

The most obvious method of curing the trouble is, of course, to reduce the pick up of the aerial by shortening it; whilst being most effective, it must be remembered that with a simple set the reaching out capabilities depend almost solely on a good aerial system, so unless we are prepared to sacrifice our distant stations we must look around for other cures. If our receiver is a battery model, most probably rectification will be on the "leaky-grid" system which will only deal with a limited input. It is quite a simple matter, however, to convert to the "power grid" principle, which actually shows at its best with a large input such as one is accustomed to get nowadays from the local station. From an examination of Fig. 1 it will be seen that the conversion is very simple, and is largely a matter of change of component values rather than any actual wiring alterations. It should be noted, however, that the grid return lead goes to L.T. negative, *i.e.*, it is at zero potential, and not biased positively as with leaky-grid detection. The only other adjustment necessary is an increase of H.T. to anything from 100–150 volts, dependent upon the valve used and the input. (Experts differ on this point.—ED.).

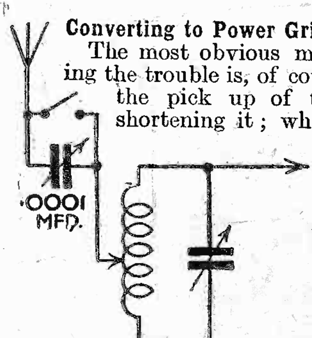


Fig 2.—The simplest form of reducing volume.

Even with this alteration, if we are so unfortunate as to live in the shadow of the station, or our detector is preceded by one or more efficient H.F. stages, overloading may still occur. As mentioned above, we do not want to restrict the range of our set by reducing aerial size; the only alternative, therefore, is to fit some form of pre-detector volume control of which there are several methods. Of course, the fitting of variable-mu S.G. stages goes a long way to solving our problem, but does not in any way assist the man with the still popular detector plus L.F. set. The cheapest remedy of all is doubtlessly obtained by connecting a small condenser in the lead-in as shown in Fig. 2; for the best results this may have a very small value, and should certainly not exceed .0001 mfd., provision being made for shorting the condenser when necessary. The great disadvantage of this system is the upsetting

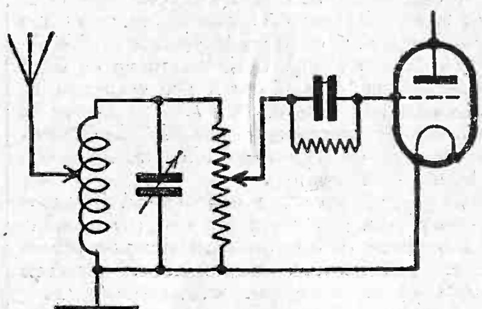


Fig. 3.—A form of volume control which does not affect tuning.

of calibration should our tuned circuit be a simple one as depicted, which is still quite common even in these days of ether congestion.

An arrangement which does not suffer from this drawback is given in Fig. 3. Here a high resistance potentiometer is pressed into service, and the input may thus be reduced at will from zero to the maximum. A rather serious snag is the unavoidable damping introduced and the resistance of the potentiometer must in consequence be high—certainly not less than 10,000 ohms. A variation of this scheme is depicted in Fig. 4, but as this involves a constant changing of aerial capacity across the coil, calibration will be seriously affected. A method very much akin to the foregoing, and one which is superior in many respects, is offered us by the capacity potentiometer system shown in Fig. 5. The only additional component needed is a differential condenser. One set of fixed plates is connected to the "top" end of the grid coil, and the other set goes to earth, the aerial being con-

(Continued on page 36)

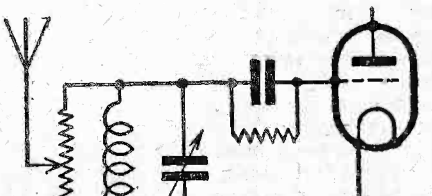


Fig. 4.—A volume control in the form of a potentiometer, which may prove noisy if a good component is not used.

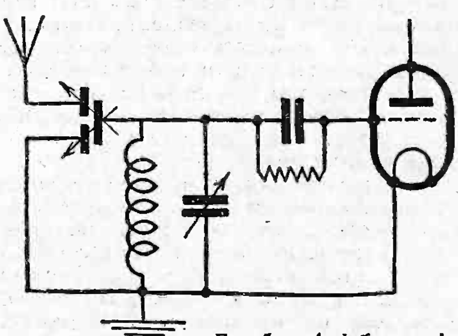
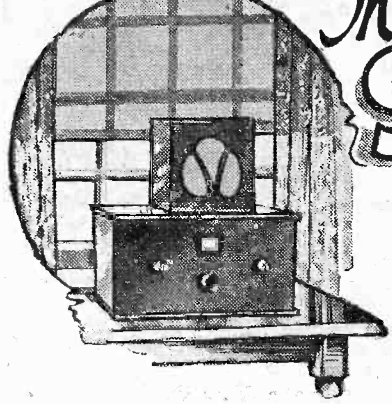


Fig. 5.—A differential reaction condenser used to reduce the input.

The SUN & WIRELESS SIGNALS



How the Changes in the Ionization of the Heaviside and Appleton Layers Affect Radio Waves

By K. E. BRIAN JAY

IN my last article, "How we hear DX," I outlined the way in which the Kennelly-Heaviside and Appleton ionized layers do their job so that my readers should be clear as to the importance of the ionization of these layers. Let me summarize the chief points in that article :—

(a) Radio waves radiated upwards from the surface of the earth are returned to the earth by one of two ionized layers in the upper atmosphere, called the Heaviside layer (60 miles up) and the Appleton layer (160 miles up).

(b) The waves are bent round in these layers by a refractive process, the amount of bending increasing with the number of free electrons per cubic centimetre (electron density) and decreasing with wavelength.

(c) The waves affected are called the indirect waves, and in conjunction with the direct or ground wave give rise to skip distance effects.

(d) The range of indirect waves depends on the height of the layer.

(e) The indirect wave is attenuated in the layer, the attenuation increasing with electron density and decreasing with wavelength.

The important fact that emerges from this summary is that all the processes undergone by the indirect waves depend on the degree of ionization of the layers. It is the ionization that matters, and therefore it is the changes in the ionization that cause most of the queer effects to which radio signals are prone. Clearly, then, we must look to the ionizing agent for an explanation of these effects.

The Causes of Ionization

In defining ionization I said that a gas molecule becomes ionized when some external agency supplies enough energy to detach an electron from it. In the case of the ionized layers of the atmosphere the source of this energy is the sun, the energy being actually supplied by radiation from the sun. The most obvious of the sun's radiations are, of course, light and heat, but in addition there are the invaluable ultra-violet radiations whose therapeutic properties have been so widely recognised of late years, and it is to these very short wavelength rays that the bulk of the ionization of the reflecting layers is attributed. The invisible ultra-violet rays possess immense energy which easily splits up the gas molecules into ions and electrons. In the case of the lower Heaviside layer there is reason to believe that some of the ionization may arise from another ionizing agent in the form of a stream of corpuscles, actual concrete bodies, shot out by the sun. These corpuscles travel at the relatively slow rate of about 1,000 miles per second and possess enough energy when they impinge on the atmosphere to split up the gas molecules and ionize them ; definite proof of the existence of this corpuscular stream, however, has not yet been obtained. In any case there is no doubt that the sun's radiations are responsible for the existence of our exceedingly useful layers and therefore we should be able to find some connexion between variations in the sun's behaviour and radio conditions.

Day and Night Effects

The most obvious solar variation is between daytime and night and the corresponding, almost equally obvious, radio variation is in the considerable improvement in signal strength and long and medium waves and the equally marked falling away in signals on waves below about 20 metres, when night time comes on. This may be explained as follows. In full daylight the amount of ultra-violet radiation from the sun is a maximum and therefore the ionization of the layers is very high. The height of the lower surface of the Heaviside layer from the ground depends on the pressure of the atmospheric gas in that region, because the greater the gas pressure the more quickly free ions and electrons will combine with other electrons and ions, so leaving an un-ionized region : below about sixty miles the pressure is so great that ions recombine almost as quickly as the ionizing agent disintegrates the molecules and so there is practically no ionization. It is fairly clear, however, that with a continual stream of ultra-violet radiation there will be a continual supply of ions and electrons and so in spite of the recombination ionization can exist at a fairly low level. As soon as the ultra-violet stream is interrupted no more ions will be supplied and, recombination taking place, the level of the layer will rise. That is what happens at night time ; the stream of electron-producing energy is turned off and ions and electrons recombine to form un-ionized gas molecules, the rate of recombination being greatest nearest the surface of the earth and fairly small in the low-pressure regions of the top of the layer and the upper layer. This results in the bottom of the layer rising so that its effective height increases and thus the range of medium waves increases. Also since the electron density is reduced when the sun disappears the attenuation of the waves is decreased, another reason for medium wave signals being louder. The case of short waves is rather different. Medium-short waves give increased signal strength because the reduced electron density in the Heaviside layer results in less attenuation as the waves pass through it on their way to the Appleton layer. Short waves below 25 to 30 metres, however, find the number of free electrons in the upper layer (Appleton layer) insufficient to bend them round so that they are not returned to earth and therefore not heard at all. In the daytime they are stronger than medium-short waves because although both are returned to earth the short waves are much less attenuated than the medium-short waves.

The height of the Heaviside layer rises about twelve miles during the night, but drops very quickly to its lower value when the sun appears again. Actually the layer is affected by the sun before the latter is visible on the earth (*i.e.*, before sunrise) because the layer is nearer the sun than the earth's surface is.

The above explanation of day and night effects serves also for the difference between summer and winter reception conditions. In summer, of course, the ionization is always much greater and the nights much shorter than in winter, so that medium and medium-short wave conditions are not so good. Below 25 metres, however, many stations may be heard and daylight conditions may last up to 1 a.m. as far as 20-metre signals are concerned.

Varying Radio Conditions

The next major variation is by no means so obvious, but is noticeable to listeners who have used their sets regularly for a long time and have found that some years produce a better bag of DX stations than others. It has, in fact, been found that general conditions for radio reception vary from year to year, but that the variation is repeated every eleven years. That is to say, that if general conditions were

(To be concluded next week.—Ed.)

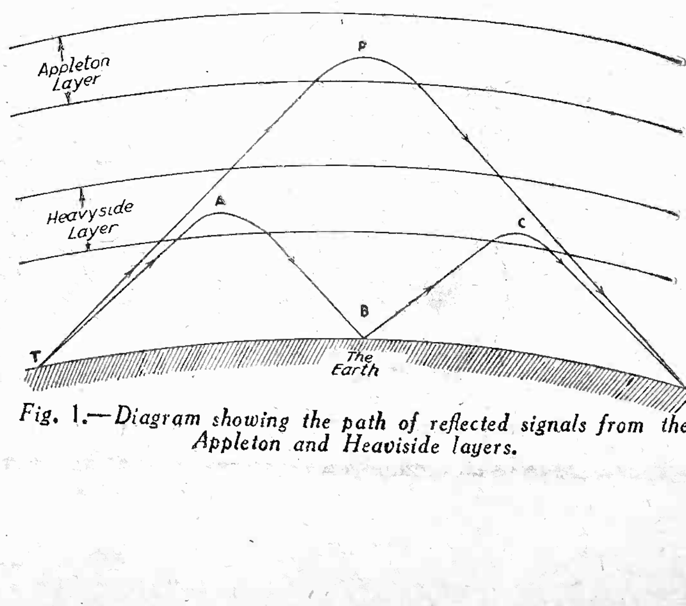


Fig. 1.—Diagram showing the path of reflected signals from the Appleton and Heaviside layers.

Wherever wireless terms are understood "Ohmite" means "The Best Resistance"

"Better than wire wound."

OHMITE RESISTANCES

The most popular and efficient type of fixed resistance for all general purposes. "Better than wire wound." All values, 50 ohms to 5 megohms.

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HEAVY DUTY TYPE 2/3

Safe maximum current carrying capacity of "Ohmites."

100° F Temperature Rise

Ohms.	Milliamps.	Ohms.	Milliamps.
1,000	40	20,000	8
2,000	35	30,000	6·75
3,000	29	40,000	6
4,000	24	50,000	5·5
5,000	20·25	60,000	5
10,000	12	80,000	4·24
Other values pro rata		100,000	3·5

Safe maximum current carrying capacity of "Ohmites" Heavy Duty Type.

100° F Temperature Rise

Ohms.	Milliamps.	Ohms.	Milliamps.
1,000	80	20,000	16
2,000	70	30,000	13·5
3,000	58	40,000	12
4,000	48	50,000	11
5,000	40·5	60,000	10
10,000	24	80,000	8·48
Other values pro rata.		100,000	7

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LEARNING THE MORSE CODE—II

By "SHORT-WAVER"

(Concluded from page 938, September 16th issue.)

Sending and Receiving

BECAUSE it seems easier, many people try to learn to send before they can receive, but this is very undesirable, and the two should go hand in hand, with the receiving getting the most attention; the ordinary listener will do more receiving in any case, and if he graduates to a transmitter it is of no use to be able to send at high speeds and not be equally expert at reading the code, in addition to which a bad receiving operator is certain to be a bad sending operator. Once the code is completely memorized and words of two or three letters can be read, however slow the speed, it is best to drop the buzzer practice and concentrate on listening only. Search round on the receiver for someone sending quite slowly; the most likely place to find such transmissions is in one of the amateur bands of wavelengths, particularly that from 41.1 to 42.9 metres, but some of the commercial stations are slow enough for this work. Having found a suitable transmission try to copy as many letters as possible; as soon as a letter is recognised write it down and *forget it*, passing on to the next at once. When learning morse code one of the hardest things to avoid is trying to think what the letter was that you just missed, instead of forgetting it and going straight on to the next; while you are searching your mind for the missed letter you are losing the next five as well! It must be frankly confessed that this listening and trying to copy letters is the most disheartening part of the whole process because so little is received and so much seems to be sent, but it is very well worth persevering because it is undoubtedly far and away the best way of learning. As soon as it is found that most of the transmitted matter can be copied, a search should be made for a station sending faster, always aiming to copy a few words a minute more than your maximum. When the stage is reached of being able to read at about eight words a minute the commercials should be used in preference to amateur transmissions, partly because they send faster and for longer uninterrupted stretches, and partly because most of their transmissions are in code, which is much better practice than plain language because it is impossible to guess the end of a word after the first few letters are copied! This is a point to be remembered when getting someone to give you buzzer practice; the best plan is for the sending operator to take as material for his transmissions a passage from a book or magazine and send it backwards, *i.e.*, from the end of the sentence to the beginning, so that the receiving operator cannot guess what is coming next.

Logging Call Signs

Once a speed of about eight words a minute has been attained a great deal of fun can be had on the amateur bands in logging call signs, while at the same time the operating ability will be improved. It will perhaps be as well, therefore, to give some idea of the type of transmissions that are likely to be heard. One of the first things to be noticed will be the great number of times the group CQ is heard, usually repeated three or four times in succession and sometimes more often. CQ is sent out by a station wishing to get into touch with any other station; it may be translated as meaning "will anyone who hears this please call me," and is sent three times followed once by DE (meaning from), and then by the call sign of the transmitting station repeated three or four times. At least, that is the correct procedure; unfortunately a regrettably large number of stations abuse the signal by sending CQ far too many times and signing their call far too little. The use of CQ, though permitted to all other countries, is forbidden to amateurs in this country and so they use the group TEST implying a desire to conduct some tests with the other station. After either of these groups comes the DE, and then the call sign of the sending station, which consists of one, two or three letters (which give the nationality) followed as a rule by a single figure and one, two or three more letters. Examples are:—

X9A—Mexican
G5EE—British
OZ7MI—Danish
HAF5H—Hungarian
W6GAT—American

When answering a CQ call the calling station sends the call sign of the CQ'ing station several times, followed by DE and his own call, repeated. Owing to the repetitions these transmissions are most likely to be picked up by the novice and quite a large bag of stations can soon be recorded, many of which may be a very great distance off, although DX is more likely to come when the listener is sufficiently familiar with the code to be able to read the call signs of very weak stations. The text of amateur transmissions, when contact has been established, is very largely interlarded with abbreviations, some merely compressions of ordinary words and some the Q signals, groups of three letters beginning with Q which were laid down in the International Radiotelegraph Convention, for the speeding up of ordinary ship to shore traffic, and which have been adopted, with occasional modifications of the literal translation, by amateurs for their own use. There is no room to give them here, but they are obtainable in several publications, notably the "Handbook for Wireless Telegraph Operators" published by His Majesty's Stationery Office at ninepence.

An Audio Frequency Oscillator

Another, somewhat aristocratic, method of providing morse signals for practice is the use of an audio frequency oscillator. This is simply a valve oscillator working at an audible frequency, and an excellent one can be rigged up with a low-frequency transformer in the circuit given last week, which it will be seen is simply an ordinary reaction circuit with the windings of an L.F. transformer in place of the usual coils and with the grid condenser and leak omitted. Such an oscillator will give a pure whistle whose pitch depends on the inductance of the transformer winding and the capacity across it, the addition of more capacity lowering the pitch. The strength of the oscillations depends chiefly on the H.T. voltage, sixty volts or so providing enough volume to work a loud-speaker, while reducing H.T. to the minimum required to maintain oscillations will permit headphones to be used and practice to be carried out without interfering with other people in the same room. If the short-wave receiver is provided with plug-in coils it can easily be converted for use as an audio oscillator without any permanent change by fitting an L.F. transformer with leads going to a plug mounting similar to that used for the ordinary coils, except that if the usual Reinartz control of reaction is used a separate lead will have to be brought out for the headphones and H.T. positive connection, the usual detector H.T. plus wander plug being removed; it is also necessary to short the grid condenser by means of a short piece of wire and two crocodile clips. Fig. 3 shows the arrangement; if no oscillations are obtained the leads to one of the transformer windings must be reversed. The advantage of using an audio oscillator is that it gives a note similar to the beat note of a C.W. station.

The code given in last week's issue is that usually referred to as the morse code, but it is more correctly the Continental morse code, morse code proper being used only in America on line telegraph circuits. In addition to the English alphabet there are

(Continued on page 56)

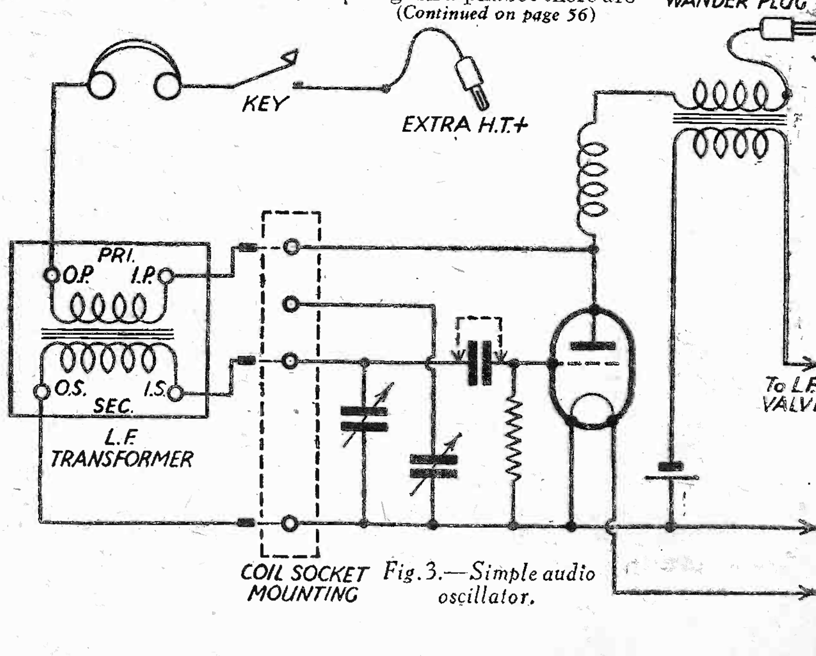
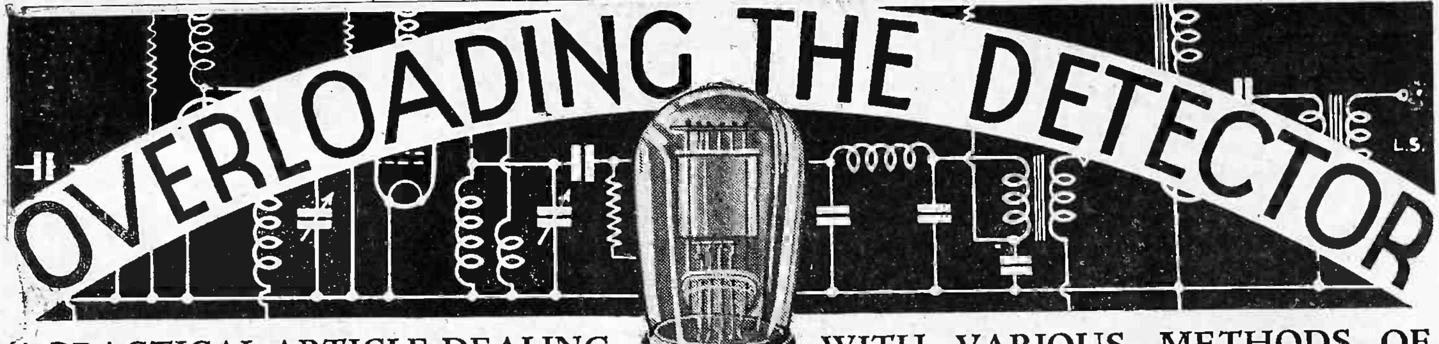


Fig. 3.—Simple audio oscillator.



OVERLOADING THE DETECTOR

A PRACTICAL ARTICLE DEALING WITH VARIOUS METHODS OF AVOIDING THE TROUBLE.

By ERIC JOHNSON

UNTIL the advent of the regional scheme the question of overloading of the detector valve rarely arose. Unless the listener actually lived under the aerial of the broadcasting station, so to speak, he was unlikely to experience this trouble. Nowadays, however, with super-power stations springing up all around us, this fault is becoming increasingly common. The popularity of one or more screened grid stages has also contributed in no small degree to this annoyance by reason of the very high stage gain.

