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Practical Wireless

3D

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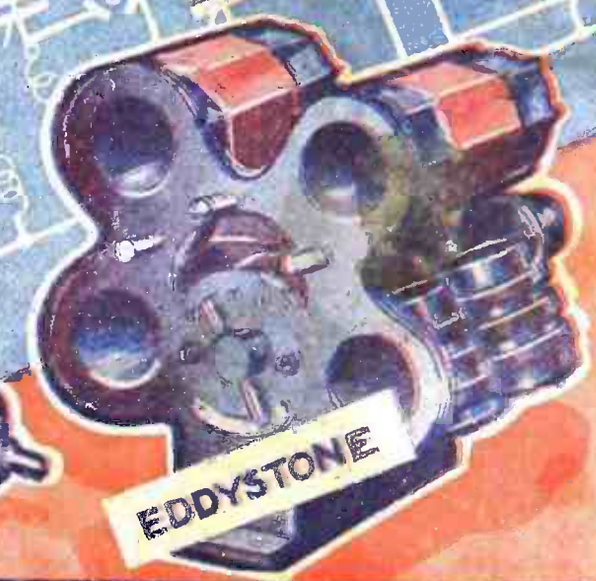

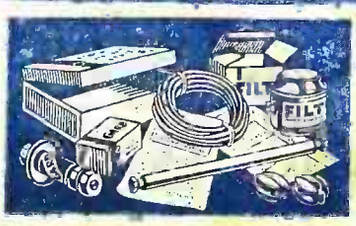

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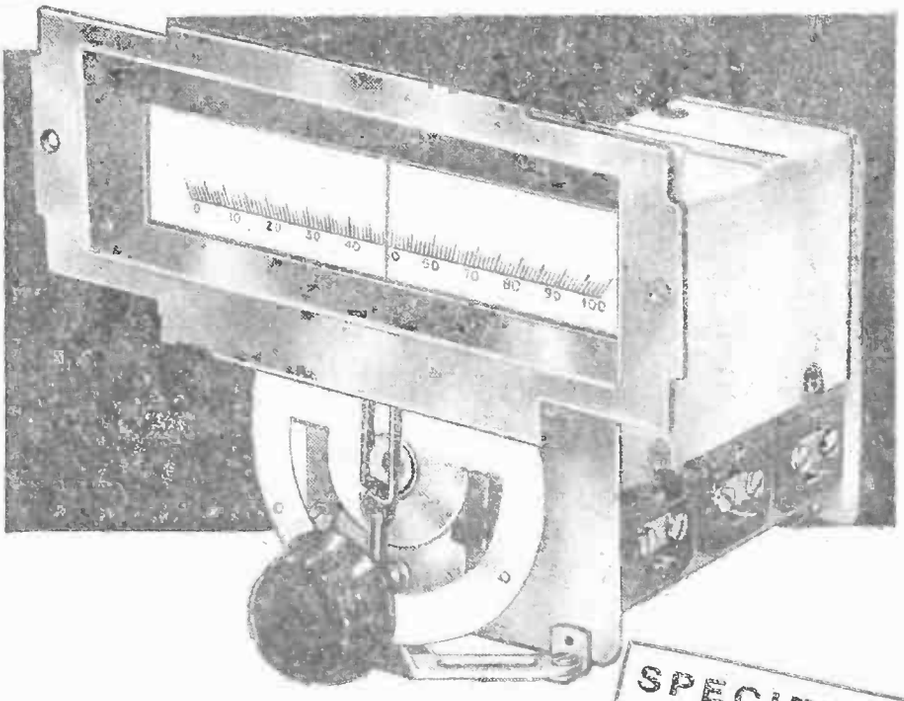

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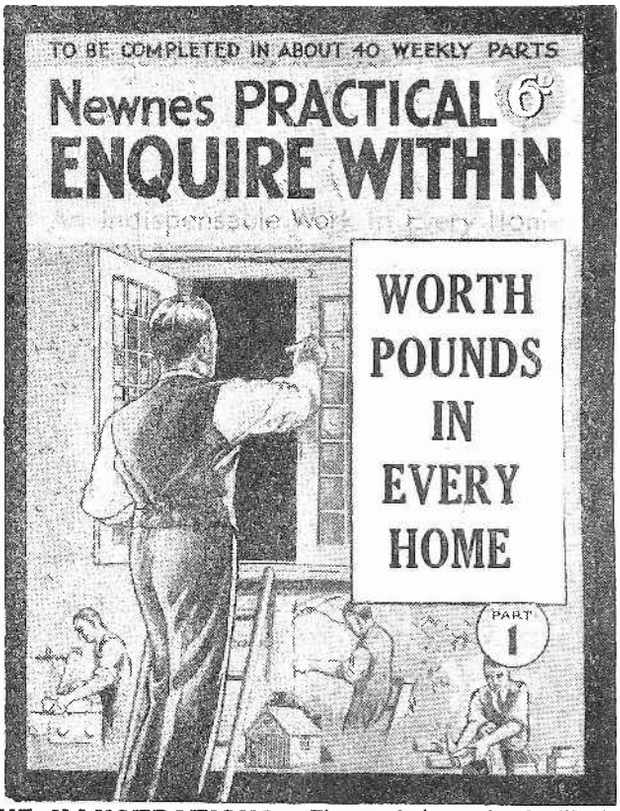

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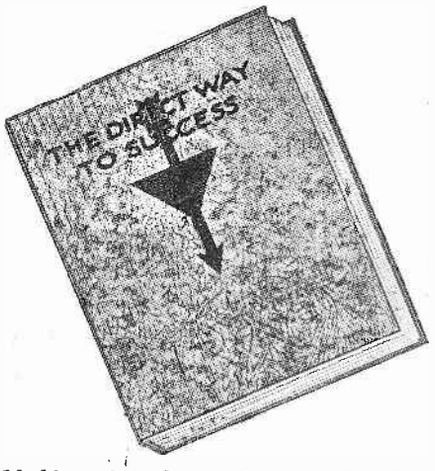

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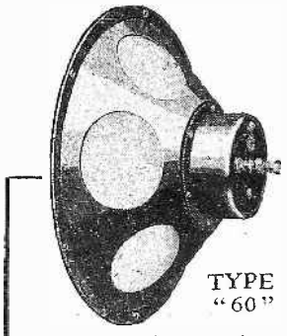

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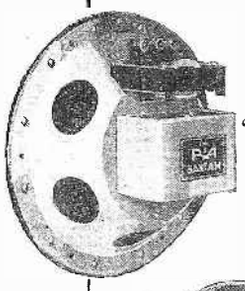
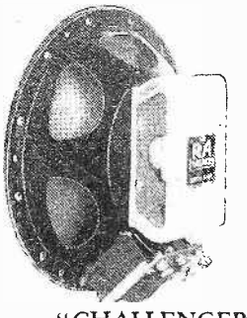


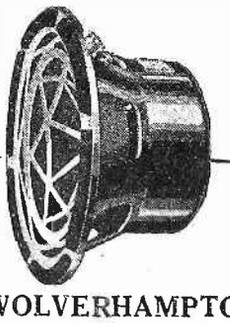
"BANTAM"



"CHALLENGER"

"ALPHA"

"VICTOR"



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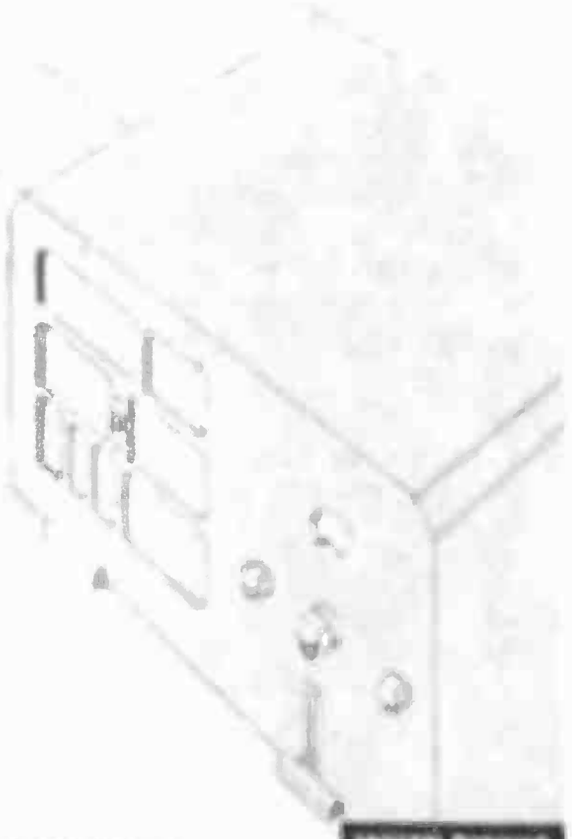

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31.3. DAVENTRY, G.S.O.
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ON ULTRA SHORT WAVES.
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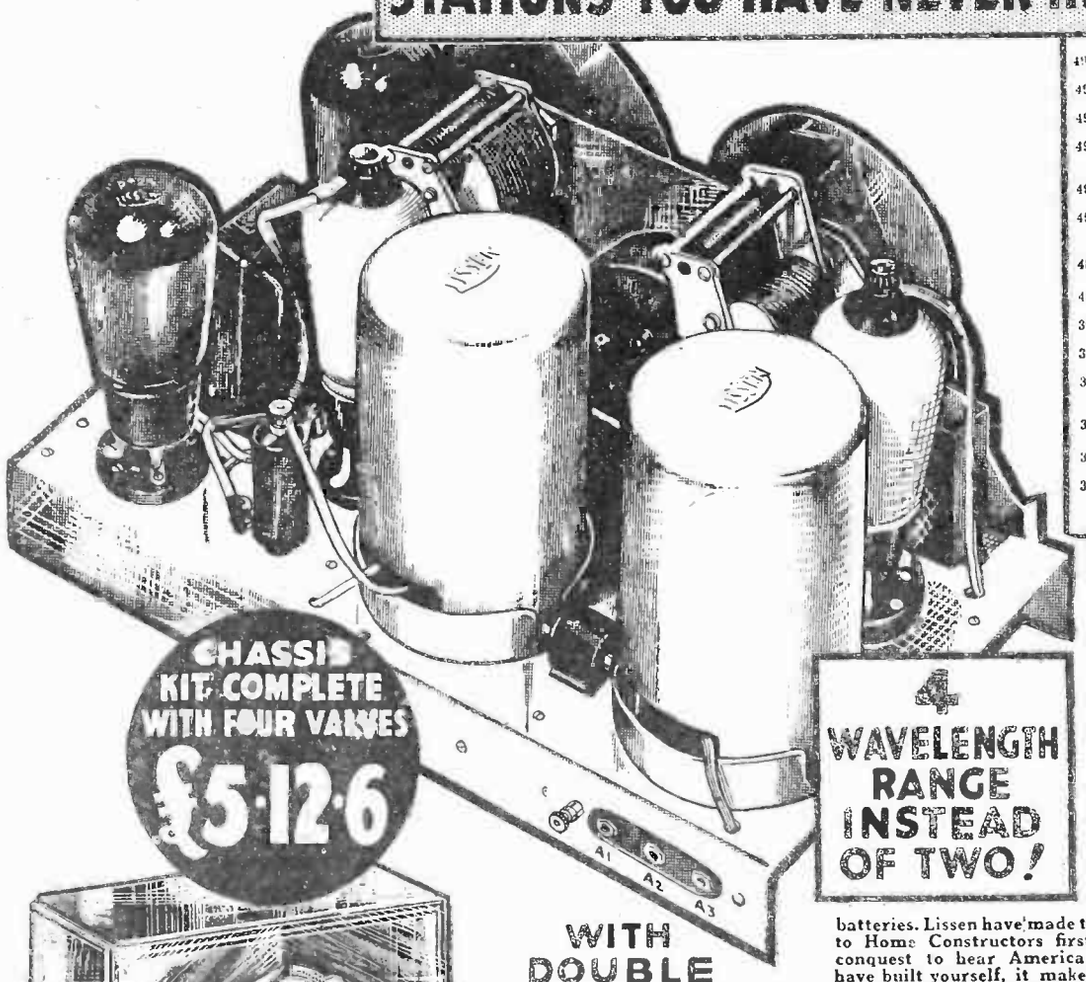

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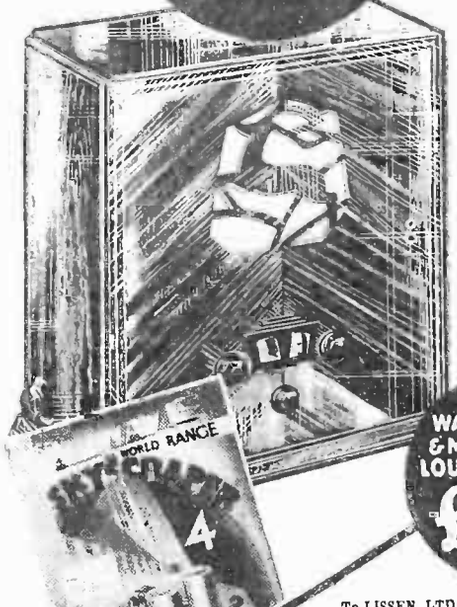

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CHART FREE POST COUPON

LISSEN ALL-WAVE ALL-WORLD 4

"SKYSCRAPER"

RESERVE YOUR POCKET TOOL KIT NOW! SEE PAGE 143

ROUND *the* WORLD *of* WIRELESS

The New Lisbon Station

TESTS are being carried out by the 20 kilowatt transmitter now nearing completion at Lisbon; the wavelength allotted to this station by Lucerne is 476.9 metres (629 kc/s), but between October 5th, when it is hoped to bring it into operation, and January it will work on 282.2 metres (1,063 kc/s). The call is: *Radio Lisboa*.

France's New Stations

THE high-power transmitters already under construction are those of PTT, Paris (120 kw.), Nice (60 kw.), Lyons PTT (100 kw.), and Toulouse PTT (120 kw.). Orders have now been placed with French makers for stations to be erected at Lille (60 kw.), Rennes-Thourie (100 kw.) and Marseilles (60 kw.). The first four are to be ready by the spring of 1934.

Egyptian Broadcasting System

AT the Lucerne Conference the Egyptian Government was granted six channels for the working of broadcasting stations. The 20 kilowatt transmitter now being built at Abu Zabal, near Cairo, will operate on 483.9 metres (620 kc/s), a wavelength shared with Brussels. The programmes will be relayed by Alexandria on 267.4 metres (1,122 kc/s), a channel on which the high-power North Scottish Regional will also work later. Tests by the Cairo station are expected to take place towards the end of November. Further stations will be installed in upper Egypt when required.

To Combat German Propaganda

IT is reported that the Polish Authorities intend to erect a station at Gydnia, a port on the Gulf of Danzig; it is to be used as an antidote to the anti-Polish propaganda broadcast through the German Königsberg and Heilsberg studios.

Sundays Only

BLOEMENDAAL (Holland) owns a small 200-watt transmitter which is only used on Sundays; it relays a sacred service from the local Reform Church at 9.40 a.m. and again at 4.40 p.m. The station has been in existence for the last five years; it works on 245.9 m.

Wireless Picture Transmissions

AS many readers will have noticed, the daily papers frequently contain illustrations which have been telegraphed from foreign countries. In some instances the transmissions are made over landlines and submarine cables, in others by wireless, *via ether*. There are at present established services operating between London, Rome, Berlin, Paris, Amsterdam, Vienna, Stockholm, Oslo and the Vatican, and by radio similar exchanges can be effected with New York, Buenos Aires, Bangkok and Bandoeng.

The Highest Transmitter in Europe

DOUBTLESS the record must be held by the small wireless station erected at the summit of the Pic du Midi de Bagnères in the Pyrenees (France), at no great distance from the famous Lourdes Pilgrimage. The transmitter is situated at 2,860 metres (9,427 feet) above sea level, and is used for the broadcast of meteorological observations. During eight months of the year the officials of the Observatory, owing to heavy snowfalls, are completely cut off from the outside world. Transmissions are carried out on 277 metres (1,083 kc/s) and on 77 metres (3,890 kc/s); it is on the short wavelength that the Observatory is in touch with the French National Meteorological Office, to assist in the compilation of weather charts.

Roma-Napoli-Bari

THE Italian broadcasting station of Bari (269.8 metres), which up to the present has always broadcast local programmes only, has now been linked up by special cable with Rome and Naples. Italy possesses two networks for the interchange of programmes, the Northern one comprising the studios of Milan, Turin, Genoa, Trieste and Florence. The Palermo transmitter will be added to the Southern net shortly.

Cincinnati's Giant Transmitter

WLW, the new 500 kilowatt station which is being built at Mason, Ohio, is expected to be ready to test in February. Its wavelength will be that of the present transmitter (428.3 metres). An idea of the size of the plant is given by the fact that to cool the 100 kilowatt valves the daily supply of water required is that used by six thousand average families!

To Assist Foreign Listeners

IT is often very difficult for British listeners to pick up programmes from Belgrade and Ljubljana. So far no alternative channel has been available. In future Czecho-Slovakia and Jugo-Slavia will exchange a series of evening entertainments, and in this manner the latter's best broadcast will be well heard through Prague.

Classification of Short Waves

IN view of the Marchese Marconi's experiments with micro waves, an endeavour is being made to give descriptive names to the higher frequencies now used for transmissions below 200 metres. Down to the 10 metre wave band, it is suggested that the channels be designated as *short* waves; from 10 metres to 1 metre, "metre" waves; from 0.99 to 10 centimetres (0.10 metres) "decimetre" waves; 9.99 centimetres to 1 centimetre as "centimetre" waves, and the lower wavelengths down to 0.001 as "millimetre" waves.

SPECIAL NOTE TO NEW READERS.

Owing to the enormous demand for the last two issues of PRACTICAL WIRELESS, containing our FREE GIFT set of WIRELESS SPANNERS, many readers were unable to obtain copies. In order to satisfy those readers, we have therefore arranged to supply a limited number of sets of these spanners at 3½d. each set, post free. Fill in coupon below and send with 3½d. in stamps, addressed to:—

Spanner,
"Practical Wireless,"
Geo. Newnes, Ltd.,
8-11, Southampton Street,
Strand, W.C.2.

and amplified. In addition to this, another feature of the short waves is the sharpness of tuning, or number of stations which can be heard over a given portion of the tuning dial. On a normal tuning condenser of .0005 mfd. capacity, the London National will tune at approximately 15 degrees on a 100 degree scale, and the Regional will tune at an-

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

International Programmes

ARRANGEMENTS have been made by the U.I.R. (Geneva) for a series of International concerts to be relayed by a number of Continental stations. They are to be contributed by Bucarest (October 3rd), Budapest (November 4th), Vienna (December 8th), and to be followed in 1934 by Prague (January 6th), Brussels (February 7th), Belgrade (February 23rd), London (March 25th), and Stockholm (April 4th).

Fall in German Listening Licences

IN August, 1933, Germany possessed 4,480,278 licensed listeners, or 37,828 fewer than on the corresponding date in July. Over 531,000 free licences have been distributed by the authorities to unemployed and war invalids.

Radio for Snake Charmers

AT the Algiers (Radio Alger) studio, before an invited audience, an Arab performer made his snakes sway rhythmically to the music of a broadcast transmission. It was demonstrated that the conventional reed pipes were not a *sine qua non*, but that even the relay of a foreign syncopated dance band was able to charm the reptiles!

Luxembourg's Midday Programmes

IN addition to the concerts broadcast every evening at 7.0, 8.30 and 10 o'clock, Radio Luxembourg is now on the air daily with a lunch-hour transmission from 12.30 until 2 p.m. The wavelength is 1,190.5 metres; the power 200 kilowatts.

German Amateur Transmitters

FOLLOWING a total cancellation of all licences, the German authorities have now granted permits to 184 amateurs to carry out experimental broadcasts. Stringent conditions have been imposed. All licensees must be recognized members of the National Socialist Party, and are required to advertise Nazi aims in all their broadcasts to foreign countries! In order to encourage the movement the cost of the licence has been reduced by 75 per cent.

Extended Sunday Broadcasts

A CONTINUOUS programme is now offered to listeners by the B.B.C. on Sundays from 12.30 to 10.30 p.m., as the hitherto silent period between 6 and 8 p.m. has been filled with musical items and talks.

Site of North Ireland Regional

IN view of the fact that Belfast is surrounded on three sides by hills, the site chosen for the installation of the B.B.C. North Ireland Regional high-power station is in the immediate neighbourhood of Lisburn, a small cathedral city some eight miles south-south-west of Belfast.

League of Nations Short-waver

THE political and news bulletin hitherto broadcast by the League of Nations through the Prangins (Switzerland) transmitter on Sunday nights are now given on Saturdays on 31.3 and 38.47 metres. The English version is timed to start at 23.30, and is followed by the French and Spanish translations at respectively 23.45 and midnight B.S.T.

INTERESTING and TOPICAL PARAGRAPHS

THE LATEST COLUMBIA FOUR-VALVE RECEIVER

Trying out the new Columbia "CQA Battery Four." This powerful receiver provides "mains" reproduction through its moving coil loud-speaker although it operates from batteries. The dials are calibrated in wavelengths and stations. The cabinet is of specially picked walnut and its price is 11 guineas.

For the Safety of Alpine Climbers

AT Biella (Italy), situated some fifty miles north-east of Turin, a five-metre transmitter and receiver has been installed for direct communication with the Margaret Hut on the Monte Rosa (Switzerland). The distance covered by these short-wave telephony transmissions is, roughly, forty miles. Listening posts have also been erected by the authorities at the base of the mountain with a view to bringing assistance quickly to climbers in the event of accidents.

Is This a Record?

JEAN ROY, the Radio Toulouse (France) announcer, in a recent interview, stated that from April 1st, 1925, when he first took up his duties, he has presided at the microphone for more than 22,000 hours!

Berlin's Deutschlandsender

AS the Germans are anxious that transmissions from their high-power station should be heard not only throughout Germany but also in neighbouring countries, the power is to be increased to 150 kilowatts. At the same time a new system of aerial towers is to be used to eliminate fading effects in the broadcasts. There exists also the possibility that a more favourable site than Zeesen may be found for the new station.

Record Short-wave Transmissions Between Aircraft in Flight

REMARKABLE instances have been forthcoming lately from the Empire routes of Imperial Airways of long-range wireless communication between aircraft in flight, and also between aircraft and ground stations. The other day, while one of the new "Atalanta" type air-liners was flying near Mpika, on the Africa air-mail, its operator got into touch and maintained communication for several minutes with another aircraft of the same type which was then in the neighbourhood of Victoria West, approximately 2,000 miles away. Even at such a distance—representing a record for communication between aircraft on the Empire routes—both operators found reception excellent, with no fading or interference. Recently, also, while the air-liner *Astraea* was making an aerodrome survey along sections of the Empire route between India and Australia, communication from the air was established with Sydney over a distance of more than 5,000 miles, and maintained without difficulty for some time.

BALANCED PENTODE OUTPUT AND MOVING COIL SPEAKER

And when you see the World "Skyscraper" 4, to work it and why it agree at once that it was rather than buy a factor you these new and intr CHART simplifies ever with every wire numbe identified. YOU CAN'T

B.B.C. Public Concerts Season

THE Promenade Concerts end on October 7th, and the B.B.C. has announced the opening of its winter season of Public Concerts on October 18th. There will be the season of eighteen Symphony Concerts on Wednesdays, starting on October 18th and continuing weekly until December 13th, after which there will be a break until January 31st. During this break there will be a series of Six Concerts of British Music on January 1st, 3rd, 5th, 8th, 10th and 12th. The London Music Festival will be held again on May 4th, 7th, 9th, 11th, 14th and 16th. All these concerts will be at Queen's Hall. A series of twelve Public Chamber Concerts will be given fortnightly on Fridays, at the Concert Hall, Broadcasting House, the first of which will be heard on October 20th.

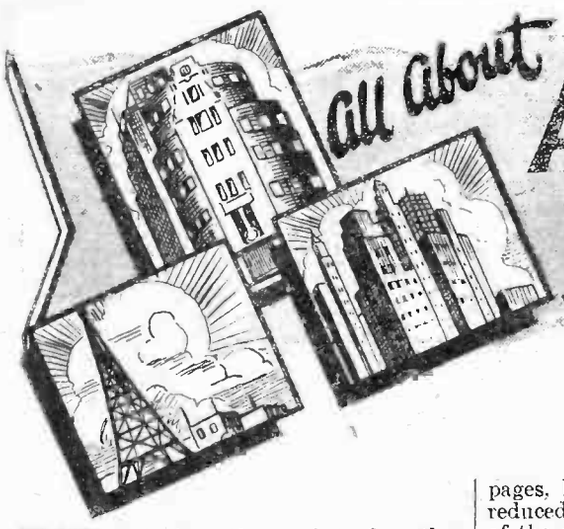
(*Continued on page 158*)

emission, and the fuse was replaced still without result. The S.G. circuit was tested and found in order, as was the detector circuit, but when the grid bias was varied on the L.F. valve no change in anode current was recorded. What had happened? Three books will be awarded for the first three correct solutions opened. Address your envelopes to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2, and post to reach here not later than October 9th. All envelopes should be marked Problem No. 55.

SOLUTION TO PROBLEM No. 54.

Whitaker overlooked the fact that there would be a voltage drop due to the current passed through the smoothing choke; and also forgot that the grid bias voltages had to be added to the total high tension voltage. He therefore required at least 250 volts in order to satisfactorily operate his receiver.

List of Prizewinners for Problem No. 53:
Mr. Wm. Adderley, 82, Scotia Road, Burslem, Staffs; Mr. S. W. Salman, 44, Constantine Road, Colchester; Mr. R. K. Hulsing, Blankenberghe, Cite des Genets.



All About ALL-WAVE TUNERS

The Principles Underlying the Design of Combined Short and Long-wave Tuning Coils and Receivers.

THE arrival on the market of another tuner designed to cover the short waves as well as the normal broadcast band arouses the interest of the home-constructor, and to many the question no doubt arises, "Is it worth it?" So far, there are very few of these tuners, and in view of the many difficulties which have already been explained in these pages regarding the reception of short-wave stations, it is only natural that to many minds it will appear that the use of a combined tuner will only result in a compromise upon one or other of the wave-bands covered. Up to a point this is quite true. The losses which are introduced by switching, etc., can easily destroy all gains which are effected in clever design and workmanship, but there are certain features which may be introduced and which will enable a very good all-round result to be obtained on any wavelength. Suppose, therefore, we examine the requirements of an "all-wave tuner" and see just what is required and how best to utilize the various features which are found essential on each waveband.

Short-wave Work

As has been repeatedly stated in these pages, losses on the short waves must be reduced to an absolute minimum in view of the very high frequencies which are in use. Perhaps to understand this better it is necessary once again to point out the desirability of thinking in frequencies instead of wavelengths. When we refer to the London National station transmitting on a wavelength of 261.6 metres, and then state that Boundbrook, New Jersey, transmits on 46.69 metres, we do not realize the vast difference that exists in the actual frequency which is used for these stations. The frequency of the London transmitter is 1,147 kc/s, but the frequency of the Boundbrook station is 6,425 kc/s. You will remember, from the various beginner's articles, that by frequency is meant the number of vibrations, or changes of direction, per second. Obviously, with the lower frequency variations there is little risk of the signal jumping across small gaps or otherwise finding its way to earth. With the high frequency, however, the slightest capacity will serve to provide a path where it is not wanted, with the result that the signal will either disappear or partly do so before being fully rectified and amplified. In addition to this, another feature of the short waves is the sharpness of tuning, or number of stations which can be heard over a given portion of the tuning dial. On a normal tuning condenser of .0005 mfd. capacity, the London National will tune at approximately 15 degrees on a 100 degree scale, and the Regional will tune at approximately 30 degrees. The difference between these two stations in metres is 94.4, but the difference in kilocycles is 304. In other words, at this part of the wave-band a difference of 94 metres equals 304 kc/s. When, however, we enter the 30 to 100 metre wave-band we find a vastly different state of affairs. Thirty metres equals 10,000 kc/s, and 50 metres equals 6,000 kc/s. We have, therefore, a difference of 4,000 kc/s, equalling 20 metres, and as the separation between stations to permit full reproduction of side-bands is 9 kc/s, we find that many more stations will be obtainable over the same number of degrees on this band.

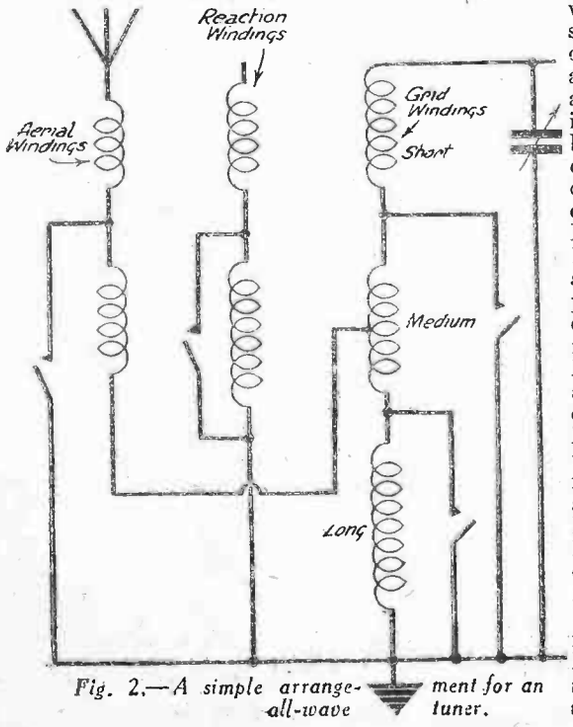


Fig. 2.—A simple arrangement for an all-wave tuner.

Tuning Arrangements

This introduces our second difficulty. Some form of tuning will have to be adopted which will enable us to select one of these stations, and in a receiver designed especially for short-wave work it is customary to employ a very low capacity tuning condenser (.0001 mfd. usually), and in addition to use a slow-motion dial.

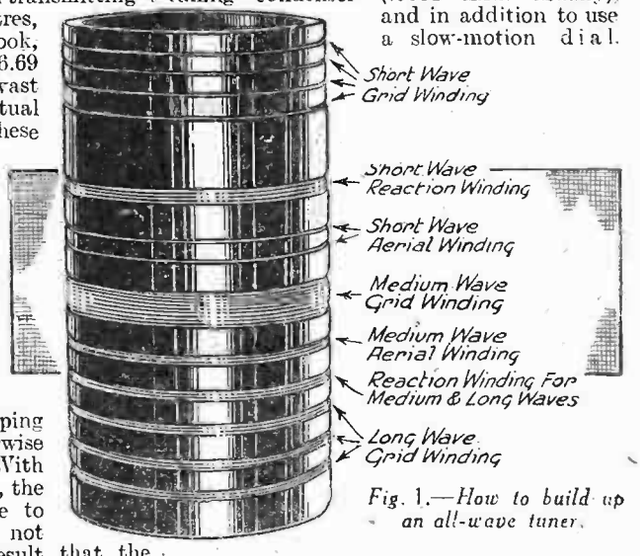


Fig. 1.—How to build up an all-wave tuner.

For the long waves, however, such a value would not enable us to tune from Luxembourg to Huizen on a single coil, so we must compromise. Careful design, by which is meant careful choice of coil turns and their disposition on the former, will enable a winding to be adopted which may be used for various wave-bands without introducing the unwanted capacities referred to in the opening part of this article, and which at the same time may be tuned by a .0005 mfd. condenser in a fairly satisfactory manner. Obviously, however, a good slow-motion drive will have to be used in order to assist station selection on short waves.

Reaction Arrangements

A further point of difficulty arises in arranging reaction windings. For the medium and long-wave windings it is customary on a dual-range coil to use a single reaction winding of such a size that it provides smooth control for the long waves. This is usually too great for the medium waves, so it is disposed on the coil former in a position close to the long-wave winding, in which position it offers greater coupling to that coil than it does to the medium-wave winding, and the result is that smooth control may be obtained with a single

(*Continued overleaf*)

ALL-WAVE TUNERS

(*Continued from previous page*)

reaction condenser over both bands without the difficulty of introducing switching. When, however, we wish also to include the short waves we find that it is not easy to dispose a single winding to provide adequate control over three bands. The best method of arranging the winding is to split it, and use a few turns for the short waves, coupled to the short wave grid coil, and utilise the remainder of the winding in the usual way. This can give splendid results if the turns ratios are correctly chosen. The design of the H.F. choke affects the reaction control, and although there are several chokes available which will work with efficiency on all waves from 20 metres upwards, I find it preferable to employ two chokes, one especially designed for the short waves, and one standard choke. These are joined in series and they each come into effect on their respective wave-bands.

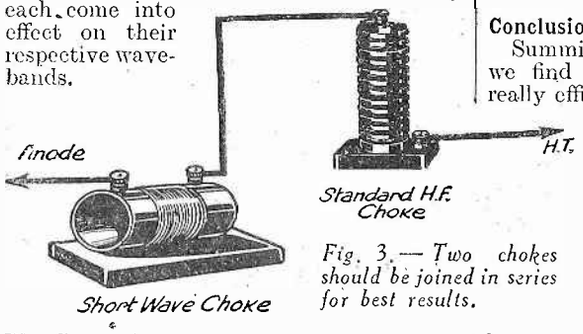


Fig. 3.— Two chokes should be joined in series for best results.