Detector overloading manifests itself as a rather peculiar form of distortion which is somewhat dissimilar to overloading of the L.F. stages. To the inexperienced ear there is little difference—in both cases harshness and blasting are prominent; over-accentuation of sibilants, however, which are produced with a curious rasping sound, may be taken as a likely indication of detector overloading. A cure may be effected in a number of ways. Let us examine these in detail.

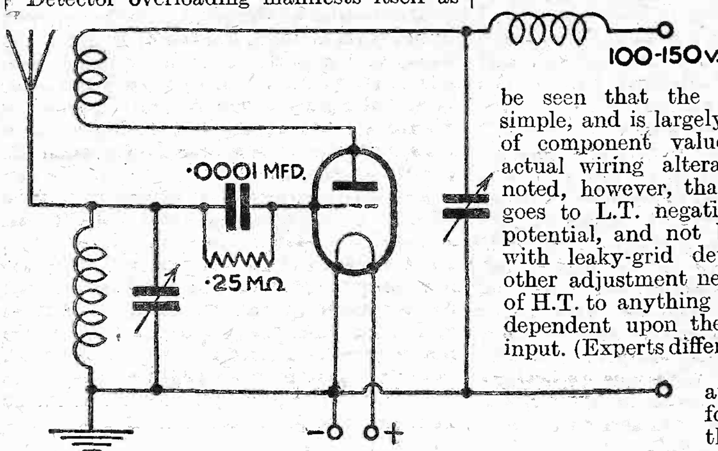


Fig. 1.—The circuit of a power grid detector.

Converting to Power Grid Detection

The most obvious method of curing the trouble is, of course, to reduce the pick up of the aerial by shortening it; whilst being most effective, it must be remembered that with a simple set the reaching out capabilities depend almost solely on a good aerial system, so unless we are prepared to sacrifice our distant stations we must look around for other cures. If our receiver is a battery model, most probably rectification will be on the "leaky-grid" system which will only deal with a limited input. It is quite a simple matter, however, to convert to the "power grid" principle, which actually shows at its best with a large input such as one is accustomed to get nowadays from the local station. From an examination of Fig. 1 it will be seen that the conversion is very simple, and is largely a matter of change of component values rather than any actual wiring alterations. It should be noted, however, that the grid return lead goes to L.T. negative, *i.e.*, it is at zero potential, and not biased positively as with leaky-grid detection. The only other adjustment necessary is an increase of H.T. to anything from 100-150 volts, dependent upon the valve used and the input. (Experts differ on this point.—Ed.).

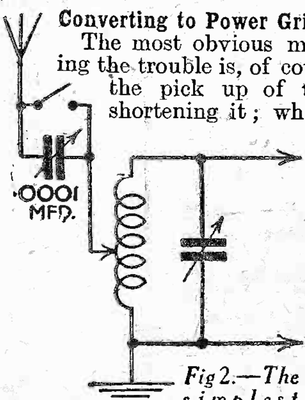


Fig 2.—The simplest form of reducing volume.

Even with this alteration, if we are so unfortunate as to live in the shadow of the station, or our detector is preceded by one or more efficient H.F. stages, overloading may still occur. As mentioned above, we do not want to restrict the range of our set by reducing aerial size; the only alternative, therefore, is to fit some form of pre-detector volume control of which there are several methods. Of course, the fitting of variable-mu S.G. stages goes a long way to solving our problem, but does not in any way assist the man with the still popular detector plus L.F. set. The cheapest remedy of all is doubtlessly obtained by connecting a small condenser in the lead-in as shown in Fig. 2; for the best results this may have a very small value, and should certainly not exceed .0001 mfd., provision being made for shorting the condenser when necessary. The great disadvantage of this system is the upsetting of calibration should our tuned circuit be a simple one as depicted, which is still quite common even in these days of ether congestion.

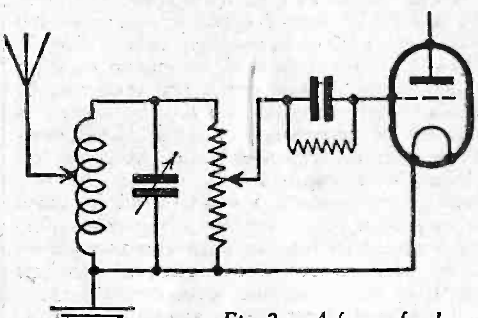


Fig. 3.—A form of volume control which does not affect tuning.

An arrangement which does not suffer from this drawback is given in Fig. 3. Here a high resistance potentiometer is pressed into service, and the input may thus be reduced at will from zero to the maximum. A rather serious snag is the unavoidable damping introduced and the resistance of the potentiometer must in consequence be high—certainly not less than 10,000 ohms. A variation of this scheme is depicted in Fig. 4, but as this involves a constant changing of aerial capacity across the coil, calibration will be seriously affected. A method very much akin to the foregoing, and one which is superior in many respects, is offered us by the capacity potentiometer system shown in Fig. 5. The only additional component needed is a differential condenser. One set of fixed plates is connected to the "top" end of the grid coil, and the other set goes to earth, the aerial being con-

(Continued on page 36)

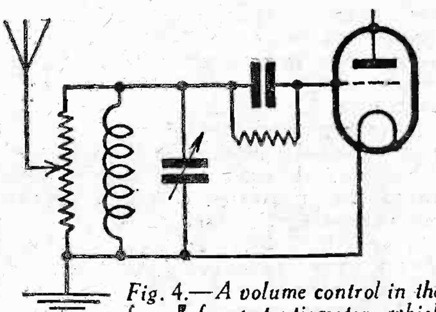


Fig. 4.—A volume control in the form of a potentiometer, which may prove noisy if a good component is not used.

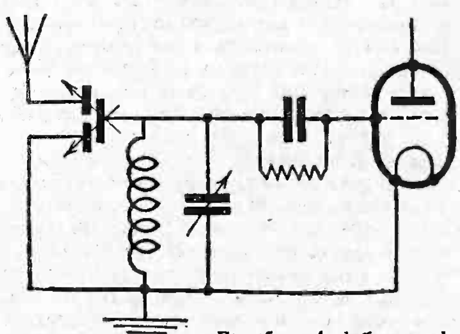
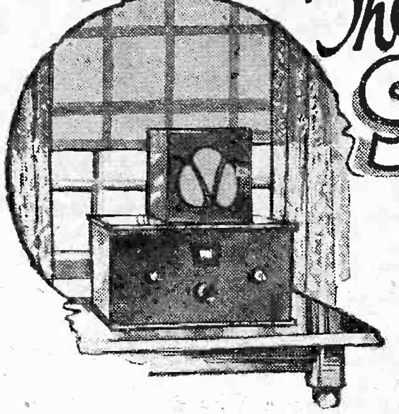


Fig. 5.—A differential reaction condenser used to reduce the input.



The SUN & WIRELESS SIGNALS

How the Changes in the Ionization of the Heaviside and Appleton Layers Affect Radio Waves

By K. E. BRIAN JAY

IN my last article, "How we hear DX," I outlined the way in which the Kennelly-Heaviside and Appleton ionized layers do their job so that my readers should be clear as to the importance of the ionization of these layers. Let me summarize the chief points in that article :—

(*a*) Radio waves radiated upwards from the surface of the earth are returned to the earth by one of two ionized layers in the upper atmosphere, called the Heaviside layer (60 miles up) and the Appleton layer (160 miles up).

(*b*) The waves are bent round in these layers by a refractive process, the amount of bending increasing with the number of free electrons per cubic centimetre (electron density) and decreasing with wavelength.

(*c*) The waves affected are called the indirect waves, and in conjunction with the direct or ground wave give rise to skip distance effects.

(*d*) The range of indirect waves depends on the height of the layer.

(*e*) The indirect wave is attenuated in the layer, the attenuation increasing with electron density and decreasing with wavelength.

The important fact that emerges from this summary is that all the processes undergone by the indirect waves depend on the degree of ionization of the layers. It is the ionization that matters, and therefore it is the changes in the ionization that cause most of the queer effects to which radio signals are prone. Clearly, then, we must look to the ionizing agent for an explanation of these effects.

The Causes of Ionization

In defining ionization I said that a gas molecule becomes ionized when some external agency supplies enough energy to detach an electron from it. In the case of the ionized layers of the atmosphere the source of this energy is the sun, the energy being actually supplied by radiation from the sun. The most obvious of the sun's radiations are, of course, light and heat, but in addition there are the invaluable ultra-violet radiations whose therapeutic properties have been so widely recognised of late years, and it is to these very short wavelength rays that the bulk of the ionization of the reflecting layers is attributed. The invisible ultra-violet rays possess immense energy which easily splits up the gas molecules into ions and electrons. In the case of the lower Heaviside layer there is reason to believe that some of the ionization may arise from another ionizing agent in the form of a stream of corpuscles, actual concrete bodies, shot out by the sun. These corpuscles travel at the relatively slow rate of about 1,000 miles per second and possess enough energy when they impinge on the atmosphere to split up the gas molecules and ionize them ; definite proof of the existence of this corpuscular stream, however, has not yet been obtained. In any case there is no doubt that the sun's radiations are responsible for the existence of our exceedingly useful layers and therefore we should be able to find some connexion between variations in the sun's behaviour and radio conditions.

Day and Night Effects

The most obvious solar variation is between daytime and night and the corresponding, almost equally obvious, radio variation is in the considerable improvement in signal strength and long and medium waves and the equally marked falling away in signals on waves below about 20 metres, when night time comes on. This may be explained as follows. In full daylight the amount of ultra-violet radiation from the sun is a maximum and therefore the ionization of the layers is very high. The height of the lower surface of the Heaviside layer from the ground depends on the pressure of the atmospheric gas in that region, because the greater the gas pressure the more quickly free ions and electrons will combine with other electrons and ions, so leaving an un-ionized region : below about sixty miles the pressure is so great that ions recombine almost as quickly as the ionizing agent disintegrates the molecules and so there is practically no ionization. It is fairly clear, however, that with a continual stream of ultra-violet radiation there will be a continual supply of ions and electrons and so in spite of the recombination ionization can exist at a fairly low level. As soon as the ultra-violet stream is interrupted no more ions will be supplied and, recombination taking place, the level of the layer will rise. That is what happens at night time ; the stream of electron-producing energy is turned off and ions and electrons recombine to form un-ionized gas molecules, the rate of recombination being greatest nearest the surface of the earth and fairly small in the low-pressure regions of the top of the layer and the upper layer. This results in the bottom of the layer rising so that its effective height increases and thus the range of medium waves increases. Also since the electron density is reduced when the sun disappears the attenuation of the waves is decreased, another reason for medium wave signals being louder. The case of short waves is rather different. Medium-short waves give increased signal strength because the reduced electron density in the Heaviside layer results in less attenuation as the waves pass through it on their way to the Appleton layer. Short waves below 25 to 30 metres, however, find the number of free electrons in the upper layer (Appleton layer) insufficient to bend them round so that they are not returned to earth and therefore not heard at all. In the daytime they are stronger than medium-short waves because although both are returned to earth the short waves are much less attenuated than the medium-short waves.

The height of the Heaviside layer rises about twelve miles during the night, but drops very quickly to its lower value when the sun appears again. Actually the layer is affected by the sun before the latter is visible on the earth (*i.e.*, before sunrise) because the layer is nearer the sun than the earth's surface is.

The above explanation of day and night effects serves also for the difference between summer and winter reception conditions. In summer, of course, the ionization is always much greater and the nights much shorter than in winter, so that medium and medium-short wave conditions are not so good. Below 25 metres, however, many stations may be heard and daylight conditions may last up to 1 a.m. as far as 20-metre signals are concerned.

Varying Radio Conditions

The next major variation is by no means so obvious, but is noticeable to listeners who have used their sets regularly for a long time and have found that some years produce a better bag of DX stations than others. It has, in fact, been found that general conditions for radio reception vary from year to year, but that the variation is repeated every eleven years. That is to say, that if general conditions were

(To be concluded next week.—Ed.)

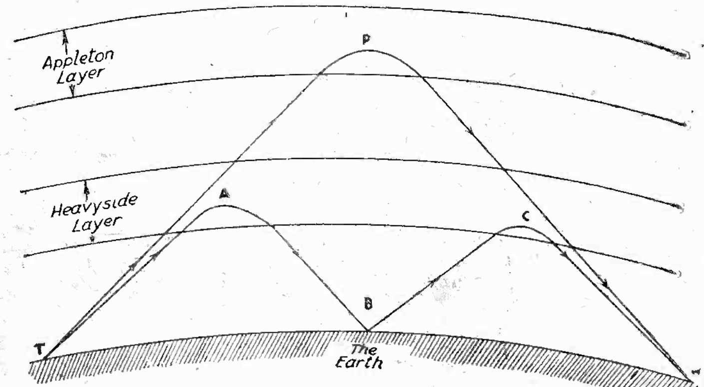


Fig. 1.—Diagram showing the path of reflected signals from the Appleton and Heaviside layers.

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HEAVY DUTY TYPE 2/3

Safe maximum current carrying capacity of "Ohmites."

100° F Temperature Rise

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1,000	40	20,000	8
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3,000	29	40,000	6
4,000	24	50,000	5·5
5,000	20·25	60,000	5
10,000	12	80,000	4·24
Other values pro rata		100,000	3·5

Safe maximum current carrying capacity of "Ohmites" Heavy Duty Type.

100° F Temperature Rise

Ohms.	Milliamps.	Ohms.	Milliamps.
1,000	80	20,000	16
2,000	70	30,000	13·5
3,000	58	40,000	12
4,000	48	50,000	11
5,000	40·5	60,000	10
10,000	24	80,000	8·48
Other values pro rata.		100,000	7

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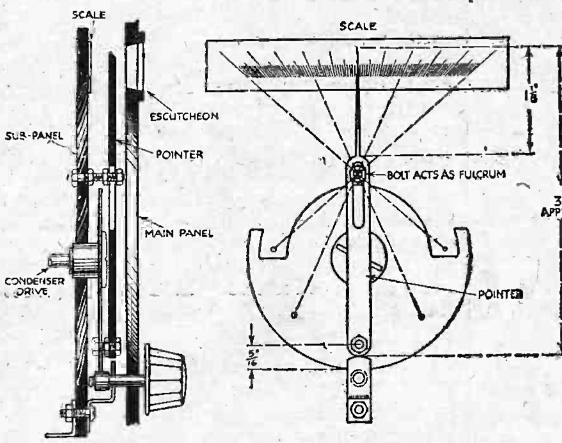
READERS' WRINKLES

THE HALF-GUINEA PAGE

Slow-Motion Device and Full-Vision Scale

THOSE constructors who have found the "wrinkle" in June 3rd issue, on "A slow-motion device for reaction condensers" useful, may be interested in this added refinement, so that it may be adapted to a tuning-condenser with a full-vision scale. It requires instead of a narrow piece of ebonite a slightly larger piece. It must be made long enough to be able to glue a scale on underneath the end of the pointer. This is made by cutting a piece of aluminium (an old condenser plate will answer) to the shape shown. A hole is drilled in the end opposite the pointer and a slot cut at the other end. Just clear of the slow-motion gear drill a hole in the ebonite and fasten a bolt in, allowing it to protrude through the slot. The other end of the pointer is

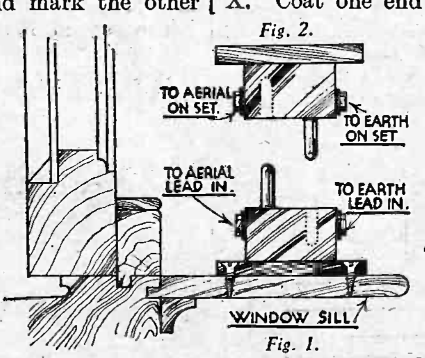


A side and front view of the slow-motion device and full vision scale.

slipped on a bolt on the slow-motion gear. It must be allowed to move freely, but not too much so. Now turn your mechanism to its limit, and make a pencil mark on a slip of paper. Holding it firm, turn the gear through 180 degrees and mark the other end. Between these two marks divide a line into as many divisions as you require (90, 100 or 180) and when finished glue it down in the position it was in when you marked it. A window, slightly larger than the scale, should then be cut in the panel. The sketches clearly show the arrangement. — R. TAYLOR (Sunderland).

Use for Old Plug-in Coil Mounts

I HAVE utilized two of these mounts as a connection from the set to aerial and earth leads-in, one mount being fixed to the window-sill as shown in Fig. 1. For short circuiting these when the set is not in use, or during a thunderstorm, I have another mount short-circuited, as in Fig. 2. I have also extended this idea for plugging in a loud-speaker to the set, as in Fig. 3.—F. RICHARDSON (Poole, Dorset).



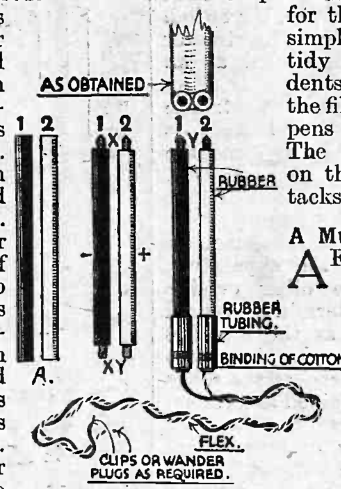
Showing how a use may be found for old plug-in coil mounts.

THAT DODGE OF YOURS!

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

Inexpensive Test Prods

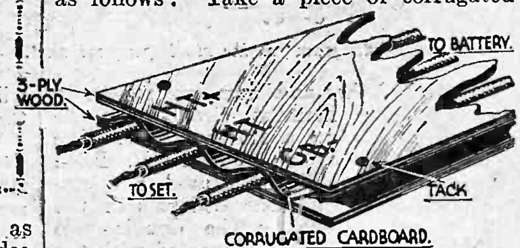
THE materials required for making the useful set of prods, shown in the accompanying sketches, is as follows: One 6in. length of tough rubber-stranded wire; one 8in. length of rubber tubing; 1yd. of thin flex, and two clips, wander plugs or spades, as required. The tough rubber-covered stranded wire is used by electricians for power circuits. First cut away the outer tough rubber, leaving two separate rubber covered wires, as shown at A. Next remove ⅛in. of rubber from each end of both wires, as shown at X. Coat one end of stranded wires with solder, and trim with file, leaving solid pointed ends, as at Y. Bare the flex for about one inch, untwist the strands at XY, and interlace the bare ends of flex. Solder the strands and flex together. Slip over the rubber tubing, and the result is a really good pair of testing prods. The rubber tubing can be obtained from any ironmongers, and is used for preventing draughts. The prods are fairly rigid, but I find it an advantage to bend them whenever an awkward position confronted me. The colours of the rubber are black and white, therefore, an advantage, inasmuch that the meter will always be correctly connected.—W. A. HOOK (Birmingham).



Making inexpensive test prods.

Keeping Battery Leads Tidy

USUALLY, when working on a new set, the constructor finds a great deal of trouble in keeping his battery leads from getting entangled. This can be remedied as follows: Take a piece of corrugated



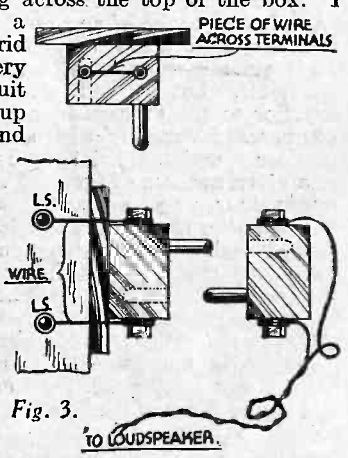
A simple dodge for keeping battery leads tidy.

cardboard and run your wires through the corrugations, as shown in the accompanying sketch. Now glue a piece of three-ply wood on the top of this, and mark the connections for the leads, as shown. This simple device keeps the bench tidy and prevents any accidents, such as putting H.T. on the filaments, as very often happens when wires are mixed up. The device can be kept steady on the baseboard by means of tacks.—G. BURNS (Glasgow).

A Multi-Purpose Unit

AFTER a good deal of experimenting I have made a unit which I use for trickle charging, a microphone or pick-up amplifier, half-wave rectifier, and other purposes.

All the components are assembled in an old crystal set cabinet measuring 6ins. by 7ins. by 5ins. The microphone is enclosed in the lid, while the valve and transformer are inside the cabinet with the terminals arranged on a piece of bakelite running across the top of the box. I also have a nine-volt grid bias battery in the circuit of the pick-up terminals and transformer, and this battery is also housed in the cabinet. The diagram of connections is given in the accompanying illustration. I connected the com-

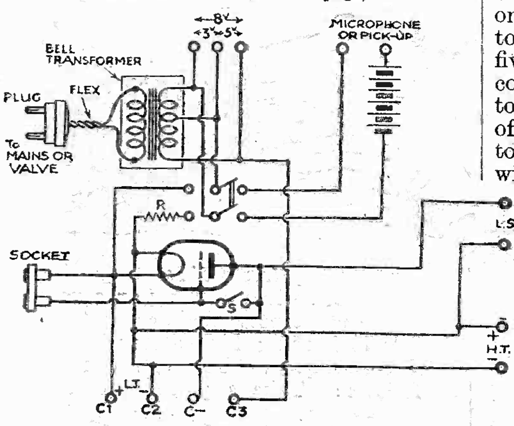


A further use for plug-in coil mounts.

(Continued on page 28)

RADIO WRINKLES

(*Continued from previous page*)



The circuit diagram for the multi-purpose unit.

ponents together as shown, my resistance in the valve filament circuit from the transformer being a 1.5 fuse bulb. The valve used was an old 1.L.F. P.M., bought for a shilling. I used a microphone button, and concealed this in the lid of my cabinet. The double-pole double-throw switch is connected with the poles to the three-volt output of the transformer, two spring contacts to the valve filament, and two spring contacts to the microphone or pick-up circuit. The break and contact switch is between the grid and anode of the valve, the switch being closed when using the apparatus for charging, and opened when used as an amplifier.