The Lay-out

It is a great mistake to imagine that one of these all-wave tuners may be purchased and built into a receiver designed for normal broadcast reception and that all the short-wave stations will then be at your finger tips. Nothing is farther from the truth. It is quite possible that you may be lucky in hearing one or two stations, but unless the receiver is well-designed you will probably find that not only will the sensitivity be low but that those stations which can be heard are only obtainable when reaction is pushed so far that it is only C.W. or a heterodyned carrier which is heard, and that speech and music cannot be satisfactorily resolved. Of course, if the receiver had been designed on sound lines in the first case, and was efficiently wired and arranged, it is quite possible that the addition of the all-wave tuner in place of the existing tuning coil will result in quite a good short-wave selection, but the best will not be obtained from the coil unless the above-mentioned points have been attended to.

Conclusions

Summing up the above remarks, therefore, we find that it *is* possible to design a really efficient coil which will satisfactorily tune over short, medium and long wave-bands, and that in order to obtain maximum results on all bands it is essential to use a really good tuning condenser operated by means of a good slow-motion dial. That for smooth reaction it is preferable to use two H.F. chokes in series. That the lay-out must be very carefully chosen and a certain amount of care and experiment is necessary in order to obtain maximum results. That the receiver must really be designed as though it were a short-wave receiver, when the medium and long-wave stations may be left to look after themselves. It will no doubt interest our readers to know that we have spent a great deal of time and thought on the subject of all-wave receivers, and the results of our tests are embodied in a single-valve receiver which employs one of the latest tuners, and it will be described in next week's issue. Although only a one-valve set it will bring in a large number of short-wave stations at remarkable strength, and on certain occasions the loud-speaker has been connected to the set, without the use of any amplifiers, and good results have been obtained. In addition, medium and long wave stations have been tuned in direct on the speaker. Full details will be given next week.

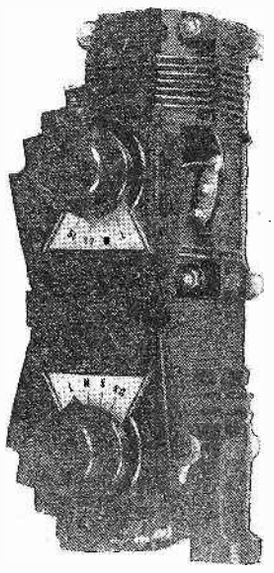


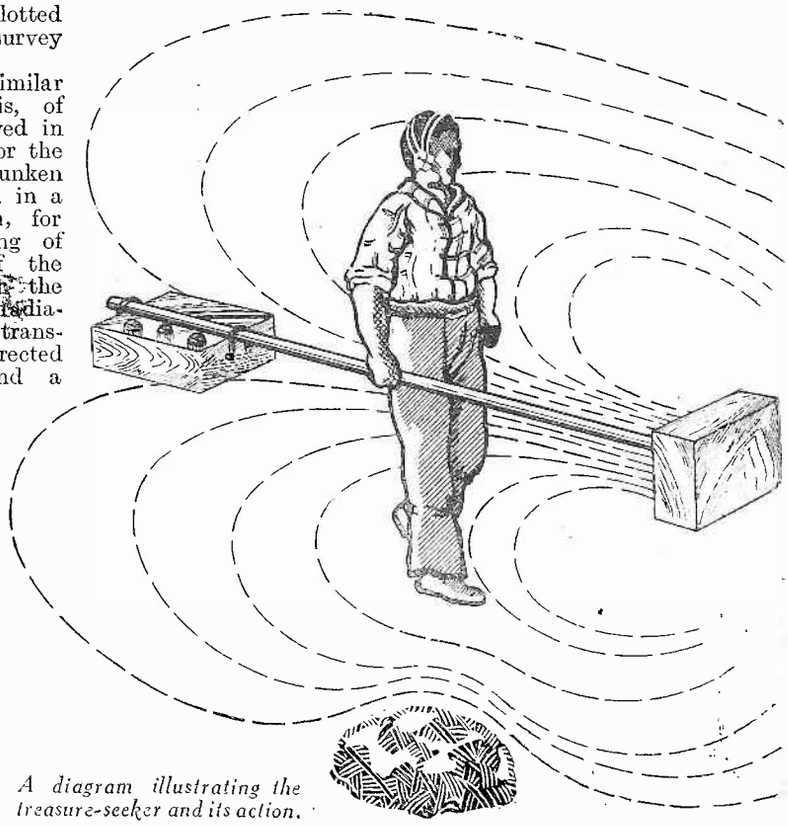
Fig. 4.— A neat commercial tuner which covers short and the normal broadcast bands.

A TREASURE-SEEKER

IF you are thinking of taking a holiday on Cocos Island, or in the land of the Incas, or at any other spot where vast treasure is reported to be securely hidden, here is your chance to locate it, and return to your native land rich beyond the dreams of avarice. The great idea comes from the land of the almighty dollar, and consists of a portable wireless apparatus which will indicate the near presence of a secret hoard or, presumably, any other mineral deposit. As will be seen from the illustration, the searcher after wealth trails a long pole, at either end of which is carried a type of portable set. The forward one is a transmitter, and is adjustable as to its angle with the receiver at the rear end of the pole. The transmitter consists of a one-valve Hartley oscillator, the radiating aerial being a "loop" or frame wound around the outside of the containing case. The receiver at the other end has a three-valve straight circuit, with tuned loop, and a tuned coupling between the screened grid and detector valves. The latter is coupled by transformer to a pentode output. A variable series resister controls the H.T. supply to the screening grid as well as oscillation. The theory of operation is simple. Radiation from the transmitter heterodynes the oscillations of the receiver, which is tuned to a wavelength slightly above or below that of the transmitter, so causing a whistle or beat note in the headphones. If the prospector walks over or near a metallic deposit, the deflection of the waves radiated, or the absorption of power by the metal, alters the note to a greater or less extent according to the magnitude and distance of the "find." The receiver may also be worked in a non-oscillating state, but adjusted to be "on the edge." In this condition any disturbance of the surrounding electrical or magnetic conditions causes oscillation and a consequent note in the 'phones. The wavelength used may be between 100 and 200 metres, that being the band allotted to geological survey in the U.S.A.

A very similar arrangement is, of course, employed in naval circles for the location of sunken craft and also, in a modified form, for the ascertaining of the depth of the ocean bed. In the latter case the radiations from the transmitter are directed downwards and a special type of directional aerial is employed. The radiations are reflected when they touch the ocean bed, and the direction of radiation is arranged so that the returning wave from the ocean bed strikes the ship. A receiver is placed in this position, and by working out the length of time for the wave to return the depth can be ascertained.

HAVE YOU RESERVED YOUR GIFT?
See page 143



A diagram illustrating the treasure-seeker and its action.

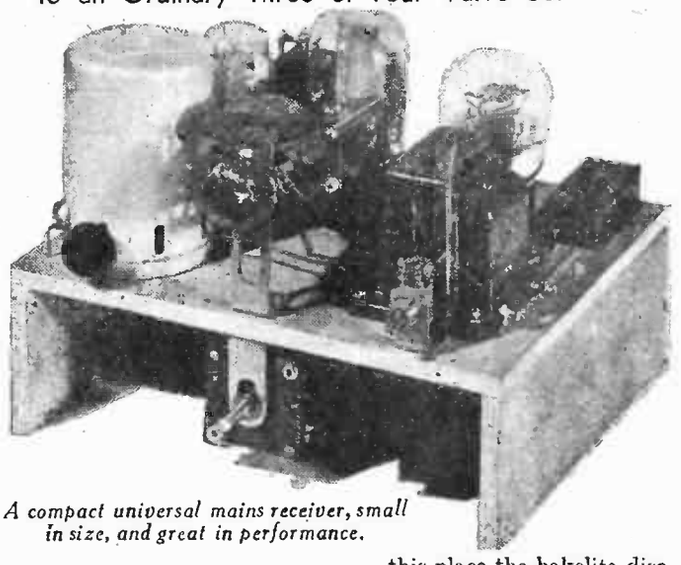
The A.C.-D.C. TWO

A Simple Universal Receiver Which may be Used on either A.C. or D.C. Mains, and Which Gives Results Equal to an Ordinary Three or Four Valve Set

By W. J. DELANEY

NOT so very long ago I described a simple two-valve set which operated entirely from A.C. mains, and which gave results which had hitherto not been obtainable with such a small number of valves. In this case a pentode valve was used as a detector. Many listeners who are in the position of only having the D.C. mains at their disposal asked for a similar type of circuit, and unfortunately this was not a practicable proposition, owing principally to the difficulty of obtaining the large output with the D.C. valves then obtainable. There have been introduced into this country recently some special valves which operate with 200 to 250 volts direct on the heaters, and these valves are of what is known as the universal type. That is to say, they may be used with either A.C. or D.C. on the heaters, and, providing that the circuit is correctly designed, hum is non-existent. In addition to this valuable feature, the valves have most remarkable characteristics. For instance, a detector valve is obtainable which has the remarkable amplification factor of 100, as against the more conventional 20 to 40. After a little experiment I have developed the circuit shown in Fig. 1, which is a great improvement on my previous A.C. Twin, and which may be used on any type of mains without alteration, and which will provide sufficient volume to almost fill a small hall.

Owing to the few components which are required in this receiver, it has been found possible to get all the components on a baseboard measuring only 10ins. long by 8ins. deep. The receiver is also remarkably cheap, and will no doubt prove immensely popular to those who desire an easily-constructed, powerful mains set for use with D.C. or A.C. mains.



A compact universal mains receiver, small in size, and great in performance.

The Construction

The construction of the receiver should be a matter of only one evening's work, and will occasion no difficulty even to those who have never before built a wireless receiver. Apart from one or two soldered connections—which, unfortunately are unavoidable—there are only two points which require any explanation. The first is in regard to the assembly of the special 6-pin valve-holder for the detector valve. When you purchase this you will find that there is a bakelite disc and a tin disc in addition to the actual valve-holder. These two discs have holes arranged in the same manner as the valve legs, and they must be assembled in a certain way in order to obtain perfect screening between the heater and grid legs. Take the valve-holder in the left hand, with the connecting lugs at the bottom, and on top of this place the bakelite disc. Now on top of this place the tin disc, and when all the holes are accurately lined up turn the complete assembly over and bend round the long soldering lug which is to be seen near to the vertical strip of metal running across the valve-holder. There are actually two of these lugs, but only the one nearest the anode terminal should be bent, and the exact position may be seen from the wiring diagram. Bend it right round until it lays flat on the tin disc, and then screw the valveholder to the *under side* of the baseboard. The other valveholders are screwed on top of the base in the usual manner. The other point requiring mention is the 2 mfd. fixed condenser which is mounted on top of the base. This is coated with green enamel all over, but in order to provide a return earth connection to the chassis the enamel should be scraped off both top and bottom of the projecting lug at one end, and this condenser should then be screwed down with this bared lug nearest the earth terminal. Again, reference to the wiring diagram will make this point quite clear.

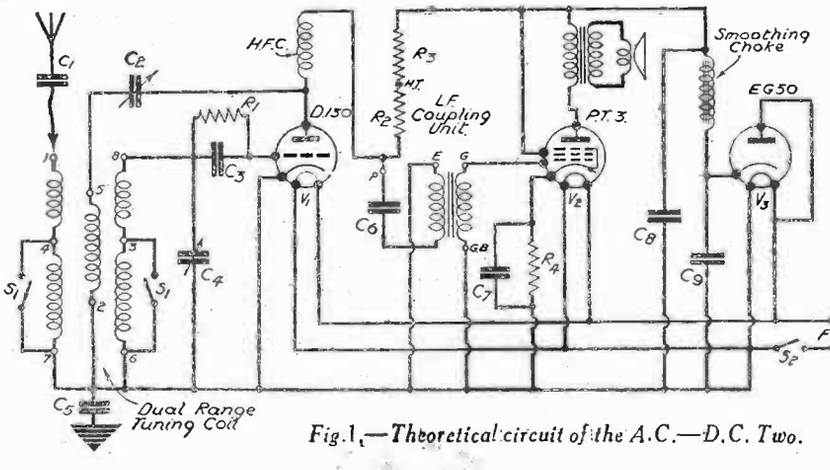


Fig. 1.—Theoretical circuit of the A.C.—D.C. Two.

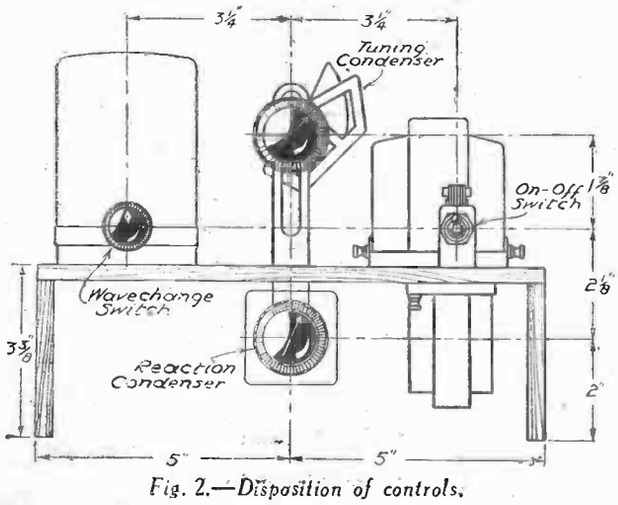


Fig. 2.—Disposition of controls.

Mounting the Components

It will be seen from the wiring diagram that there are very few parts to be screwed down, a saving having been effected by using the special Telsen coupling unit, comprising a resistance, condenser, and

(Continued overleaf)

(*Continued from previous page*)

transformer in one housing. The resistance is, however, of too low a value to give maximum results with the particular valve employed for detection, and it is therefore necessary to increase the value by connecting a further resistance in series. This is joined between one terminal on the choke and the H.T. terminal of the coupling unit. To prevent any risk of a short-circuit to the chassis, a small piece of insulated sleeving should be slipped over one of the wire ends of the Dubilier resistance, and then this wire should be passed through the hole in the chassis to make connection with the coupling unit. The other end of the resistance is joined direct to the choke. Before screwing down the Telsen unit make certain that there is sufficient clearance for the small bracket which accommodates the on/off switch. To simplify the wiring this is mounted upside down, which means that instead of pushing the dolly down to switch on (as in the majority of ordinary house-lighting switches) it operates in the reverse direction. This should be borne in mind when the receiver is first put into use. Mount the three brackets in their respective positions, then the Telsen unit, following these by the fuse-holder, condenser, H.F. and L.F. chokes. The small fixed condensers may then be screwed down, and finally the tuning coil.

The Wiring

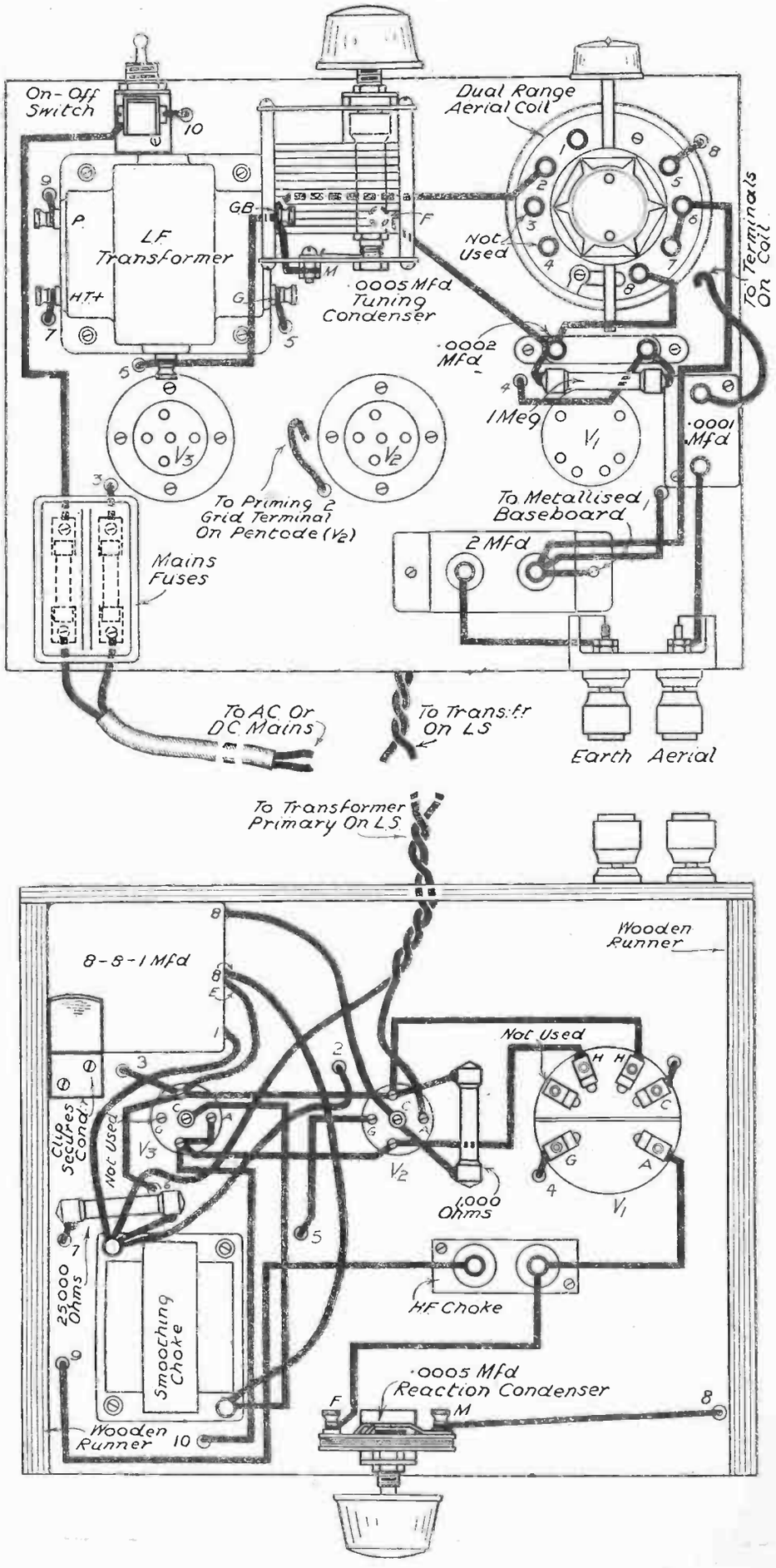
If you have never made a receiver before you may find it preferable to remove one or more of the components when putting the wires into position, as some of the contact points are a little difficult to get at. A little patience, however, will soon help you out of any seeming difficulty, and the wiring should be completed within an hour. Leave the variable condenser until the wiring is practically finished, and fix the two leads for this component before mounting it on its bracket. To ensure a neat appearance the condenser should be held in position whilst the leads are measured, and then it should be removed whilst the wires are fitted. Upon replacing it on the bracket the wires will then reach just to the coupling unit and coil.

(*Further Note Next Week*)

LIST OF COMPONENTS FOR THE A.C—D.C. TWO.

One Tuning Coil, Type W.216 (Telsen).
One .0005 mfd. Tuning Condenser with slow motion dial, Type No. 1046 (Jackson Bros.).
One 10/1 Coupling Unit (Telsen).
One .0005 mfd. Reaction Condenser (Graham Farish).
One Smoothing Choke, Type D.Y. 22 (R.I.)
One .0002 Condenser, Type 34 (T.C.C.).
One .0001 Condenser, Type S (T.C.C.).
One 2 mfd. Condenser, Type 80 (T.C.C.)
One Double Fuse-holder (Belling Lee).
One Terminal Block (Belling Lee).
Two Terminals (Aerial and Earth), Type B (Belling Lee).
One Electrolytic Condenser Block, Type A.D. (Hellesens).
One Minor Binocular H.F. Choke (B.R.G.).
Two 5-pin chassis type Valveholders (Clix).
One 6-pin chassis type Valveholder (Ostar Ganz).
One 1000 ohm resistance (Dubilier).
One 25,000 ohms resistance (Dubilier).
One 1 Megohm Grid Leak (Dubilier).
One Mains On-Off Toggle Switch, Type S. 80 (Bulgin).
One Component Bracket, Type 23 (B.R.G.).
One Component Bracket, Type 22 (B.R.G.).
One Component Bracket For Mounting Toggle Switch (B.R.G.).
Two Coils Insulated Connecting Wire (B.R.G.).
One Valve. D.130 (Ostar Ganz).
One PT.3. Valve (Ostar Ganz).
One EG.50 Valve (Ostar Ganz).
One Bantam Moving Coil Loudspeaker (R. and A.).
One Metaplex Chassis (Peto Scott).
One Cabinet (Peto Scott).
One "Aeroficient" Kit (Graham Farish).
One Combination Mains Connector, flex, screws, etc.

TOP AND SUB-BASEBOARD WIRING DIAGRAM



Cutting Out INTERFERENCE!

Ways and Means of Effectively Dealing with Unwanted Noises

By W. B. RICHARDSON

OWING to the great increase in all kinds of electrical appliances and machinery which has taken place within recent years interference with radio reception has gradually become more serious.

It is now no longer possible to ignore the problem—it must be recognized and tackled accordingly. Believing that an ounce of practice is worth a ton of precept we shall attempt here to give some practical hints on overcoming this objectionable form of interruption.

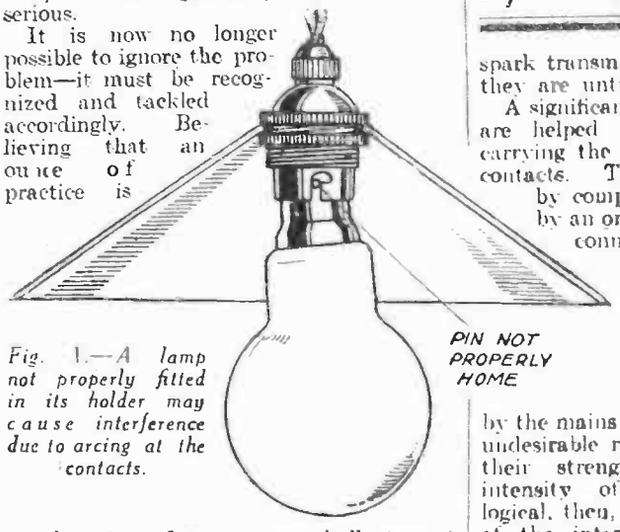


Fig. 1.—A lamp not properly fitted in its holder may cause interference due to arcing at the contacts.

Some of the commoner sources of man-made static include electric signs, trolley buses, accumulator charging plant, electric motors, fans, vacuum-cleaners, etc. The effects they produce on reception usually take the form of harsh irregular crackling noises which are equally persistent on any wavelength.

There are clearly two methods of tackling the problem (1) At the source and (2) At the receiver. Obviously the former is the better method. Not only is it usually more effective, but if successful will benefit other listeners in the neighbourhood. Of course, in some cases this is not possible, and then recourse must be made to devices applied to the receiver itself.

The Cause of the Crackles

The actual cause of electrical interference is the sparking at brushes or contacts of the offending piece of apparatus. Perhaps the most obvious example is that of a motor-car engine. Here each spark, as it jumps across the gap of the sparking plugs, will cause a crackle in a nearby receiver. The faster the engine runs, the more rapid are the crackles until at high "revs" they merge into one continuous roar. Another example is that of an ordinary house-lighting switch. When the lights are switched on or off a crackle is heard in the loud-speaker. This is due to the slight spark which occurs at the contacts of the switch. The spark radiates damped waves similar to those produced by a spark transmitter with the exception that they are untuned.

A significant point is that the radiations are helped very largely by the wires carrying the current to the spark gap or contacts. This fact may be illustrated by comparing the disturbance caused by an ordinary electric bell or buzzer connected to a battery with very short leads with the same instrument when operated by a battery connected by long leads. In the latter case the radiations will be considerably stronger.

Apart from the part played by the mains or leads in propagating these undesirable radiations it is obvious that their strength depends also on the intensity of the spark. It is only logical, then, that efforts at the elimination of the interference should be directed towards (1) A reduction of the sparking itself and (2) The elimination of the radiation of its energy by means of the wires carrying the current.

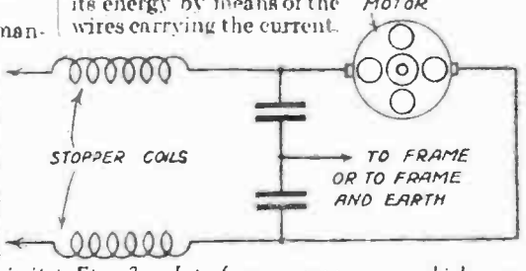


Fig. 3.—Interference suppressor which may be fitted to various domestic appliances.

Before describing the methods which are used to accomplish this let us consider the source of the interference itself. Although this might be caused by outside agencies, such as tramways, power stations, charging plant, etc., it is just as well to first ascertain that the trouble does not lie nearer at home. For instance, amongst some of the commoner causes of crackling noises emanating from the domestic supply system are the following: Faulty switch contacts, electric bulbs which have not been properly pushed home in their holders (see Fig. 1), bad contact at terminals of switches, ceiling roses, fuses, etc. The reason for radiations in cases of this sort is due to "arcing" at the offending contact. A wire connected to a binding screw or terminal may be making only intermittent contact owing to, say, a loose grub screw. This will cause an arc to bridge the gap during the periods when there is no direct contact. Walking across the room may provide sufficient vibration to "make" contact and so start the arc. In the case of wall switches, the trouble may be caused by the contacts losing their springiness after some years of use. Pinching the copper springs slightly closer together with a pair of pliers, as in Fig. 2, may be all that is needed to effect a cure.

Little faults of this sort, besides being usually easy to overcome, are also fairly easy to trace. Switching off the various lamps, appliances, etc., in the house one by one will soon determine the source of the offending crackles.

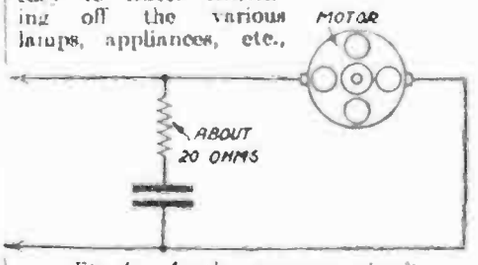


Fig. 4.—Another suppressor circuit.

The Use of Condensers and Chokes

Of course, such domestic appliances as electric fans, vacuum-cleaners, ice cabinets, etc., may cause trouble, although all the connections, switches, and so on, are in perfect order. The radiations here are due chiefly to the sparking which occurs at the commutator and brushes of the motor. Although cleaning the parts carefully with a rag dipped in petrol may help considerably, it may be necessary to fit some sort of suppressor device as well. Quite an effective circuit is that shown in Fig. 3. It consists of a choke or "stopper coil" in each lead to the motor of the fan, cleaner, or whatever the machine is, and two condensers in series across the leads. The centre point of the condensers is joined to the frame of the motor. It is

(Continued overleaf)

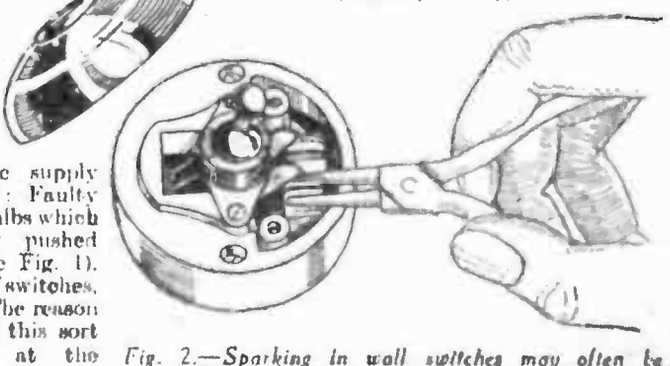


Fig. 2.—Sparking in wall switches may often be overcome by pinching the contacts closer together.

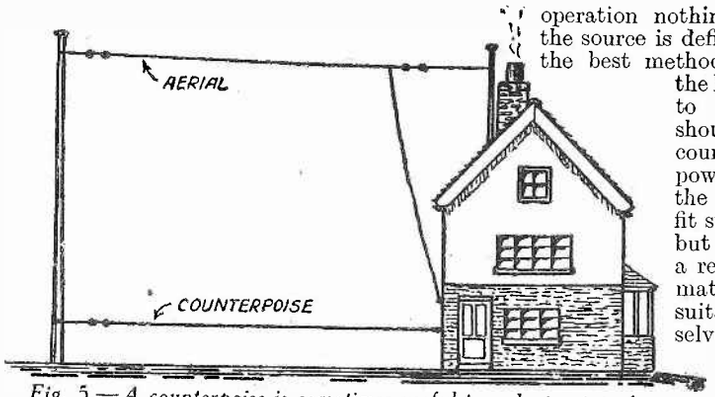


Fig. 5.—A counterpoise is sometimes useful in reducing interference.

(*Continued from previous page*)

sometimes an advantage to earth this point as well. If possible, this should be tried. The object of the coils is to prevent radiation along the mains, and that of the condensers to reduce the intensity of the sparks at the brushes. The coils and condensers should be fitted as close to the motor as possible in order to subdue the interference at its source. Suitable sizes for the coils are as follows: 50yds. (about 100 turns) of 18 or 20 gauge D.C.C. wire wound on a 6in. diam. former. The former will have to be 8in. long, but a less cumbersome arrangement can be made by winding a hank of about 50yds. of single flex and binding it round with insulation tape. The coils will stand up to 5 or 6 amps. For smaller consumptions correspondingly finer wire may be used. The condensers should be .01 mfd. capacity for A.C. mains and 1 mfd. for D.C., and should be rated at a working voltage not less than that of the supply.

A less elaborate circuit which is often quite satisfactory consists simply of the two condensers without any stopper coils, or even one condenser connected direct across the leads may be quite sufficient. With this last arrangement it sometimes happens that the interference still persists on one waveband due to the condenser forming, in conjunction with the coils of the motor, an oscillatory circuit. This can be overcome by connecting a resistance of about 10 or 20 ohms in series with the condenser, as in Fig. 4.

Tramways and Flashing Signs

So far we have only considered the case of interference caused by plugs, switches, electrical appliances, etc., in the house itself. This can usually be fairly easily traced and remedied as we have already explained. Now often the most annoying and persistent disturbance is caused by outside agencies, such as trams, electric signs, and battery-charging plant, and here the question of suppression is rather different. First of all, if the trouble is to be tackled at its source, it means approaching the owners of the offending apparatus. Naturally, without their consent and co-operation nothing can be done. If the source is definitely traceable then the best method of approach is via the Post Office authorities, to whom application should be made. Of course, they have no powers as yet to *force* the parties concerned to fit suppression apparatus, but many firms will take a reasonable view of the matter, and either install suitable suppressors themselves or allow you to have them fitted. Often a pair of condensers is all that is necessary to cut out the crackle.

Failing satisfaction in this direction (and, curiously enough, where one would naturally expect the most courteous treatment, that is from local authorities, it is sometimes that the greatest opposition is met), the only thing is to attempt to barricade all possible channels by which the interference may find access to the receiver. Obviously this is not always easy, especially as usually the interference arrives by the same path as the wanted signal, namely, down the aerial.

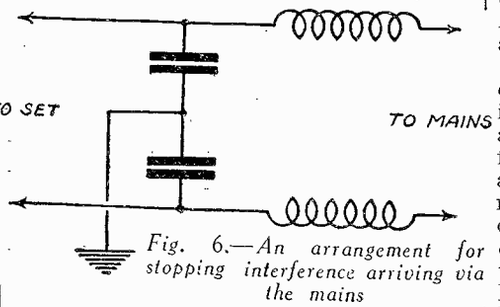


Fig. 6.—An arrangement for stopping interference arriving via the mains

It may appear rather obvious to mention that the direction of the aerial may have some effect on the degree of pick-up from interference sources, but for the benefit of those who have not heard of it before it may be stated that it is always advisable to run the aerial at right angles to tram or trolley-bus wires, electric train lines, etc.

What is often a very effective device is a counterpoise earth. The more orthodox form is shown in Fig. 5. It consists of a wire similar to the aerial wire suspended directly under the aerial and a foot or so from the ground. It is insulated from the earth either by using bare aerial wire and porcelain insulators, or else by using rubber-covered wire. An alternative arrangement which is very easy to fix up consists merely of a length of flex laid along the floor of the room in which the receiver is used. Its position should be varied until the best place is found, when it can be concealed under the carpet.

Screening the Aerial

Sometimes interference may be caused by currents induced in the aerial by nearby gutter piping, metal stove pipes, corrugated iron roofs over workshops, etc. Naturally the aerial and lead-in should be kept as far away from these as possible. Failing this a screened lead-in may be useful. These may be obtained from radio dealers and consist of a central lead-in wire surrounded by a metal sleeve which is insulated from the central wire. The sleeve should be earthed. In the case of the iron roof just mentioned a good plan is to earth it at one or two points by soldering wires to it, the other ends being connected to earth tubes, or pieces of old metal buried in the soil. The roof will then become an earthed screen to any electrical machinery in the building instead of an inductor to create currents in the aerial above it. All joints in the roof should be electrically as well as mechanically sound.

Apart from the aerial-earth system the other most likely pathway for interference is down the mains. This, of course, only applies to mains sets. Here the best device for barricading the entrance consists of a similar arrangement to that used to reduce radiation from the source, namely, chokes in each of the mains leads and two condensers in series across the leads, with the centre connection earthed. (See Fig. 6.) In this case the current which has to pass through the chokes is comparatively small, and can be wound with thin wire and are, therefore, quite compact. Chokes and condensers specially made for this purpose can be obtained from various manufacturers. Examples of those marketed by Messrs. Bulgin and Co., Ltd., are illustrated in Fig. 7.

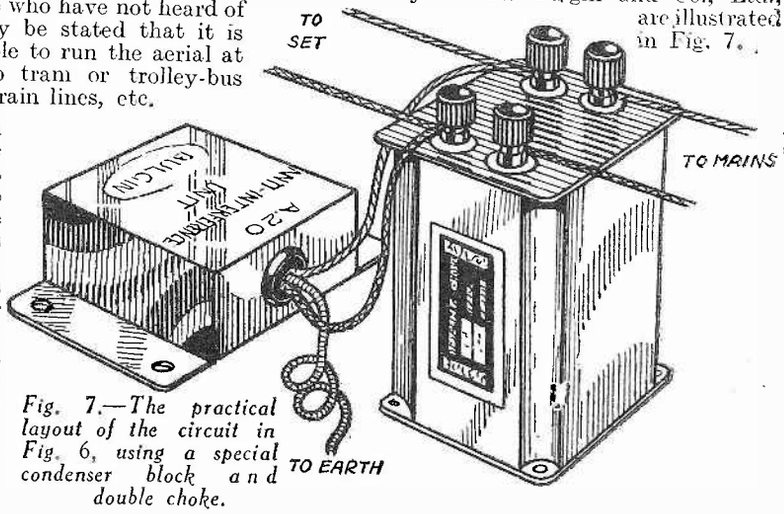


Fig. 7.—The practical layout of the circuit in Fig. 6, using a special condenser block and double choke.

Broadcasting in British India

ALTHOUGH the total population of British India is roughly 350,355,000 souls, the broadcasting system has received comparatively little support. The number of listening licences has only increased from 3,000 in 1928 to a figure in the neighbourhood of 10,000 to-day. One of the principal difficulties with which the broadcasting authorities have had to contend is the diversity of languages. Indian programmes are broadcast in Urdu, Gujarati, Bengali, Hindu, Telugi, Marathi and Tamil, but in all, in the Indian Empire, 222 *languages are spoken*, of which twenty-three only by more than one million natives.

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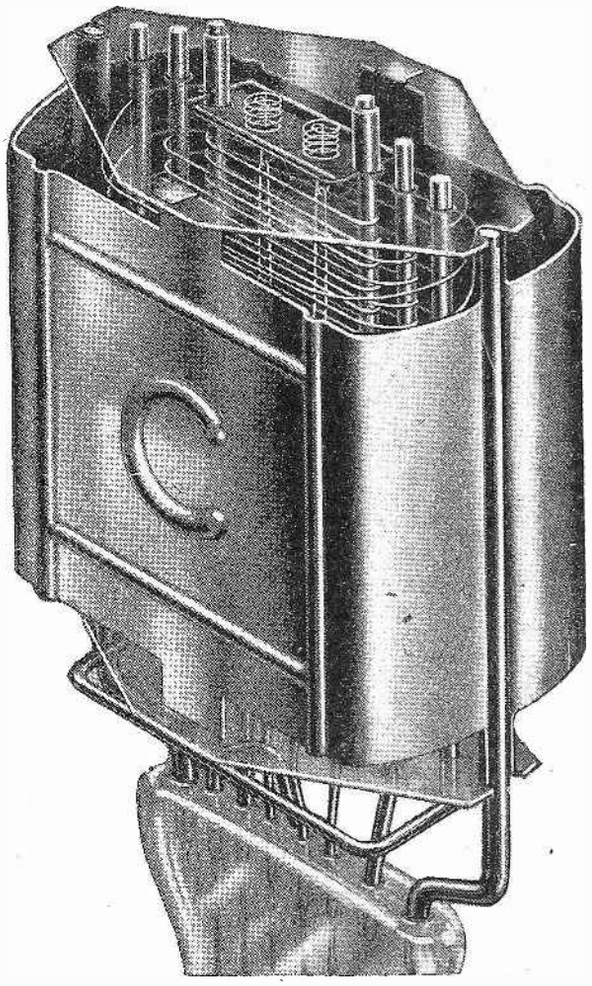

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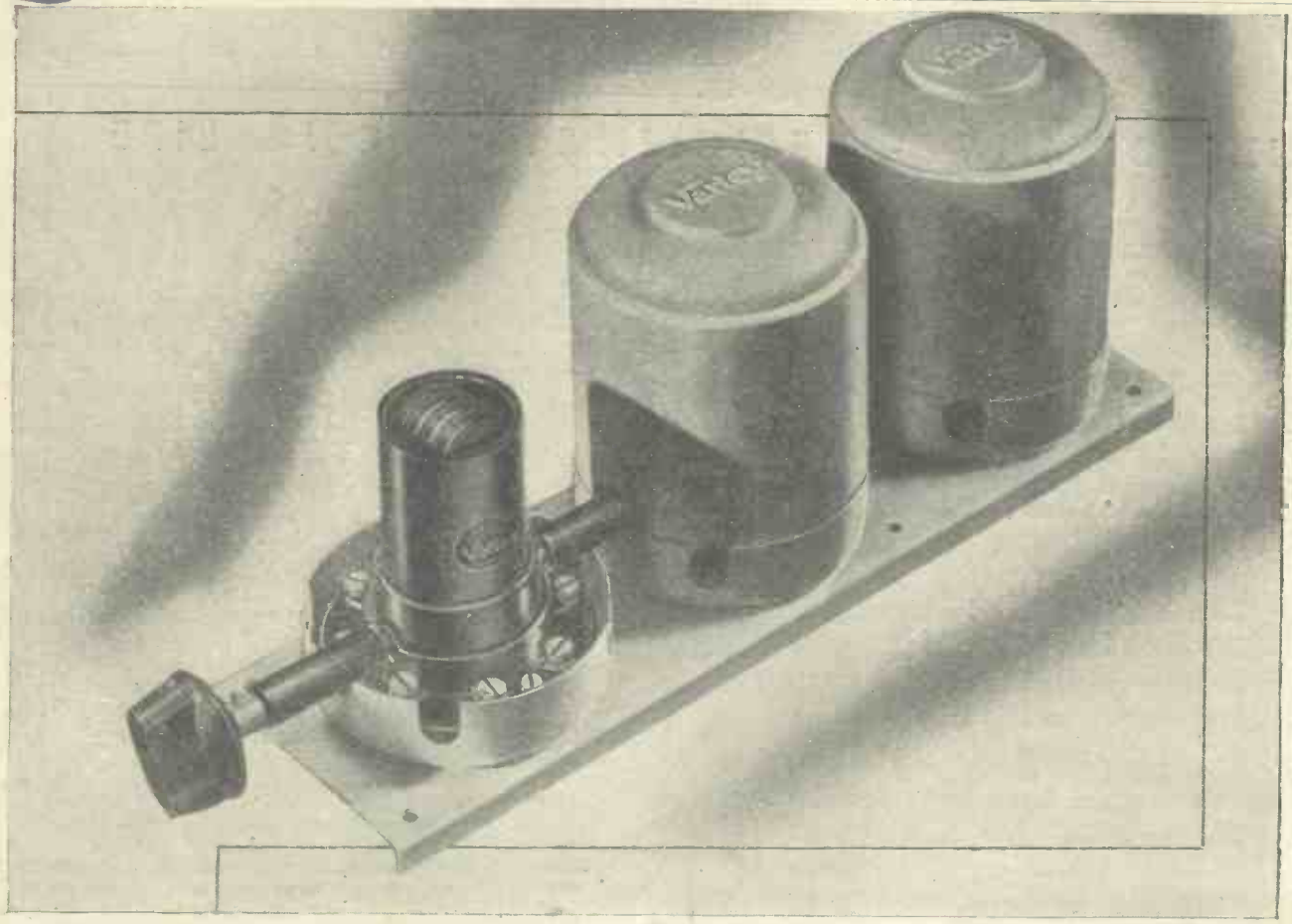

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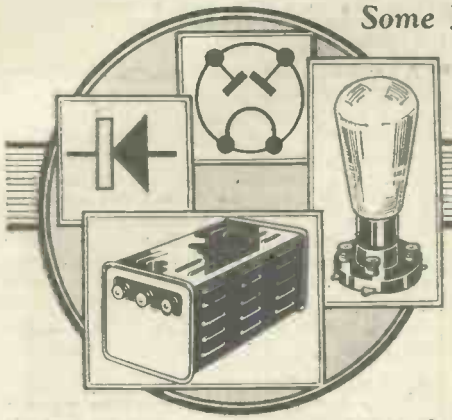
Some Interesting Points Concerning A.C. Mains Rectifying Valves



The RECTIFIER — and its Peculiarities

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc., A.M.I.E.E.

(Continued from page 74 of last week's issue.)

IT is true that the percentage change of current, and consequently, of voltage, is not very great in the case of a single variable-mu stage, but with two such stages the effect may, perhaps, be noticeable. Where it will have a serious effect, however, is in the grid bias to the output valve, if the circuit is of the type in which the anode currents of all the valves pass through the biasing resistance. A ten per cent. change in the total anode current will, in this case, cause a ten per cent. change in grid bias, which is quite a serious matter. The only method of avoiding this effect is, of course, to alter the grid biasing arrangement to one in which each biasing resistance carries only the anode current of its own particular valve, such a scheme being indicated in Fig. 12.

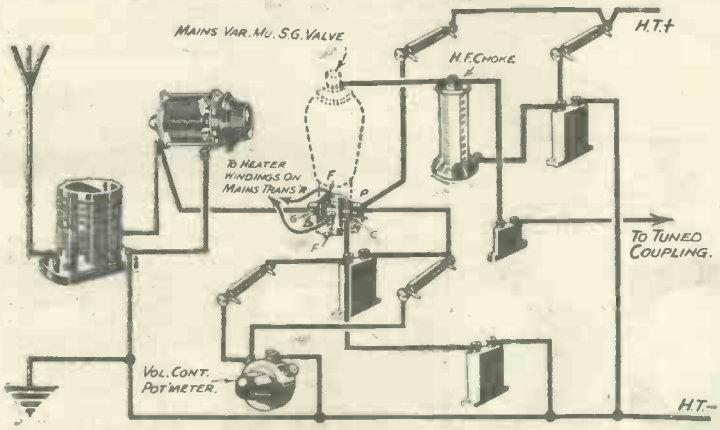


Fig. 12.—Using a variable-mu valve so that the biasing resistances carry the valve's own anode current.

The next case to which we must give our attention is the continual variation in the anode currents of the various valves due to the signals themselves. It will be appreciated that any valve, with no signal applied to its grid, takes a steady anode current. When a signal is received, be it a high-frequency signal as in the case of screened grid valves or detectors, or a low-frequency signal as in the audio-frequency amplifiers and output valve, the anode current is caused to vary in sympathy with the signal. Now these variations of current are so rapid that an ordinary milliammeter connected in the high-tension circuit will not show them. They exist, however, all the same, and they set up a corresponding variation in the voltage drop across the rectifier.

Back Coupling

Since the rectifier is part of the anode circuit of every valve in the set, it will be clear that these rapid variations of voltage, due to the variations of anode current of one valve, will be passed on to other valves. This "back coupling," as it is called, is liable to set up oscillations in the circuit, of which the effect known as "motor boating" is a familiar example.

In order to avoid these troubles it is necessary to "decouple" the various circuits in the receiver. This consists of including in each anode circuit a fairly high resistance, the end of which farthest away from the high-tension input is by-passed to earth by a condenser, as indicated in Fig. 13. Such an arrangement is, in fact, a species of additional smoothing circuit, any high- or low-frequency component in the anode feed taking the easy path through the condenser to earth.

If, as is usual, the rectifier is designed to give 250 volts H.T. for operating 200-volt valves, the various voltage dropping resistances required for the different valve stages can be employed as decoupling resistances. In the case of a power grid detector, for example, where it is desired to reduce the H.T. voltage as little as possible, a choke can be substituted for the decoupling resistance, but the condenser must never be omitted. For most decoupling purposes condensers of 2 microfarads capacity are quite large enough, while in the high-frequency stages ¼ to ½ mfd. is sufficient.

It may be remarked here that a further type of rectifier valve is available, although it has not yet come into general use. This is the mercury rectifier in which the bulb is filled with mercury vapour. One of the principal advantages of this type of rectifier is that its internal resistance is very low, so that even violent changes in load current do not make any appreciable change in the output voltage

Combating Voltage Breakdowns

If you examine once more the output curve for a typical rectifier valve—that is, Fig. 11—you will see that the rise in voltage at no load is much more rapid than at half or full load, so that when no current is taken from the rectifier the output voltage is as high as 360 volts, although under load it is nearer 250 volts. It may be thought that this is a matter of little importance, since in the average set all the valves, including the rectifier, are switched on at once. It certainly does not matter if the rectifier is used in conjunction with a battery-operated receiver—*and the receiving valve low tension is switched on before the rectifier is plugged into the mains.* Neither does it matter if the rectifier forms part of an A.C. mains set in which the output valve is of the directly heated type. In that case the filament of the output valve and of the rectifier heat up together, and the output valve takes high-tension current immediately it is switched on. But many sets employ an output valve of the indirectly heated type, in which the cathode takes about half a minute to heat up. If the rectifier is of the directly heated type, it will therefore be switched on to practically an open circuit, and a sudden surge of H.T. voltage will occur which is liable to break down the insulation in parts of the circuit.

To combat this tendency, some valve manufacturers have introduced indirectly heated rectifier valves, in which, instead of

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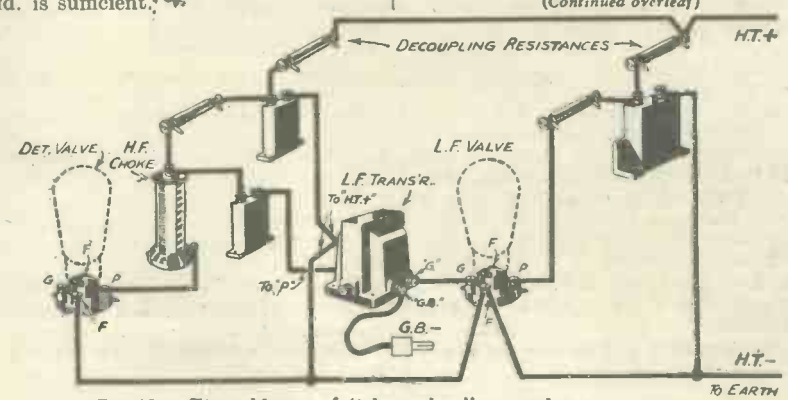

Fig. 13.—The addition of "decouplers" to stabilize a receiver.

(*Continued from previous page*)

the usual filament, the emitted element is an independently heated cathode similar to those employed in A.C. mains receiving valves. Thus the cathodes of both receiving and rectifying valves heat up simultaneously, and the voltage surge associated with switching the rectifier on to an open circuit is avoided.

Another alternative is the use of a thermal delay switch which closes the filament circuit of a directly heated rectifier valve at a definite time, usually half a minute, after the main receiver has been switched on, and thus renders the rectifier inoperative until the receiving valves have had time to warm up.

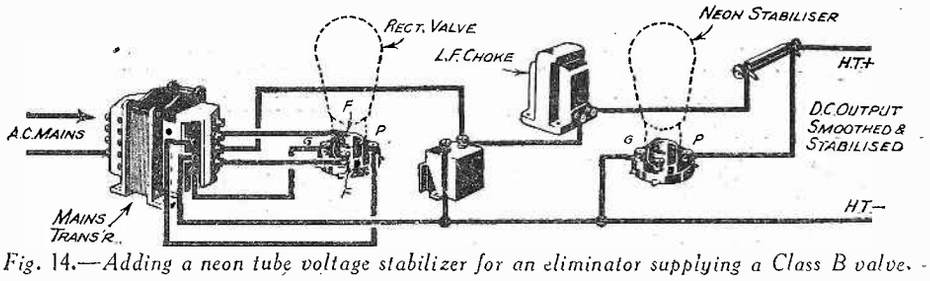

Fig. 14.—Adding a neon tube voltage stabilizer for an eliminator supplying a Class B valve.

A Special Case

A very special case of the variation in anode current affecting the performance of the set occurs in receivers where the output stage comprises two valves operated in quiescent push-pull, or a single Class "B" output valve. In such cases the "standing current" in the output stage is a matter of a few milliamperes only, while the peak values of the anode current may be ten times as great, or even more.

Such a receiver, operated from an ordinary H.T. eliminator, could not be expected to be stable. Of course, Q.P.-P. and Class "B" are really devices for obtaining a large maximum output *with battery H.T.*, and there is actually little point in employing an eliminator. Still there are a few people who desire to use an existing H.T. unit with Class "B" output, and it is therefore necessary to show how this may be satisfactorily achieved.

In the case of a metal rectifier it is frequently sufficient to feed the Class "B" valve through a separate smoothing system which is particularly generously designed in the matter of choke inductance and condenser capacity.

Where a valve rectifier is employed, however, further steps must be taken. The best solution, in addition to providing very efficient smoothing, is to connect across the H.T. positive and H.T. negative terminals a "gas discharge" tube, of which several reliable makes are on the market. (See Fig. 14.) It must be remembered, however, that the effect of such a tube is merely to maintain a constant drain from the eliminator by taking *additional* current when the anode current of the valve drops. Thus the actual H.T. consumption approximates to the maximum value of the anode current of the valve, and the high-tension economy, which is one of the prime advantages of Class "B," is lost.

The only reason for using Class "B" with an eliminator is that one certainly obtains a greater maximum output than could otherwise be obtained with a single battery valve—but no H.T. saving is effected thereby.

Fuses

A matter about which I am always receiving inquiries, and upon which a great diversity of opinion seems to exist, is the question of fuses in the rectifier circuit. Listeners as a whole seem to be divided roughly into two main groups—those who are over anxious to be on the safe side and simply plaster their mains equipment with fuses, and those happy-go-lucky people who hope for the best and omit fuses altogether. There is, of course, a small minority who form the happy medium.

From an examination of a large number of shop-made mains sets of different designs, and sold at different prices, one forms the opinion that in the case of expensive and high-quality apparatus it is standard practice to incorporate fuses only on the input side, while the less expensive sets have no protection at all. Possibly the argument is that the set will be plugged into the house mains and will therefore be adequately protected by the sub-circuit fuses. This, however, is a fallacy, because sub-circuit fuses are seldom lighter than five amperes rating, and in the event of a short circuit or other mishap in the receiver quite a lot of damage may be done without blowing a five amp. fuse.

My personal practice is to fit a double-pole fuse, rated to blow at one ampere, at the mains terminal of the receiver. These fuses may be fitted in a baseboard mounting fitment, of which several good types are available, or in a neat combined inlet plug and fuse, which is a very handy arrangement. Then I fit a smaller fuse—usually of ½ amp. capacity, in the H.T. positive lead, as close to the valve as possible—*i.e.* before the smoothing circuit, as indicated in Fig. 15. The object is to provide protection for the rectifier and transformer in the event of any short or earth, wherever it may occur in the apparatus, be it a breakdown of one of the smoothing condensers, breakdown of insulation in a choke winding, or elsewhere. To my mind this gives all the protection needed in the event of all likely contingencies.

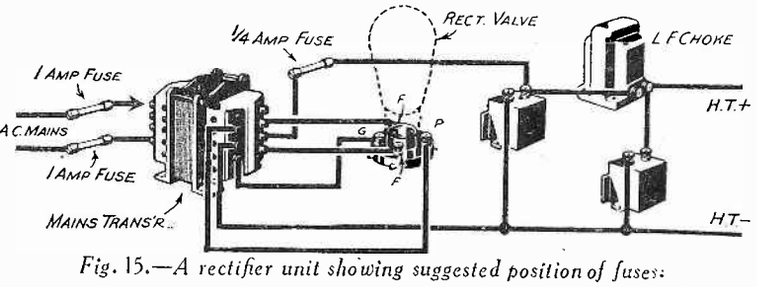

Fig. 15.—A rectifier unit showing suggested position of fuses.

L.C.R. AND L.S.D.

(*Concluded from page 99, Sept. 30th issue*)

A SIMPLE power pack scheme was shown in Fig. 2, the rectifying valve V being either of the directly or indirectly heated cathode type. According to the rectified power demanded by the set, so the type of rectifier valve will vary, but it derives the voltages for feeding its anodes and own filament from separate secondary windings on the mains transformer. Power will be consumed by each of these windings, and then we have to consider one or more additional secondary windings that feed the filaments of the mains valves in the set itself.

For Practical Purposes

Now for all practical purposes we can consider the "load" applied by the rectifying valve V as being purely resistive, and since the resultant impedance in ohms is much smaller than that applied by the branches of the smoothing equipment we can, for rough calculations, assume that the wattage consumed by the valve V constitutes the secondary load. It might be thought that since the full voltage across the secondary winding is twice the rectified output voltage, then double the rectifier's output must be taken by the secondary. One half of the secondary winding is inoperative during each half cycle, however, and, in consequence, the assumption is not correct.

Furthermore, owing to the predominance of this rectifier resistive load in comparison to the inductive and capacitative loads we can, for all ordinary purposes, neglect the difference in phase between current and voltage. Our problem is, therefore, simplifying itself. Of course, we should take into account the losses and efficiency of the mains transformer, but with a good class component incorporated in the receiver this efficiency is quite high. To counterbalance the transformer efficiency factor the maximum wattage output of which this rectifier valve is capable. The set seldom draws this full power, but I have found this method a very good one for offsetting any losses which are difficult for the amateur to measure.

To this figure we must add the consumption of the valve filaments, but by tackling the problem in this way we have simplified matters and overcome the difficulties of phase angle differences.

An Example

To learn the consumption, therefore, the course to follow is simply this. Ascertain which rectifier valve is being employed—say a D.W.2, D.W.3, D.W.4, etc., and see what its maximum output is rated to be. For example, with a very powerful set using a D.W.4 rectifier valve we have an output of 120 milliamperes at 500 volts, that is, 60 watts. Add to this the rectifier filament power consumed, namely 2 amps. at 4 volts, giving us 8 watts, and finally, the filament consumption of the set. This latter could be, say, four valves at 4 volts 1 ampere, together with one valve at 4 volts 2 amperes, giving a total wattage consumption of 24 watts. Our total is, therefore, 60 + 8 + 24 = 92 watts, which means that the set will work for nearly eleven hours before one unit of electricity is consumed.

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(See page 143)

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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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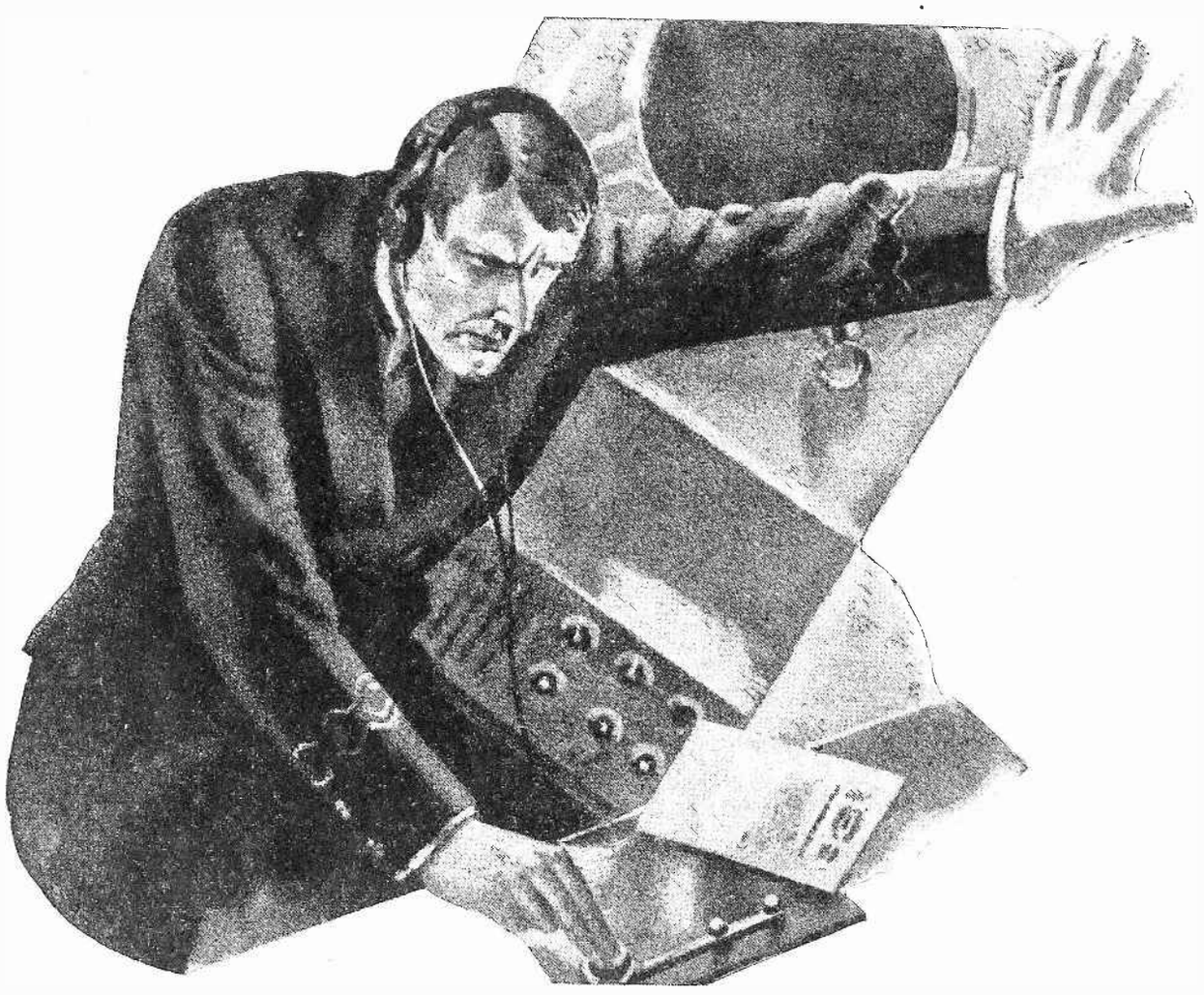

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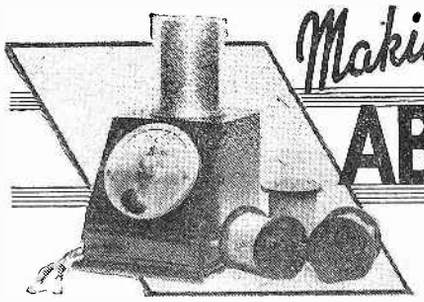


Making an IMPROVED ABSORPTION WAVEMETER

In This Article the Writer Describes a Simple and Efficient Instrument Suitable for Use in Conjunction With Modern Short-wave Receivers. By ALF W. MANN

THE fundamental principle of this wave-meter, of course, is not new, and is a variant of the popular absorption wave-meter used by amateurs the world over. It is, however, a definite improvement over the aforementioned type, and is universal in application, and can be used with any type of short-wave receiver—unscreened, partly, or totally screened. Screening makes absolutely no difference whatever, and providing it is possible to magnetically couple the four turn coupling coil to the detector grid coil, or, in the case of aperiodic coupling being used in the receiver, to the aperiodic coil, this wave-meter will function efficiently. The same applies with reference to the various types of tuning coils employed in short-wave receivers, two, four or six pin, and dual-wave coils. The coupling coil may be wound on the same former if there is room, on the mounting or plug-in base, or above the coil itself, according to the design and the position of the coil it is desired to couple with.

Details of Construction

It will be noticed that the cabinet is of desk type construction, and if made exactly to the dimensions given, it will be found that the angle at which the panel is set will enable the user to take accurate dial readings, either in daylight or artificial light.

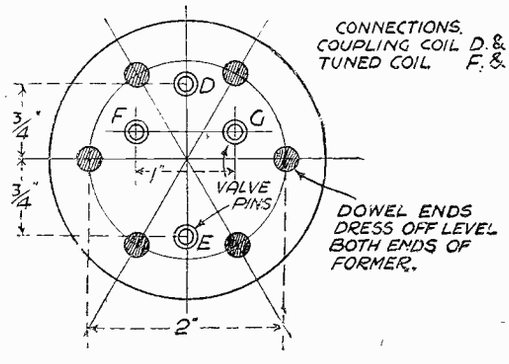
The coil screen obviates direct pick-up by the coil windings, and so assists in accurate calibrations being made.

Fig. 1 shows general construction of coil formers, together with winding data. Each former has a permanent coupling winding of four turns wound alongside of the tuned winding, four pins only being required, fitted as per plan of former base.

Fig. 2 gives constructional details of the four-turn coupling coil which is permanently installed in the receiver. The dimensions of the base will be governed by the amount of space available where it is desired to place t in the receiver. However, the dimensions of the original one are given. The most suitable coupling of this coil in relation to the grid or aperiodic coil must be found by experiment. Place it as near as possible to commence with.

Fig. 3 will make clear the methods used in connecting the wavemeter to the receiver.

Fig. 4 shows how the coil mounting base of four and six-pin coils may be utilized as a former on which to wind the permanent coupling coil. The constructor will devise his own method of cabinet construction, but should rigidly adhere to dimensions given.



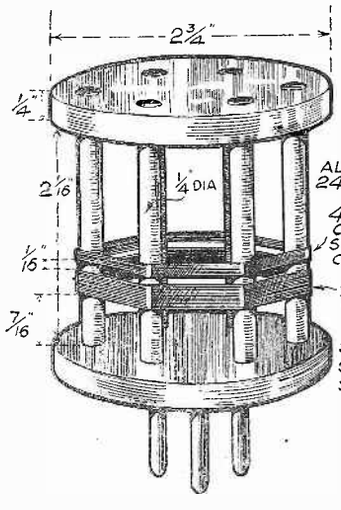


Fig. 1.—Details of coil-former and windings.

COMPONENTS REQUIRED.

1 .0003 mfd. variable condenser (SL or LML).
1 vernier dial, 0—100° or 180°.
1 .0003 mfd. fixed condenser, unless .00015 variable is used.
1 six-pin coil base and screen.
Length of twin flex (good quality; see text).
2 2ft. 6in. length of wood dowelling ¼in. diameter.
14 valve legs and 2 valve holder sockets.
4 banana plugs and sockets, 2 red, 2 black.
2 ounce reel 24 gauge copper-enamelled wire, or sufficient to wind coils, if on hand.
1 piece 3in. diameter by ¼in. six-ribbed former.
Shellac varnish for wood former.
2 pieces of ebonite, 2½in. by 1½in. by ¼in.

Drill and mount as in Fig. 5, in back of wavemeter, and back of detector end of receiver cabinet, wired to coupling coil, Fig. 3.

Mounting the Components

The components should be next fitted up, also the socket strip. Remove terminals from coil base, also aluminium spigot around which screen fits. Screw base to underside of cabinet (top) with sockets protruding through hole A (Fig. 5). Keep them central. Now mount spigot on top of cabinet and screw in place. If base and spigot are in one piece, (ebonite), mount it on top of cabinet complete with terminals. The other method, however, is neater, as all leads go direct to socket screws inside the cabinet, thus drilling holes for leads in cabinet top is avoided. Fit tuning condenser in centre of panel and make sure the moving vanes clear the sides.

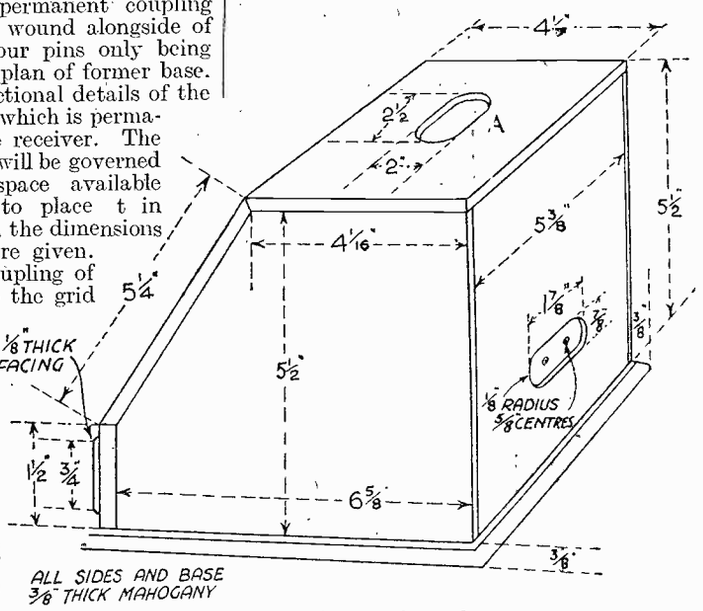


Fig. 5.—Details of cabinet for coupling absorption wavemeter.

Fix slow-motion dial in place, and then wire up the tuning condenser, fixed condenser, and coil base and sockets, as shown in Fig. 3. Screw on bottom of cabinet and the wavemeter is complete.

The coil construction can next be taken in hand. The twin flex lead may be of any length, so that the wavemeter can stand close to the set or some distance away, according to the requirements of the individual. Variation in length does not affect the calibrations, as the coils and coupling flex form a complete untuned link circuit.