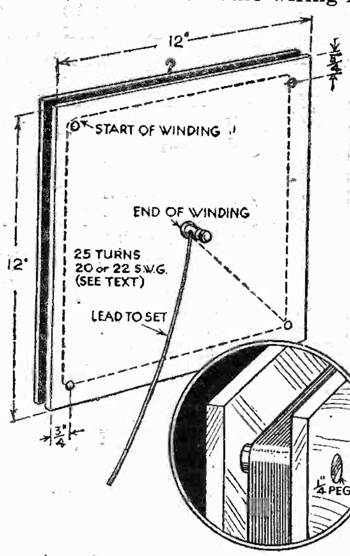
When the apparatus is used as a trickle charger the negative of the battery is joined to terminal marked C.1— and the positive to L.T.+ terminal on apparatus. In the case of charging three accumulators, they are joined in series, and the positive end of one outside accumulator joined to terminal marked C.3 on the apparatus; the negative end of the other outside accumulator is joined to terminal marked C.— which is always used as the negative pole in charging. For charging two accumulators the positive end of the series connected accumulators is joined to terminal marked L.T.—. For charging, the plug on flex joined to primary of transformer is plugged into the mains supply. When used as an amplifier, the plug is plugged into socket on apparatus.—C. Suttie (South Shields).

An Efficient Indoor Aerial

To those readers who are looking for an indoor aerial of an unusual type, the one described below may be of interest. It is quite easy to construct, the cost is negligible, but it will give results far superior to the average indoor aerial, and compares favourably with a well erected outdoor aerial. Briefly, it consists of a given number of turns of wire, wound round four pegs, supported on a piece of wood after the manner of a large square-shaped coil. The construction offers no difficulties and the sketch, together with the following description, should make the method quite clear.

Cut two pieces of plywood about 12in. sq. (the size is not critical), and drill four holes ¼in. diameter ⅝in. from each corner, and in one piece a fifth hole is drilled in the centre to take an ordinary type pillar terminal; this is for the connection to the lead-in. From a length of ¼in. diameter wood or ebonite rod, cut four pegs ½in. long plus double the thickness of the wooden sides. Glue the wooden pegs in the piece of wood having five holes, leaving the centre one out. Allow a short time for the glue to set, and then proceed to wind on twenty-five turns of 20 or 22 gauge d.s.c. or d.c.c. copper wire. Commence winding at the top left-hand peg (anchoring the start of winding securely to same), and proceed to put remainder of turns on in a clockwise direction, taking care to keep the wire tight and free from kinks. At the twenty-fifth turn, stop at the bottom right-hand peg, and finish off by looping end of wire round the centre pillar terminal. The insulation will have to be removed before making connection to this point, this being the connection for the lead-in to the set. The second side can now be glued in position, and if strips of wood, cut to size, are glued to sides of frame, the winding will be dust-proof. A small eye screwed to the back of the frame will enable it to be hung in any part of the room.

When hung on the wall in an upper room with a good shielded lead-in of the seven strand type, this arrangement will give remarkable results, both as regards selectivity and volume; it will also eliminate the interference from the house wiring installa-



An efficient indoor frame aerial.

tion. If you use a series condenser in your aerial lead, you can dispense with it, as there is no need for it with an aerial of this type. If the wood is stained or papered to match the colour scheme of the room, the lead-in taken along the picture moulding, down the wall, through the floor board, and then to the set, it will not be seen, but the aerial will still function efficiently. If tuning should be too sharp, add one or two more turns to winding.—W. Aspinall (Manchester).

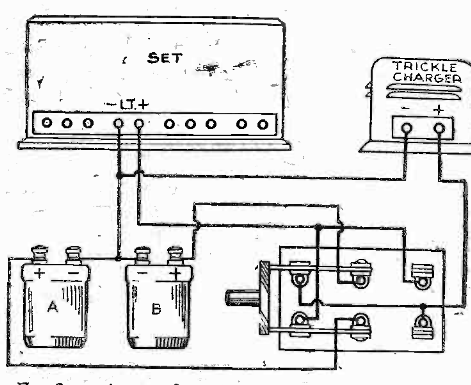
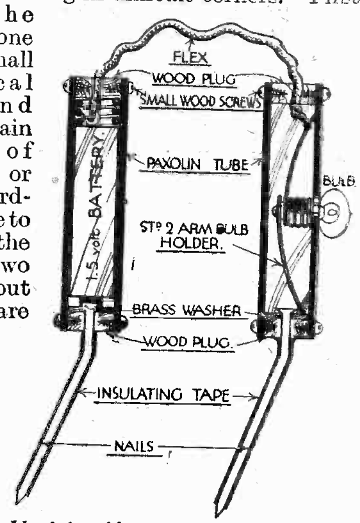


Fig 2.—A switching arrangement for accumulator charging.

A Pair of Testing Prods.

As can be seen from the accompanying sketch, these testing prods are very easy to construct, and they are very useful for testing in difficult corners. First choose the battery, one of the small cylindrical type, and then obtain a piece of paxolin, or tough cardboard tube to fit over the battery. Two nails about 3in. long are next required, and four pieces of hard-wood, ½in. thick, and the same diameter as the inside of the tube. Hammer a nail through the centre of each piece of wood, taking care not to split them. Put a washer under the head of each nail to ensure good contact, and proceed to bind insulating tape round the nails, leaving a ½in. bare at the ends. Then fit another wooden disc in end of tube, either by two woodscrews or glue. Thread flex through holes in the discs, which should be about ⅛in. diameter, and solder to the spring, which can be obtained from an old torch. After putting the battery in the tube, fix the plugs, holding the prods with two woodscrews.—E. Barnes (West Ealing).



Useful self-contained test prods.

Two Useful Dodges

A simple method of "slowing down" the tuning on the short-wave band is to reverse the end *fixed* plate of the tuning condenser (the inside one is to be preferred to avoid fouling any other components), so that, as you tune up the scale, the moving plates are travelling "in" to the reversed plate, as they are travelling "out" to the normal fixed plates. It broadens the tuning to a remarkable degree, due, I suppose, to the starting with a higher minimum, moving to a lower maximum. (See Fig. 1.)

The second illustration, Fig. 2, shows the connections for switching an accumulator (A) from a trickle-charger to the set, at the same time switching another accumulator (B) from the set to the trickle-charger with one movement of an ordinary double-pole, double-throw switch (or a D.P. D.T. jack-switch), and without any troublesome changing over of leads. The first-named type of switch is to be preferred on account of the greater isolation of the contacts.—A. Bingham (Liverpool).

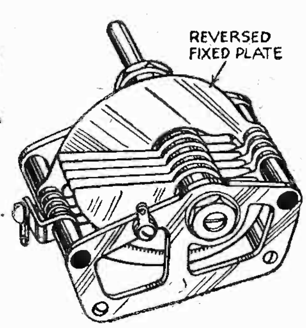


Fig. 1.—Method of slowing down tuning on the short-wave band.

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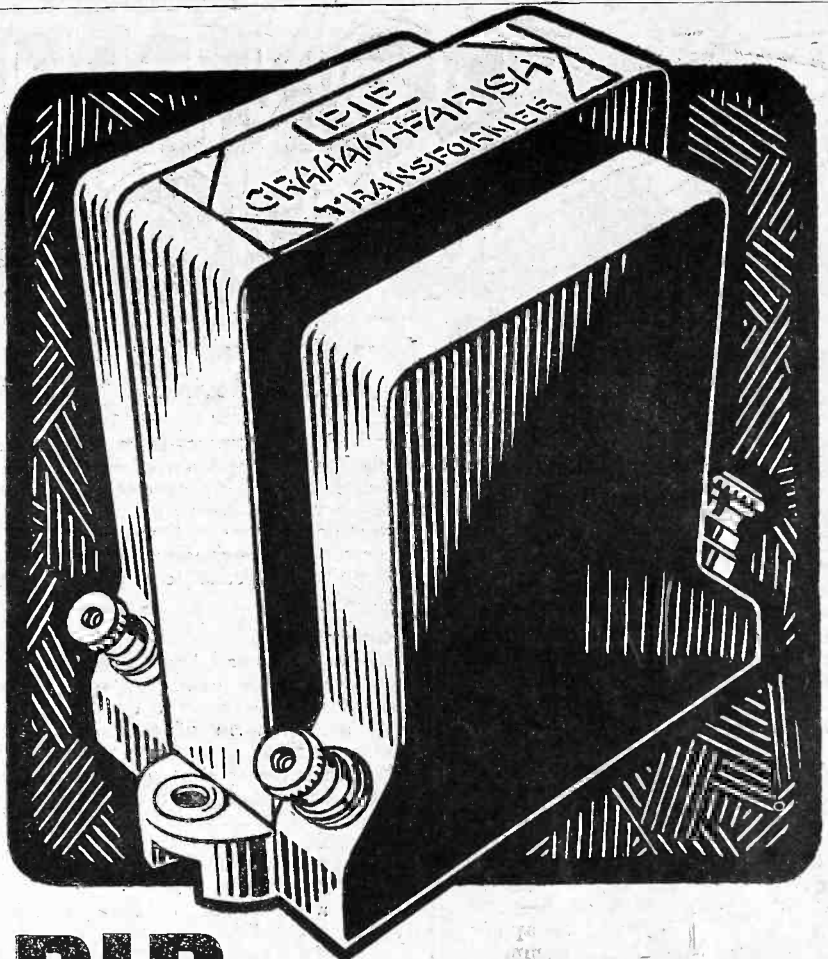

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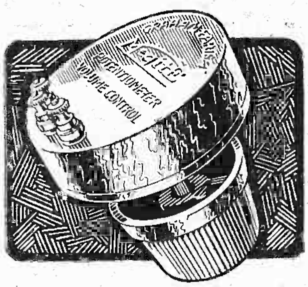

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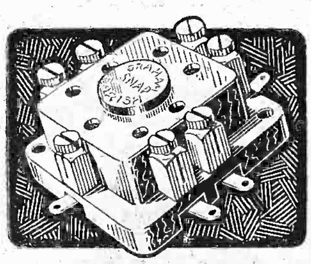

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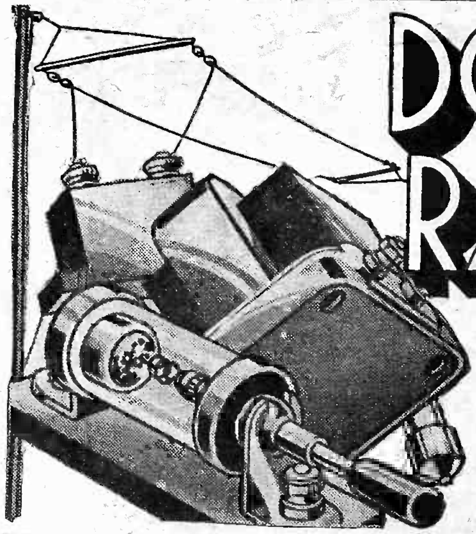

DON'T PERPETUATE RADIO FALLACIES

Some Notes and Suggestions on a few Common Ideas that need to be Forgotten or Revised.

By H. BEAT HEAVYCHURCH

EVEN such a comparatively new scientific development as radio is not free from the danger of being hedged in by false ideas very akin to superstitions. For this reason, every technically-minded listener ought to endeavour to keep abreast with the advances in both the theory and the practice of radio and be ready to jettison old beliefs in favour of the latest ideas.

Looking back to the early days of broadcasting, in the light of modern knowledge, it is easy to see how a number of misconceptions and fallacies arose—fallacies of which listeners ought to disabuse their minds at once.

First of All, Aerials

For example, just because the original broadcast licence limited the total length of wire in a receiving aerial to one hundred feet, the public came to the conclusion that the longer the aerial the more efficient it was. Actually, of course, it is the effective height and not the length of aerial which counts, the longitudinal portion having very little to do with its efficiency. Another fallacy in connection with aerials is that it is desirable always to use the full hundred feet of wire. With present-day high-power transmissions and congested wavebands, and with modern highly-sensitive radio frequency amplification, a too-efficient aerial is something of a disadvantage; stations come in too powerfully to be tuned out, *i.e.*, selectivity is at a premium. It often pays, if selectivity is poor, to reduce the height and length of the aerial and to make fuller use of your H.F. stages.

Before we leave the aerial, let us scotch another superstition, namely, that the best reception is obtained when the aerial is pointing directly in line and away from the station it is required to receive. There is little, if any, foundation in fact for this theory, and if there was, the effect of a directional aerial would be almost entirely masked by other local conditions, such as the contour of the surrounding country, shielding, and so forth. Besides, with our modern receivers, we desire to receive stations from every point of the compass, so that little purpose would be served in designing an aerial which would be particularly effective in one direction.

L.F. Coupling

The next fallacy which I should like to lay low is that L.F. transformer coupling is vastly inferior to R.C.C. I admit to a particular liking, personally, for resistance capacity coupling—but for quite other reasons. I will readily admit, however, that the average, let alone the best present-day L.F. transformer, is so very superior to the best production of early broadcasting days, that this form of coupling, properly used, is very unlikely to introduce serious distortion. Indeed, I would go farther, and say that a reasonably good transformer is definitely superior to a poorly-designed R.C. coupling.

Detectors

Many fallacies have arisen around detectors. For example, many people imagine that a crystal detector is the most perfect form of rectifier from the quality point of view. As a matter of fact, the curve of the average specimen of crystal is very far from linear, and the device can distort quite badly. This may not be very noticeable when using headphones, but many of us recollect the bitter disappointment we experienced when first we coupled a crystal set to a two-valve low-frequency amplifier.

Then there is a fallacy that an anode bend detector is *necessarily* freer from distortion than a leaky grid detector. It is nothing of the sort. On weak signals it distorts far more than a rectifier of the leaky grid type, while if the applied signals are *too strong*, double rectification will also occur, with the consequent distortion. All statements concerning detectors need to be governed by other conditions, one of the most important being strength of signal.

Do not run away with the idea, also, that all you have to do to convert an ordinary leaky grid rectifier into a power grid detector is to increase the high-tension voltage. Increase them you must, for that is one of the essential features of power grid, but you must also make certain alterations to the values of the grid condenser and grid leak—usually both must be very considerably reduced.

Again, the unfortunate choice of the term "power grid" has given rise to the wholly fallacious idea that a detector of this type necessarily increases the output power, and hence the volume of the receiver. The only reason for power grid detection is to enable the detector stage to rectify bigger signals without an undue amount of distortion—in other words, to increase the effective grid base of the detector valve. In a receiver employing one or more efficient stages of high frequency amplification, comparatively large voltages are available at the grid of the detector and an ordinary leaky grid detector operated at a low anode voltage is apt to distort them. By increasing the working anode voltage, however, the acceptance of the valve is greatly increased.

Distortion

While on the subject of distortion, it will be as well to point out that the belief that distortion occurs mainly in the low frequency and detector stages is quite erroneous. From personal observation I am convinced that in the average set the low-frequency side is usually remarkably free from distortion—components have improved so greatly in design and the valve makers instructions anent correct grid-bias have very generally been taken to heart. What distortion does occur on the low-frequency side generally is the result of overloading the output valve, of which, however, more later.

A considerable amount of distortion certainly occurs in the detector stage, generally due to incorrect operating conditions, or to the misuse of reaction, but the stage which is the most prolific source of distortion is the high-frequency stage. Overloading, by which, of course, is meant applying too great a signal voltage to the grid of the valve, is of very frequent occurrence in the high-frequency side, and especially in the second of two radio frequency stages. As a result, partial rectification of the signal occurs in the high-frequency stages, the H.F. valves being able to amplify without distortion only a limited input signal. It is for this reason that the variable-mu screened-grid valve was introduced. The effect of increasing the negative grid-bias applied to a variable-mu valve is very similar to the effect of increasing the anode voltage to a "power-grid" detector, namely, to increase the acceptance of the valve, that is to say, to increase the valve's signal handling capacity. In the case of the variable-mu valve, however, an increase of grid-bias also has the effect of decreasing the sensitivity of the valve. A variable-mu valve, therefore, not only permits of adjustment in order to avoid overloading and distortion on strong signals, but also forms a very convenient method of controlling volume.

On the Output Side

The output stage of a receiver is a most fruitful source of radio fallacies. A very common one is that by reducing the volume of sound it is possible to reduce the anode consumption and thus save high-tension current. Except in the case of a Class "B" valve, this is absolutely untrue. A receiving set fitted with an ordinary triode or pentode output valve will always take the same amount of high-tension current, whether the signal volume is loud or soft and even when no signal is being received at all. The high-tension current is fixed by the value of grid-bias and high-tension voltage. What actually happens is that as the volume control is turned up, a larger proportion of the power drawn from the high-tension source is converted into sound energy. Things are rather different in the case of a

(Continued on page 56)


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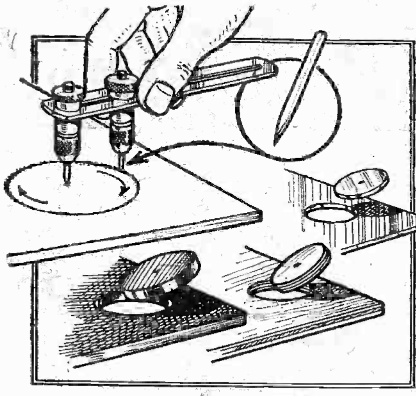

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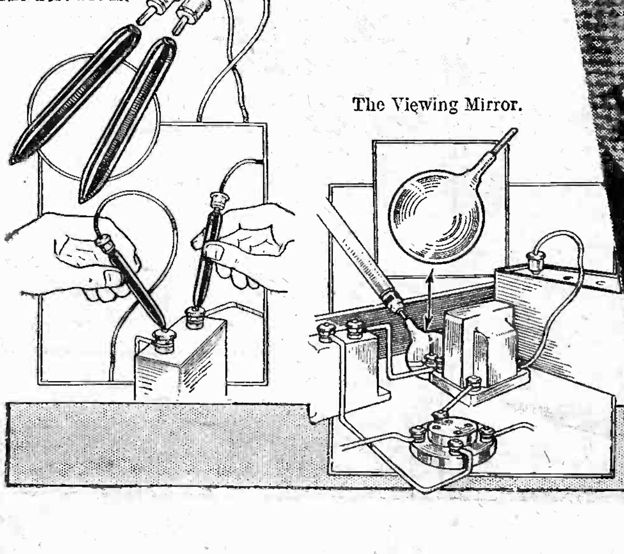

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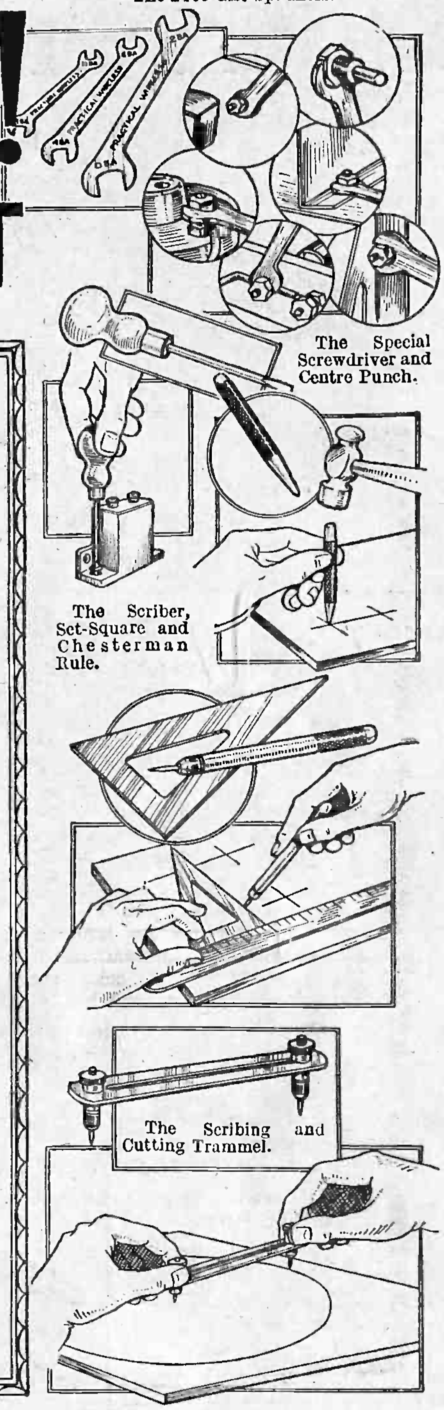

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Tele-Talkie Topics

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

RADIOLYMPIA provided an excellent opportunity for learning exactly what readers wanted, and it was most gratifying to find that such a number are

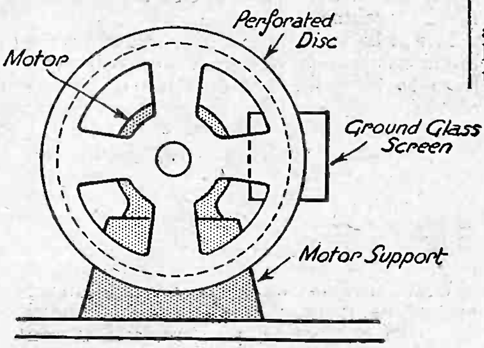


Fig. 1.—Testing the disc for faults arising from incorrect spacing.

keenly interested in the practical side of television. In response to many requests, therefore, I am continuing my Tele-Talkie series, and in this article I propose to continue the subject where it was left in the July 15th issue.

Let us assume that the directions have been followed carefully and that the thirty-hole disc has been punched and the brass boss added. Obviously the thing to do now is to carry out one or two simple tests in order to ascertain whether the marking out and punching operations have produced a disc free from mechanical errors. There are several ways of doing this, but I shall content myself with describing one.

Common Disc Faults

The commonest disc faults arise from two causes—namely, lines (black or white) due to incorrect spacing of the holes along the radii, and "steps," or a jagged line effect brought about by mistakes in marking-out the angles between individual radii. To check the former, mount the disc on its motor shaft and revolve it before a diffused light source, such as a ground-glass screen in front of a metal filament lamp, or even butter-paper will do if you cannot lay your hands on a piece of suitable glass. The idea is shown in Fig. 1, the screen with the lamp behind it being mounted conveniently on a block of wood.

If any black vertical lines are noticed as the screen is observed through the disc holes, then this may be due to dust clogging the punched apertures, and the offending particles are best removed with a stiff brush. Or again, the punching operations may have produced burrs, and these should be rubbed down with very fine blue-back emery paper. Should any black lines still persist, it shows that two adjacent holes have their respective inner and outer edges underlapping instead of being on the same circumferential arc. The defect is remedied with a fine three-cornered jeweller's needle file. Be sure to check the disc repeatedly while carrying out these filing operations, so as to ensure that too much metal is not removed from the offending hole sides.