(*Continued on page 158*)

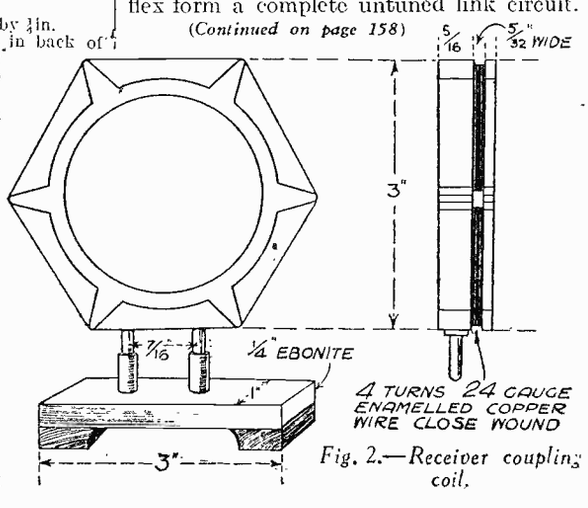


Fig. 2.—Receiver coupling coil.

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.

WE are now approaching the most interesting stage of our discussion on the simple disc television receiver, namely, assembly; but before dealing with that, let me first of all have a word to say on the question of lenses for magnifying the image.

Lenses

The image, as it is built up by rotating the spiral of holes in the disc before the modulated neon glow of the lamp, is limited in its size by the dimensions of the disc. For example, with a disc having an external diameter of 20ins., the actual image area size is slightly less than 2ins. high and just over ¾in. wide. For most practical purposes this is too small to watch for any length of time without eye strain, so a lens or a pair of lenses must be mounted before the image so as to enlarge it optically.

Do not attempt to magnify the image too much, or with the present thirty-line transmission it will lose definition. A limit of four to five times will, as a general rule, be found ample. Suitable lenses may be obtained at any opticians. An ordinary reading glass will serve, but usually a combination of two lenses will be productive of better results. One very good combination is a 6in. diameter single convex and one 4in. diameter double convex with focal lengths of 17ins. and 11½ins. respectively. These should be clipped or fixed on to a mount 1in. apart with the smaller or double-convex lens nearer the disc and the larger or single convex lens farther from the disc. This is shown in Fig. 1 and the exact distance of the mount from the disc itself can be ascertained by observation, but about 2½ins. will be found to be the approximate distance.

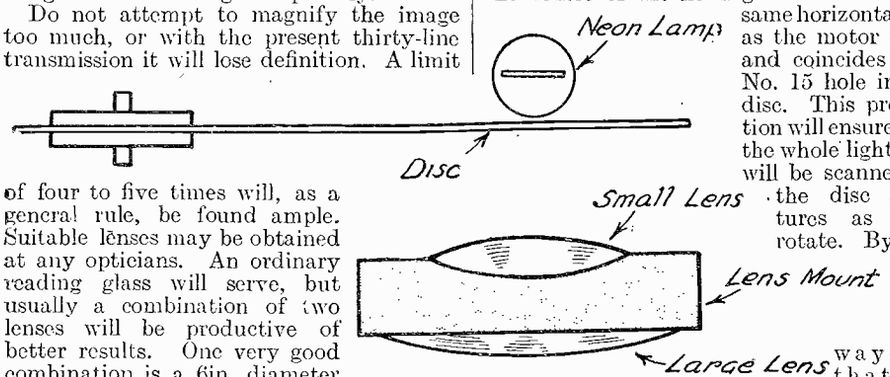


Fig. 1.—Showing the relative positions of disc, neon lamp, and lenses.

Assembly

The assembly of the various components is quite a straightforward matter, and in view of my previous articles will present no difficulty to the reader. Of course, there are several variants according to the æsthetic taste of the constructor, but in every case one or two points must be observed. First of all, screw the motor to a wooden mount so that when the disc is placed on the shaft it will clear the table or bench on which the mount is resting. One example of this is shown roughly in Fig. 2. The neon lamp must be fitted in the usual type of bayonet-type holder at the back and on the right of the disc so that the centre of the neon glow area is on the same horizontal line as the motor shaft and coincides with No. 15 hole in the disc. This precaution will ensure that the whole light area will be scanned by the disc apertures as they rotate. By the way, see that you have the disc mounted the right way round on the motor shaft—that is to say, when facing the front the spiral of holes should progress towards the centre in a clockwise direction. Then, if the motor is made to rotate in an ante-clockwise direction, the scanning movement will be as the B.B.C. standard—namely, hole movement bottom to top and strip movement right to left.

Further Suggestions

If the motor is mains or accumulator-driven it will require both a fixed and variable resistance in series with the leads. These can be mounted as shown, the variable resistance being adjusted to make the motor run at its correct speed of 750 revolutions per minute. The same mount that is used to screw down the motor can be employed to hold the lens or lenses which are positioned immediately in front of the disc and neon.

You will notice that I have not made any mention of synchronizing apparatus at this juncture, as this is a subject which must be treated separately at a later date. I am concerned now only with the simplest of instruments and the correct motor speed must be maintained by a delicate handling of the variable resistance or, alternatively, introducing some form of friction brake on to the motor shaft.

Examples

By referring to Fig. 3 the reader will obtain a very fair impression of how a machine of this character can be built up from relatively crude apparatus and yet made to function quite well and give hours of pleasure. Notice the "tunnel" in front of the lenses so as to screen off any extraneous light, and also the reflector at the back of the neon lamp to concentrate the neon glow. Fig. 4 shows yet another variant, this time a machine made up from commercial parts.

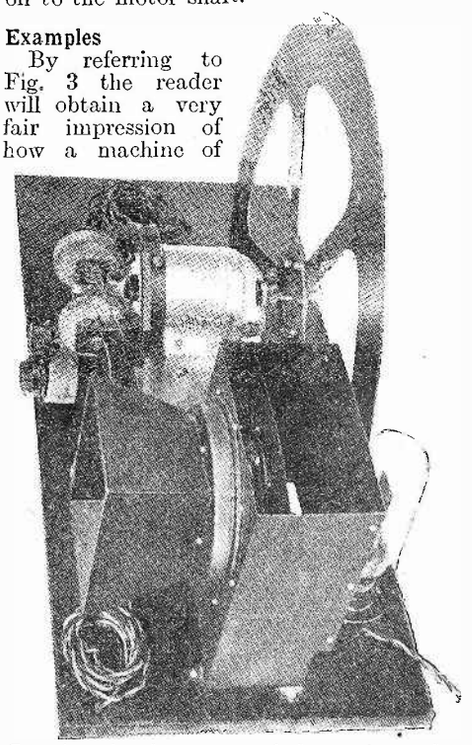


Fig. 4.—Another suggested design for a disc television receiver made up from standard parts.

The next important point for us to study concerns the various methods of connecting the neon lamp to the output circuit of the wireless receiver, and I am making this the subject of a special article which will appear in a subsequent issue.

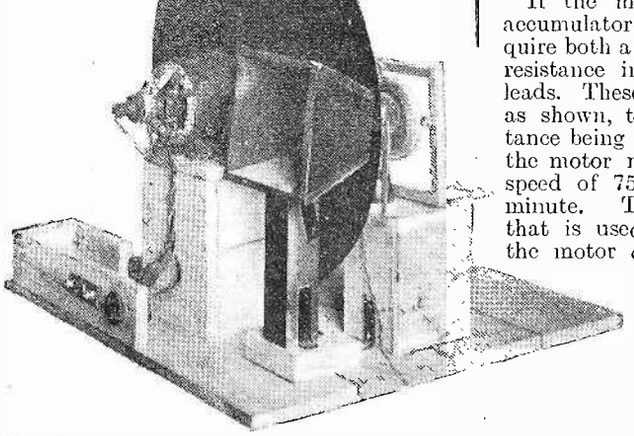


Fig. 3.—A good amateur effort of building disc television apparatus from rather crude materials.

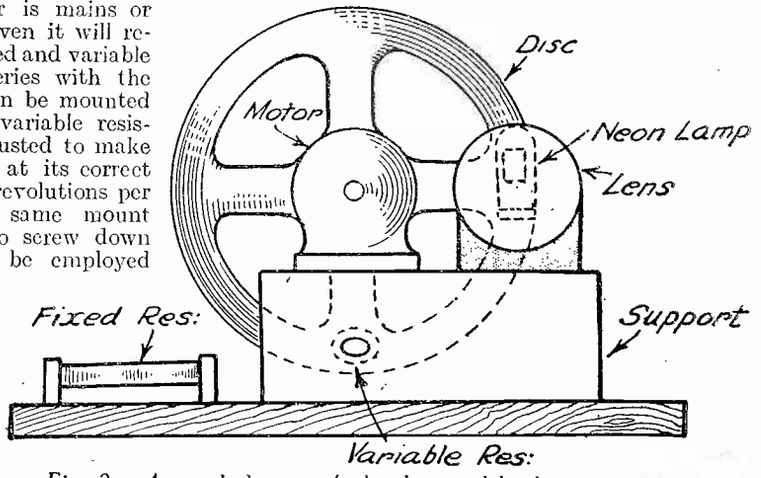


Fig. 2.—A rough layout of the disc model television apparatus.

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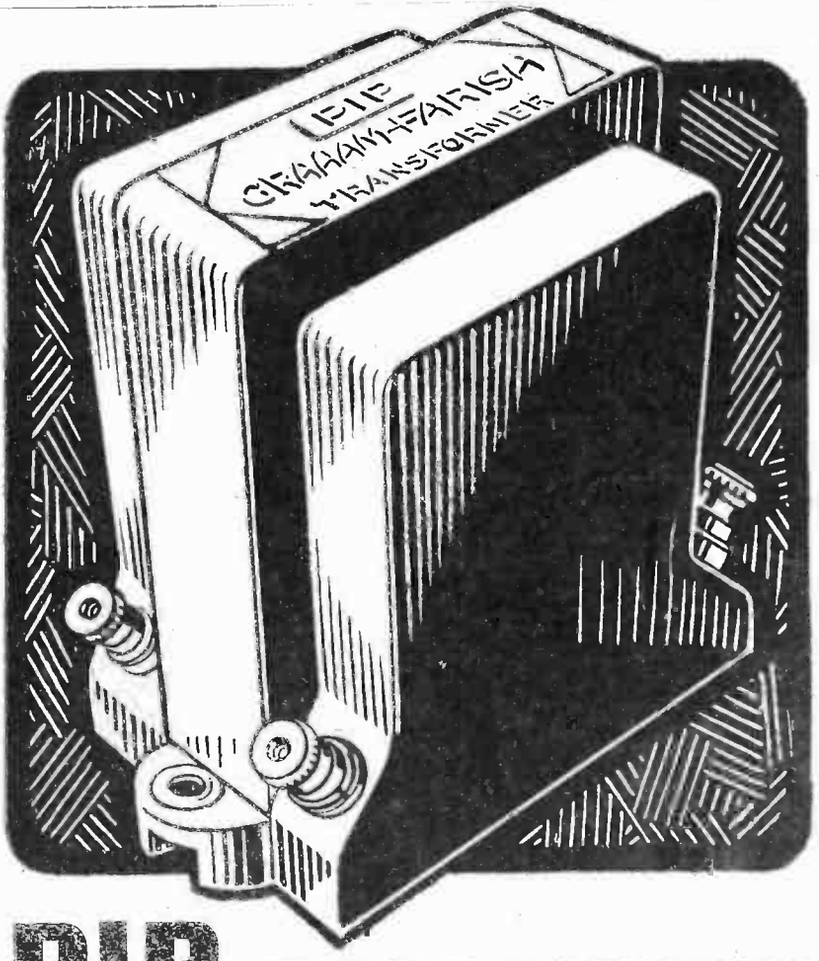

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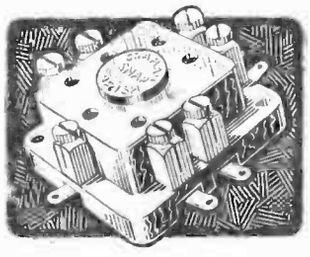

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Type, 6d.	Type, 8d.	Type 1/3

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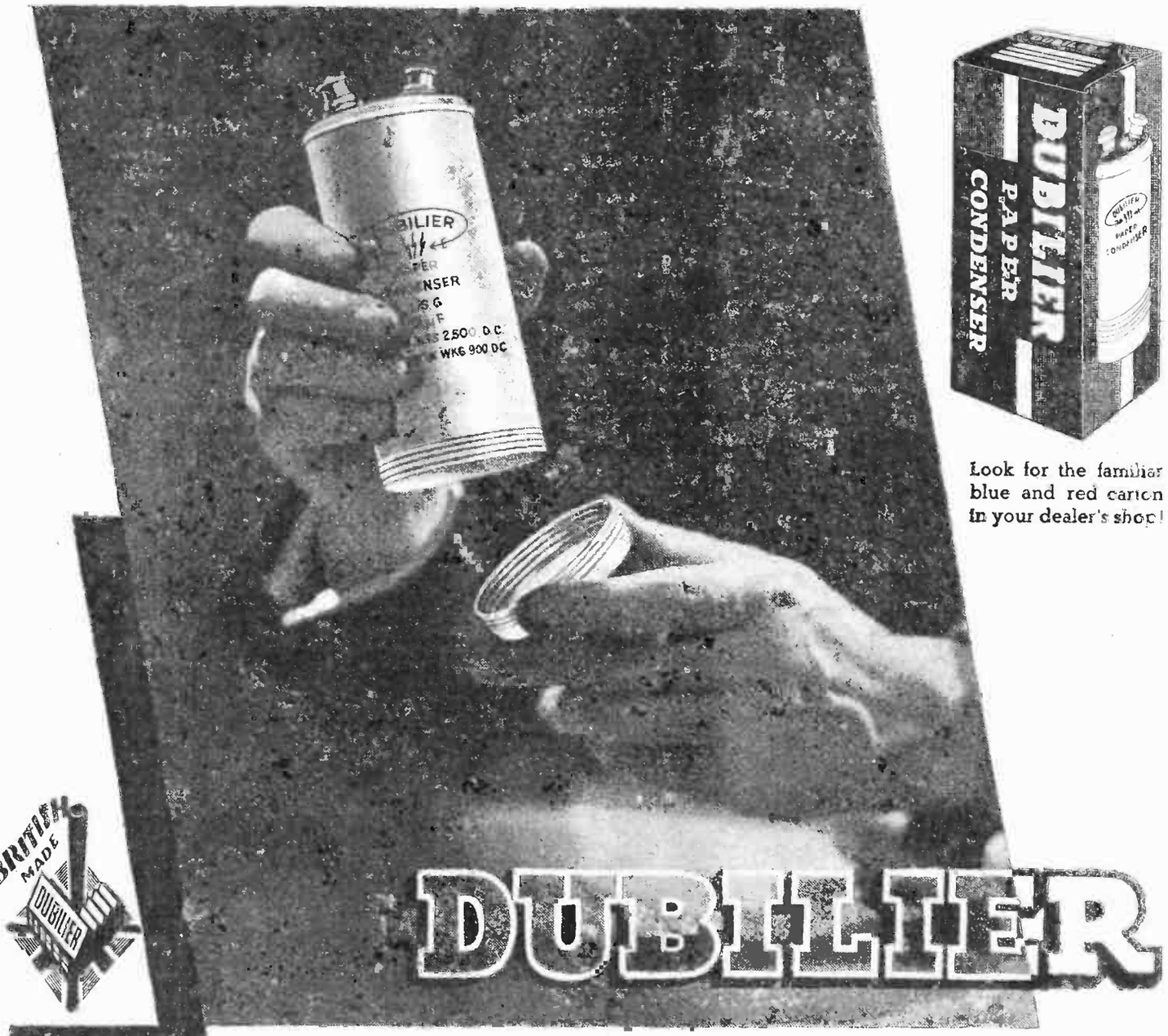

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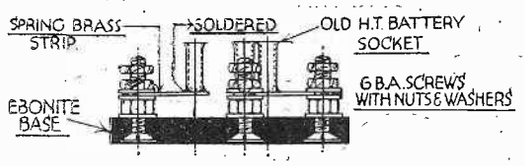
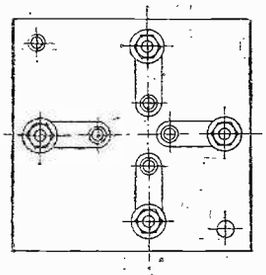
READERS' WRINKLES

THE HALF-GUINEA PAGE

A Valve-holder from Scrap Material

THE accompanying sketches show a valve-holder made entirely from scrap material. Old high-tension battery sockets serve as valve sockets, and these are soldered to pieces of springy strip brass. Each socket complete with strip is mounted on a block of ebonite, cut to the shape required, and fastened thereto by a counter-sunk head screw and lock-nuts in the manner illustrated.—GEORGE R. BENT (Reddish).

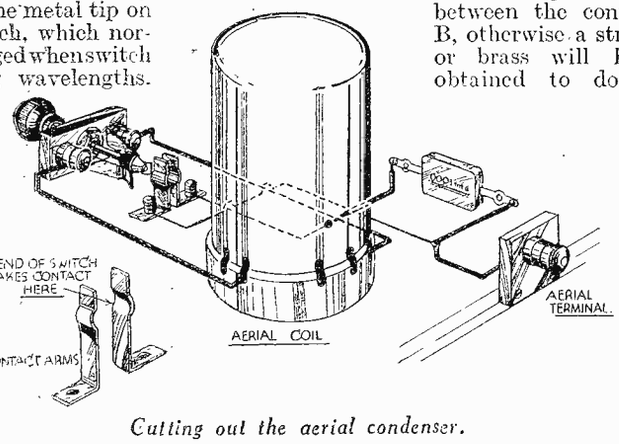




Details for making a valve holder from scrap metal

Cutting Out the Aerial Condenser

WITH the majority of dual-range coils a difficulty presents itself. A fixed condenser of approximately .0001 mfd. is placed directly in aerial lead, but the problem is how can one cut the condenser out when on long waves, as reception on this wave-length proves better without it. The usual method is to have two aerial terminals, or else the lid of the cabinet needs lifting to make an adjustment. By referring to the accompanying diagram it will be seen that the necessary adjustment is done automatically when switching to long waves. Furthermore, there is no financial outlay, owing to the fact that the same switch does the work by making use of the metal tip on end of the switch, which normally is disengaged when switch is set for long wavelengths. The only materials required are two pieces of tin cut and shaped as shown and two pieces of wire, and these can be connected up in a few minutes.—L. T. W. SMITH (Chelmsford).



Cutting out the aerial condenser.

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.

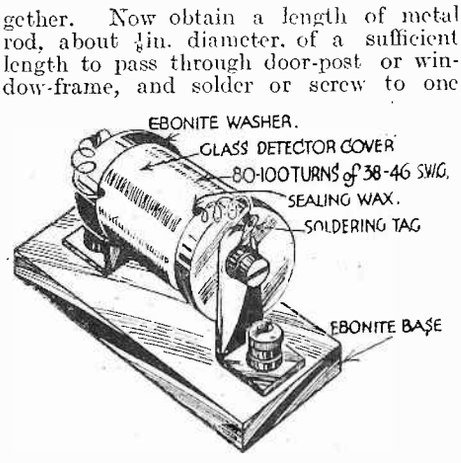
Short-wave Choke from a Crystal Detector

A CHEAP but efficient short-wave choke can be made from an old crystal detector of the glass tube type, two 4 B.A. nuts and bolts, two soldering tags, and a small quantity of wire (silk or enamel covered). First remove the cup and the cat's whisker arm and on the glass tube, starting about 3/16in. from the end, wind a choke of approximately 80–100 turns of 38–46 S.W.G. Put a spot of Chatterton's compound or sealing-wax on the first and last wires to keep them in place. Solder a tag to each end of the wire for connecting purposes. Then take a 4 B.A. bolt, pass it through the end soldering tag, the brass bracket, and the large ebonite washer, put on a nut and tighten. After unscrewing the other brass bracket from the base, repeat the above process at the opposite end, and then slip the glass tube into position between the ebonite washers. Re-fix the bracket on the base, and the choke is complete.—J. IRWIN (Blackburn).

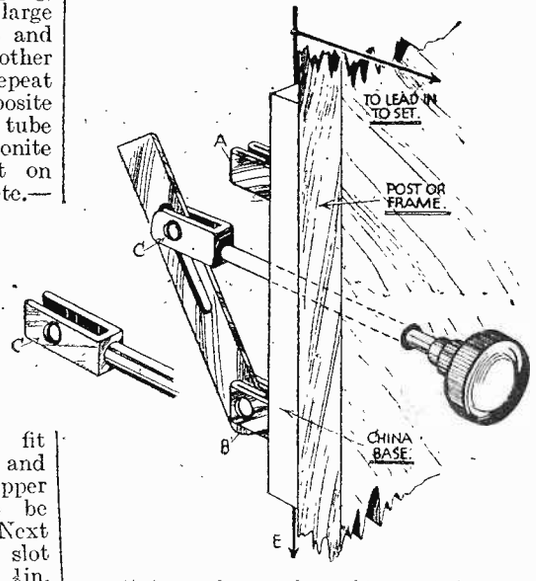
An Aerial Earthing Switch

A VERY efficient aerial earthing switch, which can be fixed outdoors and operated indoors, can be made from a china base single-pole double-throw switch. First remove switch blade from centre of base and it will in all probability be found long enough to fit between the contacts A and B, otherwise a strip of copper or brass will have to be obtained to do so. Next cut a slot about ½in. long and ⅛in. wide in the centre of the blade, then place blade in contact B and drill a small hole right through so that contact and blade can be bolted together. Now obtain a length of metal rod, about ¼in. diameter, of a sufficient length to pass through door-post or window-frame, and solder or screw to one end a U-shaped piece of metal, as shown in the illustration at C, and drill for a small bolt and nut. The rod is then passed through centre hole in switch base and operating rod attached to the blade with a small bolt and nut. It is essential that this should be a loose fit. It only remains to drill a small hole right through the door-post or window-frame where it is desired to fit the switch and screw knob on the indoor end of the operating rod. The illustration is almost self-explanatory, and no doubt the majority of readers will have sufficient material in their junk boxes to make up one of these switches. It will be found that the switch is "self-cleaning," owing to the spring contacts A and B.—W. J. A. DAVIES (Uxbridge).

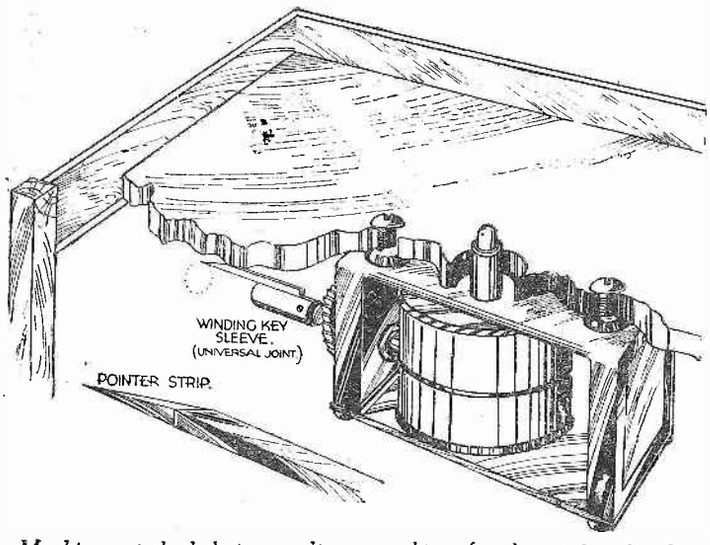
(Continued overleaf)



Making a short-wave choke from a crystal detector.



A simple aerial earthing switch.



Marking out the hole in a radiogram cabinet for the winding handle.

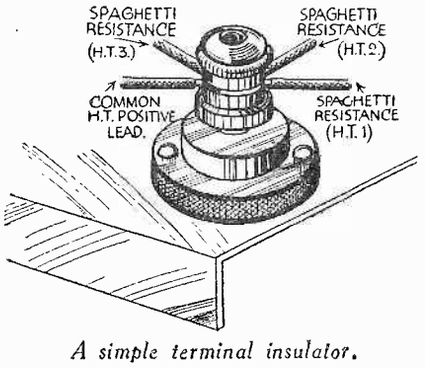
READERS' WRINKLES

(Continued from previous page)

Marking Out Hole for Winding-Key

AFTER having fitted a spring motor to the motor-board in my radiogram cabinet, my next job was to drill the hole in the side of the cabinet to take the winding-key escutcheon. The winding sleeve on this motor having a universal joint made it difficult to find the centre position for the hole in the side of the cabinet. It can easily be done in the following way: Cut a piece of strip metal about ½in. wide by ⅛in. thick, having a straight edge at the bottom. The length of the strip must be the distance from the end of the sleeve to the inside of the cabinet. File one end of the strip to a sharp point as indicated in the sketch. With one hand push the sleeve as far out of centre as it will go, holding it firm. Place the pointer flat on the sleeve and slide forward until the point pricks the wood panel. Repeat this all round the sleeve, taking care to push it out of centre at each position.

You will then have a circle of prick marks on the panel. The centre of this circle is the dead centre line. Drill a small hole from inside the cabinet and enlarge from the outside to take the winding-key escutcheon.—F. MORLEY (Hayes).



A simple terminal insulator.

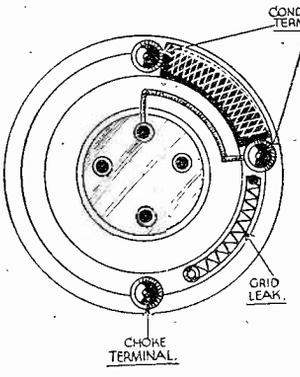
A Simple Terminal Insulator

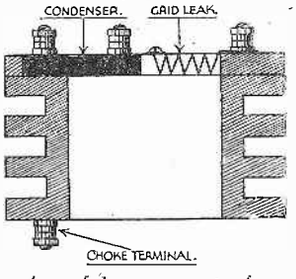
DIFFICULTY is sometimes experienced in making fully insulated connections on a metal chassis. The following suggestion will be found very helpful and an excellent means of using up old-type condenser knobs which are to be found in almost every constructor's junk box. One of these knobs should be inverted and two holes drilled in the flange. It should then be bolted to the baseboard, and a terminal screwed into the top of the knob, as illustrated. A sound electrical connection is then available and H.T.+ leads and spaghetti resistances may be joined with ease.—W. H. MASON (Stalybridge).

A Useful Component of Compact Design

THE illustration shows a component which takes up little space, and reduces the number of leads in a set. The scheme consists of an ebonite former which slips over the valve socket with a friction grip. The component contains a former for the choke, and the grid condenser and grid-leak are also contained in the former.

The condenser and grid-leak are enclosed in a cap in the form of a ring in which a circular groove is cut. The dielectric and condenser leaves are in the form of a part circle as shown, and the grid-leak is wound on a flat former which fits in the groove, one end being attached to one terminal of the condenser. No difficulty will be experienced in connecting up the grid-leak, either in parallel or in series with the condenser. This arrangement may be made up by any experimenter, and attached to any set, and the space saved allows a better arrangement of the rest of the components. This idea incorporated in the valve-holder is much more convenient than the method shown, but it is easier for the amateur to make and fit to the valve socket as shown. The idea was first carried out by attaching the same arrangement to a valve socket from which the globe had been taken or broken.—W. H. GRAYLING (Cambridge).





A useful component of compact design.

For Resistances less than 1,000Ω red plug in B

Then Res.= $\frac{\text{Voltage} \times 1{,}000}{\text{Reading}}$ —1,000 ohms

Resistances of higher value than 10,000Ω may be placed in series with higher voltages across A and neg. sockets.

Then Res.= $\frac{\text{Voltage} \times 1{,}000}{\text{Reading}}$ ohms

By winding the 1 ohm resistance with .94oz. No. 18 S.W.G. Eureka wire, and using black plug in B, 1 to 5 amperes can be read on the meter.

A Cheap Universal Tester

THE following particulars relate to a universal tester which I have made and found reliable. The components required are 1 moving coil milliammeter reading 1 to 5 milliamps, 7 resistances, values as shown (strip Colverstats were used as these are 5-watt type), 31½ft. 26 D.C.C. wire wound on a card for a 1 ohm resistance, 13 sockets (11 red, 2 black), 1 black and 1 red plug, 4½-v. G.B. battery, and a strip of tin for bus bar. The other end of the leads have crocodile clips which may also be clipped on to two prods. The tests available are as follows:—

For *Volts* use neg. socket with:

Socket B for 1 to 5 volts reading is actual
" C for 3 to 15 " " " × 3
" D for 10 to 50 " " " × 10
" E for 50 to 250 " " " × 50
" F for 100 to 500 " " " × 100
across supply.

For *Milliamps* use neg. socket with:—

Socket A for 1 to 5 mA. reading is actual
Black plug in G_1 and Socket G for 5 to 50 mA. reading is × 10
Black Plug in H_1 and Socket H for 20 to 100 mA. reading is × 20
in one of the leads.

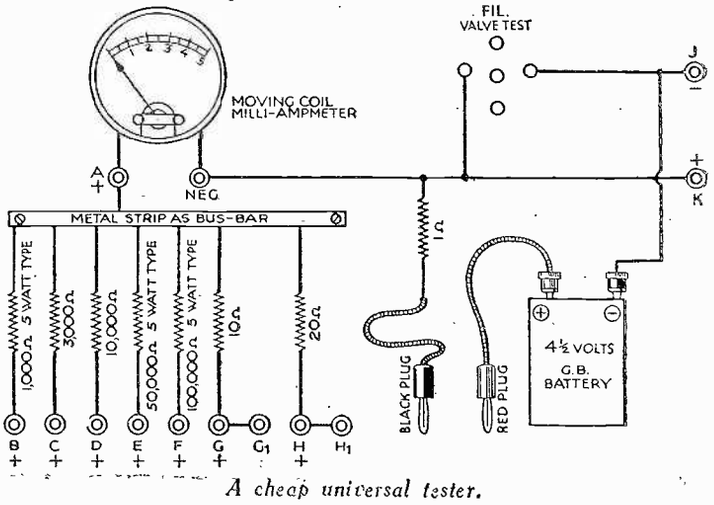
For *Continuity* test use Sockets J and K with:—

For high resistance tests red plug in A
For low resistance tests or filament tests } red plug in B or C across circuit to be tested

For *Ohms* (1) Read off exact voltage of battery with red plug in B by shorting J and K

(2) For resistances 1,000Ω to 10,000Ω red plug in A. Place resistance across J and K

(3) Then Res.= $\frac{\text{Voltage} \times 1{,}000}{\text{Reading}}$ ohms



A cheap universal tester.

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Offer closing immediately—reserve Your Kit AT ONCE!

THIS is your last chance to obtain the PRACTICAL WIRELESS Pocket Tool Kit to which, as a reader of PRACTICAL WIRELESS you are entitled in accordance with the Simple Conditions set out below.

Every home constructor will appreciate the value of this Kit—which if sold in the ordinary way would cost at least 12s. 6d. Each tool is specially designed, made from best quality steel and fits snugly in its place in the neat metal case—which slips easily into the pocket.

If you have not yet reserved your Kit a glance down the list of Tools and at the illustration (much reduced) will surely make you keen to possess it. Fill in the Forms at once!

LIST OF TOOLS IN THE "PRACTICAL WIRELESS" KIT

One 4in. spring steel Chesterman rule No. 300D-2.

One special steel scriber with adjustable chuck for scribing point renewal.

One pair of special ebonite test prods with wander plug socket ends and brass test points.

One special 4in. trammel with one fixed and one sliding head enabling circles to be scribed from O up to 3⅝in. in radius. This tool may also be used for cutting holes in ebonite and baseboards too large to be drilled in the ordinary way.

One 60 degree 16-gauge steel set square with finger fret, for easy use.

One special viewing mirror for inspecting obscure parts of the set. This viewing mirror fits into the scriber chuck.

One steel screwdriver with brass ferruled handle, extremely useful for locking screws, securing components to baseboard, etc.

And the three steel spanners O-B.A., 2-B.A., 4-B.A., 6-B.A., 8-B.A., 10-B.A., given Free to every reader of PRACTICAL WIRELESS fit in a special recess beneath the set-square.

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Fill in this form and the label on left in Block Letters.

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THE MANCHESTER RADIO EXHIBITION

OUR STAND No. 11— GROUND FLOOR

COMPLETE REPORT BY OUR TECHNICAL STAFF

With Copyright Illustrations by Our Own Artists

The Stand-to-Stand Report given here is arranged in alphabetical order of exhibitors' names to facilitate quick reference.

STAND No. 85, Gallery
AERIALITE LTD., Amber Street, Manchester

THIS firm specializes in aerial materials and accessories, and have on show an interesting display of the now well-known "Levenstrand" aerial wire, invisible aerial strip, percolative earth tubes, and complete sets of aerial-earth components.

The "Levenstrand" aerial wire is somewhat unique in that a £200 insurance against lightning is given with every length sold. It can be obtained in lengths 100ft., 75ft., and 50ft., at 3s. 6d., 2s. 6d., and 1s. 9d., respectively. The price of the complete aerial equipment, which includes every accessory required, from the aerial wire to the earth lead, is only 7s. 6d., and this equipment is attracting a considerable amount of interest.

STAND No. 34, Tonman Hall
AMPLION (1932) LTD., 82-4, Rosoman Street, London, E.C.1

ONE of the most interesting items on this stand is the new "Sonette" permanent magnet moving-coil speaker selling at the low figure of 27s. 6d. This is a really excellent line, and is truly one of the best low-priced speakers on the market at the present time. There is also a larger P.M. speaker on show, which is named the "Audiola." Selling at 49s. 6d., it is an excellent adjunct to a powerful receiver or for small public address amplifiers.

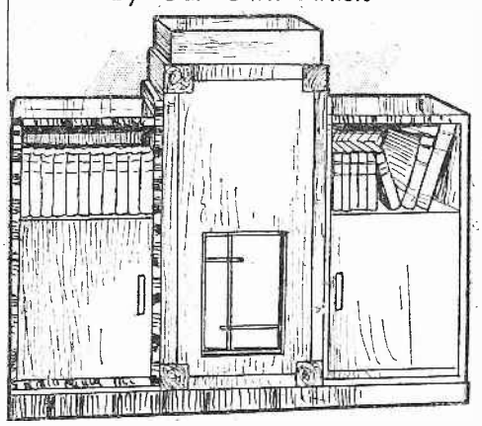
Although in the past Messrs. Amplion have devoted their attention almost entirely to the production of loud-speakers, the position is nowsomewhat different, for they are making a full range of Class B components which are worthy of the reputation which the name of Amplion has attained. There is a three-ratio driver transformer, which can be matched to any Class B valve, listed at 9s. 6d., as well as a tapped output choke retailing at the same price.

Yet another line of outstanding merit is the new screened H.F. choke, priced at 3s. 6d. This is an excellent component, having a low D.C. resistance, combined with extremely high inductance and low self-capacity.

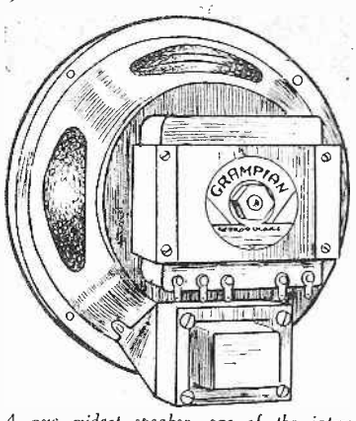
STAND No. 11b, New Hall
AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD., Winder House, Douglas Street, London, S.W.1

THE well-known and very popular "Avometer" is exhibited on this stand, in both A.C. and D.C. types, selling at 12 guineas and 8 guineas respectively. Additionally, there is the "Avodaptor," a useful unit for use in conjunction with the multi-range "Avometer" when taking measurements on valves. A combination of these two instruments nowadays forms the full testing equipment of nearly every radio engineer.

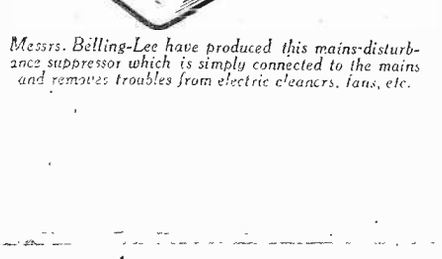
Another interesting exhibit is the "small brother" of the "Avometer," namely the "Avominor." This is a very accurate multi-range meter that can be used for measuring three different ranges of milliamps, three voltage ranges and four resistance ranges. It sells at the very remarkable price of 40s., and is so compact that it can easily be carried in the pocket. Do not miss this stand if you are interested in high-grade measuring instruments.



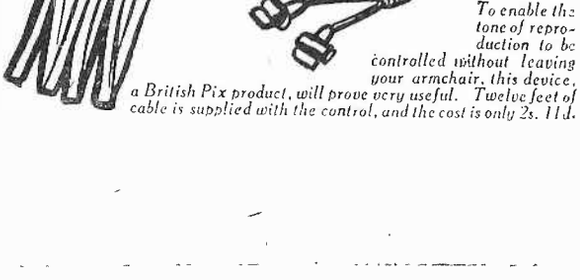
A neat modern cabinet, showing how utility is being considered by makers of wireless cabinets.



A new midget speaker, one of the interesting Grampian range. Priced at 25s., this speaker is only 2¾in. deep but handles 2½ watts without distress.



Messrs. Belling-Lee have produced this mains-disturbance suppressor which is simply connected to the mains and removes troubles from electric cleaners, fans, etc.



To enable the tone of reproduction to be controlled without leaving your armchair, this device, a British Pix product, will prove very useful. Twelve feet of cable is supplied with the control, and the cost is only 2s. 11d.

STAND No. 73, Main Hall
BALCOMBE, A. J., LTD., 52-8, Tabernacle Street, London, E.C.2

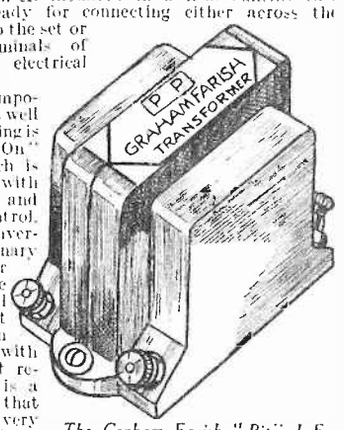
A FULL range of "Alba" receivers is to be seen here, and the wide variety of superheterodynes of modern design, in both battery and mains form, calls for very favourable comment. The novel tuning control, which consists of twin tuning scales for long and medium-wave reception, mounted one on each side of the operating knob, gives a particularly good appearance to the receivers, and is worthy of every visitor's attention.

A self-contained four-valve Class B battery set has a wide appeal to battery users in view of the many refinements which it incorporates. It is shown in both console and radiogram form, the cabinet work in both cases being particularly pleasing.

STAND No. 27, Main Hall
BELLING & LEE, LTD., Cambridge Arterial Road, Enfield

CONNECTING devices of every kind, for which Messrs. Belling and Lee have been known so long, are shown in an attractive setting, and the visitor cannot fail to observe the excellent finish that even the smallest wander plug carries. An item of especial interest is the newly introduced interference suppressor. It consists of an arrangement of condensers mounted in a neat bakelite case all ready for connecting either across the mains leads to the set or to the terminals of interfering electrical machinery.

Another component which is well worth inspecting is the "Clip-On" pick-up, which is complete with track arm and volume control. This is for converting an ordinary spring-motor gramophone to an electrical instrument when used in conjunction with the broadcast receiver. It is a handy gadget that is proving very popular indeed, not only because it is novel and ingenious, but because it is so extremely efficient.

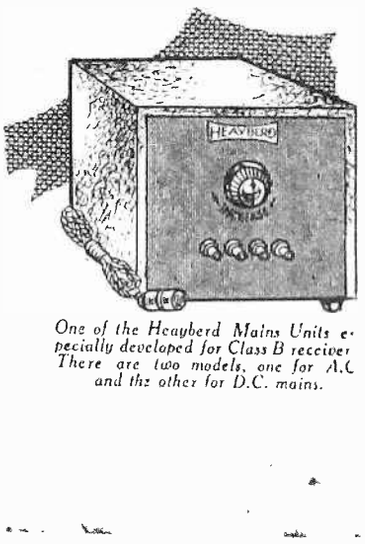


The Graham Farish "Pip" L.F. Transformer, obtainable in ratios 5-1 and 3-1 at 6s. 6d.

STAND No. 54, Main Hall
BLOCK BATTERIES, LTD., Abbey Road, Barking Essex

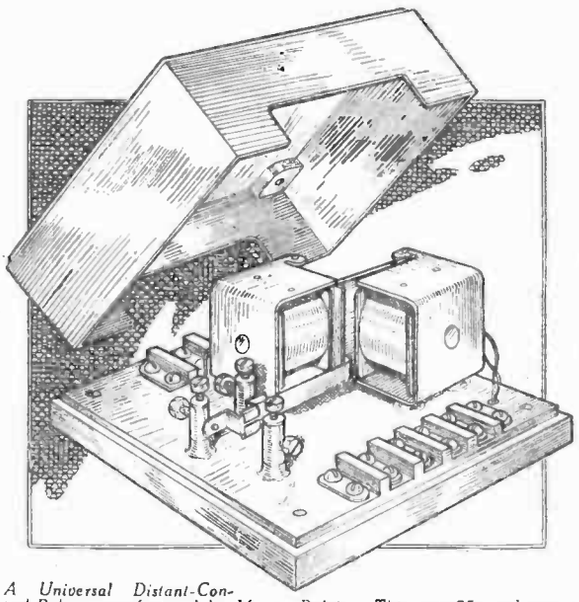
THIS firm has made a definite and successful attempt to overcome the problem of high-tension supply for the person whose house is without electric lighting. They have produced a new "Block" high-tension accumulator that is light, robust, compact, and electrically efficient. As an example, it might be stated that the 60-volt size (it has a capacity of no less than 5,000 m.a. hours by the way), measures only 14¾in. long by 4¾in. wide by 5¼in. high, and weighs about 16 pounds. The price of this is 37s. 6d., whilst a 30-volt type costs only 21s.

The "Block" L.T. accumulator is also on show, and is attracting a good deal of careful attention. Like the H.T. ones, it is plate-less, and therefore practically immune from the usual ills which befall



One of the Heayberd Mains Units especially developed for Class B receiver. There are two models, one for A.C. and the other for D.C. mains.

THE MANCHESTER



A Universal Distant-Control Relay, manufactured by Messrs. Bulgin. This costs 25s. and may be used with any type of receiver, D.C., A.C. or battery-operated.

accumulators of normal type. All patterns of "Block" batteries are housed in beautiful containers made of green bakelite and are fitted with neat leather carrying straps.

STAND No. 2, Main Hall
BRITANNIA BATTERIES, LTD., 233, Shaftesbury Avenue, London, W.C.2

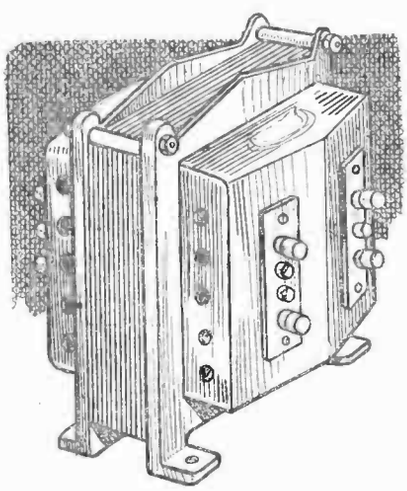
THIS firm is widely known as makers of the popular "Pertrix" high-tension batteries and accumulators so, as one would expect, these are very much in evidence on this stand. The high-tension batteries, which are unique in that they do not contain any sal-ammoniac, are to be seen in all types and sizes. One of the most interesting is that specially designed for Class B receivers. It has a high output rating, and is capable of delivering peak currents up to 35 milliamps or so without any undue voltage drop.

Batteries and accumulators of various sizes and for every purpose are available for inspection.

STAND No. 50, Main Hall
BRITISH BLUE SPOT CO., LTD., 94-6, Rosoman Street, London, E.C.1

A MOST comprehensive range of loud-speakers in balanced armature, moving-coil, and inductor patterns is displayed here and, whatever his needs may be, the constructor can find an instrument to meet them. Any type of Blue Spot speaker can be obtained in a form suitable for use with a Class B amplifier, and several of the moving-coils are available in either permanent magnet or energized form.

Besides the range of speakers, the Blue Spot Pick-up is also shown, and is worthy of careful examination by the intending purchaser of one of these accessories.



This illustration gives a good idea of the sound construction of Heayberd mains transformers.

STAND No. 86, Gallery
BRITISH PIX CO., LTD., 118, Southwark Street, London, S.E.1

THE "Pix" aerial selectivity device needs no introduction to our readers, but those who wish to see it will find that it is well displayed on this stand. There is also the famous "Pix" indoor aerial material, which consists of a strip of metallic conductor made up in an adhesive covering so that it may be fixed round the wall of a room, under the carpet, or in any odd place, with the minimum of trouble. The material can be obtained in a variety of colours to match the furnishings.

A complete range of "Pix" valves of both battery and mains types is also to be seen and is attracting attention in view of the low prices at which the valves are listed.

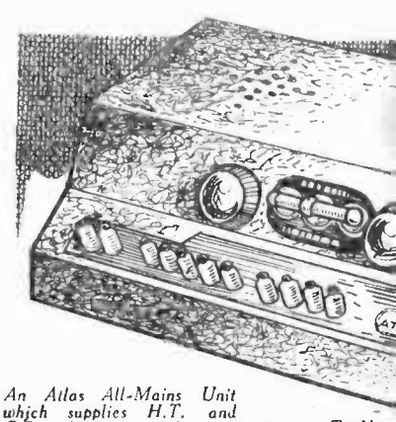
STAND No. 14, Tonman Hall
BRITISH RADIOPHONE, LTD., Aldwych House, W.C.2

SOME new models of the really excellent "Radiopak" complete tuning units are shown. Types for either "straight" sets or superheterodynes can be seen and are very interesting to the home constructor, due to the fact that the coils and gang condenser sections are matched with perfect accuracy before the units are despatched from the works. Other components (the full range is too great to enable us to mention them all) are a range of straight line condenser dials, midget shielded gang condensers, super intermediate frequency transformers, short-wave condensers, and a wonderfully efficient gramophone pick-up. The latter has been designed with extreme care, to ensure that it shall give uniform response over the full range of musical frequencies. A sharp top-note cut-off ensures against needle scratch, whilst the medium-impedance winding is carefully arranged to prevent hum and excessive bass.

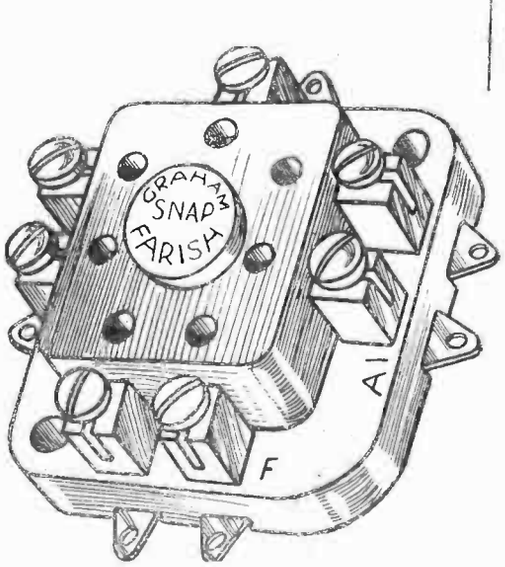
STAND No. 75, Main Hall
BRITISH ROLA CO., LTD., Minerva Road, Park Royal, London, N.W.10

SPEAKERS of every type are to be seen here. From the new midget to the large auditorium types they are obviously well made, and are well-nigh perfect electrically. The miniature speaker, which is specially intended for use in small or motor-car sets, is of especial interest, whilst battery users will be pleased to see the new combined P.M. moving-coil speaker and Class B amplifier. Nearly every type

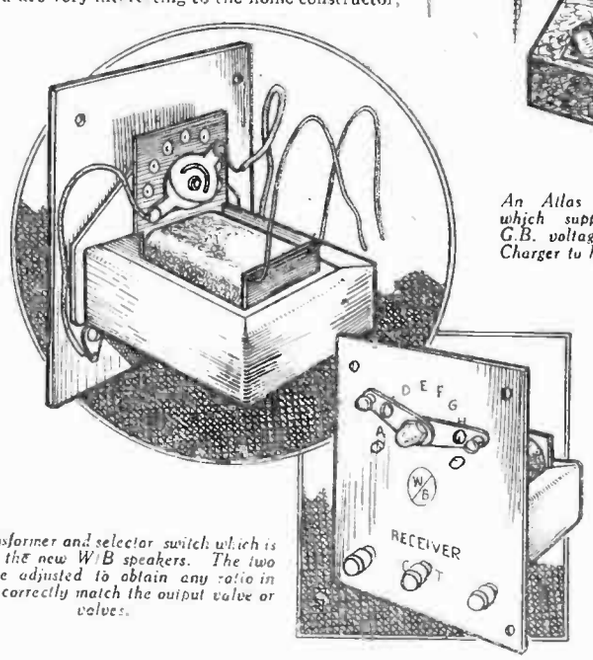
A fine example of radio cabinet design — a combined cocktail bar, electric clock and wireless receiver.



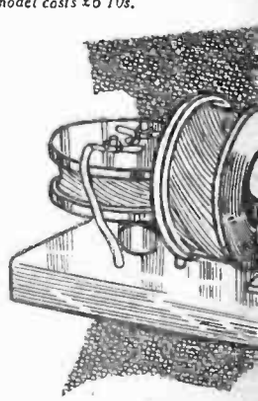
An Atlas All-Mains Unit which supplies H.T. and G.B. voltages as well as possessing a Trickle Charger to keep the L.T. battery in trim. This model costs £6 10s.



A new type of valveholder, manufactured by Graham Farish. The new idea in terminals enables a number of wires to be accommodated without the trouble of the wires becoming loose owing to the nut untwisting the loop. The wire ends are accommodated in the slots in the terminals.



The transformer and selector switch which is fitted to the new W/B speakers. The two arms are adjusted to obtain any ratio in order to correctly match the output valve or valves.



ADIO EXHIBITION (continued)

Rola speaker can be obtained in either Class B, ntode, or triode form, and there is no doubt that y speaker requirement can be met by one from the ola range.

A feature which is proving of especial interest is the riety of speakers which are being supplied in matched pairs for buyers who are seeking for perfect reproduction.

STAND No. 69, Main Hall
BULGIN, A. F., & CO., LTD., Abbey Road, Barking, Essex

THE most extensive range of home-constructor components and gadgets, for which Messrs. Bulgin are so well known, is attractively displayed on this stand. In addition to last year's designs that are being continued there are several brand-new ones. Among these special mention should be made of an ingenious unit for fitting to the tuning control of almost any receiver. Known as the "Mechanical Colour-Change Wavelength" unit, this useful accessory automatically shows a different coloured light when the set is turned from, say, medium to long wave.

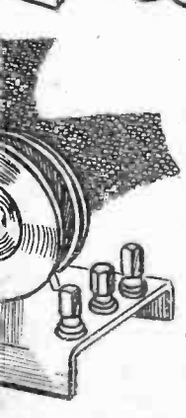
Other interesting components include a convenient range of tone control units; these are known as "Controlatones," and consist of a small bakelite moulding with adjusting knob arranged for one hole panel mounting. An illuminated signal device is yet another fascinating feature of this stand. The signal is intended for connection in the L.T. leads of the set, and lights up when the set is switched on. The device is of particularly attractive appearance and consists of a beautiful bronze figure which is illuminated by diffused light. Do not miss this stand if you are a home constructor.

STAND Nos. 94/7, Gallery
BRITISH BROADCASTING CORPORATION, Portland Place, London

STAND No. 44b
BEARDSALL, W. E., & CO., Victoria Bridge, Manchester

STAND No. 44
CARRINGTON MFG. CO., LTD., Camco Works, Sanderstead Road, South Croydon

HERE we find a very excellent range of cabinet work suitable for every radio requirement. In addition to various console and radiogram cabinets, a feature is made of a newly-designed foot-rest, which is particularly well suited for use when listening in. All the exhibits are of modern design and make an excellent display.



Heterodyne Whistle Filter, which is made by Messrs. Wright and Weaire. This enables the annoying whistle which often accompanies a station to be cut right out and uninterrupted signals to be heard.

STAND No. 1, Main Hall
CELESTION, LTD., London Road, Kingston-on-Thames

CELESTIONS have been very popular manufacturers of loud-speakers for several years, and one is not disappointed in the wonderful range of instruments now shown. There are speakers of both energized and P.M. moving-coil types, and all the latter are available fitted with a Class B transformer. The smallest Celestion speaker, the "Soundex," is worthy of inspection in view of the extremely good value which it represents.

The Celestion pick-up is also featured, and should be as popular as the speakers, in view of the extremely good response which it gives to the full range of musical frequencies.

STAND No. 114
CIFEL PRODUCTS, LTD., 134, Pentonville Road, London, N.1

THE chief features of interest here are a number of attractive receivers in both mains and battery-operated types. Perhaps the one which attracts most attention is the four-valver, fitted with two efficient variable-mu stages, but the smaller sets will also prove worthy of examination.

Of the components exhibited there are a number of L.F., Class B and Q.P.P. transformers, in addition to a full range of fixed condensers.

STAND No. 29, Main Hall
CLARKE, H., & CO. (Micr), LTD., Atlas Works, Patricroft

BESIDES the very complete range of high-tension units shown by Messrs. Clarke, there are some very interesting new receivers on view. The most popular of these is the A.4, a mains-operated four-valver giving an undistorted signal output of no less than 3 watts. Another receiver which is of equal interest to the battery user is the four-valve Class B instrument, which is fitted in a console cabinet and has a really good moving-coil speaker.

STAND No. 16, Main Hall
CLIMAX RADIO ELECTRIC, LTD., 59, Parkhill Road, Hampstead

A WIDE range of particularly handsome and modern receivers comprise the Climax exhibit. The most interesting of these are perhaps a three-valve band-pass receiver, styled the "T.C.III" and a four-valve (plus rectifier) superheterodyne for mains operation. The former instrument is of the completely self-contained transportable type, and is offered at the modest figure of 12 gns., or at 14 gns. complete with an attractive pedestal.

STAND No. 18, Main Hall
COLE, E. K., LTD., Ekco Works, Southend-on-Sea

MESSRS. COLE have been known to all wireless enthusiasts for several years as makers of mains units, and the new season's models are well up to the high standard of those which have been so popular in the past. In addition to these there is an entirely new range of receivers, built into futuristic bakelite cases, and which can be supplied with suitable chromium-plated pedestals of pleasing appearance.

An item of especial interest is a new car radio outfit, which is claimed to be more than usually efficient. It is certainly very neatly designed and can be fitted to almost any kind of car.

STAND No. 32, Main Hall
COLVERN, LTD., Mawneys Road, Romford

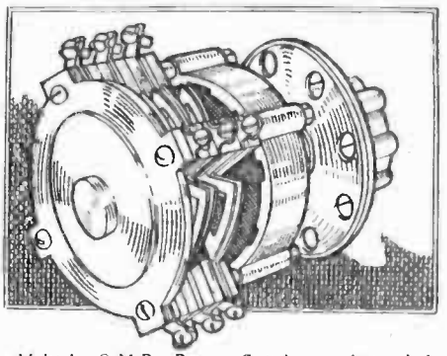
NOT only are Messrs. Colvern showing their extensive range of tuning coils of both "Ferrocart" and air-core types, but they have now a number of well-made complete tuning assemblies comprising the necessary "Ferrocart" coils, gauged tuning condenser and multiple switch. All these components are mounted together on a rigid aluminium chassis which can be adapted to numerous forms of set construction. Some models are provided with a four-way switch which serves for wave-changing, connecting a pick-up, and for switching the set on and off.

Altogether a most interesting display.

STAND No. 6, Main Hall
COSSOR, A. C., LTD., Highbury Grove, London, N.5.

THIS stand is of particular interest in view of the giant-scale models of various types of Cossor valves which are shown. These models are cut away to show the internal electrode assembly and are an education in themselves.

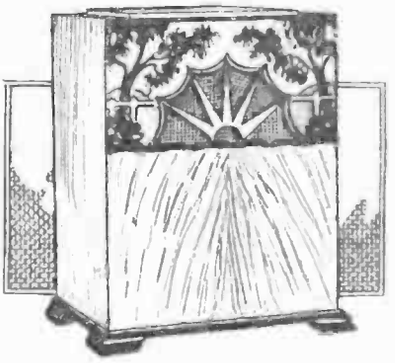
There is also a really wonderful display of home-constructor kit sets, some of which are mounted on a rotating axle to enable the visitor to inspect them with ease. Besides the kit sets, however, there are also the complete Cossor sets which are indicative of the very wonderful value for money which Cossors are offering.



A Multiple Q.M.B. Rotary Switch manufactured by Messrs. Bulgin. This is obtainable in single, bi-polar or tri-polar types, at prices from 3s. 6d. upwards. Definite positions are given by an ingenious type of contact maker.

STAND No. 104, Gallery Bridge
COSMOCORD, LTD., Cambridge Arterial Road, Enfield

A NEW and extremely good potentiometer volume control is shown here in both the plain type and also fitted with a ganged Q.M.B. switch. This is a line which we have tested recently and which was found to have a perfectly smooth movement and to show a steady resistance variation over the complete scale.



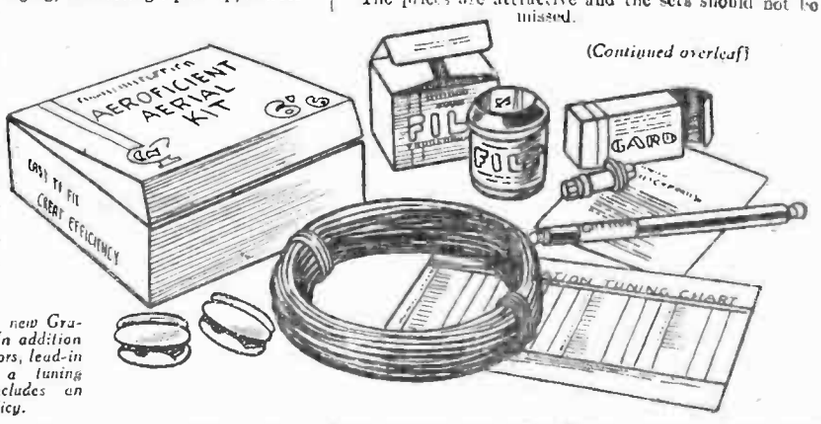
Something new in cabinet design. This is one of Messrs. Osborn's new season's products, and strikes a new note.

The new "Universe" pick-up is also given a prominent position, and is of outstanding interest in that it gives the extremely high signal output of 4 volts. It is a well-designed unit and gives an almost perfectly even response to the full range of frequencies.

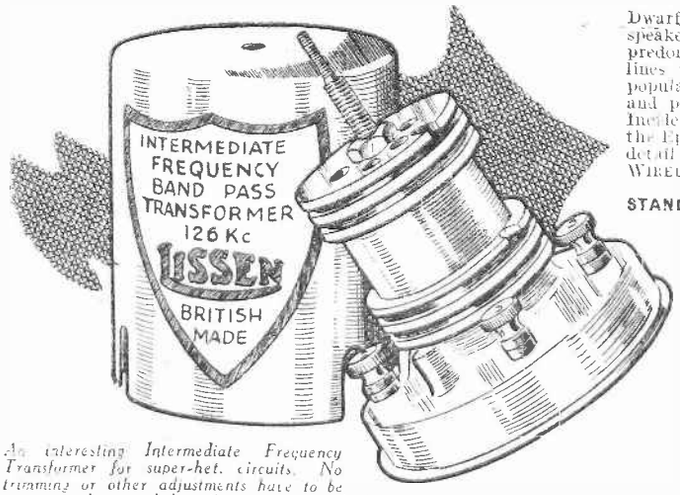
STAND No. 30, Main Hall
CROMWELL (SOUTHAMPTON) Ltd., 32, Brinton's Terrace, Southampton.

THIS firm has fairly recently devoted its attention almost solely to the production of high-grade receivers. These are shown in various types, one of which must surely be suitable for everyone's needs. The prices are attractive and the sets should not be missed.

(Continued overleaf)



The contents of the new Graham Farish Kit. In addition to an aerial, insulators, lead-in tube, Filt, and a tuning chart, this kit includes an insurance policy.



An interesting Intermediate Frequency Transformer for super-het. circuits. No trimming or other adjustments have to be carried out, and the coils are pre-set to the best position. It is a Lissen product.

(*Continued from previous page*)

STAND No. 79, Gallery
CITY ACCUMULATOR CO., LTD., 7, Angel Court, Strand, W.C.2

THIS stand is notable for the wide variety of high-grade cabinets which are shown. There are types for any kind of receiver, be it of the table, console, or radio-gram variety. The appearance and finish is in all cases very commendable.

STAND No. 9b, New Hall
CLIFFORD PRESSLAND SALES, LTD., 80, Eden Street, Kingston]

STAND No. 107, Gallery Bridge
DAWES, F., London Road, Manchester

STAND No. 84a, Gallery
DIGGLE, A., & CO., Jane Street, Rochdale, Lancs

STAND No. 36, Tonman Hall
DYSON, J., & CO., LTD., Godwin Street, Bradford

STAND No. 9a, New Hall
DENT, R. H., 309, Oxford Street, London, W.1

STAND No. 81, Gallery
ECONASIGN CO., LTD., 92, Victoria Street, London, S.W.1

STAND No. 12, Tonman Hall
EDGE, W., & SONS, LTD., Bolton, Lancs

HERE you can see a new range of "Drummer" receivers. These are of modern design, and all are housed in most attractive cabinets. A special feature is a really *de luxe* set built into a large cabinet which is fitted with twin gramophone turntables, accurately balanced multiple loud-speakers and two convenient cupboards. This is one of the most effective exhibits in the whole show and was the centre of many admiring crowds at Olympia.

STAND No. 28, Main Hall
EDISON SWAN ELECTRIC CO., LTD., 155, Charing Cross Road, London, W.C.2

THE exhibits on this stand include all the articles sold under the trade names of "Ediswan" and "B.T.H." Both these names are synonymous with quality apparatus, so the visitor is sure to find the exhibits of interest. In addition to the popular R.K. moving-coil speakers, there is a full range of Mazda valves, the well-known B.T.H. pick-ups, and a cathode ray apparatus. The latter will be found very interesting.

STAND No. 109, Gallery Bridge
ELECTRO DYNAMIC CONSTRUCTION CO., LTD., Devonshire Grove, London, S.E.

HERE we find a range of excellent battery chargers which will appeal mainly to the service engineer. Additionally, however, there are shown several models of H.T. generators specially designed to use in conjunction with car radio sets. They can easily be fitted through a small hole in the floor boards and work entirely from the starter battery.

STAND No. 53, Main Hall
EVER READY CO. (GT. BRITAIN), LTD., Hercules Place, Holloway, London, N.1

THIS firm is known throughout the world for its dry batteries and accumulators and a very comprehensive range is exhibited. They cover every battery requirement and include some special H.T. batteries designed for use with Class B receivers.

STAND No. 6, Tonman Hall
EXPRESS RADIO FACTORS, LTD., 25, Great Eastern Street, London, E.C.2

STAND No. 83, Gallery
EPOCH RADIO MFG. CO., LTD., Exmouth Street, London, E.C.

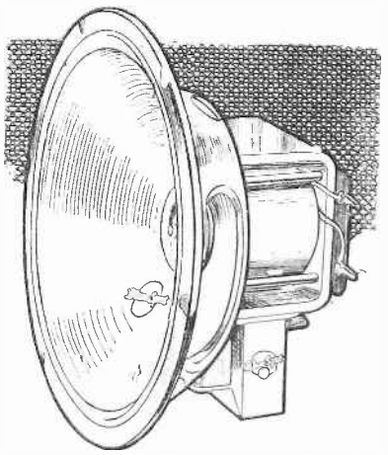
"SPEAKERS for every requirement and at a price that all can afford," describes fairly well the exhibits on the Epoch stand. From the "Super-Dwarf" to the large auditorium speaker high quality and good value predominate. One of the newest lines which is already proving very popular is a combination Class B unit and permanent magnet M.C. speaker. Incidentally, it might be added that the Epoch range was described in some detail in last week's issue of PRACTICAL WIRELESS.

STAND No. 20, Main Hall
FERRANTI, LTD., Hollinwood, Lancs

MESSRS. FERRANTI need no introduction to our readers, and their stand is exemplary of the high-grade components and receivers for which the makers are so highly respected. In addition to the extensive range of transformers, resistances, condensers, etc., the loud-speakers and superheterodyne receivers are of outstanding interest. Electric clocks in various patterns are also shown, and these are made in case types and also in forms suitable for the inclusion in the cabinets of wireless sets.

STAND No. 19, Main Hall
GENERAL ELECTRIC CO., LTD., Victoria Bridge, Manchester

ALL the various types of "Osram" valves can be seen here, as well as the new "G.E.C." super high-tension battery. The latest kit set, called the "Three-



A Blue Spot energised speaker which can be obtained in three different voltage ratings. The price in each case is 27s. 6d.

Thirty," which is a worthy successor to the "Music Magnet" series will also appeal to a large number of visitors.

Of the complete receivers, the latest five-valve superhet fitted with wavelength calibrated tuning scales, tone control, and other up-to-date features is, perhaps, the most interesting, but an eight-valve *de-luxe* A.C. superhet is bound to attract those who are in search of a really high-grade instrument.

STAND No. 52, Main Hall
GRAMOPHONE CO., LTD., 98-108, Clerkenwell Road, London, E.C.1

THE excellent range of H.M.V. receivers do not need any introduction, but all should see the new season's models on this stand. One of the most interesting is the "Super Ten Autoradiogram." This is a real aristocrat, and though it costs 95 guineas, it is sure to be sought after by the discerning buyer. It is a superhet with delayed automatic volume control, automatic record changer, tone control, mains aerial device and innumerable other modern features. A number of other sets at almost every price are also to be seen in conjunction with several moving-coil speakers and a really excellent pick-up.

STAND Nos. 23-6, Main Hall
GRAHAM FARISH, LTD., Masons Hill, Bromley, Kent

THIS stand might well be described as the Mecca of home constructors. A most comprehensive range of excellent components at prices quite out of comparison with the quality offered are exhibited. It would not be possible to refer to them all here but mention must be made of the latest tuning condenser—called the "Zelos." We have already specified this component on more than one occasion and know it to be a most excellent article. An entirely new type of valve holder, fitted with a new type of split terminal, is also to be seen. Its designers are to be congratulated upon the production of so fine an article at so low a price as 10d. The terminals are designed to take up to six connecting wires with ease, and this alone is a feature which the constructor cannot help but appreciate.