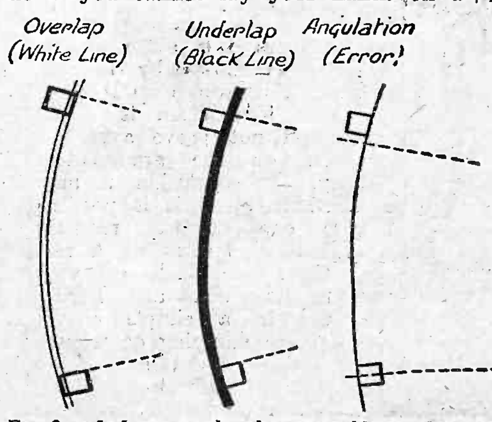


Fig. 2.—Indicating the three possible mechanical errors in the disc.

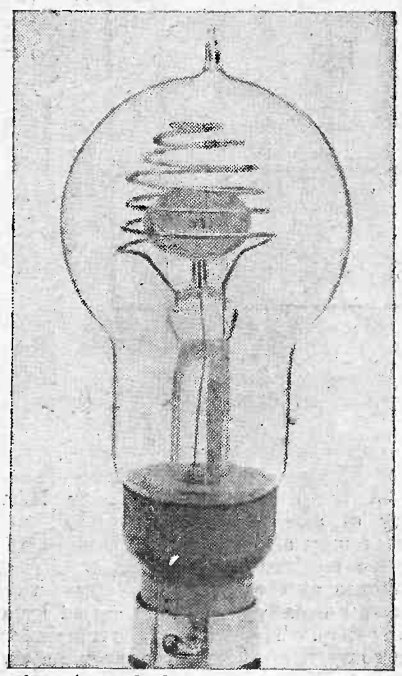


Fig. 3.—A simple beehive Neon which can be used in a disc model television receiver.

Sometimes the hole edges overlap, and this causes white lines to appear. This effect can be quite readily tolerated, but for those amateurs who desire to remove them it will be found a good plan to "spread" the metal at the hole edges by using a flat punch and light hammer taps. The jeweller's file will then be brought into commission once more to trim the hole sides.

Where angular errors exist their presence will not be detected until the disc is actually being used for receiving the television images. Then a straight line will have an irregular stepped effect, and metal spreading and filing will soon put matters right again. The three effects just described are shown in simple form in Fig. 2, and are self explanatory. Of course, if the disc should be mounted eccentrically on the motor shaft then naturally the scanning operation will be very irregular and matters can only be put right by remounting the boss.

The Neon Lamp

Assuming that we now have our disc mechanically perfect, attention must be turned to the source of illumination which has to be modulated by the incoming television signals. A Neon lamp is used here and can be of the flat plate variety such as was illustrated on page 857 of the September 2nd issue or of the beehive pattern as shown in Fig. 3. The former is the better type as the neon glow is diffused evenly over the rectangular plate surface. It is necessary to furnish a polarizing current of about 25 milliamperes, however, while a voltage in the neighbourhood of 180 is essential for "striking" the lamp and maintaining the required brilliancy.

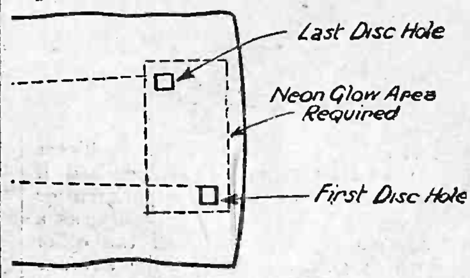
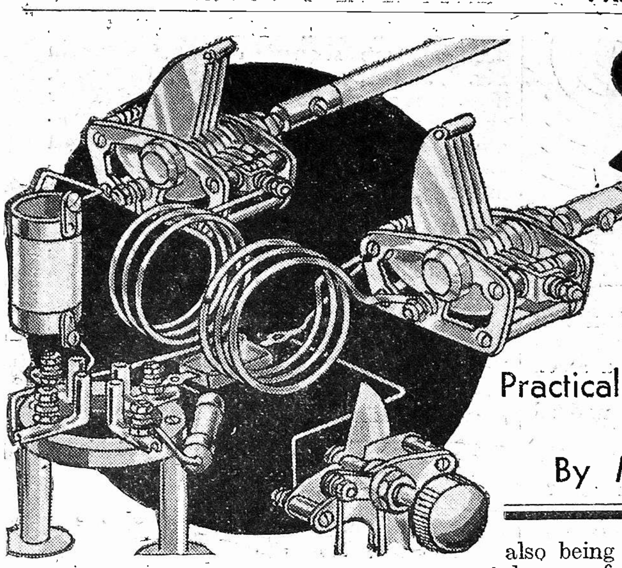


Fig. 4.—The dotted rectangle shows the neon glow area necessary.

These two facts, coupled with the high cost of this special type of lamp, make it necessary in many cases to adopt the beehive or lettered neon pattern as a substitute. They work quite satisfactorily, but naturally, since they are rated at a much smaller milliamp consumption, the resultant television image is not so bright. Again, the neon glow is not diffused evenly over a flat area, and it is a great advantage therefore to "doctor" the lamp before using it.

This is done by attaching very carefully over the glass bulb a layer of tinfoil such as one obtains from chocolate or cigarette packets, leaving a "window" slightly larger than the area formed by the rectangle as indicated in Fig. 4, which shows the first and last holes on the punched disc. The foil may be stuck on with glue and where possible the "window" should be "frosted." The neon glow will then be diffused, while the tinfoil covering will serve to reflect the light inside the bulb and give a better illumination. In my next article I shall deal with suitable lenses.

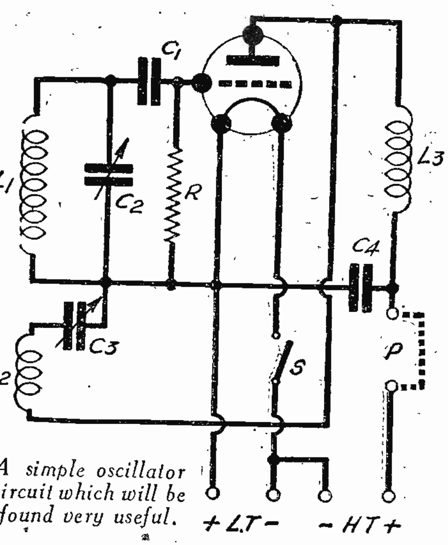


Short Wave Section

Practical Points on the Technical Side

By MANDER BARNETT

THE value of a short-wave test oscillator would be more quickly realized if more short-wave experimenters would regard this piece of apparatus as a very necessary addition to all the other parts which go to make up the average short-wave amateur's test bench—or, to be rather less polite, the "junk box"! A test oscillator has many practical uses, and it can easily be built up from old parts lying on hand. The circuit of such an oscillator is given on this page. It can be regarded more or less as the foundation circuit for a single-valve oscillator, as there are very many variations of this circuit in use to-day. This one is, however, probably the most useful for general work. The coils in the oscillator circuit, comprising L1 and L2, may take the form of any convenient type of plug-in coils, preferably also with coils available for the medium and long waves. The choke L3 will either have to be of the special type of choke which will operate efficiently from about 14 to 2,000 metres or, alternatively, two chokes may be used to cover these wavebands, a short-wave choke being connected immediately after the valve anode, followed by a normal choke, the two being connected in series. The whole oscillator can be built into a small wooden case (don't make the mistake of shielding it as we are relying on the coils in the oscillator to do an amount of radiating, although there is no objection to using a metal front panel), the batteries themselves also being included in the case. For any degree of accurate calibration it is very important to see that the value of high



A simple oscillator circuit which will be found very useful.

tension used is kept constant—thus a lower or higher value will produce slight alterations in the dial readings. If an H.T. battery of about 60 volts is used, the oscillator may also be used as a complete one-valve receiver by inserting a pair of headphones at the point "P," these two terminals normally being kept closed by a shorting strip. The values of the remainder of the components used are approximately as follows: C1—.003 mfd., C2—.00025 mfd., C3—.00025 mfd., C4—.0003 mfd., R—2 megohms.

It will be seen that in order to cover the broadcast bands a number of coils will have to be used, owing to the small size of the condenser C2. A larger condenser could be used, but this would very materially reduce the usefulness of the unit on the short waves. Almost any type of 2-volt battery valve can be used to produce oscillations, but with a general purpose type of valve the H.T. consumption will not be more than about 1.5 milliamps.

Using the oscillator is a very simple matter as it only requires to be placed near the short-wave receiver, and it can then be calibrated by tuning in one or two of the more prominent short-wave stations on the receiver and turning the oscillator dial until a "chirp" is heard, plotting the oscillator dial readings on some squared paper. For anything approaching accurate calibration it is necessary to receive at least three stations of definitely known wavelength. It is also very important to note the setting of the reaction condenser C3. If the position of this condenser is changed, the corresponding dial setting on the tuning condenser C2 will also be changed. It is, however, necessary to use a variable condenser here owing to the fact that reaction effects are very much stronger at one end of the tuning dial than at the other, and that if they become too strong the oscillator will not produce a pure note and will become more or less uncontrollable. It is therefore advisable to fit a small dial on the reaction condenser in order that a definite note of the required setting in relation to that of the tuning dial may be made.

In the next article some further notes will be given concerning the various uses of this oscillator.

OVERLOADING THE DETECTOR

(Continued from page 23)

nected to the moving vanes. The great point in favour of this scheme is that tuning is not altered to such a serious degree; as the aerial capacity across the coil is reduced when we are decreasing the input, so a compensating increase in capacity results by the moving vanes engaging with the other set of fixed plates. By a happy choice of condenser size, which should be selected by trial and error, it will be found that the capacity increase on one side can be very nearly balanced by the corresponding decrease on the other. Little change of tuning should then be noticed.

Using a Diode

Although any of the above suggestions can be very effective for the prevention of detector overloading, by far the best solution to the problem is to choose some system of rectification which will not overload however high the input, and should the output be in excess of our requirements, fit post-detector volume control which, in general, is more easily achieved without any accompanying disadvantages.

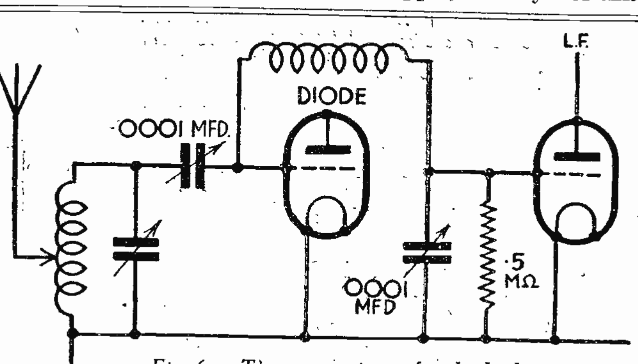
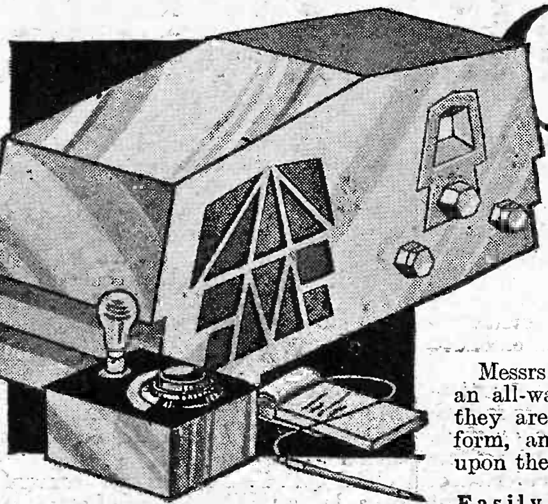


Fig. 6.—The connections of a diode detector.

Diode detection is undoubtedly the only sound method; it is virtually impossible to overload a diode, but absolutely no amplification is obtained therefrom, and an extra L.F. stage will be necessary as shown by Fig. 6. As a diode consumes no H.T. (or very little if reaction is fitted) this should not prove a serious drawback on the grounds of economy. In conclusion, it may be mentioned that it is possible to use one of the recently introduced Westectors as a rectifier; these will deal with very large inputs, but are hardly suitable for use in a simple circuit owing to the severe damping occasioned by their low resistance. Where a receiver is intended solely for local station reception, however, and selectivity is unimportant, one of these should certainly be tried.



OUR VIEWS ON RECEIVERS

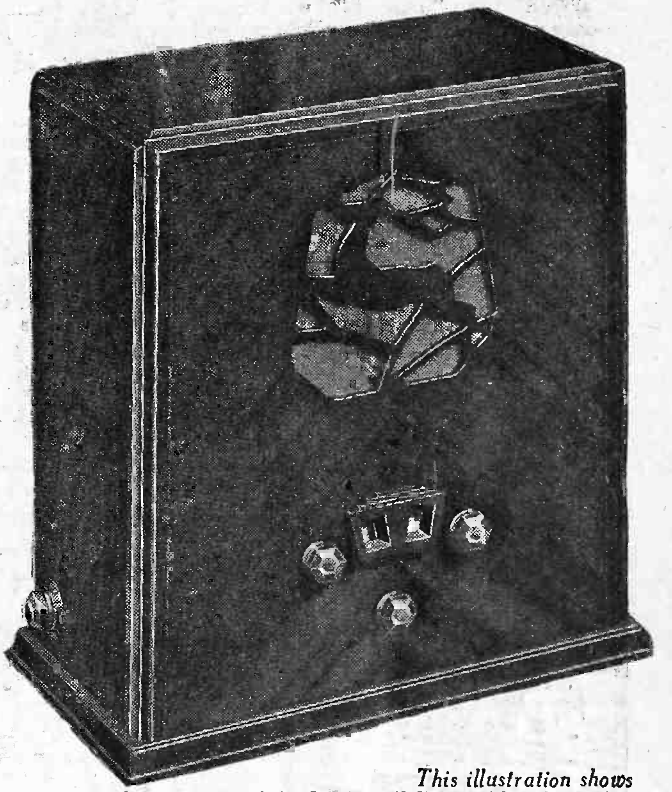
The Lissen "All-Wave Skyscraper 4" Kit Set

MESSRS. LISSEN, of Isleworth, Middlesex, need no introduction to our readers as makers of all wireless components and kits of parts for complete receivers. The 3-valve "Skyscraper," which Lissens have produced in kit form during the last two seasons, has proved to be an amazingly popular set for home-constructors, but we feel sure that the latest "Skyscraper," the "All-Wave 4," will be made in even greater numbers. It has for some little time past been obvious that our previous conceptions of a broadcast receiver (one which could be tuned to wavelengths between about 200 and 2,000 metres) must be modified since there are now hundreds of broadcasting stations in all parts of the world which are sending out excellent and interesting programmes on the short and ultra-short waves. With a short-wave receiver of good design there is no difficulty in obtaining entertaining programmes not only from European, but also from American and Australian stations at most hours of the day, but as there are few amateurs who care to go to the expense of buying two separate sets for normal and short-wave reception it is perfectly clear that sooner or later receiver manufacturers must turn their attention to the production of receivers which will cover every waveband.

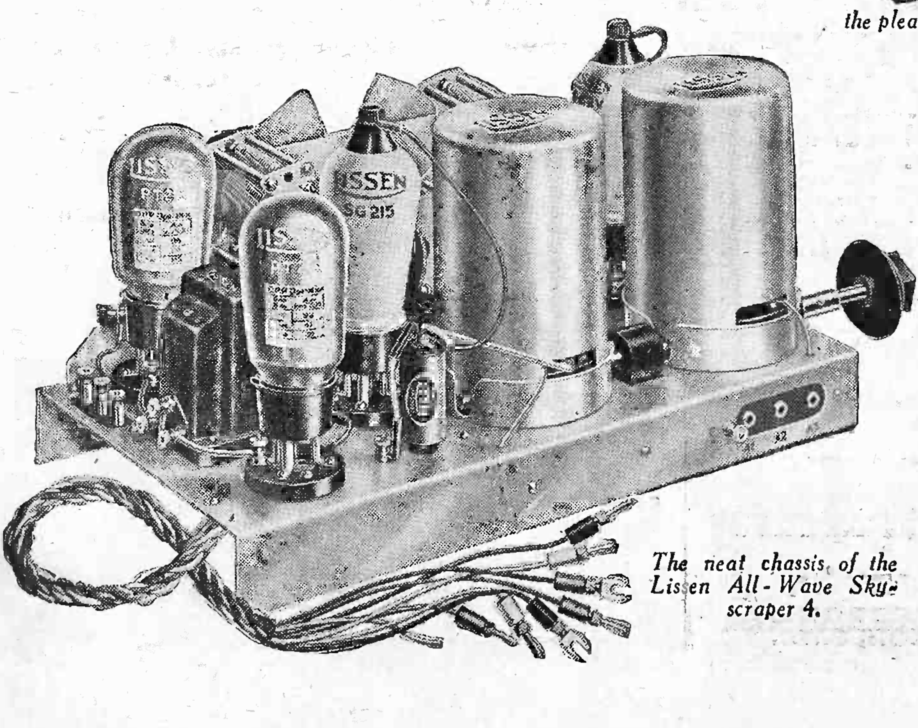
Messrs. Lissen are not the first to produce an all-wave receiver, but we believe that they are the first to produce one in kit form, and they are to be congratulated upon their enterprise.

Easily followed Constructional Chart

It gave us great pleasure to receive the "All-Wave Skyscraper 4" for test, and we were more than pleased with the performance which it gave. Perhaps it would be best to describe the set by beginning with the kit of parts which are supplied to the constructor in a strong and partitioned carton. Every component is clearly marked so that the veriest beginner can recognise it by making reference to the constructional broad sheet, whilst it is soon found that there is a supply of screws and wire so that the complete set can be assembled by means of nothing more than a screwdriver and a pair of pliers. A stout aluminium baseplate is accurately drilled to receive all the component holding down screws, and the task of mounting the parts is one that can be completed in less than an hour by following the full-size drawings supplied. The wiring has been simplified to a considerable extent by extremely careful design, and every connection required is numbered on the plans. Still further to simplify the work, however, the connections are fully described; for example, "Connection 13.—Wire 4½in.—secure under T 31—Sleeving 3½in.—pass up through hole "G" and secure under terminal "P" of the Q.P.-P. transformer." Incidentally, there are only 30 connections in all, so it will be realized from this that the construction has been reduced to the simplest possible form.



This illustration shows the pleasing lines of the Lissen All-Wave Skyscraper 4.



The neat chassis of the Lissen All-Wave Skyscraper 4.

Alternative Kits

The kit can be obtained in three different forms, the first of which is suitable when the constructor already has a cabinet and speaker which he wishes to use; the second includes a table cabinet (which can be assembled in next to no time without the use of glue) and the third includes a console type of cabinet fitted with the excellent Lissen permanent magnet moving-coil speaker. The prices of the three models, including Lissen valves in each case, are £5 12s. 6d., £6 8s., and £8 2s. 6d. respectively—extremely good value.

(Continued overleaf)

The completed set was fitted into its cabinet, which was of the console type with self-contained M.C. speaker in our case, and the batteries connected up exactly as stated in the instructions, when Rome was immediately tuned in. After this, no less than thirty other medium-wave stations were brought in at good programme strength, despite the fact that the aerial in use consisted of only a 40-ft. length of wire erected at a height of 25 feet. To keep the volume down to reasonable proportions in the averaged size drawing-room the volume control had to be made use of on about half the total number of stations received. By connecting the aerial to the least selective of the three tappings provided, the "spread" of the local stations less than ten miles away was no more than six degrees on the dials, whilst when the most selective tapping was employed the "spread" was reduced to only two degrees, with a slight reduction in maximum volume. Without doubt the set is amply selective for modern requirements, and should give every satisfaction in this respect when used in any part of the country. On the long waves we were able to bring in eight stations at good strength, and no difficulty was experienced in receiving Radio Paris, Warsaw, or Eiffel Tower entirely free from the National. There was no trace of medium-wave break-through at any long-wave condenser setting. Although two tuning dials are used they worked so well "in step" that the operation was almost as easy as with any single knob set we have used.

Tuning on the short waves was found to be just as easy as on the higher bands, once the knack of rotating the condensers slowly had been acquired, and within half an hour we were able to bring in eleven stations on the short-wave range (that is, between 28 and 80 metres) and eight on the ultra-short waveband (12 to 35 metres). Of these, three were the American stations, Pittsburgh, Springfield, and Bound Brook, one was Sydney, four were European broadcast transmitters, and the others were amateurs in various parts of the world. Of particular interest among the latter was a Canadian station calling up G2SO in London. No doubt a considerably greater number of short-wavers could have been received had the tests been extended over a longer period.

We feel that the makers are to be particularly commended upon the perfectly smooth reaction control which is to be obtained on the short waves, for this is one of the greatest difficulties with the majority of short-wave sets. Due to this excellent control, the "Skyscraper" was just as docile and reliable on the short as upon the normal broadcast wavebands.

As the same coils are used to cover the four wavelength ranges we rather expected to find some little interference or "break-through" of the local transmitters, but there was absolutely nothing of this kind.

After trying out the set we measured the high-tension current consumption and found this to be almost exactly 9 milliamps, which is an extremely low figure when the tremendous volume of signal output is taken into consideration.

In regard to the technical details of the "Skyscraper All-Wave 4," the interested amateur can find many points of particular interest. The circuit comprises four valves, of course, of which the first is a variable-mu high-frequency amplifier, the second is a screened-grid detector (which is no doubt due in no small measure for the excellent short-wave performance of the set), whilst two Lissen type PT2A pentodes are used in quiescent push-pull for the output stage. An extremely interesting and ingenious device is the volume-control, which consists of a grid-bias potentiometer acting on the V.-M. valve, ganged with the reaction condenser. This is so arranged that over the first half revolution of the knob the potentiometer is varied from "minimum" to "maximum" volume. Once the V.-M. valve has been brought to its most sensitive condition the reaction condenser comes into play and enables a further degree of amplification to be obtained.

The Q.P.-P. stage is on conventional lines, but a practical point of great importance is that the two pentodes supplied with the kit are carefully tested before despatch and labelled to show their optimum anode and priming grid voltages. Thus, by applying these voltages the constructor knows that the valves will be perfectly matched.

To anyone who intends to buy a kit set for battery operation and who desires to obtain an up-to-date receiver at a most reasonable price, we recommend the Lissen "Skyscraper All-Wave 4."