Other new lines are the "Aerofficient" complete aerial-earth equipment selling at only 6s. 6d., and a range of small L.F. transformers which are being sold under the trade name of "Pip."

STAND No. 33, Main Hall
GRAMPIAN REPRODUCERS, LTD., Station Avenue, Kew Gardens, Surrey

GRAMPIAN speakers are made in a wide variety of types, and the display on this stand is intended to show the intending purchaser which instrument is most suitable for his particular requirements. Very complete technical details in regard to every type are given, and there is in attendance a competent staff who are pleased to advise any visitor in regard to the choice of a suitable instrument.

STAND No. 103, Gallery Bridge
GOODMANS, LTD., 69, St. John's Street, Clerkenwell, London, E.C.

ALTHOUGH there is shown here a very wide range of speakers, for which Messrs. Goodmans have become so well known, the midget speaker with shallow cone, and which is specially intended for use in car radio equipments, is probably the most interesting. The chassis is actually part of the magnet system and the form of construction adopted results in the production of a most rigid unit.

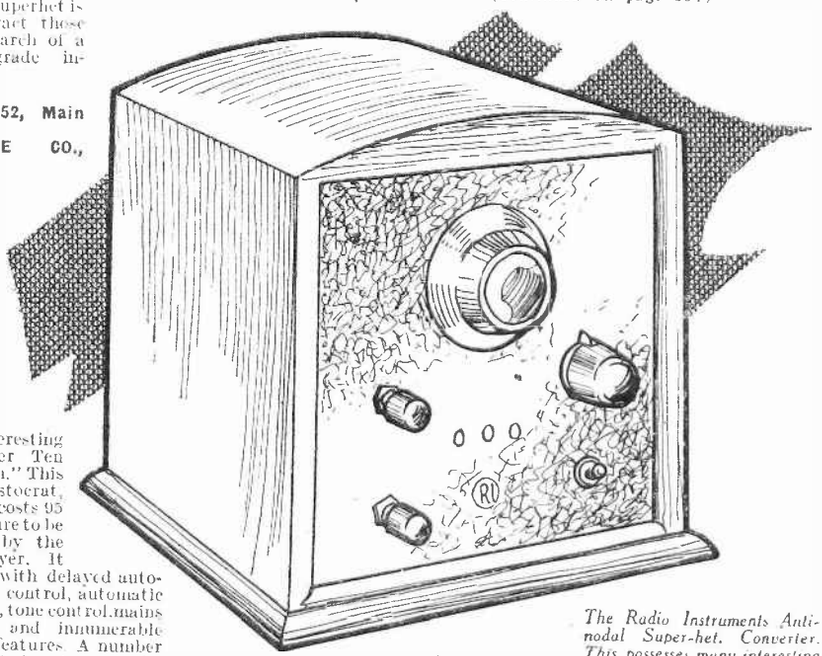
STAND No. 39, New Hall
HEAYBERD, F. C. & CO., LTD., 10, Finsbury Street, London, E.C.2

MAINS transformers and kits of components for complete mains units are the centre of attraction on this stand, but other interesting exhibits include a portable 5-watt public address amplifier. A portable battery charger from one to thirty 2-volt cells at 1.65 amps. is also shown, and is proving very popular with those dealers who wish to charge a small number of batteries for the convenience of their customers.

STAND No. 6a, Tonman Hall
HELLESENS, LTD., Hellesen Works, Morden Road, London, S.W.

HIGH-TENSION batteries occupy a large portion of this stand, but there is also a complete range of electrolytic condensers in every conceivable type.

(*Continued on page 164*)



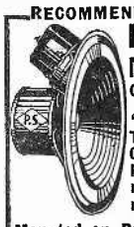
The Radio Instruments Anti-nodal Super-het. Converter. This possesses many interesting features and avoids all the normal short-wave troubles, such as dead-spots, etc.

PETO-SCOTT

EVERYTHING RADIO — CASH C.O.D. or EASY TERMS

Peto-Scott are pioneers in Radio and Television. Our service to the British public was introduced in 1919, and during fourteen years of Solid Service and Satisfaction we have established a reputation for fair dealing that defies competition. Customers in all parts of the globe come to us regularly for all their radio requirements.—Sets, Kits of all descriptions, Part Kits, Miscellaneous Components, Speakers, Eliminators, and Accessories. Purchases can be made for cash, C.O.D., or on Easy Payments. WE DEAL WITH YOU DIRECT. Peto-Scott's Easy Way System, with its strict privacy and no third-party collections, will bring radio to your home by convenient monthly payments. Send list for quotation; no obligation.

RECOMMENDED FOR THE PREMIER SUPER



PETO-SCOTT PERMANENT MAGNET MOVING-COIL SPEAKER

Cash or C.O.D. Carriage Paid, 15/- SEND ONLY **5/6**

"CLASS B" Type. Cash or C.O.D. Carriage Paid, 22/6, or 4 monthly payments of 6/3. Balance in 2 monthly payments of 5/6.

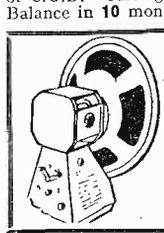
Mounted on Peto-Scott Baffle Baseboard Assembly, Cash or C.O.D. Carriage Paid 18/6 or 4 monthly payments of 5/6.

NEW LISSEN P.M. MOVING-COIL SPEAKER with input transformer. Cash or C.O.D. Carriage Paid, **£1/5/0.** Balance in 4 monthly payments of 5/6. Send **5/6** only

NEW LISSEN WALNUT CABINET MOVING-COIL SPEAKER, with input transformer. Cash or C.O.D. Carriage Paid. **£2/10/0.** Balance in 9 monthly payments of 5/6. Send **5/6** only

NEW BLUE SPOT PERMANENT MAGNET MOVING-COIL SPEAKER 29 P.M. With input transformer. Cash or C.O.D. Carriage Paid, **£1/12/6.** Balance in 6 monthly payments of 5/-. Send **5/-** only

NEW BLUE SPOT 99 P.M. PERMANENT MAGNET MOVING-COIL SPEAKER. Complete with tapped input transformer. Cash or C.O.D. Carriage Paid, **£2/19/6.** Balance in 10 monthly payments of 6/-. Send **6/-** only



NEW W.B. P.M.4.A. MICROLODE PERMANENT MAGNET SPEAKER complete with switch controlled multi-ratio input transformer. Cash or C.O.D. Carriage Piad, **£2/2/0.** Balance in 7 monthly payments of 5/9. Send **5/9** only

EPOCH MODEL 20C, 20CB and 20CQ PERMANENT MAGNET MOVING-COIL SPEAKER for ordinary power, "Class B" and Q.P.P. respectively, complete with input transformers. Cash or C.O.D. Carriage Paid. **£1/15/0.** Balance in 6 monthly payments of 5/6. With order **5/6**

NEW FERRANTI MOVING-COIL SPEAKER (type M.5.T.) with input transformer suitable for Power, Pentode or "Class B" output. Cash or C.O.D. Carriage Paid, **£1/17/6.** Or 7 monthly payments of 5/-. Send **5/-** only

NEW ROLA "CLASS B"

PERMANENT MAGNET MOVING-COIL SPEAKER AND AMPLIFIER

Complete with Valve and input transformer. Two models: A for PM2B, PD220 and 220B; B for 240B and HP2 (state which when ordering). Cash or C.O.D. Carriage Paid, **£3/11/0.** Balance in 11 monthly payments of 6/6. Send **6/6** only

F6P.M. PERMANENT MAGNET MOVING-COIL SPEAKER, with input transformer. Cash or C.O.D. Carriage Paid, **£2/9/6.** Balance in 8 monthly payments of 6/-. Send **6/-** only

NEW AMPLION SONNETTE PERMANENT MAGNET MOVING-COIL SPEAKER, with Universal Transformer. Cash or C.O.D. Carriage Paid, **£1/17/6.** Balance in 7 monthly payments of 5/-. Send **5/-** only

NEW GARRARD MODEL 202A. 12-in. Turntable. Electric Motor for A.C. mains. Cash or C.O.D. Carriage Paid, **£2/10/0.** Balance in 8 monthly payments of 6/-. Send **6/-** only

B.T.H. MINOR PICK-UP AND TONE ARM. Cash or C.O.D. Carriage Paid, **£1/1/0.** Balance in 4 monthly payments of 4/6. Send **4/6** only

NEW MARCONIPHONE MODEL 19 PICK-UP. Cash or C.O.D. Carriage Paid, **£1/12/6.** Balance in 6 monthly payments of 5/-. Send **5/-** only

PILOT AUTHOR KITS

D.C.—A.C. TWO

KIT 'A' Author's Kit of FIRST SPECIFIED Parts, including Peto-Scott **METAPLEX** Baseboard, drilled for valve-holders, but less valves and cabinet. Cash or C.O.D., Carriage Paid, **£4/4/0.** YOURS FOR **7/9** *Balance in 11 monthly payments of 7/9.*

These are the Parts the Author used

	s.	d.
1 **PETO SCOTT** "Metaplex" Chassis 10 x 8 x 3" ..	3	0
1 **TELSEN** tuning coil type W.216	7	0
1 **J.B.** .0005 mfd. tuning condenser with slow-motion dial, type 1046	7	6
1 **TELSEN** 10/1 coupling unit	12	6
1 **GRAHAM FARISH** .0005 mfd. reaction condenser..	2	0
1 **R.I.** smoothing choke, type D.Y.22	17	6
1 **T.C.C.** .0002 mfd. condenser, type 34J	1	3
1 **T.C.C.** .0001 mfd. condenser, type S	1	3
1 **T.C.C.** 2 mfd. condenser, type 80	4	0
1 **BELLING LEE** double fuseholder	2	6
1 **BELLING LEE** terminal block		6
2 **BELLING LEE** type B terminals, A and E	1	0
1 **HELLESENS** electrolytic condenser Block type 8-8-1, 300 volts peak, common negative	7	6
1 **BRITISH RADIOGRAM** Minor Binocular H.F. choke	3	6
2 **CLIX** 5-pin chassis type valveholders	1	6
1 **OSTAR-GANZ** 6-pin chassis type valveholder ..	1	3
1 **DUBILIER** 1,000 ohm resistance	1	0
1 **DUBILIER** 25,000 ohm resistance	1	0
1 **DUBILIER** 1 Megohm resistance	1	0
1 **BULGIN** S.80 Mains ON-OFF Toggle switch ..	1	6
1 **BRITISH RADIOGRAM** Component bracket type 23		6
1 **BRITISH RADIOGRAM** Component bracket type 22		6
1 **BRITISH RADIOGRAM** Component bracket for mtg. toggle switch		6
2 **BRITISH RADIOGRAM** coils insulated connecting wire	1	0
Screws, flex, etc.	2	3

Kit 'A' Cash or C.O.D. Carriage Paid £4-4-0.

EXCLUSIVELY SPECIFIED

PETO-SCOTT D.C.—A.C. OAK CONSOLETTE. In Handsome Figured Oak Hone French Polished. As above but in the white, unstained and unpolished, **12/6.** Cash or C.O.D. Carriage Paid. **15/-**

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Exact to Specification

PREMIER SUPER

KIT 'A' Author's Kit of FIRST SPECIFIED Parts. **including Peto-Scott METAPLEX Chassis,** but less valves, speaker and cabinet. Cash or C.O.D., Carriage Paid, **£6/12/6.** YOURS FOR **12/3** *Balance in 11 monthly payments of 12/3.*

PREMIER SUPER RADIOGRAM

Kit of additional specified parts for converting the **PREMIER SUPER** to Radiogram Model, including Pick-up and **Peto-Scott Adaptagram.** CASH or C.O.D. Carriage Paid. **£5:1:9**

Or 12 monthly payments of 9/4.

EXCLUSIVELY SPECIFIED

PETO-SCOTT 1934 WALNUT ADAPTAGRAM

Model "A," ready to take Premier Super, with Metaplex Baseboard. CASH or C.O.D., 63/-. Carriage 2/6 extra. SEND ONLY **8/3** *Balance in 11 monthly payments of 5/9.* Carriage Paid.

SEND FOR NEW CABINET CATALOGUE.

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

LISSEN KITS

NEW LISSEN SKYSCRAPER FOUR ALL-WAVE CHASSIS MODEL, in Sealed Carton. Cash or C.O.D. Carriage Paid, **£5/12/6.** Balance in 11 monthly payments of 10/3. YOURS FOR **10/3**

NEW LISSEN SKYSCRAPER FOUR ALL-WAVE CONSOLETTE CABINET MODEL in Sealed Carton. Cash or C.O.D. Carriage Paid, **£8/2/6.** Balance in 11 monthly payments of 15/-. Send **15/-** only

NEW LISSEN 7-VALVE SUPER-HET. in Sealed Carton. Cash or C.O.D. Carriage Paid, **£8/17/6.** Balance in 11 monthly payments of 16/6. Send **15/-** only

NEW LISSEN 7-VALVE SUPER-HET CONSOLETTE MODEL, in sealed Carton. Cash or C.O.D. Carriage Paid, **£11/10/0.** Balance in 11 monthly payments of 21/-. Send **21/-** only

LISSEN ALL-ELECTRIC SKYSCRAPER 3. Complete with 4 valves and constructional chart in sealed Lissen carton. Cash or C.O.D., **£7/19/6.** Carriage Paid. Balance in 11 monthly payments of 14/6. Send **14/6** only

LISSEN SKYSCRAPER 3, BATTERY MODEL. Complete with valves and constructional chart in sealed Lissen carton. Cash or C.O.D., **£4/9/6.** Carriage paid. Balance in 11 monthly payments of 8/3. Send **8/3** only

TELSEN CLASS B CHASSIS KIT in Sealed Carton, less Valves, Cabinet, and Speaker. Cash or C.O.D. Carriage Paid, £3/17/6. Balance in 11 monthly payments of 7/-. Send **7/-** only

TELSEN CLASS B4 CONSOLETTE KIT, including Telsen Class B Moving-coil Speaker and Consolette Cabinet, less Valves. Cash or C.O.D. Carriage Paid, **£5/17/6.** Balance of 11 monthly payments of 10/9. Send **10/9** only

"CLASS B" SPECIAL ITEMS.

EPOCH MOVING-COIL COMBINED SPEAKER AND CLASS "B" UNIT, with Valve. Cash or C.O.D. Carriage Paid, **£3/3/0.** Balance in 11 monthly payments of 5/9. Send **5/9** only

NEW FERRANTI "CLASS B" SUPER-POWER CONVERTOR. Instantly converts your set to "Class B." Complete with Valves. Ready assembled. Cash or C.O.D. Carriage Paid, **£3/3/0.** Balance in 11 monthly payments of 5/9. Send **5/9** only

MULTITONE "CLASS B" CONVERTOR, with Valve, ready to plug into your present battery set. Cash or C.O.D. Carriage Paid **£2/11/6.** Balance in 9 monthly payments of 5/9. Send **5/9** only

Pilot "Class B" Conversion Kit

Converts your present Battery Set to "Class B" Amplification. Complete with all necessary components, including driver transformer, "Class B" output choke, W.B. 7-pin valve holder, B.V.A. 240B valve, wire and screws, etc. Full-size Blueprint, assembly instructions, and diagrams. Cash or C.O.D., 37/6. Balance in 7 monthly payments of 5/6. ALL "CLASS B" Components and other Parts unobtainable from your local dealer SENT C.O.D. We have the largest stocks in the country. Orders over 10/- sent Post Paid. (Easy Terms available on orders over £2.) Quotations by return. No obligation. Send **5/-** only

NEW REGENTONE A.C. ELIMINATOR, Type W.I.F. 7 voltage Tappings. 120/150 volts at 12 m/A. Cash or C.O.D. Carriage Paid, **£2/15/0.** Balance in 9 monthly payments of 6/-. Send **6/-** only

ATLAS C.A.25, for Mains, "Class B" and Q.P.P., four tappings: 60/80, 50/90, 120, 150, 25 m/A. Cash or C.O.D. Carriage Paid, **£2/19/6.** Balance in 10 monthly payments of 6/-. Send **6/-** only

PETO-SCOTT CO., Ltd., 77, City Road, London, E.C.1. Telephone: Clerkenwell 9406-7. **West End Showrooms: 62, High Holborn, London, W.C.2.** Telephone: Holborn 3248.

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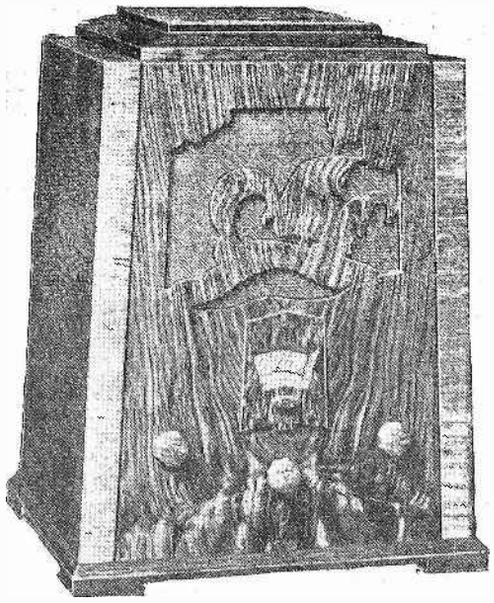
OUR VIEWS ON RECEIVERS



The new Varley Square Peak "4."

VARLEY SQUARE PEAK "FOUR"

IN this receiver we have one of the most modern types of superheterodyne circuit. Four valves only are employed, the first being of the latest H.F. Pentode type and acting as a combined first detector and frequency changer. The second is a variable-mu H.F. Pentode, and is employed as the intermediate frequency amplifier, being coupled to the second detector, a Mullard 354V, through the normal type of I.F. transformer. The output valve is an Osram Pentode. Before further discussing the circuit arrangements we must mention the particular design of the cabinet and controls, in which this receiver shows more than the average thought and care in design.

The Cabinet

As may be seen from the illustration, the cabinet presents a somewhat unusual appearance and is a really substantial piece of work. At the top a large hole is cut in the wood, and a small baffle piece inserted below to assist in preventing the passage of dust, etc. Let into the hole is a solid metal handle for carrying purposes. This falls flush when the cabinet is standing down, but the fingers are easily inserted round the handle through the medium of the hole and it comes up sufficiently far to enable a really firm grip to be obtained and the cabinet transported with comfort. The back of the cabinet is fitted with a neat removable door, with holes cut to prevent resonance, and the usual gauze to prevent dust, etc. A pair of metal brackets are fitted at the lower end of this back in the form of a cleat, and the mains flex, which is of more than usual length, is wound round this cleat out of the way. This is the first good point which strikes one on looking over the receiver, as too often the flex provided with commercial receivers turns out too short to enable the receiver to be stood in a suitable position in the home and connection to be made to the nearest mains socket. In this case the unwanted flex may be left wound round the cleat, and this provides a neat job. An opening in the back reveals two toggle switches and seven well insulated sockets, all of different colours and clearly identified. One is for a mains aerial connection, with an appropriate plug, whilst the usual aerial and earth connections are made to two of the remaining sockets. Two sockets are for pick-up connections, and the remaining sockets are for the use of an external loud-speaker, for which purpose one of the toggle switches is provided to disconnect the speaker already fitted to the cabinet. The remaining toggle switch is for the normal purpose of switching the set on and off.

The Controls

On the front of the cabinet there are only apparently three controls in addition to the usual escutcheon. The lower central knob controls the station selection, the left-hand knob is the normal volume control (working on the I.F. valve), whilst the right-hand knob provides a reaction control for boosting the strength of weak stations. So far no mention has been made of the wave-change switch, and this is apparently, at first sight, absent. An ingenious arrangement is incorporated in the escutcheon by means of which the wave range is changed and at the same time the station identifications are also changed. The tuning dial is engraved with the normal degree scale, and above this is printed the names of the principal European medium-wave stations, whilst the names of the long-wave stations are printed below the scale. The opening in the escutcheon is of such a size that only the figures on the scale and one row of names are visible. Thus, when tuned for the medium-wave stations, the names appear above the scale which appears just above the lower edge of the window. When it is desired to listen on the long waves the whole of the escutcheon is pulled downwards, when the scale occupies the top of the window and the names of the long-wave stations appear at the bottom. This is a very simple device and works most efficiently.

RECEIVER: Varley Square Peak "4," Model AP.46.

MAKERS: VARLEY (OLIVER PELL CONTROL, LTD.).

CIRCUIT: Four-valve superheterodyne. H.F. Pentode as first detector and frequency changer; variable-mu H.F. pentode for Intermediate frequency amplification; power rectifier, and pentode output. Class B valve rectification, with mains field and electrolytic condensers for smoothing. Provision for pick-up and external loud-speaker. Reaction control provided.

RESULTS: Selectivity and sensitivity of a very high order, and perfect separation of the normal broadcasting stations obtainable at all parts of the dial.

PRICE: £15-15-0.

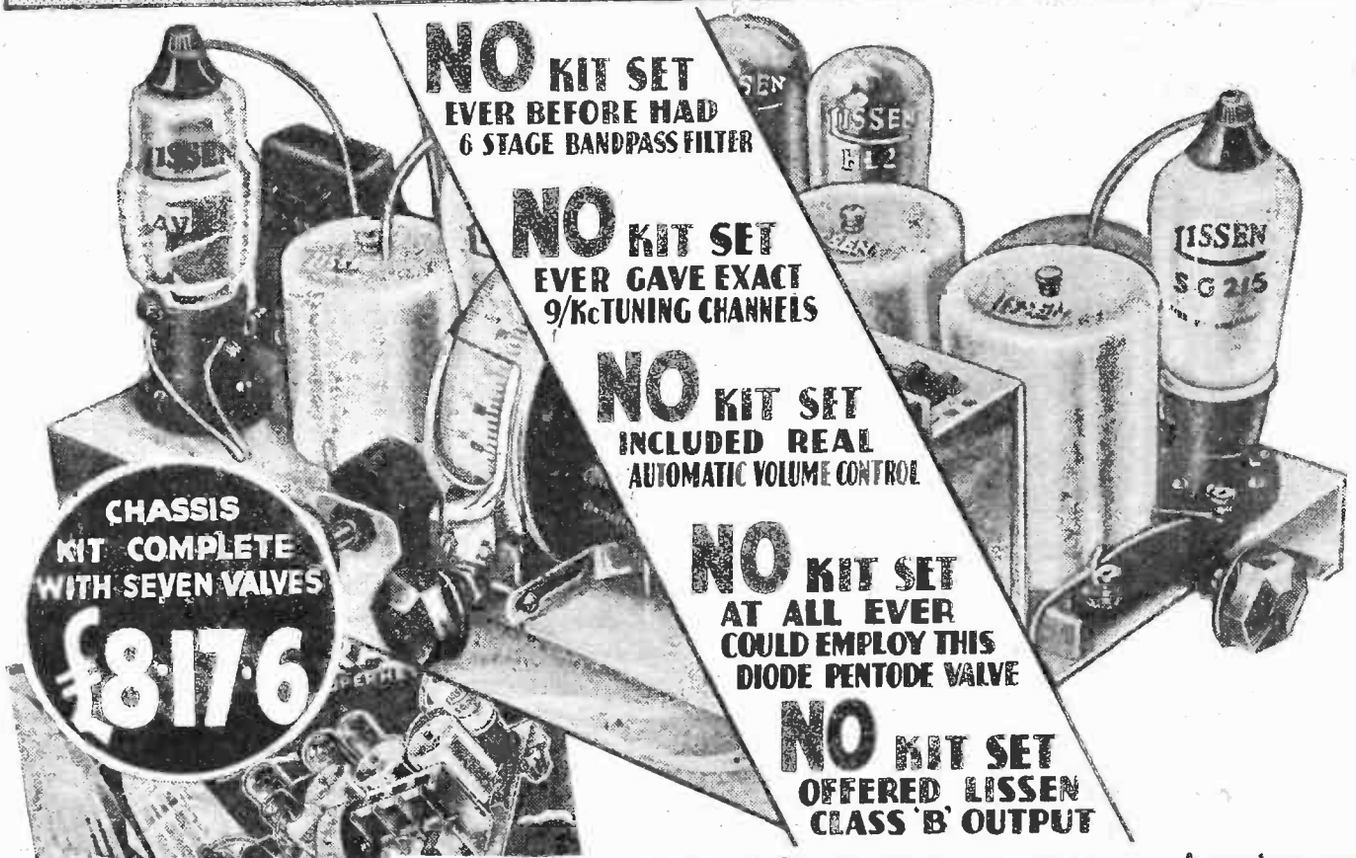
The Circuit

As already mentioned, four valves are employed for the purpose of providing a super-het circuit of modern design. The variable-mu intermediate I.F. valve works very efficiently with its associated volume control and enables the most powerful local to be reduced to inaudibility. The reaction control also works very well and has no effect on the tuning settings. All exposed leads in the wiring are metal sheathed and earthed, whilst the I.F. valve is also of the metallized type and earthed. There is thus no direct pick-up on the wiring, the majority of which is carried out inside the metal chassis. The mains side of the receiver is furnished by means of a Varley transformer and a Class B rectifier, whilst the field of the moving-coil loud-speaker is provided for smoothing purposes. Adequate smoothing is provided by two 8 mfd. electrolytic condensers, and a pilot light is wired to the heater leads to provide an indication that the receiver is alive, as well as to facilitate tuning by illuminating the dial.

Test Results

The receiver was tested in North-West London, first with the outside aerial and then with the mains aerial. On the normal outdoor aerial the local London stations provided adequate volume with the control at its minimum setting, and it was found quite possible to obtain adequate strength with the aerial removed altogether and left hanging near the set. Some indication of the actual efficiency of the circuit may be obtained when it is stated that Fécamp may be heard in the particular district mentioned, with the volume control turned to a position less than two-thirds on and with no reaction whatsoever. The only point to mention with regard to tuning is that the markings on the dial do not correspond with the actual stations, unless the short length of flex which the makers provide is used for an aerial. On the full outside aerial, for instance, the actual station settings are two or three degrees off the actual indication. Upwards of fifty stations are readily obtainable on this aerial, and very few of the good European stations required the volume control full on. Some of the very weak Italian stations were selected in order to test the reaction control, and one was found which was only just audible with the volume control at maximum. The reaction control was then advanced, with only the very slightest alteration in the tuning point and provided a comfortable signal. The tone of reproduction is very good indeed, and complete absence of cabinet resonance is one of the principal characteristics. Hum can only just be discerned when the receiver is set to a point just off oscillation, a condition which, of course, should not occur in normal use.

This Lissen 7 valve Superheterodyne is absolutely UNIQUE!



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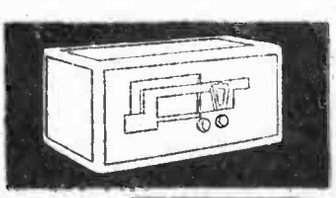

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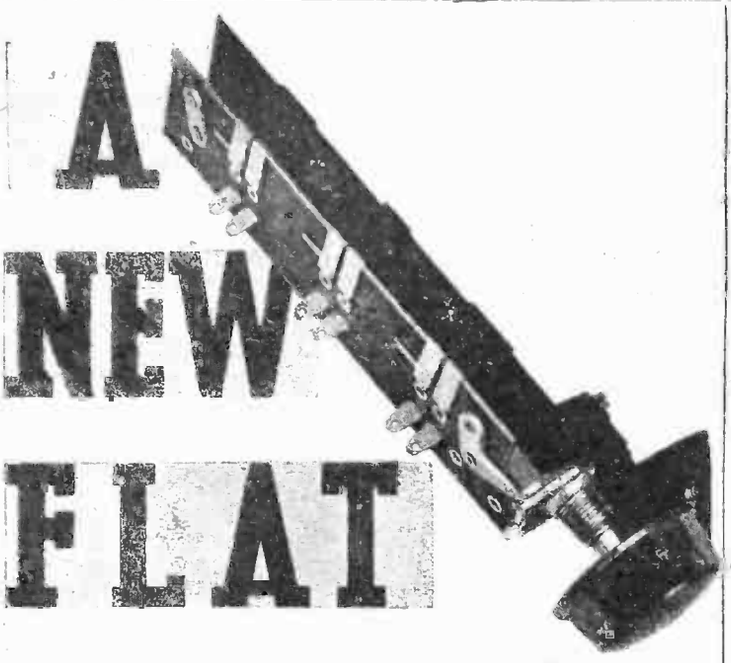

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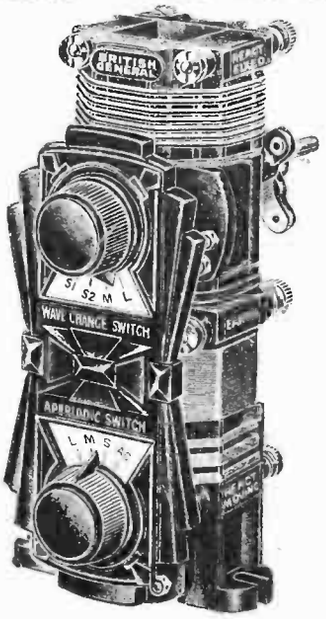

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THE BEGINNER'S SUPPLEMENT

HOW YOUR RECEIVER WORKS.—V

In the Concluding Article of this Series, FRANK PRESTON, F.R.A., Explains the Function of the L.F. Amplifying Valve and of the Loud-speaker.

(*Continued from page 96, Sept. 30 issue*)

Transformer Coupling

THERE is another method of feeding the audio-frequency voltages to the L.F. valve, which is by means of a low-frequency transformer. This latter component, as you well know, consists of two coils of wire placed on an iron core. One coil, called the primary winding, takes the place of the L.F. choke shown in Fig. 21, whilst the other, or secondary, is connected between the grid of the amplifying valve and a tapping on the G.B. battery (see Fig. 22). Audio-frequency currents flowing through the primary set up a magnetic field which varies in sympathy with the signal impulses. This field is "concentrated" in the iron core, which offers considerably less resistance to magnetic lines of force than does air. And since the secondary winding is also on the iron core the lines of force pass through it and cause currents similar to those in the primary to flow in it. The currents produce a voltage between the ends of the secondary and this is passed on to the L.F. valve.

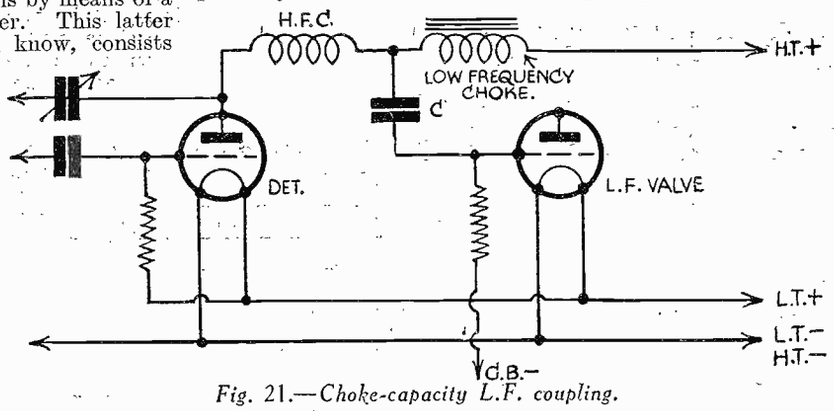

Fig. 21.—Choke-capacity L.F. coupling.

Transformer Step-Up

The transformer does much more than merely pass on the signal voltages from one valve to another, though, for it is actually made to increase (or amplify) them. By using a greater number of turns on the secondary than on the primary the voltages are increased in proportion to the ratio of the numbers of turns. For example, if the secondary had twice as many turns as the primary the voltages would be doubled; if three times as many they would be trebled, and so on. Although the latter statement is perfectly true in theory it does not quite hold in practice since there are certain losses in the windings and in the iron core. Nevertheless, the transformer does give an appreciable "step-up" effect, which is of decided advantage.

It might appear to the reader that the amount of amplification afforded by a transformer could be increased to any desired extent by increasing the ratio of secondary to primary turns, but there are definite practical limits; too few primary turns give too low an impedance for satisfactory operation of the detector valve, whilst too many turns on the secondary will produce a loss of top notes due to the increase in capacity of the winding. Generally speaking the secondary contains from two to five times as many turns as the primary winding.

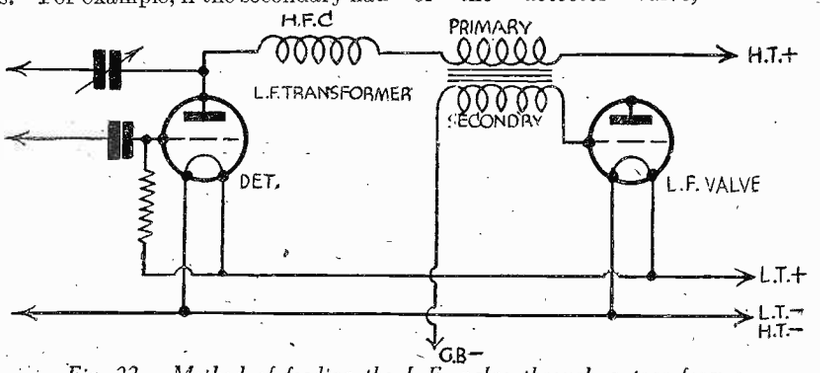

Fig. 22.—Method of feeding the L.F. valve through a transformer.

Last week we saw how signals are rectified by the detector valve and how the high-frequency component—or carrier wave—is disposed of. We also considered different methods of feeding the audio-frequency impulses to the L.F. valve so that they may be amplified before being made to operate the loud-speaker. Our present problem, then, concerns the mode of functioning of the low-frequency amplifying valve.

The general principle follows closely on that surrounding the working of an H.F. amplifier, since the object is to apply fluctuating voltages to the grid so that they might produce a corresponding anode current fluctuation. This sounds all very simple, but there are a number of factors to consider, because we require, not merely amplification of the signal, but *distortionless* amplification. To obtain a thorough understanding as to how the latter may be secured we must perforce make a brief study of the valve's "characteristic curve," which takes the form of that shown in Fig. 23. The curve is not difficult to understand for, after all, it is merely a line which shows how the anode current of the valve varies in sympathy with the voltages applied to the grid, assuming the anode voltage to be constant (as it is in practice). We can see, for instance, that when the grid potential is zero the anode current is 15 milliamps, whilst when a negative potential of about 9 volts is applied to the grid the anode current falls to only 2 milliamps.

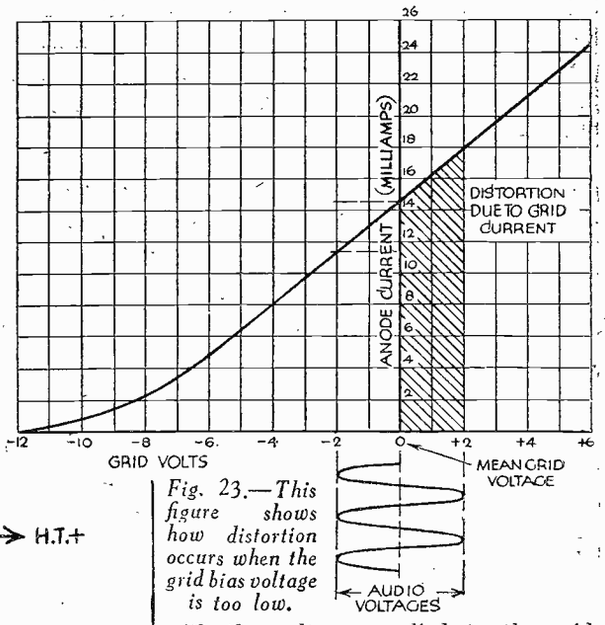

Fig. 23.—This figure shows how distortion occurs when the grid bias voltage is too low.

Grid Current Distortion

For a moment let us imagine that the

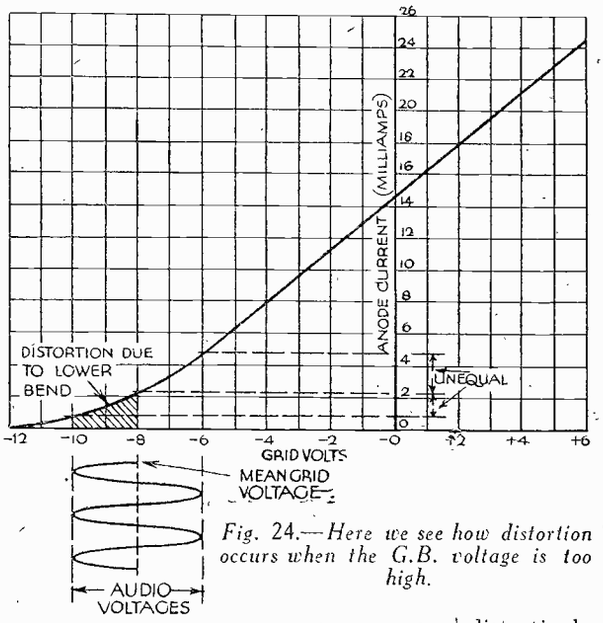

Fig. 24.—Here we see how distortion occurs when the G.B. voltage is too high.

grid voltages were made to be zero, by connecting the end of our transformer secondary or grid leak (according to the method of intervalve coupling employed) to L.T. negative instead of to a grid bias battery. And now let us represent our signal voltages as shown by the line drawn below the curve—it is assumed that the latter voltages attain a maximum of 2 volts on each side of their mean value. The effect of the signal voltages is to vary the grid potential between 2 volts negative and 2 volts positive. In practice the result of this would be hopeless and terrible distortion, because as the grid becomes positive some of the current which should pass from the filament to the anode will flow to the grid instead. Without going fully into the subject, it can be stated that when grid current flows, distortion results, due to a voltage drop being set up across the grid circuit coupling component. Besides this, however, it can be seen that the anode current would reach a very high figure and in consequence a big strain would be put on the high-tension battery and on the valve, with a result that both would be damaged.

Distortion due to the "Bottom Bend"

Suppose now we go to the opposite extreme and apply a negative bias voltage of 8 volts. The signal voltage will be added to this, as shown in Fig. 24, so that the grid voltage will vary between minus 10 and minus 6 volts. Here again we should get distortion, due to the "lower bend" in the characteristic curve. To be more explicit, the change from minus 8 to minus 6 volts would produce a variation in anode current of rather more than 2 milliamps, whereas the change from minus 8 to minus 10 would only vary the anode current by about 1¼ milliamps. Obviously, the amplification of positive and negative halves of the signal voltages would not be uniform and therefore we should get distortion.

Correct Grid Bias

I think it will now be clear that the L.F. valve should be negatively biased to a point somewhere between the two extremes which we have considered. The exact point must be chosen so that the signal voltage can never be so great as to make the grid positive, or to make it so negative that the valve will operate on the "bend" of its characteristic curve. This ideal (which is easy of attainment, by the way) is represented in Fig. 25, where the grid bias voltage is minus 6. Under such conditions of operation we can obtain distortionless amplification for a moderate expenditure of high-tension current. We can now understand the common expression that "an L.F. valve should always be operated on the straight portion of its characteristic curve," and we are able to appreciate the value of grid bias.

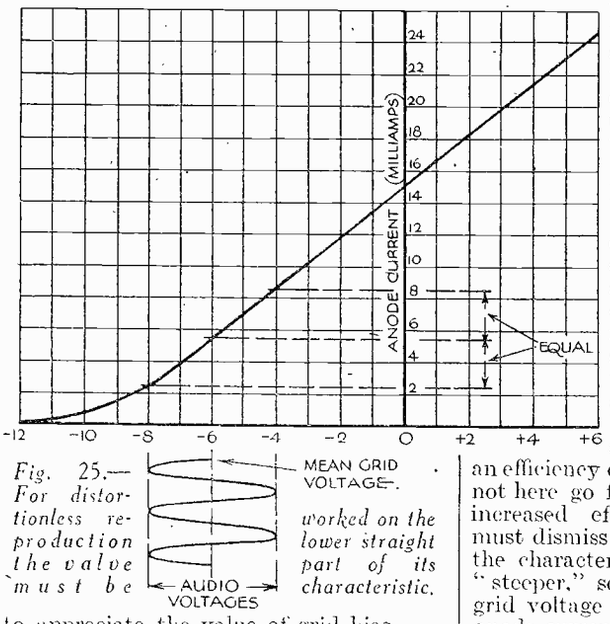

Fig. 25.—For distortionless reproduction the valve must be worked on the lower straight part of its characteristic.

Large and Small Power Valves

In the above explanation a fairly typical small power valve has been assumed, but the very same thing applies in the case of any low-frequency amplifier—the valve must always be biased so that it will operate entirely on the straight part of its characteristic. It is for this reason that the valve must be chosen according to the amplitude of the signal voltages which are to be applied to its grid, and it will be clear why we have "large" and "small" power valves. As a further explanation of this point, it might be added that if, for instance, the signal voltages applied to the valve taken as an example were of 8, instead of 4, volts, the valve would be "overloaded," since the negative half cycles would drive it on to the bend in its curve; for such comparatively large variations in grid voltage it would be necessary to employ a valve having a characteristic with a longer straight portion, or in more usual parlance, to use a "larger" power valve.

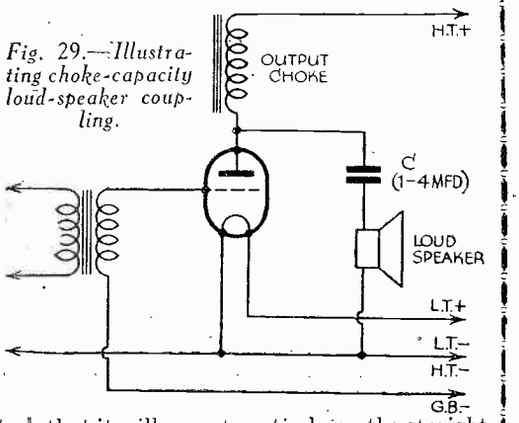

Fig. 29.—Illustrating choke-capacity loud-speaker coupling.

Efficiency

Unfortunately, the "efficiency" of an average three electrode power valve is only about 14 per cent., so that of the total power taken from the high-tension battery, something like 86 per cent. is wasted. There is no way of avoiding this waste, except by employing a pentode, an average sample of which has an efficiency of over 30 per cent. We cannot here go fully into the reasons for the increased efficiency of pentodes, but must dismiss the question by saying that the characteristic curve of a pentode is "steeper," so that any given change in grid voltage produces a larger change in anode current than it does with a triode.

Turning Anode Current Variations into Sound

We have now reached the last link in our chain, and are ready to consider how the variations in anode current caused by fluctuations of grid voltage, can be turned into sound. We know that

(Continued on page 174)

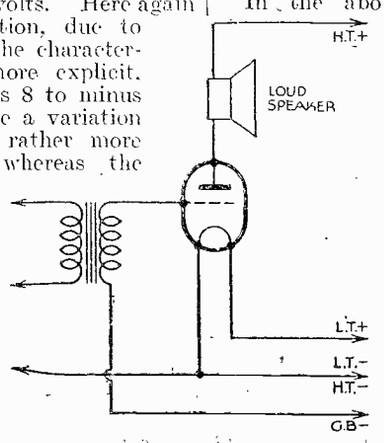

Fig. 26.—The simplest (but not the best) way of connecting a loud-speaker.

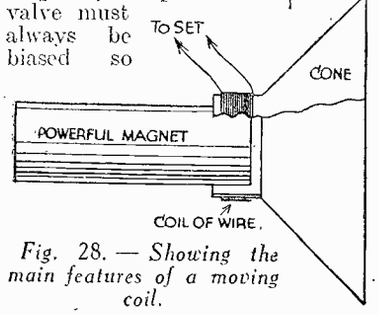

Fig. 28. — Showing the main features of a moving coil.

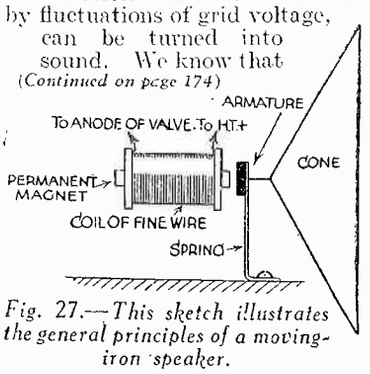

Fig. 27.—This sketch illustrates the general principles of a moving-iron speaker.

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PRACTICAL POINTS ON DECOUPLING

The Correct Values of Resistances and Capacities to be Used

By ERIC JOHNSON

BROADLY speaking, the whole art of decoupling consists of nullifying the effect of a resistance or impedance common to two circuits. This effect is very pronounced when a source of H.T. supply having a very high internal resistance is employed. Being common to all valves, undesirable voltages are set up across the impedance, and thus transferred from stage to stage, giving rise to motor-boating and other forms of L.F. oscillation. Fortunately, the cure is a simple one; upon

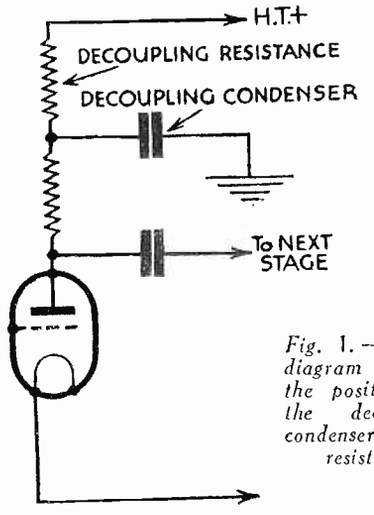

Fig. 1.—This diagram shows the positions of the decoupling condenser and resistance.

reference to Fig. 1, it will be seen that a high resistance is deliberately inserted in the anode circuit, and a bypass condenser connected from the side remote from the H.T. to earth. The resistance forms a very effective barrier to the varying voltages. On the other hand the condenser offers an easy path to earth. It will be perfectly obvious that efficient decoupling may only be assured if the reactance of the condenser is low as compared with the resistance. Let us enlarge on this somewhat.

Resistance and Capacity Ratios

We will assume that it is necessary to have a decoupling ratio of 20–1. In other words the condenser must not offer a greater reactance than twenty times the value of the resistance. Consider, for example, a case where the decoupling resistance has a value of 20,000 ohms. Our by-pass condenser must therefore offer an equivalent resistance not greater than 1,000 ohms. As, however, the reactance of a condenser rises with a decrease in frequency, we must be sure that our 20–1 ratio holds good at the lowest frequency for which our receiver is designed. It is customary to accept 50 cycles as such. The nearest standard size condenser which fulfils these requirements in this particular example is 2 mfd. (the reactance of a condenser is given by $R=\frac{10^6}{2\pi fc}$ where "C" is capacity in mfds. and "F" is frequency in cycles per second). For a given value of resistance the condenser may be as large as one likes, and, in fact, the larger the more complete is the decoupling. It is equally true that for any given condenser, decoupling will be more effective for an increase in value of resistance over that necessary to achieve the correct ratio. Generally speaking, however, it will be found more economical to keep the resistance fairly low and use a large condenser, because we cannot afford the consequent large voltage drop which must result from using a high resistance. This is especially important in battery sets where every volt of H.T. has to be conserved. On the other hand mains users will often find that their decoupling resistance acts in a dual rôle, and will replace the usual voltage dropping resistance in the eliminator, for almost invariably the H.T. output is in excess of the requirements for stages prior to the final one. In battery sets it may be found profitable to install some system of decoupling which does not absorb valuable volts.

Bearing in mind the conditions necessary for decoupling, we find that as long as we have an impedance in the anode circuit in conjunction with a by-pass condenser little trouble will be experienced. In cases where the usual voltage drop must be guarded against, therefore, it should be remembered that the resistance may be

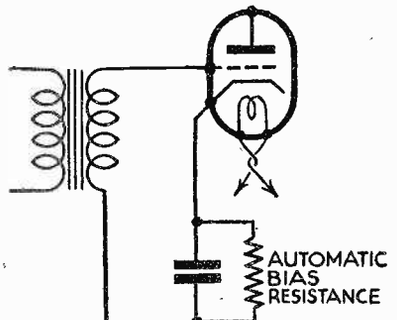

Fig. 2.—The circuit of an indirectly-heated power valve with automatic grid bias.

replaced by an L.F. choke whose reactance to the lowest musical frequency shall be equal to this resistance. Now the reactance of a choke is given by $R=2\pi fL$, "f" being the frequency in cycles per second and "L" the inductance in henrys. Substituting the values given in the previous example, we find that the nearest standard choke is a 60 H. one. As before, the larger this is, the more complete the decoupling, and as the d.c. resistance will in no case be more than 1,000 ohms the voltage drop is negligible. Care must, of course, be taken to see that the choke maintains its rated inductance at the largest anode current likely to be experienced. Although this method of decoupling is likely to find more favour among battery users, it may be found a distinct advantage in mains receivers, for the extra choke will add its quota of smoothing where it is most needed.

Grid-circuit Decoupling

Before concluding, let us discuss the essentials of grid-circuit decoupling. Fig. 2 shows a conventional output stage with automatic bias, the latter being obtained by resistance "R" in the cathode lead, a condenser being fitted to bypass the L.F. component. Now the value of this condenser is commonly quite small—home-constructors rarely use anything larger than 2 mfd. The important point to remember, therefore, is that the L.F. voltage drop across this capacity is quite high at low frequencies, *i.e.*, where its reactance is high. Unfortunately, this voltage is fed back to the grid out of phase with the normal applied voltage. The nett result is to very effectively damp out the low frequencies, and thus reduce our bass response. There are two remedies we may apply. The first one which naturally suggests itself is to replace our bypass condenser with a larger one which would have a low reactance to the bass frequencies. To meet this requirement, we find that anything under 50 mfd. would cause a distinct attenuation to the lower notes. A year or so back this would present an impossible solution, but now that we have electrolytic condensers with capacities of this order in a container as small as the more commonly used sizes, the problem no longer exists.

The second and most effective remedy for the trouble is to thoroughly decouple the grid circuit. The method is identical with anode circuit decoupling; a high resistance is inserted in the grid lead, and a 1 mfd. condenser joined from one end to the cathode. As the resistance carries no appreciable current it may be made quite large, 100,000 ohms being customary. As a consequence there is no point in using a condenser larger than that specified, as these values give very complete decoupling. A wire-wound resistance would be a luxury in this position, but care must be taken to see that one of the reliable metallised type is used, as should the resistance open circuit, the output valve may be seriously damaged by the consequent removal of bias. For this reason the ordinary non-descript grid-leak variety is not recommended.

Reserve Your Pocket Tool Kit Now! *See Page* 143.

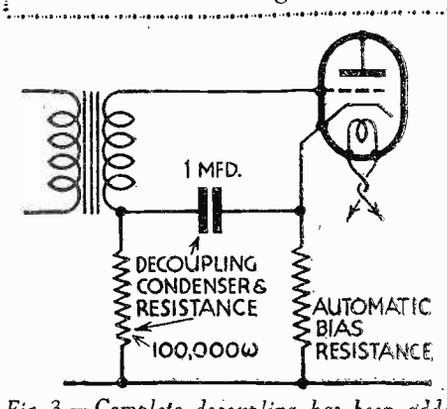

Fig. 3.—Complete decoupling has been added in this modification of the Fig. 2 arrangement

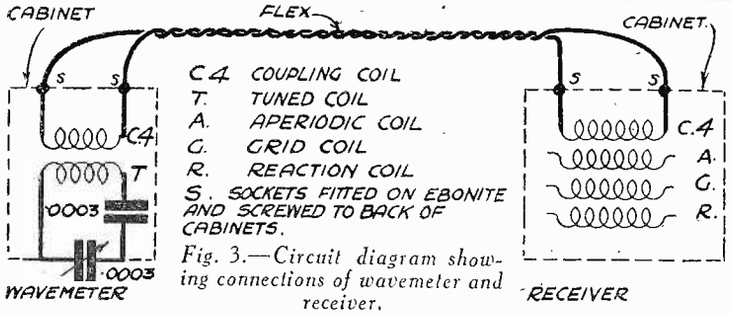

Fig. 3.—Circuit diagram showing connections of wavemeter and receiver.

Making an Improved Absorption Wavemeter

(*Continued from page 137*)

Using the Meter

The operation of the meter is exactly the same as the usual type of absorption wavemeter, tuning being carried out until the familiar "cluck" is heard in the headphones, as the wavemeter is tuned to resonance with the receiver. Calibrations also are obtained and plotted on a graph in the usual way, and further comment is therefore unnecessary upon this subject.

The complete instrument is well within the constructional abilities of the average experimenter, and if care is exercised during the calibration period, very accurate results will be obtained. Whenever possible, transmissions which are crystal-controlled should be used as a means whereby accurate reading may be obtained.

The tuning coils used by the writer cover the following wavebands when tuned by a .00007 mfd. variable condenser:—

SW1—35 to 60 m.
SW2—23 to 40 m.
SW3—13 to 25 m.

The wavemeter coils are wound to cover the same spreadover. The tunable range is, of course, slightly above and below, so far as the wavemeter coils are individually concerned, but only those bands as specified above are covered for wavelength measurement. Do not confuse *tuning* range with *tunable* range. Variation of coil and tuning condenser values will call for slight modification to suit individual requirements. Coupling coils, however, remain unaltered.

It should be noted that when the receiver incorporates one or more H.F. screen-grid

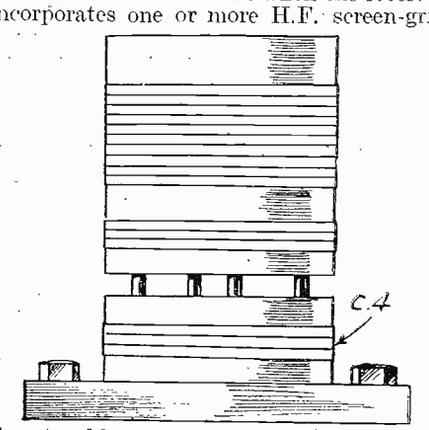

Fig. 4.—Mounting the coupling coil on the same base as the tuning coil.

stages, the coupling is exactly as when aerial series capacity condenser is used—*i.e.*, to the grid coil.

ROUND THE WORLD OF WIRELESS

(*Continued from page 124*)

The New Russian Wavelengths

WITH the bringing into operation of the Lucerne Plan, Moscow's 500-kilowatt station will work on 1,714 metres (175 kc/s) and her second high-power transmitter on 1,107 metres (271 kc/s). Leningrad, Minsk and Kharkov will continue to use the long channels, but will adopt respectively 1,224 metres (245 kc/s), 1,442 metres (208 kc/s) and 1,345 metres (223 kc/s), the latter being a wavelength which must be shared with Huizen (Holland). According to a Norwegian report the U.S.S.R. intends to build a number of stations in Siberia and in Asiatic Russia, one of which may be actually planned to radiate some *twelve hundred kilowatts*, and therefore surpass any other transmitter in the world.

Listen to Copenhagen

WITH the opening of the new 60-kilowatt transmitter at Kalundborg, the Copenhagen wireless programmes can now be well heard even in the early hours of the afternoon by listeners in most districts of Great Britain. Note the call: *Kalundborg-Kjobenhaven og Danmarks kortbolgesender* (short-wave station). Before the news bulletin is broadcast you will hear the announcer say: *God afte, her er Pressens radioavis* (Good afternoon, here is the press (news) transmission). The interval signal consists of a musical box melody resembling a small carillon; it plays the theme of an old Danish folk-song of the twelfth century. In the evening, details of the programmes are frequently given out in English and German as well as in the Danish language.

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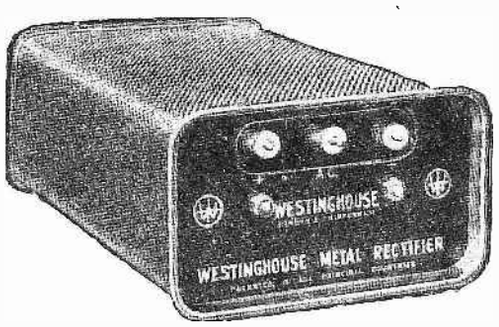

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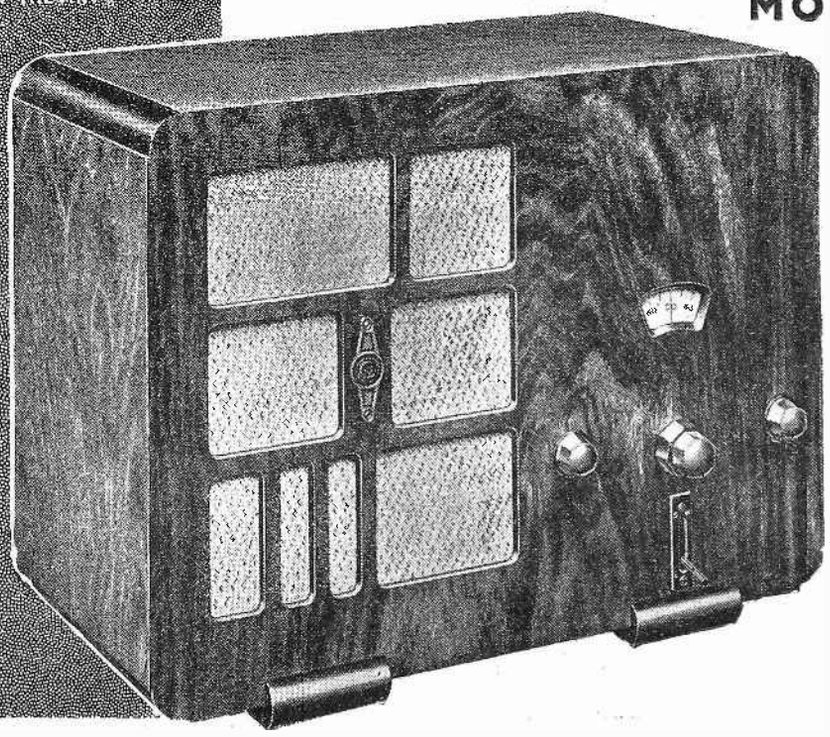

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SPECIFICATIONS

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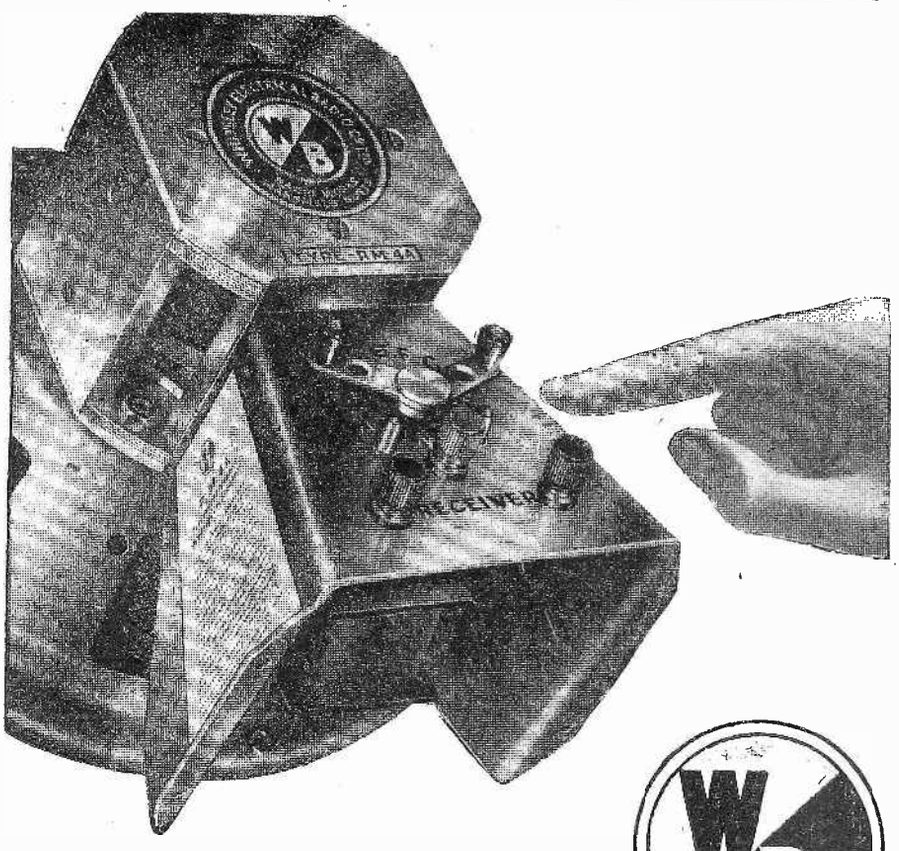

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RADIO RAMBLINGS

By JACE

Jottings from my Notebook

Background Sounds for Operatic Records

RADIO listeners who have heard the recent B.B.C. transmission of complete operas from gramophone records may have been puzzled by hearing the usual noises of an opera house, including the sounds of the orchestra tuning up, applause, coughing of the audience, etc. It is now revealed that these sounds are reproduced from special "His Master's Voice" records, which are stored in the great record library at Broadcasting House.

Festival of Radio Drama

ONE of the first plays to be broadcast by the B.B.C. in the early days at Savoy Hill will be revived when the Festival of Radio Drama opens in October. This is Richard Hughes' thriller, *Danger*, which he wrote specially for broadcasting. Another play in the series will be *The White Château*, by Reginald Berkeley, which also achieved fame several years ago. The author wrote the play for the microphone, and later it was adapted for the films and the stage.

British Batteries for Tibet

UNTIL 1904 no foreigner had ever set foot in Lhasa, the "Forbidden City" and capital of Tibet, and the news that The Chloride Electrical Storage Co., Ltd., has received an order for an Exide battery of 220 cells, for the Palace of the Dalai Lama, Ruler of Tibet, is a tribute to the prestige of British goods. Getting the battery there will be no easy task, since the only means of transport is by mule, yak, or coolie, and the 300-mile journey under these primitive conditions will involve special precautions in the packing of the glass boxes; moreover, the passes into Tibet are usually closed by snow from about the end of November, so that the shipments must reach Calcutta not later than the first week in November.

Record G.F. Orders

BUSY factories are the usual aftermath of Olympia, but Graham Farish tells me that the orders the firm has received since the Show (set designers have apparently fired every constructor with their own enthusiasm over the new additions to the G.F. range) makes the 50 per cent. factory extension at Bromley look like being quite inadequate.

More new lines at the Manchester Show . . . a heavy advertising campaign . . . Graham Farish, Limited, seem to be gathering speed for a record year. They are publishing a new catalogue this month, I hear, and I suggest that you drop them a postcard for this and the G.F. Station Tuning Chart, before you forget it—they're both worth having.

The New Hellesen Hi-Life High-Tension Batteries

VERY interesting tests have recently been made by a famous radio set manufacturer of the new Hellesen Hi-Life high-tension batteries. We understand that they were shown to give no less than 50.2 per cent. longer life than other batteries on the same test. This is the more startling as this new Hellesen Hi-Life range sells at popular prices. All Hellesen batteries are now made entirely in England with British labour, and the big factory at South Wimbledon is working at full pressure. These Hi-Life batteries are packed in attractive cartons in a new design of orange and black.

Selling at rather higher prices, the new Super Range maintains the long-standing reputation enjoyed by this firm for durable heavy-duty batteries. These Hellesen super batteries make use of a new patent which gives them a greatly increased capacity without adding to their weight or overall size.

"Ace" Radio Kits

"ACE" Radio Kits is the new trade name of Marcus Overton Radio, Ltd. The principals of this new company have had considerable experience of the needs of the home constructor, and are, in fact, already well known to many readers of PRACTICAL WIRELESS.

They can supply complete kits for all PRACTICAL WIRELESS receivers, components and manufacturers' kits and receivers—in short, anything connected with radio.

Speedy dispatch and a unique service after sales will be a strong feature in the operations of this new company, and PRACTICAL WIRELESS readers can purchase through this new avenue with every confidence of receiving absolute satisfaction.

The "Superset"—Correction

A SLIGHT draughtsman's error occurred in the wiring plan for the "Super set" on page 696 of the issue dated August 19th. The lead from terminal "I.S." on the L.F. transformer was inadvertently marked "H.T.+1" instead of "G.B.—3." It is obvious from the circuit diagram, of course, that this lead is for biasing purposes, but the error has apparently caused a little confusion in the minds of a few readers. The plug attached to the lead in question should be taken to a tapping socket on the grid bias battery giving either 6 or 7.5 volts negative; the better of these two is most easily found by trial. It need scarcely be pointed out that the set should be switched off prior to making any adjustment to the grid bias voltage.

We hope that this correction will clear away any difficulty which might have arisen.

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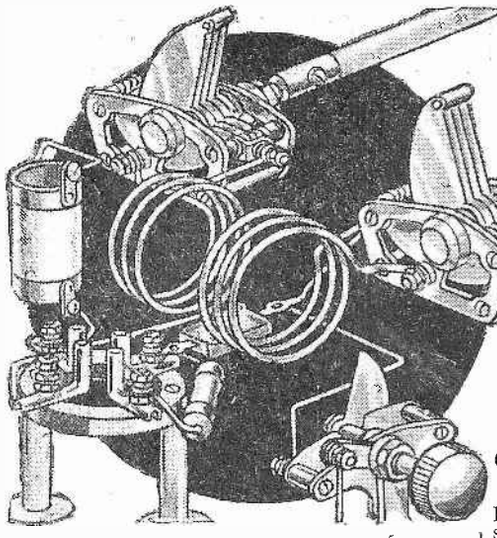


Short Wave Section

ADJUSTING THE SHORT-WAVE DETECTOR

Various Points to be Borne in Mind in Order to Obtain Maximum Results

By K. E. BRIAN JAY

THE adjustment of a detector valve to obtain optimum performance is important in any receiver, but doubly so when there is no preceding H.F. amplification and the sensitivity depends wholly on the detector, which is usually the case in a short-wave set. This adjustment is complicated by the fact that when a valve is used as a grid leak detector it has to perform three functions, viz., those of rectifier pure and simple, amplifier, and oscillator, and, unfortunately, the best conditions for one function are not usually best for the others. Rectification actually takes place between the grid and filament only, *i.e.*, in a two-electrode arrangement, the rectified voltages being then amplified by the whole valve acting as a triode; part of the current flowing in the anode circuit is then fed back into the grid circuit in order to provide reaction, and as the reaction control is advanced the valve becomes more and more sensitive until it finally acts as an oscillator. The detector is not required actually to oscillate when receiving telephony transmissions, but it must be possible to approach right up to the fringe of oscillation in order to have the maximum sensitivity available. This is generally described by saying that the reaction control must be as smooth as possible so that oscillation begins gently and without any noise or thud, and on reducing reaction the set stops oscillating at the same setting at which it began, *i.e.*, there must be no backlash.