A well-illustrated constructional broadsheet can be obtained free from the Publicity Dept., Messrs. Lissen, Ltd., Isleworth, Middlesex, if mention is made of PRACTICAL WIRELESS.

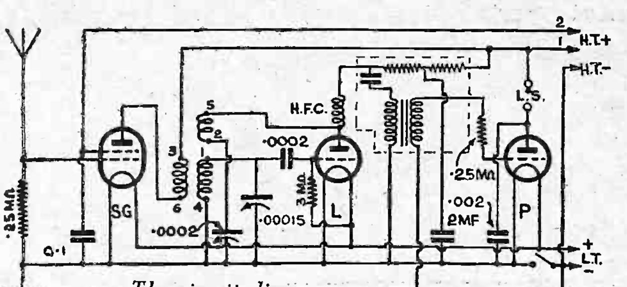
THE EXPERIMENTERS' SHORT-WAVE THREE

A Very Sensitive S.G. Receiver Which is Designed Principally for Use on Short Waves, but Which Can Also Be Used Satisfactorily on the Broadcast Bands.

By FRANK PRESTON, F.R.A.

SOME time ago I described in these columns two or three circuits suitable for efficient short-wave reception. I explained that although good short-wave reception could be obtained with an adaptor used in conjunction with the normal broadcast receiver, it was a much better plan to employ a separate and complete short-wave set. After briefly discussing different circuit arrangements, I drew the conclusion that, for all-round efficiency and reliability, making use of a screened-grid valve was most satisfactory.

The little set now to be described, and of which you see a photograph on this page, has been designed to embody all those features which experience has taught to be desirable, whilst at the same time cutting out all unnecessary gadgets and "frills." It is a sound job, which has been evolved after a good deal of experimenting, and it has been thoroughly tested under varying conditions. I do not claim that the set is "perfect"—I have never made a perfect one—but I do say that it is extremely good, and forms an ideal arrangement for the experimenter. The set is built in skeleton form, no panel or cabinet being used, so that every component is readily accessible and alterations can be made without disfiguring it at all.



The circuit diagram.

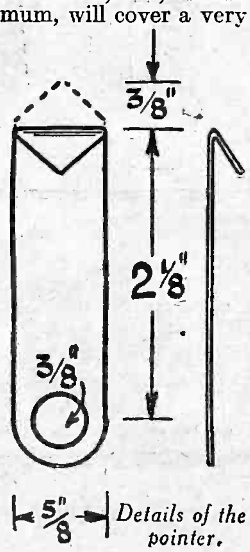
Universal Wavelength Range

Although every component is specially chosen to be "just right" for the function it has to perform, the set can be built for no more than sixty shillings. Again, despite the fact that the set was designed as an ideal short-waver, it can be used with almost equal efficiency on the broadcast wavebands. Unlike most short-wave sets, it will cover a range of from 260 to 550 metres, or from 900 to 1,800 metres, with a single coil. Needless to say, its range of reception on short waves is literally world-wide, and on the higher wavebands it is capable of bringing in some thirty-odd European stations. In all cases, loud-speaker reproduction, to say the least, is very good. Tuning is almost as easy as with a one-knob family receiver, and even the beginner need have no fears in this respect.

Circuit and Components

The circuit given on this page makes clear the sequence of the valve stages and requires only little explanation. The aerial circuit is untuned, a ½ megohm resistance providing aperiodic coupling. This obviates the necessity for a second tuning control, which would make tuning tricky. A metallised screened-grid valve is used for the first stage, the metal coating acting as a screen between grid and anode circuits. Its screening-grid receives high-tension from a separate tapping, and is by-passed to earth through a .1 mfd. *non-inductive* condenser. Coupling between the S.G. and detector stages is by means of a high-frequency transformer with tuned secondary. A reaction winding is also included on the transformer, and the degree of feed-back is controlled by a .0002 mfd. reaction condenser. The transformer is of the plug-in type, different units being used for different wavelength ranges. This system is considerably more efficient than that of employing tapped coils and shorting switches, and has the decided advantage of being adaptable to absolutely any range, rather than to two or three only. Moreover, it is only very slightly more costly.

The tuning condenser has a maximum capacity of only .00015 mfd., but, thanks to its very low minimum, will cover a very wide range of frequencies. This is very evident by the fact, previously mentioned, that it will cover either broadcast range with a single coil. Both grid-leak and condenser have more or less usual values, but these components were chosen to match the detector valve (a Cossor 210 Det. metallized). It was found afterwards, however, that they were almost equally well suited to the Cossor 210 L.F., and that is why alternative valves are specified. It was found quite unnecessary to use a potentiometer in conjunction with the grid-leak, because perfect reaction control proved possible by taking the leak to low-tension positive. A special "Universal" H.F. choke is used in the detector anode circuit because it is required to cover both long and short waves. The L.F. valve receives its input through a "Transfeeda" (one of the now popular resistance-fed transformers), and a ¼ megohm stopping-resistance is included in its grid circuit. A portion of the resistance in the "Transfeeda" is used in conjunction with a 2 mfd. condenser to decouple the detector anode circuit. The last valve is of the high amplification power-valve type, capable of giving good speaker signals even on small inputs. A .002 mfd. fixed condenser is joined between its anode and earth to keep high-frequency currents out of the loud-speaker leads.



Details of the pointer.

Assembling the Components

A list of components is given elsewhere, from which it will be seen that three mounting-brackets are specified. These are for holding the tuning-condenser, reaction condenser, and switch respectively, and replace the more usual panel. Should any constructor prefer to make the set as a finished receiver rather than as an experimental model the brackets should be replaced by a 14in. by 7in. panel. The positions of all components on the baseboard can be followed and duplicated by making reference to the wiring plan and photographs.

It will be found best to commence by attaching the brackets and then fixing the condensers and switch to them. Before mounting the tuning condenser a dial pointer must be made and secured under the mounting nut. The pointer is made from a piece of thin brass, or copper-strip to the dimensions given in the accompanying sketch. If copper or soft brass is chosen it can easily be cut with a pair of strong scissors. Next mount the valve holders and terminal blocks, but before screwing down the other components lay them all on the baseboard, insert valves and a coil, and carefully arrange them so that there is ample clearance.

Easy Wiring

The wiring is extremely straightforward, and you should try to duplicate that of my original set by carefully studying the photographs in conjunction with the wiring plan. Glazite is used throughout, a single

(Continued overleaf)

(*Continued from previous page*)

10 foot coil being more than sufficient. Keep all wires short to ensure maximum rigidity and take them from point to point by the straightest path. The anode connector is attached to a short length of flex connected to terminal 4 of the coil mounting base. Both metallized resistances are attached directly to terminals by their own connecting leads. A 5-way cord assembly is used for connecting up to the batteries, and its end is secured to the baseboard by means of a small brass stirrup, or anchor, to prevent the wires from being pulled loose. Details of the anchor can be obtained from the wiring diagram given on this page.

It will be noticed that although the cord assembly has only five wires it has seven connecting terminal points; this is explained by the fact that plugs "L.T.—," "H.T.—," and "G.B.+" are all attached to the same lead. The latter, by the way, is connected to one terminal of the on-off switch.

Coils

The 6-pin coils specified are obtainable in all sizes, but the following, given along with the tuning ranges they cover with the .00015 mfd. tuning condenser, are most useful since they cover the wavebands in constant service:—

Type.	*Wavelength Range*
2 LB	12.5 to 28 metres.
2 Y	24 to 50 metres.
2 G	260 to 550 metres.
2 GY	900 to 1,800 metres.

Battery Voltages

For the valves specified the high-tension battery should have a voltage of not less than 100 for best results, although the set will certainly function with a voltage lower than this. Plug "H.T.+1" should be taken to the highest tapping and "H.T.+2" to the 66-volt tapping. The correct grid bias for 100 volts H.T. is 3 volts. This might be increased to 4½ volts with a H.T. voltage of 120.

Using the Set

When first trying the set on short waves it is advisable to employ phones unless you have already had a fair amount of experience with short-wave reception. I advise this because, although not difficult, tuning is exceptionally sharp, and you might tune straight past a station if using a speaker. Once the knack of accurate tuning is acquired all reception can be carried out on the speaker if preferred. The method of operation, after inserting a suitable coil for the waveband required, is as follows: Switch on and set both reaction and tuning condensers minimum capacity (vanes right out of mesh). Turn the left-hand (reaction) knob slowly until a "breathing," or "rushing" sound is heard, indicating that oscillation has just set in. Now rotate the tuning dial as slowly as possible by means of the vernier knob, at the same time increasing the reaction setting if necessary, to keep the set just on the point of oscillation. During all tuning operations the reaction control must be so adjusted that the set is just in the oscillating condition for it is then most sensitive. More, or less, reaction will appreciably reduce sensitivity, especially to weak signals.

As the tuning dial is turned squeaks or whistles will be heard. Probably the first will be a morse station, and can be recognised by the "chirping" sound. When you come to a telephony station a steady whistle will be heard at first, but as the dial is slowly turned the whistle will rise in pitch, disappear for an instant and then return. Go back to the silent point between the whistles and reduce the reaction setting very slightly. By careful final adjustment of the tuning knob the telephony should be heard clearly. Remember that telephony cannot be received clearly whilst the set is oscillating, but that oscillation is necessary for the reception of morse. When using the smallest coil (type 2LB) the first station you will come to will be Buenos Aires on 14.47 metres. After that you will find Bandoeng, Java, on 15.93 metres, followed by the American W2XAD on 19.56 metres, Zeesen, Germany, on 19.7 metres, W8XK, East Pittsburg, on 19.72 metres, Vatican State on 19.84 metres, W8XK again on 25.25 metres, W9XAA, Chicago, on 25.34 metres, Rome I2RO on 25.4 metres and Chelmsford on 25.53 metres. In addition, several amateurs will be heard between 20.9 and 21.3 metres. This particular wavelength range is always the most interesting, but good reception can nearly always be relied upon on any wavelength up to 50 metres.

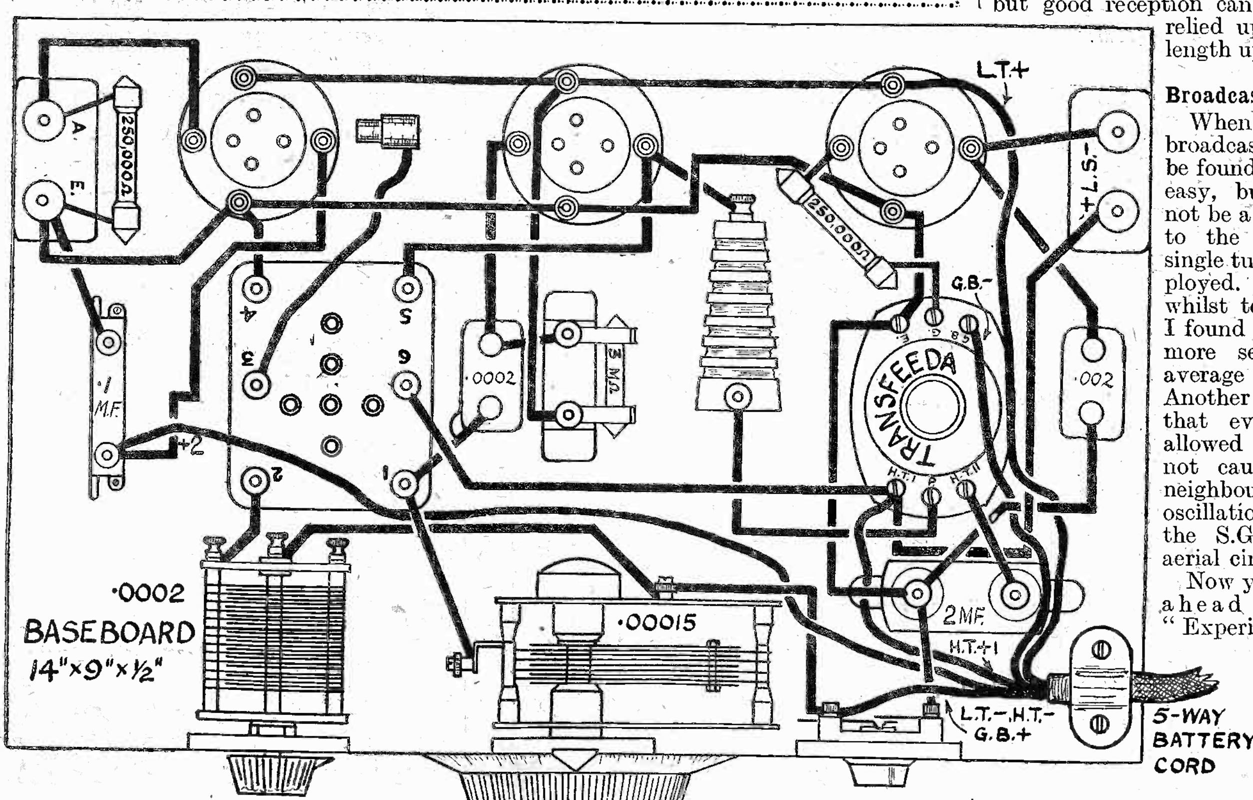
Broadcast Reception

When listening on the broadcast bands tuning will be found to be particularly easy, but selectivity will not be a strong feature due to the fact that only a single tuning circuit is employed. Nevertheless, whilst testing the receiver I found it to be noticeably more selective than the average non-S.G. set. Another very good point is that even if the set is allowed to oscillate, it will not cause interference to neighbours because the oscillations cannot get past the S.G. valve into the aerial circuit.

Now you can go straight ahead and make the "Experimenters' Short-Wave Three" with every confidence of success. We shall be pleased to hear of the results you obtain, and in case of any difficulty, great or small, our Free Advice Bureau is at your service.

COMPONENTS REQUIRED FOR THE "EXPERIMENTERS' SHORT-WAVE THREE."

- 1 Baseboard, 14in. by 9in. by ½in.
- 1 .00015 mfd. variable condenser with slow-motion drive (Jackson Bros. type "D").
- 1 .0002 mfd. reaction condenser (Jackson Bros. "Midget").
- 1 Filament switch (Colvern type "S.1").
- 3 Mounting brackets (Eddystone).
- 3 S.W. valve-holders (Eddystone).
- 2 250,000 ohm metallized resistance (Loewe 1 watt).
- 1 .1 mfd. non-inductive condenser (T.C.C.).
- 1 6-pin coil base (Eddystone).
- 1 set (Eddystone) 6-pin Coils.
- 1 .0002 mfd. fixed (grid) condenser (T.C.C.).
- 1 3 megohm grid leak (Lissen).
- 1 grid leak holder (Lissen).
- 1 universal H.F. choke (Eddystone "Scientific").
- 1 L.F. coupling unit (Benjamin "Transfeeda").
- 1 2 mfd. condenser (T.C.C.).
- 1 .002 mfd. Fixed condenser (T.C.C.).
- 2 Terminal blocks; 1 marked "A" and "E," and 1 "L.S." (Lissen).
- 1 5-way battery cord with wander plugs and spades marked "H.T—," "L.T.—", "G.B.—", "H.T.—1," "H.T.—2," "L.T.—," and "G.B.—" (Belling Lee.)
- 1 safety anode connector (Belling Lee).
- 1 coil "Glazite," small piece strip brass, screws, etc.
- 3 valves; 1 215 S.G. metallized; 1 210 det. metallized—or 1 210 L.F.; 1 220 P.A. (Cossor).
- 1 100 volt high-tension battery (Lissen).
- 1 9 volt grid bias battery (Lissen).



The wiring diagram.

SIMPLE TESTS WITHOUT INSTRUMENTS

By W. B. R.

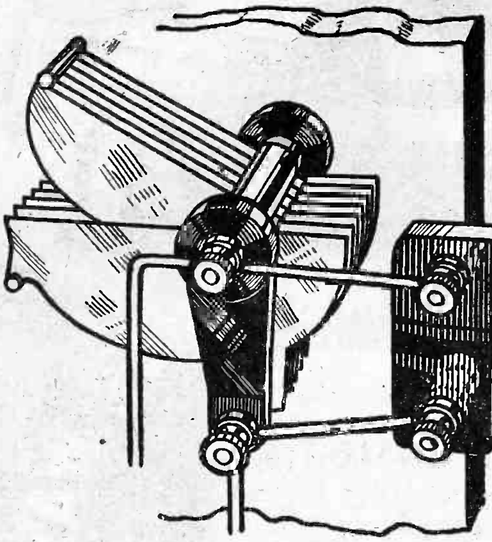


Fig. .—Fixed condensers under test are connected across the aerial tuning condenser.

Checking Capacity of Small Condensers

THE value of small condensers up to about .0004 or .0005 mfd. can readily be checked if you have on hand one or two condensers of known value. The method is one of substitution, the idea being to compare the effect on the tuning of your set of first the condenser of known value and then those of unknown value. This method is also very useful if you are making your own fixed condensers and wish to have the capacities correct. It is easier and at the same time more accurate than trying to make them up to certain values by formula alone. Making a condenser by formula means cutting the foil to exactly the right size, using mica or paper of exactly the right thickness (usually entailing the use of a micrometer) and finally making perfect contact between the layers. Unless this is done the resulting value is likely to be very uncertain and can easily be two or three times too large or too small. However, by the method to be described, such very great care need not be used in construction, since the values can be checked before the condenser is finally sealed up or mounted. Any adjustments necessary can then be carried out by adding or removing plates.

The *Modus Operandi*

Say you have a grid condenser marked ".0003 mfd." which you wish to check. What you do is to connect a good quality .0003 mfd. fixed condenser (one which is guaranteed accurate by the makers), across the aerial tuning condenser of your set, as in Figs. 1 and 2. Then tune in a fairly loud station, if possible somewhere near the centre of the dial. Note the dial reading and remove the condenser. In its place connect the condenser to be tested. If this has *exactly* the same value as the guaranteed one, the tuning will be unaltered, but if not the dial will have to be readjusted to bring in the same station as before. If the reading has to be increased the second condenser is of *smaller* value than the first, if decreased, then it is *larger*.

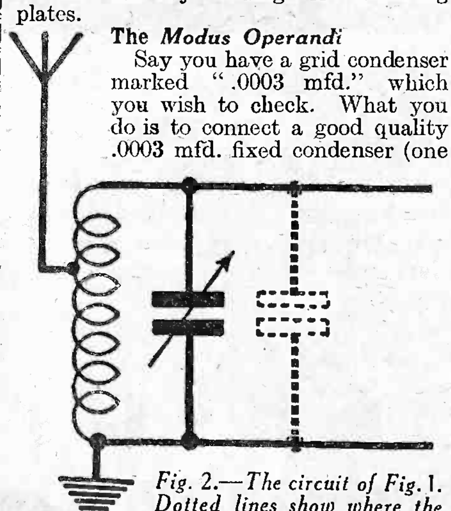


Fig. 2.—The circuit of Fig. 1. Dotted lines show where the condensers of known and unknown value are connected.

When making a home-made condenser it is best to build it up layer by layer, checking it each time a layer is added until the station is tuned-in in the right place. When nearing the correct value it may be found that the addition of another layer will carry its capacity above the required value, although it is too small without it. To make it exact you can either cut the last piece of foil so that there is less overlap or put a slightly thicker piece of mica between two of the sheets of foil.

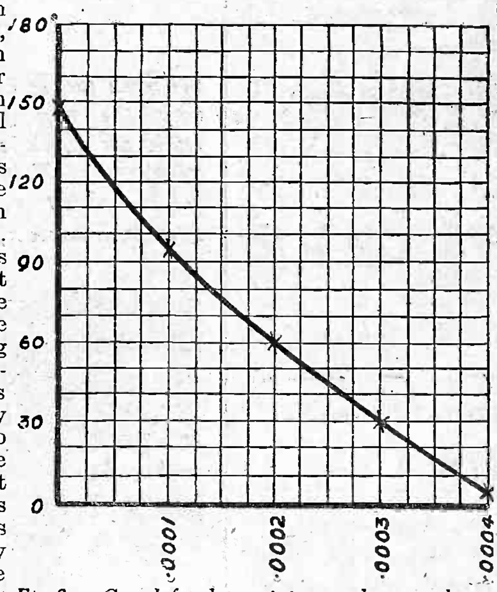


Fig. 3.—Graph for determining condenser values.

It may happen that you want to know more than just whether a condenser is larger or smaller than one of known value. You may want to know by how much. In this case it is best to plot a graph. Get several condensers of known value, say, a .0001, a .0002, a .0003 and a .0004 mfd. and connect each one in turn across the tuning condenser. Tune-in to the same station each time and make a note of the various settings. The station chosen will have to be one which normally tunes near the top of the tuning scale (tuning condenser nearly all in), otherwise when the larger fixed condensers are connected up it will be impossible to tune down far enough to get it. When the dial setting for each condenser has been obtained, they are plotted on squared paper, as in Fig. 3. The plotted points are joined by a line as shown. This is usually a curve. Once the graph is made, the valve of any condenser up to .0004 mfd. can be read off in a moment. Suppose, for example, a condenser of unknown value was connected up and the chosen station tuned-in at 50 degrees. If you follow across from 50 on the graph till you strike the curve and then follow down to the microfarads scale you will strike it at about .000225 mfd.

Larger Sizes

It is obvious that this method is limited to condensers up to about .0005 mfd. as the placing of larger condensers across the aerial coil would considerably reduce signal strength besides taking the tuning range into a region above the ordinary broadcast limits where it is often difficult to find a suitable station to which to tune.

Testing Polarity with Neon Lamp

A quick and convenient way of testing the polarity of D.C. mains is to plug in one of the neon lamps or electric night lights shown in Fig. 4. It will be noticed that it has two electrodes. One is a wire spiral shaped like a beehive and the other is a flat metal disc inside the spiral. When connected to a D.C. supply either the spiral or the disc glows, but not both. The one which glows is the one connected to the *negative* pole. A glance at the wires passing from the electrodes through the "pinch" show to which of the contacts each one is connected. The contact leading to the glowing electrode is the one which connects with the negative plunger in the lamp holder.

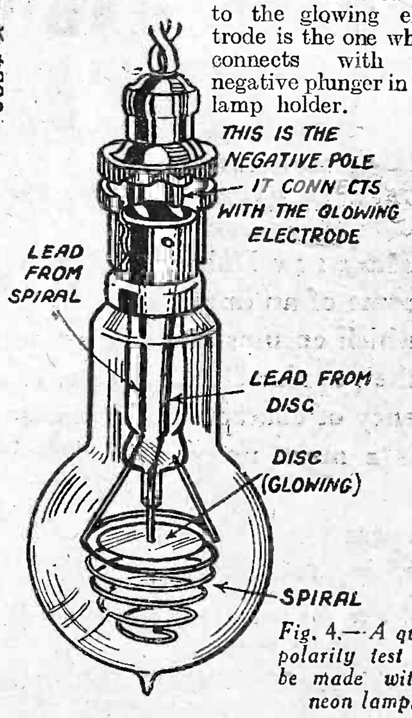


Fig. 4.—A quick polarity test can be made with a neon lamp.

THE BEGINNER'S SUPPLEMENT

HOW YOUR RECEIVER WORKS—III

By FRANK PRESTON, F.R.A.

(*Continued from page 960, Sept. 16 issue.*)

Variable-Mu

The functioning of a variable-mu is not greatly different from that of an S.G. valve, but its control grid is supplied with a steady negative potential in addition to the oscillating potential representing the incoming signal. The steady potential is derived from a grid-bias battery through the medium of a potentiometer connected as shown in Figure 12, so that the actual amount of grid bias may be varied between the maximum of the battery and zero. As the negative grid-bias voltage is increased the current flowing to the anode is, of course, reduced, and in addition the valve becomes less "sensitive." Why does it become less sensitive? To appreciate the reason we must think in comparative terms; if the grid is already receiving a voltage of, say, two or three volts it is fairly clear that the effect of the few millionths of a volt of signal currents will be less significant than if the initial grid potential were zero. It will be seen in the same way that the higher the bias voltage, the smaller will be the effect of the signal voltage, and therefore the less will be the response of the valve to it. By varying the amount of steady grid potential we can regulate the sensitiveness of the valve, and the potentiometer therefore serves as a volume control.

In the circuit of Fig. 12 a fixed condenser is joined between the "lower" end of the tuning coil and high-tension negative, its object being to allow the free circulation of oscillating, or high-frequency, currents, and at the same time to prevent a short-circuit of the grid-bias supply.

The H.F. Coupling

As we have already seen, the output from the amplifying valve (whatever its type) is in the form of an oscillating voltage which appears between the ends of resistance R connected in its anode circuit. This voltage is an exact copy of that across the aerial tuning circuit, but is of much greater magnitude. We can either amplify it still further by the use of another high-frequency valve or we can rectify it. Since the function of a second H.F. valve would be precisely the same as that already considered, we will assume that the second valve is to be a rectifier, or detector.

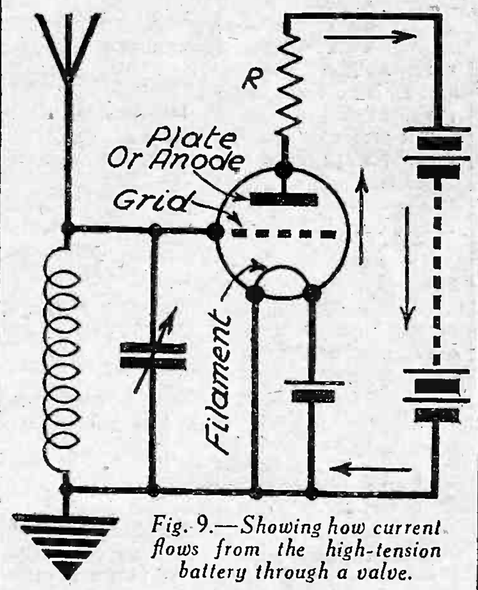
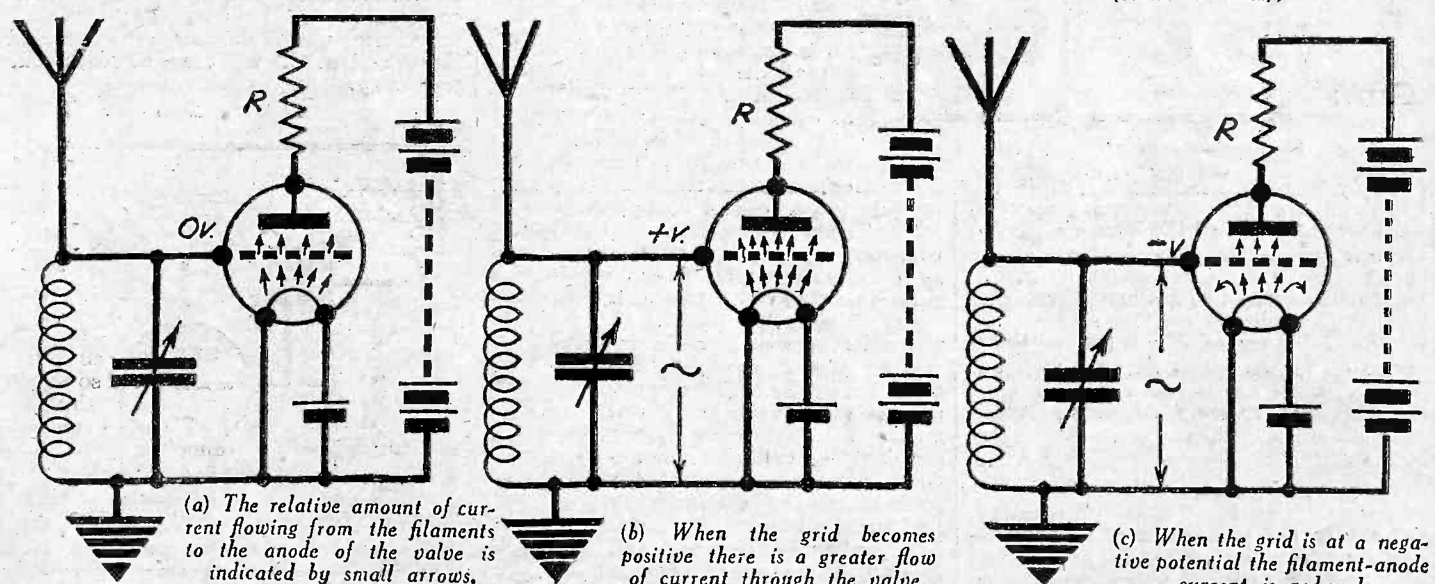


Fig. 9.—Showing how current flows from the high-tension battery through a valve.

There are various ways of feeding the amplified voltages to the detector, so perhaps we had better examine each in turn. One way, which is never used at the present time, is to connect one end of the resistance we have called R to the grid of the detector as shown in Fig. 13 (*a*). At first sight it is a little difficult to see how the voltage developed *across* R can be applied to the second valve by taking a connection from one end only, but on reflection it will be understood that the other end of the resistance is connected to the filament of the second valve, *through the H.T.* supply, as shown by a heavy line. The object of the condenser marked C is to pass on oscillating or high-frequency currents whilst preventing the high-tension voltage from being applied to the detector as excessive positive grid-bias. This form of coupling, known as resistance-capacity, is not by any means efficient, since if the resistance is of sufficiently high value to develop a maximum oscillating voltage across it, it will at the same time cause a large drop in the high-tension voltage reaching the anode of the first valve. It is clear that what is required in place of the resistance is some component that will have a high resistance (or impedance) to oscillating current and a low one to direct current. A high-frequency choke fulfils these conditions, and is connected as shown in Fig. 13 (*b*). Choke-capacity coupling is used in practice, but not to any great extent due to its comparative inefficiency. One reason is that the impedance of a choke differs according to the frequency of the current passing through it, and therefore its efficiency varies tremendously as the frequency changes.

But there is another very important reason why neither of the above systems of H.F. coupling are efficient, and this is because the capacity between the anode of the first valve and earth (by "earth" we mean in this case any point which is at low potential in respect to H.F. currents, such as H.T. positive or H.T. negative) is always sufficiently high to permit of an appreciable leakage of signal current unless some method of counteracting it can be

(*Continued overleaf*)



(*a*) *The relative amount of current flowing from the filaments to the anode of the valve is indicated by small arrows.*

(*b*) *When the grid becomes positive there is a greater flow of current through the valve.*

(*c*) *When the grid is at a negative potential the filament-anode current is reduced.*

Fig. 10.—Showing the relative amounts of current flowing through a valve when the grid is at (a) zero potential, (b) positive potential, and (c) negative potential.

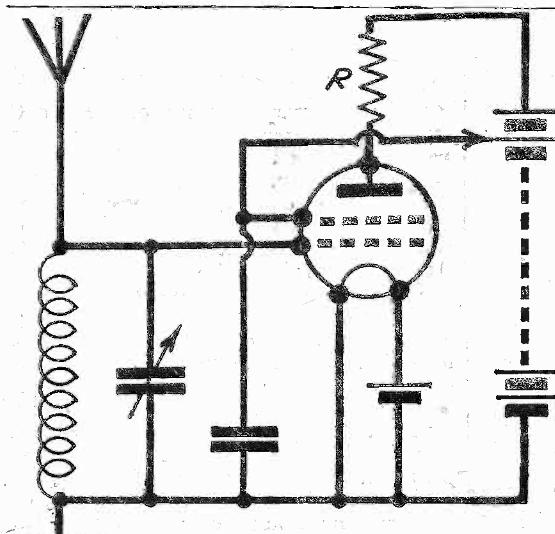


Fig. 11.—The connections of a screened-grid valve.

THE BEGINNER'S SUPPLEMENT

(Continued from previous page)

found. It is not only the actual capacity of the valve which causes the trouble, but the inevitable capacity between connecting wires and between the terminals of the coupling components themselves. This capacity is certainly small in amount, but is sufficient to cause a large and measurable loss in efficiency. Expressed in terms of impedance the capacity is often equivalent to only 5,000 ohms or so, and being in parallel with the coupling component we have called R, the impedance, and in consequence the efficacy, of the latter is reduced very considerably. The

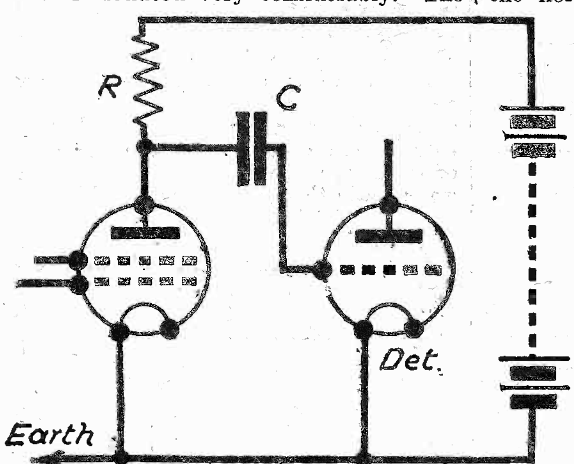


Fig. 13 (a)—Connections for resistance-capacity H.F. coupling.

impedance of a capacity varies in proportion to the wavelength of the currents passing through it, and thus the capacity is of less consequence at higher wavelengths. In point of fact, the two systems of coupling we have considered can be made to be fairly satisfactory on long wavelengths (in excess of 2,000 metres, for example), but as such waves are not now employed for broadcasting purposes, resistance and choke-coupling are of little use to us.

Tuned Anode

We previously mentioned the possibility of counteracting the "leakage" capacity, and this is not so difficult of accomplishment as might first appear. The electrical opposite of capacity is inductance, and so if we connect a coil of suitable inductance in parallel with the capacity we can nullify the effects of the latter. In other words if we were to replace our H.F. choke of Fig. 13 (*b*) by a variable inductance, we could balance out the capacity at any particular wavelength. Now a variable inductance presents many mechanical difficulties and so we achieve the same result by adding a further variable capacity (in the form of a variable condenser) and using a fixed inductance. This brings us to a particular arrangement where we have what is known as the tuned-anode circuit. By adjusting V.C. the combined capacities of the "strays" and V.C. can be brought to such a value that they are exactly neutralized, as it were, by the inductance; in consequence the losses are overcome and we have an efficient coupling circuit between the first two valves. The tuned circuit of V.C. and L. is actually almost identical with that connected between aerial and earth but, as we have seen, its purpose is somewhat different.

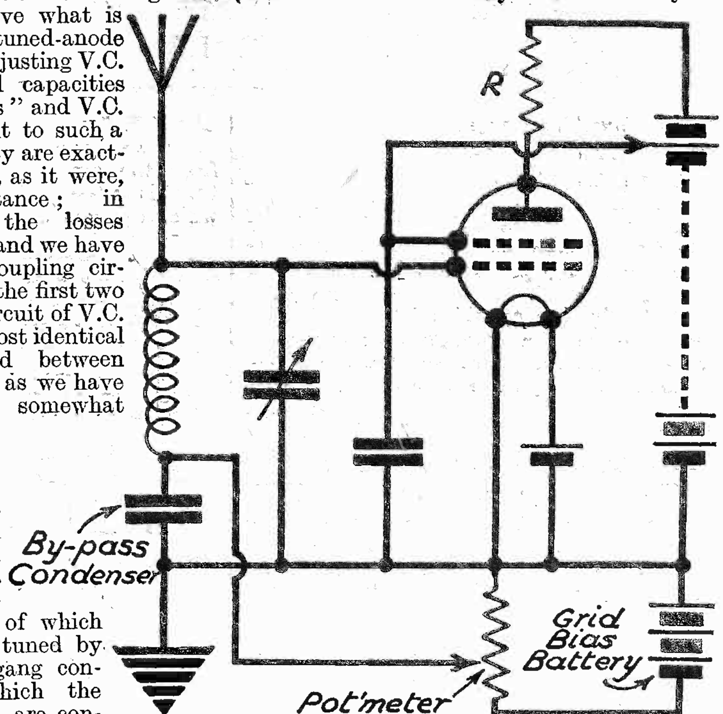


Fig. 12.—How a variable-mu valve is connected.

Tuned Grid Coupling

The tuned anode circuit, although perfect in theory and in performance, has some mechanical disadvantages, the chief of which is that it cannot be tuned by the normal type of gang condenser of which the moving vanes are connected to H.T. negative. It is principally because of this that tuned anode coupling is not extensively employed. But by making what is really a very slight alteration it can be converted to the tuned-grid circuit (to be shown next week). In this case the tuning circuit is connected, through condensers C, from the anode of the S.G. valve to H.T. negative instead of to H.T. positive. The function of the tuned circuit is precisely the same as before, since both sides of the H.T. supply are at the same *high frequency* potential. An H.F. choke is used to carry the anode current supply to the first valve and it also serves to divert the high-frequency currents from the high tension to the tuned circuit comprising L and V.C. The moving vanes of the tuning condenser are now connected to earth and so the condenser may be one section of a ganged unit, of which the other tunes the aerial circuit.

We have seen how the incoming signal voltages are amplified by the high-frequency (S.G. or V.-M.) valve and passed on to the inter-valve tuning circuit. The voltages now appear across the ends of the second tuning coil and are ready for further use. They still consist of a mixture of high and low-frequency oscillations and are not therefore suitable for operating a sound-producing system. Before they can do this the low-frequency, or audio-frequency, portion must be separated from the high-frequency fluctuations which comprise the carrier wave. In other words we must reverse the process which takes place at the transmitting station where the current fluctuations representing sound frequencies are impressed upon the carrier.

Rectification

This process is known as rectification or detection and is usually carried out by a three-electrode valve. There are four general methods of rectification, which are known respectively as "grid leak," "power grid," "anode bend" and "diode," but only the first two are now in general use. Both are very similar in principle so we will consider them jointly.

The process of rectification, as performed by a valve connected on the leaky-grid principle is somewhat involved, since there are several different actions taking place at once. However, I do not think we shall experience much difficulty in following these actions if we examine each one separately.

(To be continued.)

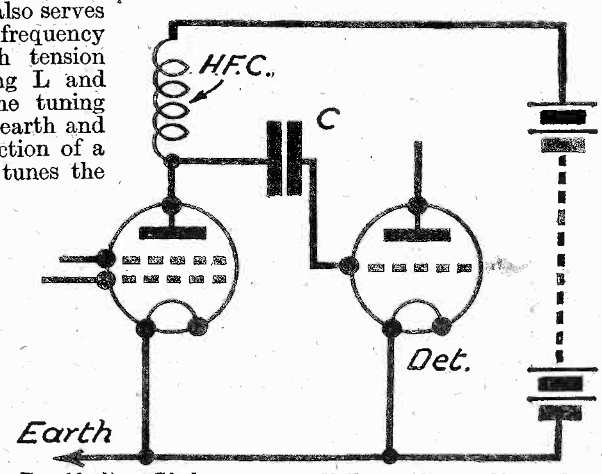


Fig. 13 (b).—Choke capacity H.F. coupling. Heavy lines show how one end of the coupling component is connected to the filament of the detector valve.

FROM THE FLASHLAMP

By Photon

A High Resistance Potentiometer.

A USEFUL adjunct to an experimental outfit is a high resistance potentiometer, such as may be used as a variable grid leak or a means of volume control or a similar purpose. One important attribute of a potentiometer or variable resistance for any high-frequency circuit is low electrostatic capacity, and many of the potentiometers on the market are not too good in this respect.

An old method of improvising a grid leak, at one time very popular with the amateur, was to draw a line with an ordinary black lead (plumbago) pencil on any suitable insulator such as ebonite, porcelain, or ground glass, or even on a strip of paper; sometimes the resistance so formed was protected by a coat of varnish or lacquer, sprayed on or carefully applied by means of a soft brush. A resistance constructed in this manner is quite able to serve its purpose, but it is not permanent and is only fit for use in an experimental set or "lash up." One advantage of such a grid leak is that its electrostatic capacity may be made very small, and by choosing a suitable "support," and being as sparing as possible in the quantity of insulating material used, the parasitic dielectric losses may be kept down; this is important in an H.F. stage.

It is difficult to say why a resistance or grid leak of this kind is not permanent, and it is difficult to believe that any slow burning away or oxidation of the graphite takes place; the temperature cannot be high enough for normal combustion, and there can scarcely be anything in the nature of electrolytic action. Nevertheless the resistance is not permanent, and its constancy is ever suspect; perhaps a change in the surface condition of the dielectric may result in some kind of separation of the graphitic particles. So far as the writer knows, the matter has never been thoroughly investigated; it might be well worth while experimenting with various dielectrics and methods of "fixing" the graphite streak. The convenience of being able to prepare grid leaks or resistances as and when required would probably justify the labour. The current such a resistance can safely carry is, generally speaking, small, but obviously several lines can be drawn in parallel and so this objection can be easily met.

In solving a problem involving differential reception it became necessary to devise a potentiometer of minimum capacity and high resistance, and the use of a graphite streak suggested itself as a possible solution. The obvious difficulty is that any rubbing contact would tend to destroy the continuity of the streak (pencil line) and so vary or increase the resistance to an unknown extent. The method adopted to overcome this objection was simplicity itself, the tap or contact was itself made of graphite, in fact it was constituted by a piece of "refill lead" of a pocket pencil, and this laid its own track and maintained it. After several movements of the arm carrying the pencil contact, the graphite streak (a semicircle) became "formed" and tended towards a stable condition, when the resistance became reasonably constant.

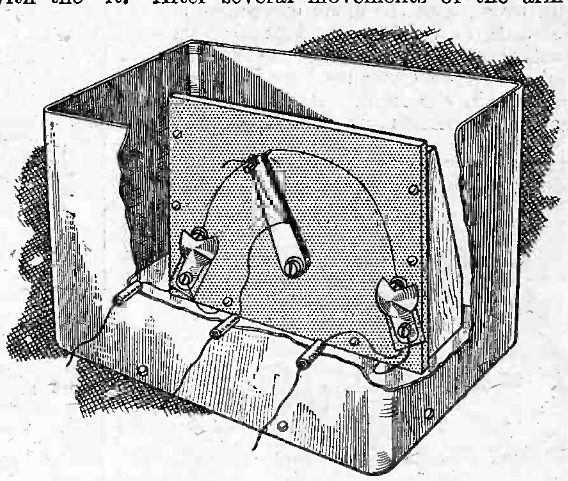
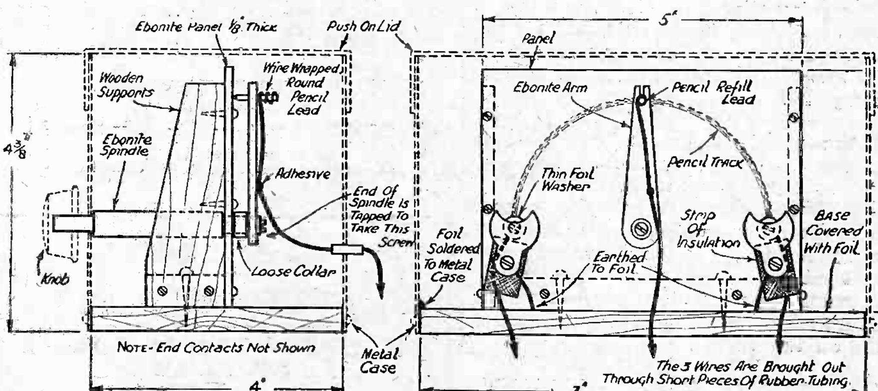


Fig. 1.—Sectional view of the complete instrument.

The complete potentiometer is illustrated in Fig. 1, which shows the interior, while Figs. 2 and 3 show the general arrangement of parts and connections. To avoid interferences the potentiometer was mounted in a screen box (earthed) as shown in Fig. 1.



Figs. 2 and 3.—General arrangement of parts and connections.

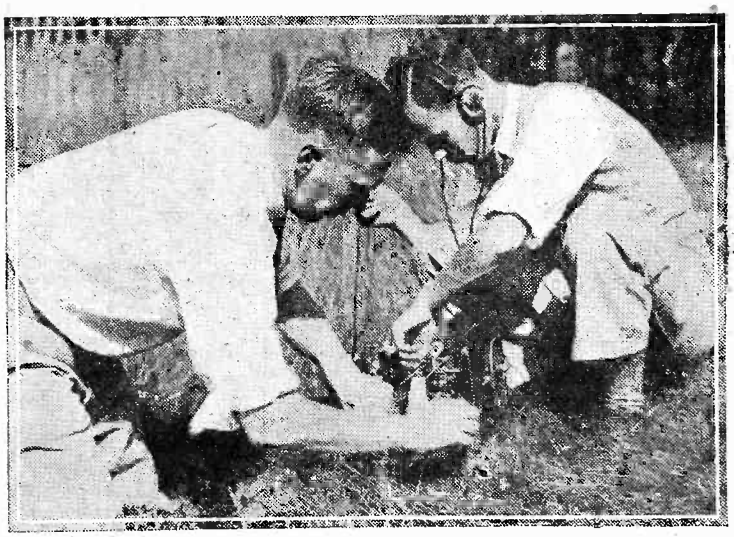
RADIO RAMBLINGS

By JACE

Jottings from my Notebook

American M.W. Reception!

FOR the last two weeks I have been receiving some of the medium-wave U.S.A. stations and suggest that you should sit up one evening and have a "go" for them. Recently I have been too busy to attempt such reception myself, but I am pleased to say that up to the time of writing these notes I have been able to spare an hour between 12.30 and 1.30 a.m. This was on the night of September 10th (or more correctly, the morning of the 11th), and although using a Det.-2 L.F. receiver I was able to obtain fairly good speaker reception from Pittsburg KDKA on 306 metres and Schenectady, WGY, on 379.5 metres. As I have just said, I commenced to listen at 12.30 a.m., and by taking the tuning position of North Regional as a guide I was very soon able to tune in KDKA. The announcements which were being made did not come in too well and the transmission suffered from high speed fading. So at about 12.45 a.m. I tried for WGY, the station operated by the General Electric Company of America, taking the tuning position of the Scottish Regional (376.4 metres) as a guide. After a little juggling with the reaction and tuning condensers I was able to hear two comedians in a kind of "back-chat" item, but reception was very weak and subject to a good deal of fading. Having located these two stations, however, I made a mental note of the dial settings and kept changing from one to the other. Neither was received really well before 1 a.m., but after that conditions gradually improved until I finally switched off. Atmospheric conditions were far from good and at times signals were entirely drowned by static, but I was satisfied that the reception of these stations was possible. Had I stayed up a little longer I have no doubt that reception would gradually have improved, but I knew that I must be up in good time for work and so, against my will, went to bed at 1.30.



SHORT-WAVE WIRELESS TESTS ON SHOOTERS HILL.

Photo shows: Two members of the International Short-Wave Wireless Club who camped on Shooters Hill (London), the highest point in the Metropolis, during the week-end, in an effort to secure a record five-metre reception of 200 miles from Snowdon, the previous record on this wavelength being 130 miles.

M.C. Speakers with Battery Sets

WHILST I was in a wireless shop the other day a customer came in and asked for a demonstration of a few loud-speakers. He was allowed to hear six or seven and decided that he liked the fifth one best of all. Before purchasing it he asked the assistant for a full specification (he already knew the price and thought it most reasonable). On being told that it was a permanent magnet moving coil, the customer looked horrified and declared that it would be no use to him because his set was battery-operated and he could not afford to be constantly buying new H.T. batteries. I was rather puzzled by this statement, but the assistant had evidently run up against the same complaint before. He tried in vain to convince his would-be customer that the moving-coil speaker would not affect the consumption of high-tension current in the least. After the customer had left, without making a purchase, I asked the assistant for an explanation. Apparently there are numerous listeners who think that a moving-coil speaker, especially if it happens to look big, causes a heavier drain on the high-tension battery. Of course, the idea is entirely wrong, and I cannot think how it can have originated. The current consumption has nothing whatever to do with the speaker but depends entirely on the valves.

NEXT WEEK!

ANOTHER FREE GIFT SPANNER

Have *YOU* Reserved Your Tool Kit Yet?

See pages 31—33 of this week's issue.

CONDENSER SPINDLE EXTENSIONS

By V. W. GREENHALGH

SOONER or later most experimenters feel the need for some kind of insulated extension for variable condenser spindles. Such an extension is very useful in short-wave work where hand-capacity effects are often a nuisance.

There are many good extension spindles with insulated couplings on the market, but none of them are cheap ; so perhaps a description of an insulated extension spindle which is at once cheap and efficient may be of interest.

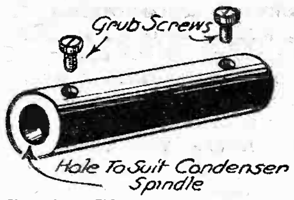


Fig. 1.—The insulating piece made from ebonite rod.

The insulating piece, Fig. 1, is made from ½in. diameter ebonite rod. A 2in. length of this is used, and a hole drilled through the length of it with a ¼in. drill. This hole must be true and great care must be taken in drilling it. It does not matter if the hole is not quite parallel with the sides of the tube, but the hole itself must not waver or change direction at all.

Perhaps the best way of doing this is to clamp the hand-drill to the bench so that it lies parallel to the bench top and far enough above it to allow of easy working. Cut a straight, shallow, V-shaped groove in a piece of timber, and lay it on the bench so that it is exactly in line with the drill, then fix it in this position either by clamping or nailing to the bench. Now place the ebonite rod in the groove and feed it up to the drill with one hand whilst working the drill with the other.

Two small holes will have to be drilled at right-angles to the longitudinal hole to take the fixing screws. These holes should be rather less in diameter than the screws they are to take, in order to allow for the thread.

If no taps are available, the screws themselves can be used as taps, since the ebonite is soft enough to be tapped in this way. Slightly countersink the holes to

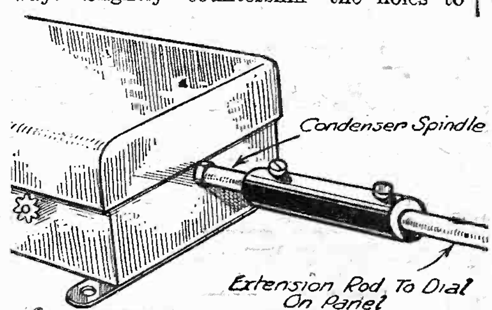


Fig. 2.—Showing the insulating sleeve connecting the condenser spindle and extension rod.

start the screws, and then force them in slowly but firmly with a screw-driver, taking care that they are kept vertical. Ordinary brass screws may be used if desired, but steel grub-screws are better, and can be bought for about a penny a pair at any ironmonger's.

The condenser spindle goes into one end of the tube, and is secured by the grub-screw, and a piece of ¼in. brass rod, cut to suitable length to connect with the dial, fits in the other end, as depicted in Fig. 2.

DON'T PERPETUATE RADIO FALLACIES

(Continued from page 30)

Class "B" valve, for here the anode current, when no signals are being received, is very small, and it rises as the signal voltage applied to its grids is increased.

Another wrong idea about the output stage is that if a super-power valve is fitted the volume of sound will automatically become greater than when a power type valve is used. Nothing could be more erroneous. Actually, for a given signal input a power valve will give a greater volume of sound than a super-power valve because of its higher amplification factor. A power valve, however, can only handle without distortion comparatively weak signals, and if, in order to increase volume, big grid swings are applied, bad distortion is sure to result. The main advantage of a super-power valve is that it has a longer working grid base, that is to say, it will handle without distortion much bigger incoming signals than a power valve, and is therefore not so readily overloaded.

As the maximum signals corresponding to the loudest passages in a programme are some four to five times greater than the average signal from a given station, a small-power valve is very apt to blast and distort when a loud passage occurs. This risk is not so great with a super-power valve, so this type should be used when really good quality is required.

On the other hand, because a super-power valve has a greater acceptance than a small-power valve, it can give for a given percentage distortion a larger volume than a power valve, providing you have a sufficiently strong signal voltage to apply to it. The increased volume, however, will not be in the same proportion as the increase in grid signal voltage, because usually the super-power valve has a considerably lower amplification factor than a power valve, which is designed primarily to give the largest output possible from a fairly small input compatible with reasonably good quality.

LEARNING THE MORSE CODE

(Continued from page 22)

several accented letters, but I have not given these, since they are very seldom heard and there is quite enough for the beginner to do in mastering the English letters. Also there are various punctuation signs which are used; it will perhaps be as well to mention the more common of these:—

Preamble — . — . — (sent once at the beginning of a transmission)

Break sign — . . . — (used by amateurs very much as a full stop)

Query (?) . . — — . .

Exclamation mark (!) — — . . — —

Other groups of this kind consist of one or two letters run together, without a break between them, and are usually referred to by the constituent letters, as for example, . . . — — — . . . the distress call, popularly known as S O S. Others commonly heard are the end of message sign . — . — . (AR) and the end of work signal . . . — . — (SK).

Lastly I must warn readers to remember the clause in their licence which forbids anyone to reveal the contents of any message intercepted by them to anybody other than a duly authorized official of His Majesty's Post Office.

CUTTING LARGE HOLES IN EBONITE

By J.M.D.

FACED with the necessity for cutting a large circular hole in an ebonite panel, many amateurs will drill holes all round and use the file to smooth up the inside edge. Using the same equipment—a small hand brace and drills—a quicker and neater job can be produced by adopting the following method.

Make a jig from a small strip of wood by drilling two holes as shown in the accompanying illustrations, one to take a centre-pin (a drill shank will do) round which the jig rotates, and the other to take a guide bush, which may be simply a screwed socket. Drill the hole for the guide bush first, push the latter home, then mark off the radius of the hole to be cut from the outer edge of the hole in the bush—see dimension X in Fig. 1. This ensures that the centre-pin hole will be accurately spaced. To avoid marking the panel, the underside of the strip should have clearance filed at both ends.

To use the jig, drill a hole in the panel for the centre-pin, and place the jig on the panel with the pin through the hole. Fix a collar to the drill in the hand brace at such a height from the point that, when lowered through the bush, it allows the drill to be fed down into the ebonite a short distance (see Fig. 1).

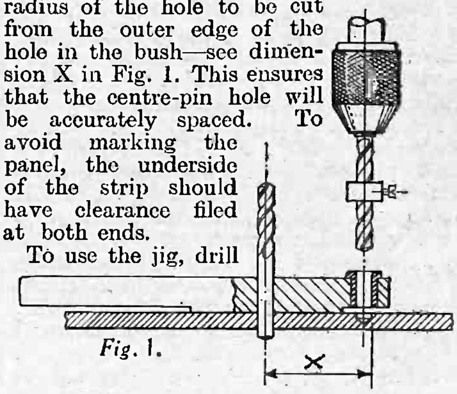


Fig. 1.

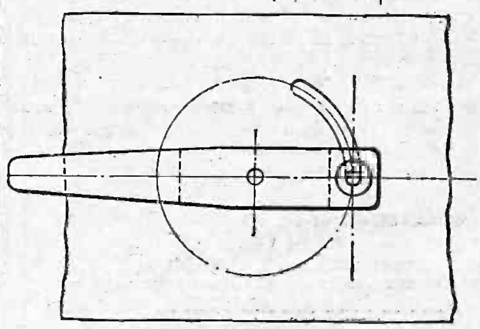


Fig. 2.

Diagrams illustrating the method of drilling large holes in ebonite.

To operate the device, get someone to slowly turn the jig round the centre-pin whilst the drill, with the collar resting on the top of the guide bush, is revolved fairly rapidly. Fig. 2 shows the groove made after travelling a short distance. After once round, sink the drill a further amount and repeat. Then turn the panel over and cut from the other side. After two or three times round the centre piece will fall out, and the slight fin left can be removed with a pocket knife.

ANOTHER STEEL SPANNER, TO COMPLETE THE SET, FREE NEXT WEEK!

NEW MULLARD HIGH-VOLTAGE OUTPUT VALVE

WHERE it is desired to get the very best out of the broadcast programme, it is essential that the output valve should be capable of delivering a really high undistorted output. This term is constantly occurring in reference to output valves, and there would appear to be some misconception among amateurs as to the precise meaning of the term. Another point which seems to cause confusion is the actual value of this output, as it is often stated that for real quality an output of 5 watts is desirable, whilst the average two-volt power valve only delivers a power in the neighbourhood of .3 or .4 watts. The following explanation may help to solve the difficulty, and will tend to show why these large super-power valves are necessary in delivering really high quality programmes.

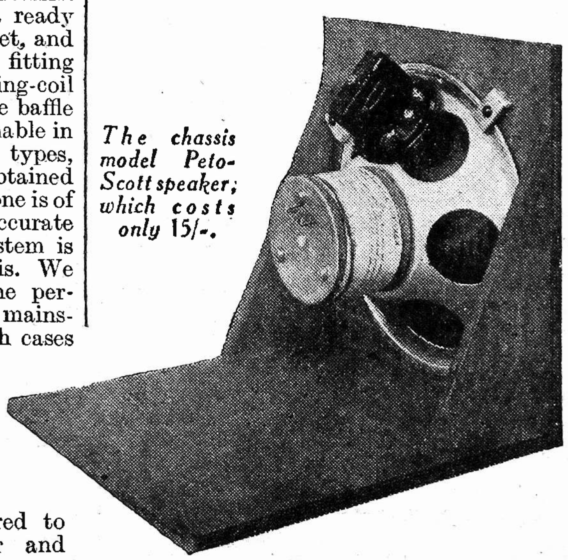
The B.B.C. transmissions are radiated at a certain strength, and while over a very large proportion of programme time a certain average value is maintained, this strength is greatly increased (perhaps to five or six times the average) when specially loud passages occur in the items being broadcast. In other words, while the radio-frequency power transmitted from a station is constant, the audio-frequency modulation varies in accordance with the programme. It is important, therefore, that the output valve in a radio set should be able to handle these extra loud passages without introducing distortion. For all normal purposes the usual triode or pentode output valves provide ample "overload capacity" for domestic reception, but those listeners who require super-excellent quality, combined, perhaps, with rather more volume than that given by the average sets, can use in the output stage of an A.C. mains receiver or radio-gram one of the larger valves giving maximum undistorted outputs of 5 watts and upwards. These valves, it should be noted, require anode voltages ranging from 400 to 500 volts.

There are many such valves obtainable, and one of the most popular domestic valves which has been available for some time now was the Mullard D.O.25. This valve had the remarkably low impedance of 800 ohms, and required 400 volts H.T. with a filament rating of 1.1 amps at 6 volts. This latter requirement prevented many listeners from taking advantage of the volume obtainable from this type of valve, as it necessitated a special transformer winding to deliver the 6 volts, or a separate accumulator had to be used. In accordance with the Mullard policy of producing a Master Valve for every purpose, experiments were carried out in order to improve this particular valve, and bring it into line with the more general type of mains-operated valve. The results of these experiments are embodied in the new D.O.26, and the valve is certainly superior to its predecessor. The H.T. voltage remains at 400, but the filament has been converted into one of the 4 volt 2 amp. type, with the additional improvement that the internal resistance of the valve has been reduced to 600 ohms. This results in an improvement of the conductance which now stands at 6.3 mA-volt. The grid bias required at maximum working voltages is 92 volts when the anode current is of the order of 60 milliamps. Enormous signals may be handled by this valve, the total input capacity being 65 volts R.M.S. This valve will undoubtedly do much towards bringing better radio to many of the keener amateurs who do not mind the high rating of the H.T. supply, and to those who do not think such voltages and valves are justified, we would heartily suggest that they take an early opportunity of hearing a receiver or amplifier working under these conditions. We are confident that they will have a pleasant surprise.

The latest Valve Guide issued by the same firm contains most interesting details of many other valves, both of this high-powered type and for the ordinary small battery receiver.

NEW PETO-SCOTT SPEAKER

AN interesting speaker is illustrated herewith, and is supplied by Messrs. Peto-Scott. As shown, it is ready for mounting into any type of cabinet, and many of the difficulties of correctly fitting one of these heavier types of moving-coil speakers are overcome by this simple baffle mount. The actual speaker is obtainable in permanent magnet or field-wound types, and the transformer fitted may be obtained for any type of output valve. The cone is of the corrugated type, with a neat, accurate centring device, and the magnet system is mounted rigidly on the metal chassis. We have tested two types, one of the permanent type and one with a mains-excited field, and the results in both cases were certainly very good. Speech was bright and forward, whilst musical items had all the characteristic timbre of the original instruments. Even when grossly overloaded, the distortion was not of the type which makes listening really unpleasant, and this appeared to be due to the particular spider and surround which was fitted. The sensitivity is not quite so great as our standard, but is sufficiently good to enable really good results to be obtained with a two-valver using a suitable output valve. The speaker is obtainable in the chassis form or in a neat cabinet.



The chassis model Peto-Scott speaker; which costs only 15/-.

By E. REID-WARR

A Dramatic Episode in Music

AMONG the bigger orchestral pieces under review there are perhaps only two which are conceived and done on the grand scale. First of all I want to mention *Liszt's Mazeppa Symphony* on three half-a-crown *Parlophone* records (*R*1579-1581). The subject has been a favourite one of painter and poet, and here we have the musical presentation of the story. Mazeppa, tied to the back of an untamed horse, is borne across the plains, until rescue comes only at the point of death. The music portrays it all with a realism that makes the present technique of cinema music seem somewhat crude. View it as you will—as noble music or as a musical drama played on a vast background—it remains still great. The Mazeppa thematic air, here and there, persisting against the noise of the horse's hoofs is impressive to a degree. Finally, the rescue, and then Liszt lets himself go. Yes; you should hear this piece, nobly played by the Berlin Grand Symphony Orchestra, and, if you please, read Byron's poem first. Then you *will* enjoy it.

Lighter Fare from Mozart

Next, the *Concertante Sinfonie for Violin and Viola* (*K*364) on *Columbia DX*478-481. First, do not imagine that the two soloists (Sammons and Tertis) are awarded the lion's share of the performance. The orchestral part (played by the London Philharmonic Orchestra), occupies the stage a great deal. This composition is Mozart on the grand scale and yet in the Rondo movement we get the delicate, intimate touch of which he was so great a master. But the whole work is one of his finest, for his own prowess with the violin has enabled us to hear a work in which this instrument plays some beautiful passages. The recording is a superb bit of craftsmanship, and the placing of the microphones uncannily accurate. Altogether a treasure to keep for your delight.

Lighter Still

A very welcome addition to the "afternoon tea" music, albeit *real* music, is Beethoven's famous *Menuett in G*, and the *Entr'acte Gavotte from Mignon* on *H.M.V. B*4466. These make a perfect coupling, the more so as they are played by Marek Weber's Orchestra. Altogether delightful, this. Then another—the *Overture to the Secret Marriage*, by Cimarosa. Here is very sprightly music with, it seems, an abundance of quips. The Berlin Philharmonic go merrily through it on *H.M.V. DA*4404. Entirely on a different plane, but suitable for the same occasions, is a potpourri played by Edith Lorands' Orchestra on *Parlophone R*1586. This is *Vienna Memories*, and it is by no means a collection of the hackneyed pieces one might expect. There are two bits of very good marches, for instance. Another to be commended—also by *Parlophone* (*R*1586) is *Love's Joy and Sorrow* and *Fairy Tale of Love*. Here the Orchestra Mascotte (in which everybody seems able to play at least three instruments), give a very cheery little performance. Then one from *Columbia*. I know this mention will cause a smile from our young moderns, but there is something very attractive about J. H. Squire's Celeste Octet's playing of *Silver Threads Among the Gold* and *My Sweetheart When a Boy*. The Aunts and Uncles will love it. The number is *DB*1155. Lastly, a real up-to-the-minute attraction—*Here's the Circus* and *A Song Goes Round the World*, on *Parlophone R*1587. One of the best recording dance bands on the continent—the Bravour—are responsible.

. . . Where They sing

Not many vocal hits to write of in this list, but there are one or two which are very tempting. The one I liked far and away the best is by a Children's Choir—that of St. Mary's School, Bridgnorth. I believe they average about twelve years, but their training must have been the work of an artist. Hear *The Lass With The Delicate Air* and Handel's *Oh! Had I Jubal's Lyre* on *Columbia DB*1166. From every standpoint—vocal, enunciative, artistic—the performance is a real gem. In the Handel piece, their "runs" are taken with the confidence of highly trained adults. This kind of record is scarce—hear it. I like Essie Ackland's *Song of Sleep* on *H.M.V. B*4465. It is a beautiful song, musically and poetically. The other side, *Danny Boy*, is hardly new (!) but many people collect it, I believe. It's very well done. Here is a queer choice—Tauber singing *My Curly Headed Baby* (*Parlophone RO*20223). In German, the song sounds equally attractive, and he *does* sing it as a lullaby. The other side, *The Ratcatcher's Song*, is not attractive, unfortunately. Norman Allin is very good in W. S. Henley's *Invictus* and *The Blind Ploughman* on *Columbia DB*1157.

A New Pianoforte Star

When a comparatively unknown pianist arrives at the studio to make a record at her own expense, the recording manager is not unduly thrilled. But in a certain case the "play-back" of the record left him a very excited man. This happened when Eileen Joyce recorded the Liszt *Etude de Concert in F Minor* amd *Etude de Concert in A flat Major*, by Paul de Schloger. Each piece is of the "brilliant" type. The performance is flawlessly certain, every note a clear, identifiable unit. For those who want something really *thrilling* in piano playing I commend *Parlophone E*11237.

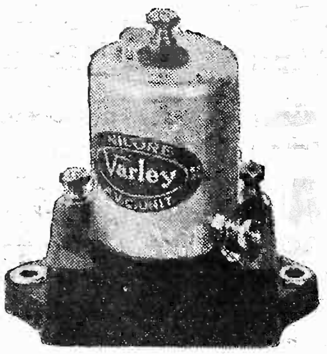
Facts and Figures

Components Tested in our Laboratory

BY THE PRACTICAL WIRELESS TECHNICAL STAFF

NICORE A.V.C. UNIT

THE method of overcoming fading by including what is known as Automatic Volume Control is fast growing in popularity, and there are no doubt many receivers in existence into which A.V.C. could be incorporated. The difficulty, however, of knowing just what extra components to add, and the method of connection, keeps many from employing the scheme. Messrs. Varley have now introduced a very neat unit which contains all the essential parts for A.V.C., and which may easily be wired into an appropriate circuit to provide perfect volume control—the actual degree of control depending, of course, upon the H.F. amplification which is available in the circuit. Although the instrument is very small, it contains, in addition to an H.F. choke, two fixed condensers, a resistance and a "cold valve." This is of the half-wave type, and the connections are arranged in such a way that all that is necessary to include the unit in circuit is to remove the present H.F. choke and replace it with the unit. Two connections are available for this purpose, and the two remaining connections on the unit are joined to earth and the H.F. stage. The ordinary manual volume control is then adjusted



The Varley Nicore A.V.C. unit.

to give the volume normally required from the receiver, when the A.V.C. unit reduces powerful stations to that level and enables the receiver to employ its maximum sensitivity when tuning-in weak or distant stations. The price is 15s. 6d.

OUR SHOW REPORTS

IN the course of the Show Numbers we mentioned the fact that Stand No. 12 at Radiolympia was in respect of Higgs Motors (Birmingham). The name of the owners of this Stand should have been given as Higgs (Great Britain), Ltd., and we shall be glad, therefore, if readers will kindly note this difference.

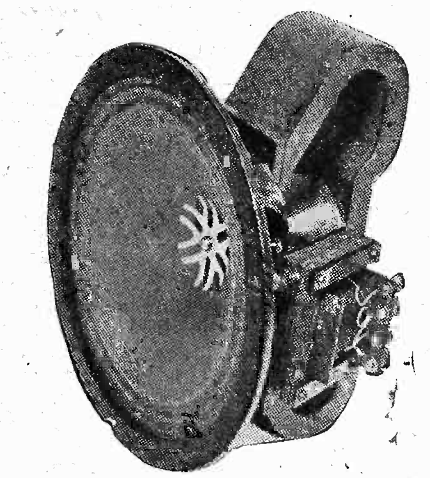
BORST "BETTBAFF"

MESSRS. BORST BROS., the well-known timber merchants, have produced an interesting baffle, bearing the above trade name. This consists of a square of plywood, 24in. by 24in., with a neat fret cut in the centre. In the particular model submitted this was 9in. in diameter, but presumably any size fret can be obtained. The finish of the front veneer may be obtained in birch, oak and mahogany, the prices being 6s., 7s. and 7s. 6d., respectively. The novelty lies in the use in the centre of the board of a layer of some compressed material about 5/16in. thick, four layers of thin ply being arranged on each side of this layer to form a total thickness of ⅝in. Resonances are effectively avoided by this construction, and the reproduction with this baffle certainly sounds less "boomy" than with a similar board of ordinary plywood. In addition, a slight added crispness could just be detected on speech. In view of the little increase in cost over the ordinary baffle, it is certainly worth while obtaining one of these "Bettbaffs" for the construction of a radio cabinet.

The Cosmochord "Universe" Pick-up, which was reported upon in our issue dated August 12th. The compensating adjustment on the rear of the carrier arm may be seen in this illustration. This enables the weight on the record to be controlled. The price is 22/6d.

SERADEX LOUD-SPEAKER

A NEAT loud-speaker has been submitted for test by Trevor Pepper. The illustration will show that a novel type of spider is employed, which is extremely light and has very little restoring effect on the cone, whilst at the same time permitting perfect freedom from side play. The magnet is particularly large for such a small type of speaker and lends great strength to the gap, namely, 7.500 gauss. A rubber gasket is fitted at the rear of this to avoid troubles due to metallic dust, etc., finding its way into the gap and thus giving rise to noises or preventing smooth movement of the speech coil, which has an impedance of 15 ohms. A pressed metal frame is employed to hold the periphery of the cone and this is fitted with a corrugated edge to enable the movement to be quite free and "piston-like." On actual test the sensitivity was quite up to standard, and reproduction was forward and brilliant, without any noticeable resonances or



The Seradex Loud Speaker.

dips in the curve. The falling off at either end of the scale was at a suitable point to avoid bad effects, and the speaker may be said to represent very good value for money. The price is 31s. 6d., and the transformer offers ratios of suitable value.

AMPLION SCREENED H.F. CHOKE

ONE of the new chokes introduced by Amplion (1932), Ltd., has been submitted to us for test, and is of rather larger dimensions than the usual type of low-priced choke. The aluminium screen, for instance, is 1½in. in diameter and nearly 3in. long. The choke is wound on a slotted ebonite former of a diameter sufficiently small to prevent losses due to the screen, yet large enough to enable a high inductance value to be obtained with a suitable gauge of wire. Eight slots are provided, and the wire is wound in these slots in the usual manner. The base is of moulded bakelite fitted with two terminals and two fixing holes, one of

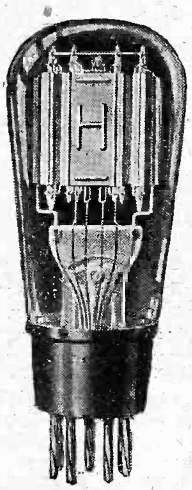
(*Continued opposite page*)

(Continued from previous page)

the latter being furnished with the usual eyelet and providing an earthing connection to the screen. The latter makes contact with a disc of aluminium in the base of the choke, so that the screening is absolutely complete. The actual characteristics of the choke are very good indeed, the inductance being sufficiently high to permit of maximum amplification being obtained with a screen-grid valve when using the choke for H.F. coupling. The self-capacity is reasonably low and the D.C. resistance is only of the order of 700 ohms, in spite of the large amount of wire which is utilized. At 3s. 6d., we can thoroughly recommend this choke.

HIVAC CLASS B VALVE

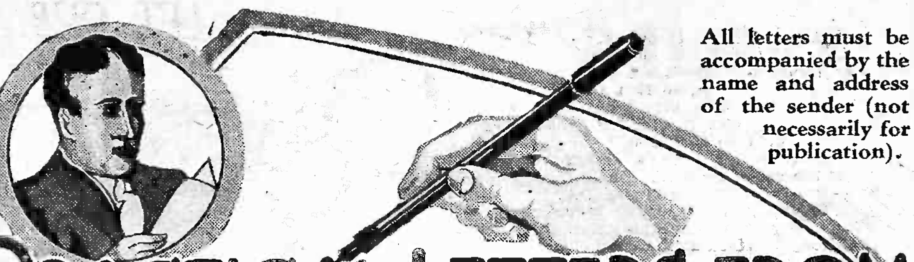
THE latest valve to be released from the High Vacuum Valve Co.'s works is the B.220. This is one of the new economy Class B valves designed with a filament of the 2 volt .2 amp type, and requiring a maximum high tension voltage of 150. The anode current under these conditions, with no signal, is only just over 1 milliamp, and on peaks it rises to the usual value of 25 to 30 milliamps. The normal current works out, during an evening programme, to approximately 15 milliamps, on actual test. The output load required is about 14,000 ohms, and the valve was tested in various circuits where this load was already in circuit. The results were fully up to standard, and the output approximated 1.25 to 1.5 watts when fully loaded. The quality was very bright and clear, with no necessity in our particular case for any tone compensation, although perhaps to some the higher notes would require slightly reducing. Various drivers and driver transformers were tried, all with a high degree of success, and we have no hesitation in recommending this valve, which costs 10s. 6d. The normal seven-pin base is, of course, fitted to the valve.



One of the Hivac Valves, from which the method of electrode assembly may be seen to be extremely robust and rigid.

"BIFLO" STATIC CUT-OUT

ONE of the recently-introduced interference eliminators which we have just examined is known as the "Biflo," presumably on account of the fact that the instrument provides two separate circuits for the aerial currents. The device is housed in a fairly substantial bakelite case, and is provided with four terminals, marked A, B, 1 and 2. According to the instruction sheet supplied with the device the aerial is joined to one terminal, the earth to another, and the aerial and earth terminals of the receiver joined to the remaining two terminals. The device consists of a resistance network arranged around the various terminals, and according to the degree of interference the connections introduce varying resistances between aerial and earth, or across the receiver, or both. As soon as a suitable "noisy" transmission is experienced, we shall be able to test the device more fully. The price is 12s. 6d., and is available in three types according to the nature of the interference and the type of receiver, whether battery-operated, A.C. or D.C.



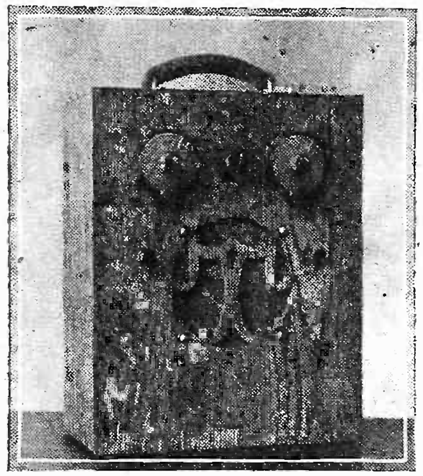
All letters must be accompanied by the name and address of the sender (not necessarily for publication).

PRACTICAL LETTERS FROM READERS

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

The Featherweight Portable

SIR,—I enclose a photograph of my Featherweight Portable, which, I trust, will interest you. I am getting on with the tuning. On the middle wave the dial now reads more uniformly. The North Regional and North National are at



142 and 62 respectively. All I can account for bringing about this change is the new grid bias flex. I tuned in Rabat, Katowice, Belfast, and Barcelona last night. I also logged Daventry at 81 and 24 on the dials, using 110 volts.—J. THOMSON (Liverpool).

An Appreciation from S. Africa

SIR,—I wish to inform you that I received the Wireless Constructors' Encyclopædia, for which I thank you. I have, so far, been highly satisfied with the information that adorns its many pages.

After about ten years' experience in the construction of wireless sets (as an amateur) I find the Encyclopædia a most up-to-date library for any constructor, whether a beginner or an old-stager.—L. LANE (Transvaal, S. Africa).

A Three-valver With Permeability Tuning

SIR,—I am very interested in any articles on Permeability Tuning. It may be of interest to you and to some readers to know that I have a "Straight Three" of my own design working on that principle; there is no tuning condenser, the aerial and reaction coils are on two cylinder formers, one inside the other fairly close coupled. A metal cylinder passes into this between the two coils, and as the cylinder passes into the coils the stations come in without any reaction condenser in the circuit, but with a reaction condenser it makes a great improvement. The tuning is much sharper than it is when using a condenser for tuning the aerial coil. The set has a straight reading scale. If any readers are interested I shall be pleased to give full details. I have taken PRACTICAL WIRELESS since No. 1, and every issue seems to get better. Wishing your paper a very long run and every success.—JOHN BLACK (Kirkconnel).

A Woman Constructor

SIR,—I should like to take this opportunity of thanking you for the very valuable help that your book, PRACTICAL WIRELESS, has been to me. I have taken it from the first number and I still have them from No. 1. They are the best books of reference I have on wireless. I have constructed three sets from your specifications and have never had any trouble with them. My wife has also take a great interest in your journal, and she has constructed a three-valve set to one of your designs.—R. FLETCHER (Rochester).

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT short wave coils are often constructed of copper tube instead of ordinary copper wire.
—THAT the reason for this is that high-frequency currents travel along the surface of a conductor.
—THAT when the reactance of a coil and condenser are equal the total reactance is nil.
—That a circuit in the above condition is said to be tuned.
—THAT the sign Ω should not be used for the word "megohm," but reserved for "ohm."
—THAT the correct expression for "megohm" is $M\Omega$.
—THAT a condenser should always be included in the earth lead of a D.C. mains receiver.
—THAT an artificial centre-tap for a push-pull input transformer may be introduced by means of two high resistances joined in series across the secondary.
—THAT a pentode valve may be used as a grid-leak detector with a high degree of efficiency.

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.

ANOTHER FREE GIFT SPANNER NEXT WEEK!

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.

THE DIODE AND REACTION

"I have been using a diode detector for a long time now and in my opinion it is impossible to find a better form of rectification. The only drawback is that it is, so far as I am at present aware, impossible to employ reaction, and my H.F. stage is arranged on the low gain principle. Do you think it is possible to add any form of regeneration to the H.F. valve, without upsetting stability, so as to give me a little extra boost in weak stations?"—(C. P., Nottingham).

We presume that you are using an ordinary valve as a diode, with the anode left free. If, however, you have linked anode and grid, you may disconnect the anode and use this for the purpose of applying reaction. We would not recommend the use of feed back in the H.F. stage, but an ordinary H.F. coil with a reaction winding could be used in the diode stage, and the anode of the diode connected in the usual way to the reaction winding and a reaction condenser. An H.F. choke should, of course, be included in the anode circuit between a positive tapping on the H.T. battery and anode. It should be possible to find a voltage which will enable smooth reaction to be obtained and which will in no way affect the quality of the diode detector.

GANGING AND INSTABILITY

"I have finished building a three-valver (S.G., detector and pentode), but do not like the arrangement of the circuit. I find that the small screws on the side of the ganged condenser are rather flat, and I have to turn the middle one right in to get the set to oscillate. Can I alter this so that I can control it from the panel as it is awkward to get at it inside the cabinet."—(M. H., Lancaster).

We are afraid that your set in unstable, and you have not quite understood its adjustment. The receiver should be perfectly stable with the trimmer controls adjusted correctly. As the centre one controls oscillation it is obvious that the H.F. stage is unstable, and when you adjust the trimmer for resonance the receiver goes into oscillation. You must therefore find the cause of the instability, and when correctly adjusted you will find that the trimmers may be adjusted to give a maximum setting without any trace of oscillation, and then the panel controls will function normally.

MAINS INTERFERENCE

"I am troubled by a peculiar form of interference in my house. Some nights, when I am listening to the wireless programmes I hear a rather noisy scraping from the loud-speaker. It does not occur every night, but two or three times a week. It starts with a faint click and seems to be very regular, with a form of up-and-down singing hum. I do not know whether you can recognize any fault from this description, but any suggestions you can make will be very thankfully received."—S. A. (Margate).

The noise is probably due to some form of electrical apparatus being used in a nearby house. It may be some medical instrument, or even an electric fan. As, however, the sound appears to rise and fall, it would seem to be due to a motor of some sort which runs under varying loads, and you can prevent the interference by fitting a double-centre-tapped condenser across your mains input leads. If you do not wish to make up the condenser (which should, of course, be totally enclosed in the interests of safety), you should purchase one of the many devices which are now available and advertisements regarding which appear in our pages.

DATA SHEET No. 52

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

OHMS LAW SIMPLIFIED

$$\text{OHMS} = \frac{\text{Volts}}{\text{Amperes}}$$

or

$$\frac{\text{Volts} \times 1{,}000}{\text{Milliamperes}}$$

$$\text{VOLTS} = \text{Amperes} \times \text{Ohms}$$

or

$$\frac{\text{Milliamperes} \times \text{Ohms}}{1{,}000}$$

$$\text{AMPERES} = \frac{\text{Volts}}{\text{Ohms}}$$

$$\text{MILLIAMPERES} = \frac{\text{Volts} \times 1{,}000}{\text{Ohms}}$$

COLOURED SWITCHING LIGHTS

"I have seen remarks regarding a form of dial-light which changes colour as you switch from one waveband to another, and I should like to rig up an arrangement for my set on these lines. Could you please give me any details regarding how to wire the scheme, so that I could fit it to my set?"—R. M. S. (Rotherham).

There is nothing in the arrangement which can be called difficult, and the simplest method is to use two separate pilot lamps, one coloured, say, red and the other blue. One side of each lamp should be connected together and to one L.T. lead, and the remaining side of each lamp to a change-over switch. The arm of the switch should be joined to the remaining L.T. lead. The switch should be ganged or otherwise controlled by your normal wave-change switch, and the method of doing this will depend upon the special switch which your set employs. A much neater arrangement would, of course, be to purchase the new Bulgin Colour Signal, which is suitable for any type of coil switch.

EXTENSION SPEAKERS

"I have added a moving-coil loud-speaker to my receiver, which is at present fitted with an ordinary speaker. I find, however, that the speaker in the other room takes all the power from my old speaker, and this is too weak. Is it due to the leads to the next room, or does the moving-coil speaker take more power and thus starve the old one?"—R. Y. (Westbourne Park).

Whilst a moving-coil speaker may require a little more volume to operate it efficiently, it does not take this power at the expense of the old speaker which you have. You have overlooked the fact that the impedances of the two speakers are different. (There is, too, the possibility that the extension leads are having an adverse effect.) If it is not possible to obtain a transformer which will enable you to match up both speakers with your valve, it will be preferable to join them both in series and so obtain more or less equal signal strength from both. An alternative method would be to obtain an output transformer of correct rating to enable the moving-coil loud-speaker to be included in the anode circuit, and use the primary of the transformer as a choke for feeding the ordinary speaker by means of an output filter arrangement.

BINOCULAR H.F. CHOKES

"I notice that there are several firms who now make H.F. chokes with the winding split into two sections, each on a separate bobbin. This I understand is called a 'binocular' choke, and the reason is to reduce the stray field. However, some manufacturers also screen their H.F. chokes, the purpose being the same, namely, to reduce the field. Where, then, is the sense in making a binocular screened choke, as some firms do? Surely it is unnecessary, and a waste of good time and money."—H. S. F. (Romford).

On the face of it your final remark would appear to be quite right, but there are some points you have overlooked. First, the binocular choke construction does reduce the size of the field, but if this choke is fitted to a baseboard close to another inductive component, coupling between the two could exist, and perhaps instability would result. Again, we think you will find that the majority of chokes which are made up in the form you criticize consist of two ordinary chokes such as are supplied by the same firms, and therefore, instead of a waste of money, the firms in question are enabled to use a standard component, and in the binocular form you have two such components in series, which will undoubtedly give better results than one alone. Thus you get two components for your money, and in general this is not double the cost of the two single chokes. Finally, the screening serves to prevent interaction with other components and enables a more compact layout to be built.

SUPERHET CONNECTIONS

"I am trying to build up a superhet receiver, but am somewhat mystified when looking through the catalogues. I admit I do not know a lot about the subject, but the point which confuses me most is the tuning condenser. I see in some catalogues that special superheterodyne tuning condensers are used, and I do not know how these differ from an ordinary condenser. What sort should I get?"—Y. C. A. (Guiseley).

The tuning condenser must be chosen according to the coils which you use. Some types of coil require that the section of the ganged condenser which tunes the oscillator coil must be cut to conform to a different law from the remaining sections so that it will keep in step with the other coils. Other coils are designed so that an ordinary ganged condenser may be used, but special padding condensers are necessary. You must, therefore, follow the coil maker's instructions.

FREE ADVICE BUREAU

COUPON

This coupon is available until Sept. 30th, 1933, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 23/9/33.

CATALOGUES RECEIVED

To save readers trouble, we undertake to send on catalogues of any of our advertisers. Merely state, on a postcard, the names of the firms from whom you require catalogues, and address it to "Catalogue," PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8/11, Southampton St., Strand, London, W.C.2. Where advertisers make a charge, or require postage, this should be enclosed with applications for catalogues. No other correspondence whatsoever should be enclosed.

DUBILIER CONDENSERS AND RESISTANCES

IN a neat booklet we have received from Dubilier Condenser Co. (1925) Ltd., full particulars are given of their well-known condensers and resistances. Included in the range are mica, paper, and block condensers of various capacities, a new type of non-inductive condenser, and high voltage dry electrolytic condensers. Metallized resistances of an improved type, covering a wide range of standard values in 1, 2 or 3 watt ratings, are also listed. The data given concerning these resistances should be particularly useful to home constructors. These resistances are now obtainable with their ohmic value indicated by means of distinctive colour markings. Also included in the list are motor radio suppressors and "Spirohm" ten-watt wire-wound resistances. The address is Ducon Works, Victoria Road, North Acton, W.3.

EDISWAN H.T. BATTERIES

FROM the Edison Swan Electric Co., Ltd., comes a neat booklet giving some useful information concerning the Ediswan H.T. and grid-bias batteries. 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.

RADIO CLUBS & SOCIETIES

SLADE RADIO

A LECTURE on "5 metre work" was given by Mr. H. K. Bourne, B.Sc. (G2KB), at the meeting held last week. After stating that he was dealing with what are known as ultra-short waves, and explaining that the first experiments by Hertz were probably on a wavelength of about one metre, he went on to the year 1921, when the outlook was changed, and instead of using long waves, much lower wavelengths were adopted even by commercial stations. He then proceeded to deal with propagation, skip distances, advantages, interference, and applications, both existing and possible. The receiver and transmitter were then described and the circuits given, after which aerials, including various beam types, were dealt with. During the interval members took the opportunity of examining the apparatus, and on resuming he described the commercial equipment which is used for transmission and reception across the Bristol Channel. A number of questions were raised and answered, after which some details of his experiences were given. The lecture proved exceptionally interesting and was enjoyed by those present. A hearty invitation to attend a meeting of the Society is extended to anyone interested. For details apply Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

B.R.I.—NEW SESSION

THE new session of the B.R.I. opened on Friday, September 22nd, at 7.30 p.m., with a lecture by Dr. L. E. C. Hughes, who chose for his subject "The Reproduction of Sound *via* Radio." The meeting was held at King's College, Strand, W.C.2, the chair being taken by Prof. C. L. Fortescue, O.B.E., M.A.

Replies to Broadcast Queries

COPPERNOB (East Ham): PAOAZ, H. E. Jacobs, 44, Graaf Florislaan, Hilversum (Holland). We do not know wavelength used but many Dutch experimenters work on the 75 m. (4,000 kc/s)—85.7 m. (3,500 kc/s) band. HAYWARD (Stoke-on-Trent): Without doubt an amateur experimental transmitter in your immediate vicinity. Although transmission was made on a lower wavelength, this would account for a break-through on a higher portion of the waveband. Cannot trace identity unless call-letters are given. LENIN (Southport): Telephony between ships (trawlers, etc.) on 177.5 m. (1,690 kc/s.) *e.g.* GLNK, River Clyde.

FIRST DETAILS OF A NEW OUTPUT VALVE (*Continued from page 12*)

An output of 4 watts is obtainable and it appears to be quite suitable for operation in conjunction with existing H.T. power arrangements, in the great majority of mains receivers. Fig. 3 shows the circuit arrangements when this valve is employed in push-pull. With this circuit excellent quality can be obtained with about 10 watts output. Harmonic distortion is generally reduced with push-pull arrangements and particularly so with this valve, especially the odd harmonics, which are considerably reduced.

The output stage of battery sets have recently received considerable attention. Is the pendulum swinging once more in the direction of mains receivers ?

ADVERTISEMENT INDEX

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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 worl[illegible] post free, for 17/4 per annum; six months, 8/8. Regist[illegible]d at the General Post Office for Transmission by Canadian Magazine Post.