Controlling Reaction

Before saying anything about the appropriate adjustments to obtain this desirable silkiness of control, let us first discuss the possible methods of controlling reaction. Figure 1 shows the most popular circuit, a modification of Reinartz's arrangement, in which a small variable condenser of about .0002 mfd. is used in series with the reaction coil to control the impedance of the circuit and so vary the feed-back current through the coil. Figure 2 shows a method that is somewhat older and not so much used nowadays, but is still a great favourite with the writer; it is called the "throttle" condenser method because the reaction condenser C_2 is used to provide a variable path to earth for high-frequency currents, so that at the minimum setting of the condenser the reactance of this path is high and the H.F. currents are throttled back, as it were, and prevented from flowing through the reaction coil; increasing the capacity then permits more H.F. to flow so that there is a larger current through the reaction coil and the feed-back is increased. Both of these circuits are capable of very smooth control, but it is not easy to eliminate from either of them another fault common to all reaction circuits—their tendency to affect the tuning of the grid circuit so that altering reaction detunes the station being received and thus complicates the tuning process. The use of a variable resistance in series with the H.T. positive lead to control reaction is an alternative method that suffers far less from this defect, while at the same time being capable of very smooth action. A circuit is given in Figure 3, in which R_3 is the reaction control resistance; any good instrument of about 50,000 ohms will be satisfactory provided it is silent in operation, the 2 mfd. condenser C_4 helping to ensure this. The amount of reaction obtainable depends on the condenser C_2, which is about .0003 to .0005 mfd. capacity; the larger this condenser the stronger the oscillations obtainable with a given reaction coil, or, conversely, the smaller the reaction coil need to be to obtain sufficient oscillation. This is another point in favour of the arrangement, since a small reaction coil reduces the amount of detuning caused by the control. If a very wide range of frequencies is to be covered with one reaction coil it may be desirable to make C_2 variable in case the variation allowed by the resistance is not great enough to give controllable reaction at both ends of the frequency range.

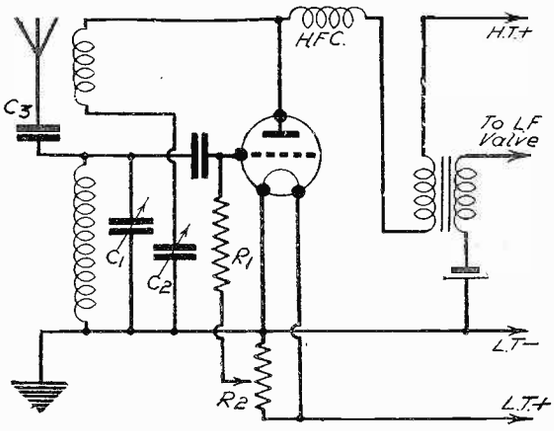


Fig. 1.—A simple reaction arrangement.

Adjusting H.T. Voltage

In order to obtain the maximum amplification from the valve the H.T. voltage should be as high as possible, but, unfortunately, this often leads to harsh reaction control; the H.T. should therefore be varied until the loudest signals are obtained

(Continued overleaf)

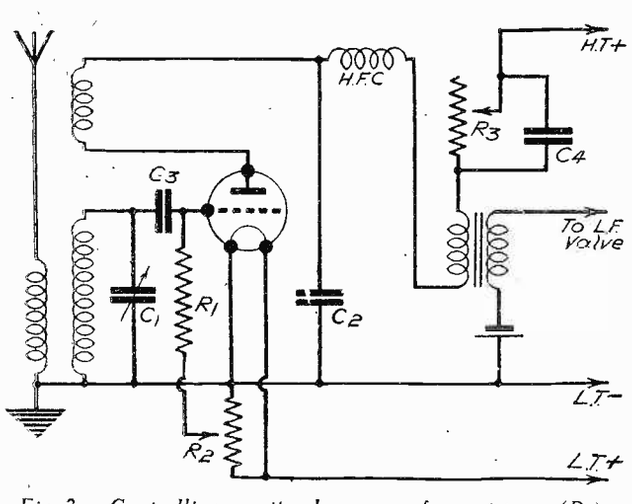


Fig. 3.—Controlling reaction by means of a resistance (R_3).

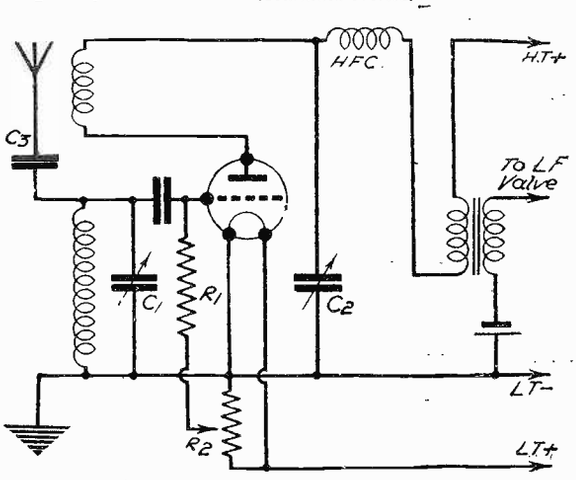


Fig. 2.—A modification of Fig. 1.—This is the throttle reaction control.

SHORT WAVE SECTION

(Continued from page 162)

consistent with smooth reaction, and in making this adjustment it is desirable to try the effect of varying the number of turns in the reaction coil, since the increased H.T. volts will make a smaller coil possible, and this often leads to greater smoothness and less effect on the tuning of the set. It will be noticed that in all the circuits given the grid leak is not taken direct to the L.T.+ as usual, but to the slider of a 400-ohm potentiometer R_2; this is a refinement that is sometimes helpful in improving reaction by making possible a slight variation of the bias applied to the valve. The knob is rotated until an improvement in reaction control is obtained, but it should not be taken too near the negative L.T. or signal strength will be materially reduced. A higher value of grid leak is usual on short waves than on long and generally leads to greater sensitivity, but it may also adversely affect the reaction, causing it to be very thumpy; if smooth control is unobtainable with reasonable values of H.T. volts it may be worth while to try another grid leak of about 2 megohms, if the one already fitted is from 5 to 7 megohms, but this should only be done as a last resort when all other methods of improving the control have failed.

Trying-out Different Valves

Before settling on one particular valve for the detector in a short-wave receiver it is always worth while to try out all the valves available in this position; even if one class is best for the purpose it often happens that one specimen of a certain type, even from the same maker, works better than another or is quieter in operation. Quietness is perhaps the greatest virtue in a short-wave set, for it is no use having loud signals if they are made unreadable by hisses or battles in the background arising from either a noisy valve or bad connections, dust in variable condensers or run-down batteries. Some of the small power valves of the LP2 class, or the old 2-volt power valves of a few years ago, having an impedance of 6,000 ohms or so, often make very good, quiet detectors, although naturally one would expect the newer special detector types or the HL2 class to be more efficient. Another possible source of noise is the aerial, especially in picking up mains hum; the method of coupling the aerial by a very small fixed condenser C_3 to the grid end of the coil, shown in Figures 1 and 2, while being very convenient and simple, sometimes tends to accentuate this trouble, and a change over to the aperiodic coupling coil shown in Figure 3 may improve matters, especially on wavelengths above 60 metres; the number of turns should be about one-half to three-quarters of the number in the grid coil, and it is convenient to make the coupling variable.

50 TESTED WIRELESS CIRCUITS

By F. J. CAMM *(Editor of "Practical Wireless")*

This handbook contains every modern circuit, complete with instructions for assembling, component values, and notes on operation. Whatever the circuit you require, it is in this book.

Obtainable at all Booksellers, or by post 2/9 from Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. **2/6**

CLASS 'B' SPEAKER AMPLIFIER

SEVEN TIMES THE VOLUME

FITTED WITH THE AMAZING 5-WAY AUTO ADAPTOR.

SENSATIONAL OFFER

10/- ALLOWED ON YOUR PRESENT SPEAKER

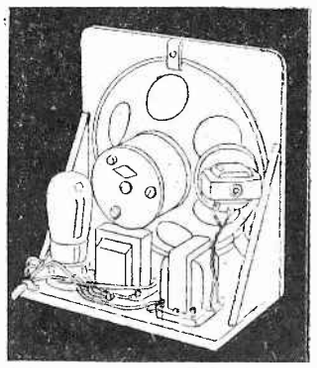
Without "Class B" amplification your present Battery Set is obsolete. Realising this, we have produced this marvellous self-contained Unit; comprising guaranteed Peto-Scott "Class B" Moving-Coil Speaker, "Class B" Transformer and Output Choke, B.V.A. "Class B" Valve. Gives 7 times the volume . . . with mains quality and power. Low H.T. consumption. SIMPLE TO CONNECT. **JUST PLUG IN the amazing 5-WAY Automatic Connector** and get better Radio NOW. We have made it easy for you to buy.

If you have a Speaker worth more than 10/- send us full particulars for special quotation.

SEND FOR IT NOW ON 7 DAYS' TRIAL.

Send your present Speaker Carriage Paid with 5/- P.O. If approved, balance payable in 10 monthly payments of 5/-.

Cash or C.O.D. Carriage Paid. **59/6**



Already Mounted on acoustic Baffle Board, as illustrated, and complete with B.V.A. Class "B" Output Valve.

If desired, the Pilot "Class B" SPEAKER AMPLIFIER is supplied in the handsome polished Walnut Cabinet illustrated. With fretted back for perfect boom-free Tone.

Cash or C.O.D. **69/6**

Or 10/- for your present speaker, 6/- with order and if approved balance in 9 monthly payments of 6/-. Without Speaker in part Exchange, 6/- with order and, if approved, balance in 11 monthly payments of 6/6.

Without a Speaker in Part Exchange SEND ONLY **5/-** If approved, balance payable in 11 monthly payments of 5/6. Carriage Paid to your door.

New Times Sales Co.

56, LUDGATE HILL, LONDON, E.C.4.

SOUTHERN RADIO'S Wireless Bargains.—Set manufacturer's guaranteed surplus :—

VARIABLE Condensers.—British Radiophone 4-gang superhet type, fully screened and trimmers, 0.0005, 8/9 (list 45/-). Same type, complete with dial knob and escutcheon, 12/9 (list 50/-). Polar 3-gang condensers, 0.0005, fully screened with trimmers, escutcheon, knob and dial, 11/- (list 45/-), Lotus 2-gang, fully screened, with trimmers, knob, escutcheon, dial, 8/9 (list 27/6). Hydra block condensers, brand new, 16 mfd. 2+2+8+2+1+1, 1,000 volt test (made for Canadian Marconiphone Co.), 8/9; 4 mfd., 2/6; 2 mfd., 1/9; 1 mfd., 1/-; all 750 volt.

SPEAKERS.—Celestion Soundex permanent magnet, 16/- (list 27/6); Rola F6 permanent magnet, 28/- (listed 49/6); D.C. mains energised, 2,500 to 6,500 ohms, complete with humbucking coils and transformers, 16/6 (list 39/6); Peter Grassman dynamic speakers and chassis, 10/6 each (list 35/-); G.E.C. Stork speakers, complete in magnificent cabinet, 19/6 (listed £3/15); Ormond speakers, complete in cabinets, 10/- (listed 25/-); Utah D.C. mains energised pentode or power, 9in. cone, 21/-, 5in. cone, 13/6; ultra-permanent magnet speakers, 95 P.M., 35/- each. A really hefty job (listed £4/15/0).

CONSTRUCTORS' Kits.—Ready Radio "303" battery 3-valve kits, less valves, 18/- each; complete with 3 Mullard valves (P.M.1.L.F., P.M.2, 2D.X.), 33/- each (list 70/-); Ready Radio Meteor screen grid 3-valve kit, less valves, 26/-; with 3 Mullard valves (P.M.12a, P.M.2D.X., P.M.2a), 49/- (list £5/7/6) Universal Radio 3-valve kits, ready assembled on chassis, 12/6 (listed 45/-).

READY RADIO S.T. 400 Kits, as specified by Scott Taggart, £2/19/6 each (list £4/17/6). Mullard Radio for Million 3-valve A.C. kit, complete with 3 Mullard A.C. valves (Pen. 4V, 354 V, S4V), £3/10 (list £6/10); Mullard Radio for Million 3-valve battery kits, complete with 3 Mullard valves, £3/3/0 (list £6/2/6); all kit brand new, in original sealed cartons.

B.T.H. SENIOR PICK-UPS, 1933-1934, with Volume Control, 28/- (list 37/6); B.T.H. Junior Pick-ups, 17/6 (list 25/-); British General Band Pass tuning units, 10-K.C. aerial or anode, 5/- each (list 14/6).

RECEIVERS.—Lotus 3-valve (actual) A.C. or D.C. mains, complete with M.C. speaker and cabinet, brand new, (£6/19/6) (list £21/0/0).

ALL Goods Guaranteed Brand New and Perfect and Sent Carriage Paid.

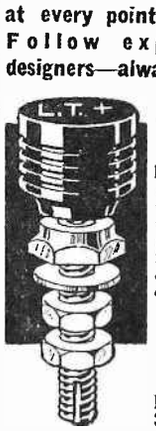
PLEASE Note.—We have opened Branches at 271-275, High Rd., Willesden Green, N.W.10, and at 46, Lisle Street, W.C.2, where callers are cordially invited to inspect our large stocks of wireless bargains. Please send all post orders to 323, Euston Rd., N.W.1.

SOUTHERN RADIO, 323, Euston Rd., London, N.W.1 (near Warren St. Tube). 'Phone: Museum 6324.

180. ACCUMULATOR CHARGERS. 10/6. ½ amp., 2-6 volts, in ventilated metal case, with mains flex (Westinghouse Rectifiers), 1 amp., 21/-. Carriage 6d. extra. 7 days' trial. Guaranteed one year. **P. ARDEN AGENCY, WOLLASTON, WELLINGBOROUGH.**

CLIX

You appreciate that, to obtain the highest possible efficiency from any receiver, reliable and silent contact at every point is essential. Follow experienced designers—always use CLIX



CLIX "MASTER" PLUG Positive METAL to METAL wiring. Firm grip and full contact with ALL sockets with internal diameters from ⅛in. to 5/32in. battery socket. Curved ends for easy insertion. Price **1½d.**

Non-Corrosive SPADE TERMINALS

Large — — 2d.
Small — — 1½d.

PANEL TERMINALS Type B, with Hexagonal Shoulder for easy mounting **4d.** Type A - 2½d.

"A MATTER OF CONNECTION"

Clix interesting New Folder "N" gives details of over 30 Perfect Contact Components. Write for a copy now.

Cheapest PERFECT Contact

LECTRO LINX LTD., 79a, Rochester Row, S.W.1

The batteries need no introduction, since they have probably been on the market as long as those of any make; it need only be said that the latest types are as much in advance of contemporary progress as the earlier types were.

The condensers are perhaps not so well known, but they certainly deserve to be, for there is no doubt that they are really excellent components in every way.

STAND No. 10, New Hall
HUSTLER SIMPSON & WEBB, LTD., Aerodyne Works, Hoe Street, Walthamstow, E.17

HERE you can examine the complete range of "Aerodyne" receivers, which, you will find, covers every receiver requirement. The sets are eminently up to date, and all are housed in attractive cabinets.

STAND No. 80, Gallery
HIGH VACUUM VALVE CO., LTD., 113-117, Farringdon Road, London, E.C.1

THIS stand is very notable for the extremely neat and "tasteful" arrangement. The very complete range of "Hivac" valves is shown and it is very apparent that these are of advanced design and of particularly sound mechanical construction. An interesting feature is the "strip-form" booklet which is being given away, and which contains useful and valuable information regarding every valve in the "Hivac" range. A new variable-mu and a high-amplification pentode are especially attractive.

STAND No. 72, Main Hall
IGRANIC ELECTRIC, LTD., 147, Queen Victoria Street, London, E.C.4

THE latest "Igranicor" iron-cored tuning coils form the principal exhibits on this stand, and leaflets giving a number of "Igranicor" circuits are being given away.

Other excellent Igranic lines, such as their broadcast and short-wave chokes, mains transformers and smoothing chokes, and the P.M. moving-coil speaker, are also shown.

STAND No. 64, Main Hall
LISSEN, LTD., Worple Road, Isleworth, Middlesex

THIS stand is of particular interest to the home constructor in view of the new "Skyscraper" kits which are being shown. These include the "All Wave Battery Four," "All Wave A.C. Four," the "Skyscraper Three," and the latest Seven-Valve Superhet Kit. Broadsheets giving detailed particulars in regard to the construction of all these receivers are to be obtained free of charge, and it can be seen from these that Messrs. Lissen have reduced the task of set construction to a fine art.

There is also on view the wide range of excellent Lissen components and valves which have earned such a good reputation in the past; the latest models show distinct advances on their predecessors.

STAND No. 70, Main Hall
McMICHAEL RADIO, LTD., Slough, Bucks

THE wide range of high-grade receivers for which this firm have become so well known is here displayed. The latest four-valve receiver is noteworthy in that it is accommodated in an entirely new style of cabinet, fitted with twin moving-coil speakers, one of which is mounted on each side of the tuning controls. A new edition of the suitcase portable receiver is also shown; this is even better than the earlier models, and is now recognized as the "standard" in portables.

THE MANCHESTER RADIO EXHIBITION

(*Continued from page 148*)

STAND No. 108, Gallery Bridge
MILNES RADIO CO., Bingley, Yorks.

MILNES H.T. units are now known throughout the country as forming an economical source of high-tension current. They consist of banks of nickel-iron accumulator cells which can be connected in series or in parallel in an instant by the operation of a switch mechanism. When they are in parallel they can be charged overnight by the ordinary low-tension accumulator, whilst by putting them in series they provide the necessary H.T. voltage. The units are shown in various sizes and at most reasonable prices.

STAND No. 17, Main Hall
MULLARD RADIO VALVE CO., LTD., 111, Charing Cross Road, London, W.C.2

THIS is indeed one of the most carefully prepared stands in the whole exhibition and is designed as a fort, of which valves form the battlements. Model guardsmen are constantly "marching" round the fort, whilst a real guard stands sentry on the stand.

Quite apart from the "display" side of things, the Mullard stand is well worth visiting, since all the latest types of valves are on show and any required technical information is readily available.

STAND No. 3, Main Hall
NEW LONDON ELECTRON WORKS, LTD., East Ham, London, E.6

AS may be anticipated, aerial equipment forms the main feature on this stand. In addition to the "Electron" aerial wire for outside use, there is also a variety intended for erection indoors. Another new device is the "Variel," which is an unusual type of selectivity device for connecting in series with the aerial lead-in.

STAND No. 11, New Hall
NEWNES, GEO., LTD., 8-11, Southampton Street, Strand, London, W.C.2

THIS stand is, of course, the "home" of PRACTICAL WIRELESS and all readers should remember that the Technical Staff is in attendance to answer their queries. Every reader is welcomed, no matter how simple or how involved his enquiry might be. Readers should also take this opportunity to examine a number of the famous PRACTICAL WIRELESS GUARANTEED receivers which are exhibited and may be inspected by any visitor to the exhibition. The two features referred to above were extremely popular at Olympia and are proving no less so at Manchester; in fact, the Northern readers appear to be making still more use of the excellent service which is offered to them free of charge.

There are also very many books on all branches of wireless, the most called-for of which is the "Wireless Constructors' Encyclopædia." Other books include "Finding Foreign Stations," "Wireless, the Modern Magic Carpet," "Wireless Step by Step," "The Mathematics of Wireless," "Accumulator Charging, Maintenance and Repair," "Fifty Tested Wireless Circuits," and "Ralph Stranger's Wireless Library."

Do not forget to call on STAND No. 11—you will be welcome.

STAND Nos. 67-8, Main Hall
ORMOND ENGINEERING CO., LTD., Ormond House, Rosebery Avenue, London, E.C.1

THIS old-established firm are showing a full range of their efficient tuning condensers in both "single" and ganged types. It is to be observed that these are all of very up-to-date design and are soundly constructed. Additionally there is the range of loud-speakers which Messrs. Ormond are continuing from last season, although these are also available fitted with terminals for Class B and Q.P.P. use.

STAND No. 78, Main Hall
OSBORN, C.A., Regent Works, Arlington Street, London, N.1

HERE we find a variety of well-finished cabinets of both the console and radiogram type. A number of the new horizontal cabinets in which the speaker is mounted alongside the receiver are attracting favourable comment.

A point of special interest in regard to Osborn cabinets is that any of them can be obtained complete and polished, unpolished, or in sets of easily assembled parts.

STAND No. 78, Main Hall
OSDUR MANUFACTURING CO., 26, Adam Street, London, W.1

THE feature of this stand is the new "Bifo" anti-interference unit which is claimed to prevent electrical and atmospheric interference of any variety. By connecting the neat unit in different ways it can be made to produce alternative effects according to the particular kind of interference which is experienced.

STAND No. 4, Main Hall
PARTRIDGE, WILSON & CO., Davenset Works, Evington Valley Road, Leicester

A WIDE variety of mains transformers, mains units and charging plants are displayed on this stand. They are all of the excellent quality which has come to be associated with the name of "Davenset" and are even better in appearance than were the last year's models.

STAND No. 66, Main Hall
PORTADYNE RADIO LTD., Gorst Road, North Acton, N.W.10

AS manufacturers of high-class receivers, Messrs. Portadyne have become justly famous during the last few years. The latest models have many novelties, not least of which is an ingenious system of tuning in which accurate tuning is secured when two portions of a red line are brought end to end. A new Class B receiver is worthy of attention.

STAND No. 55, Main Hall
PYE RADIO, LTD., Africa House, Kingsway, London, W.C.2

THE name of Pye has become synonymous with quality radio receivers and the many instruments displayed showed that the latest models are even more attractive than their forerunners. A new Class B battery set employing a novel method of L.F. coupling is of particular interest.

STAND No. 65, Main Hall
RADIO INSTRUMENTS, LTD., Purley Way, Croydon

"MADRIGAL" receivers occupy a good deal of the space on this stand and the outstanding set in this range is the six-valve superhet radiogram. This is fitted with automatic volume control, a noise

(*Continued on page 167*)

SOVEREIGN FIRST TO PERFECT

TUNING WITHOUT CONDENSERS

A SIMPLE black cylinder three inches long and two wide—it contains the greatest tuning invention of all times. It makes tuning coils and condensers obsolete. It simplifies construction and increases selectivity, due to its special iron core. Over medium (200-550 metres) and long waves (1,000 to 2,000 metres), Sovereign Permeability Tuner gives perfect response. Each Unit is thoroughly tested before passing out for dispatch, and there is absolutely nothing to go wrong when in use. Complete with smooth slow-motion dial and escutcheon.

SOVEREIGN PERMEABILITY TUNER

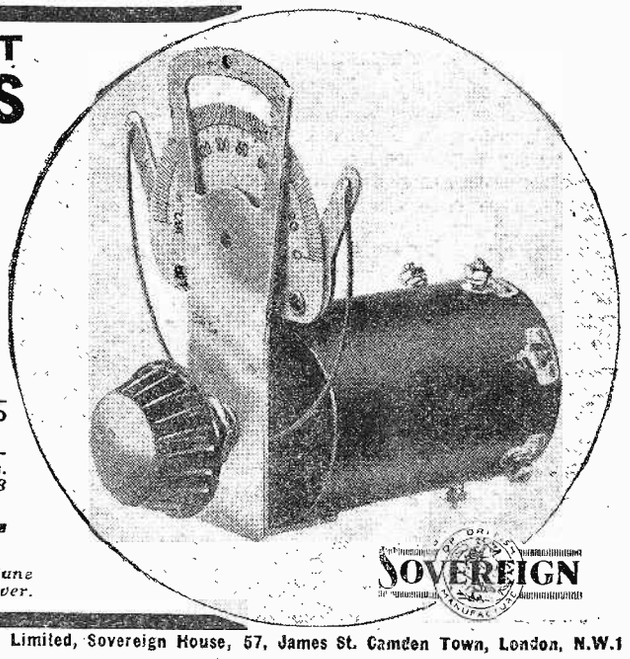
15/-

COMPLETE

Use Sovereign wherever you can

JUNIOR VOLUME CONTROL
With bakelite pointer knob, patent diaphragm contact and sturdy, silent action, three terminals, one-hole fixing. In all standard values.
Complete Graded-track Type, 3/- **2/9**

TONE CONTROL AND SCRATCH FILTER
Essential in Modern Sets. Enclosed smooth action. 3 Terminals made in all standard values. **4/-**

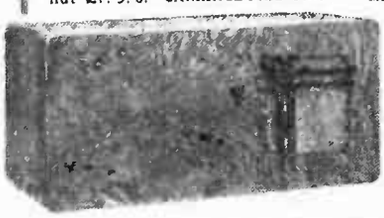


Send to Dept. Pr.W. for 1934 Sovereign Components Catalogue, and "Simplitune Three" Blueprint showing how to build a Permeability Tuned Three Valve Receiver.

Manufactured by **Sovereign Products, Limited, Sovereign House, 57, James St. Camden Town, London, N.W.1**

MODEL No. 253. A very modern Table Model radio cabinet with speaker combined. Inside measurements 24 in. long, 11 in. high, and 11 in. deep. Ample accommodation for H.T., L.T., and G.B. Batteries.

PRICES: Machined Kit of Parts. Oak 12/6, Mahogany or Walnut 15/-. Assembled Ready to Polish, Oak 17/6, Mahogany or Walnut £1. 0. 0. Assembled and Polished, Oak £1. 2. 6., Mahogany or Walnut £1. 5. 0. CARRIAGE PAID U.K.



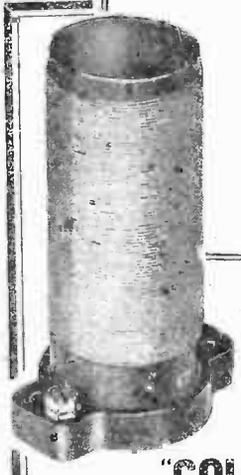
a new modern OSBORN cabinet

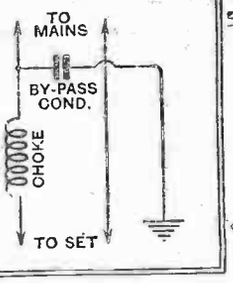
NORTHERN NATIONAL RADIO EXHIBITION, Manchester, September 27—October 7. Stand No. 78, Main Hall.

Sole manufacturers of the OSBORN BAFFLE BOX, 18in. by 18in. £1. 0. 0, 24in. by 24in. £2. 0. 0.

WRITE FOR CATALOGUE

CHAS. A. OSBORN (Dept. P.), Regent Works, Arlington St., New North Road, London, N.1. Tel.: Clerkenwell 5095. Showrooms: 21, Essex Rd., Islington, N.1. Tel.: Clerkenwell 5034.





STOP THOSE NOISES!

UNPLEASANT NOISES, SUCH AS CRACKLING, HUMMING AND OTHER EQUALLY ANNOYING INTERFERENCES, DEPRIVE THE LISTENER OF THE ENJOYMENT HE WOULD OTHERWISE RECEIVE.

"GOLTONE" INTERFERENCE SUPPRESSING DEVICES

"GOLTONE" MAINS H.F. CHOKES

(For A.C. and D.C. Supplies) as illustrated W.H.F., 3/6.

INTERFERENCE COMPENSATORS. HIGH-VOLTAGE CONDENSERS. SCREENED AERIAL DOWN LEADS. SCREENED TRANSMISSION LINES. SCREENED TUBINGS are some of the wide range manufactured. Obtainable from all First-Class Radio Stores. See the name "GOLTONE" on each component before purchasing, and refuse substitutes. If any difficulty write direct.

Let "GOLTONE" Technical Department solve your Interference Problems. Send Postcard for "Interference Elimination," Form and descriptive Folders.

FREE — Large 56-page 1933/34 RADIO CATALOGUE sent FREE on request.

Ward & Goldstone PENDLETON MANCHESTER LTD

UNIVERSE 1934 PICK-UP

Complete with volume control and connecting leads.

20/-

Output nearly 4 volts. Average output 2 volts. Base can be used in any position. Impossible for pick-up reed to go out of adjustment (patt. applied for). Special ball-catch swivel head for easy needle changing. In attractive brown bakelite moulded case. Ask your dealer for demonstration or write us for catalogue.

NORTHERN NATIONAL RADIO EXHIBITION.
Manchester, Sept. 27—Oct. 7.
STAND NO. 104. GALLERY.

COSMOCORD LTD. P, CAMBRIDGE ARTERIAL RD., ENFIELD, MIDDX.

OSTAR-GANZ

For the

"UNIVERSAL" HIGH-VOLTAGE VALVES

With these valves you can build yourself a "UNIVERSAL" All-mains set—convert battery sets to all-mains—alter present mains set to work off either A.C. or D.C. supply. No transformers or resistances needed. Easy and economical. Write for latest lists and circuits.

Sole Agent for Great Britain:
EUGEN FORBAT, 28-29, Southampton Street, Strand, W.C.2

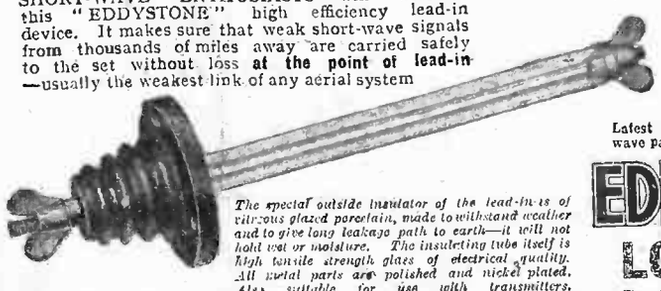
Telephone: Temple Bar 8608.

"A.C.—D.C. UNIVERSAL TWO" described in this issue you require **D.130, 17/6; 6 Pin Valveholder, 1/-; P.T.3, 19/9; E.G.50, 12/6.** KIT of Parts for above Set also supplied; also Special Model Sets—Kits and Amplifiers.
Write for Free List of Complete Range of Valves.

IMPROVE YOUR SHORT WAVE RESULTS

SHORT-WAVE ENTHUSIASTS will welcome this "EDDYSTONE" high efficiency lead-in device. It makes sure that weak short-wave signals from thousands of miles away are carried safely to the set without loss **at the point of lead-in**—usually the weakest link of any aerial system

"EDDYSTONE" LOW LOSS LEAD IN CAT. No. 946, Price 2/6.



The special outside insulator of the lead-in is of vitreous glazed porcelain, made to withstand weather and to give long leakage path to earth—it will not hold wet or moisture. The insulating tube itself is high tensile strength glass of electrical quality. All metal parts are polished and nickel plated. Also suitable for use with transmitters.

Latest list of "EDDYSTONE" short wave parts now ready, free on request.

EDDYSTONE LOW LOSS LEAD IN

STRATTON & CO., LTD., BROMSGROVE ST., BIRMINGHAM.
LONDON SERVICE DEPOT—WEBB'S RADIO STORES, 164, Charing Cross Rd., W.C.2

WIRELESS COMFORT

No longer is it necessary to get up and down to adjust the set. From your *seat anywhere in the room* you can fade out uninteresting stuff to a whisper with a MODULA and by a turn of a knob adjust the volume just as you like it, a real boon to wireless users—complete MODULA as illustrated, with 12ft. cable 2/11 or with armchair leather strap, 4/-.
The British Pix Co., Ltd. (Dept. 8), 118, Southwark Street, London, S.E.1.

2/11 COMPLETE.

MODULA ARMCHAIR CONTROL.

MARCUS, OVERTON
RADIO, LTD.
62, Borough High Street, London Bridge, S.E.1.

GUARANTEED EFFICIENCY — ACE — EXPRESS SERVICE

"PREMIER SUPER" DE LUXE KIT

SPECIFICATION:—

		£	s.	d.
1	British Radiophone Superhet 3 gang Midget variable condenser, complete with full vision disc drive. Type 582a	1	11	0
1	Set Lissen matched Superhet coils	1	10	0
2	Lissen Intermediate Frequency Transformers		15	0
1	Belling Lee w.w. 50,000 ohm Potentiometer		4	0
1	Bulgin 3-point switch		1	0
1	Bulgin Push-Pull Radio-Gram switch		1	9
3	Chassis Brackets			9
1	R.I. "New Hypermu" L.F. Transformer ...		15	6
6	Erie 1 watt resistances, 20,000, 10,000, 20,000, 30,000, 100,000 ohms and 2 megohms		6	0
2	Dubilier .1 mfd condensers type BB.		3	8
2	Dubilier 2 mfd condensers type BB.		7	0
1	Dubilier .0001 mfd condenser type 670 ...		1	0
1	Dubilier .0002 mfd condenser type 670 ...		1	0
1	Dubilier .0003 mfd condenser type 670 ...		1	0
2	Dubilier .01 mfd condensers type 670 ...		4	0
1	Polar Preset condenser .002 mfd		2	0
4	Clix 4 pin chassis valve holders (airspaced)		4	8
1	Clix 5 pin chassis valve holder (airspaced)		1	3
3	Belling Lee Terminal mounts		1	6
6	Belling Lee "R" type terminals		1	3
6	Belling Lee "Bowspring" wander plugs ...			9
1	"Ace" drilled and foil covered chassis ...		3	0
1	Belling Lee fuse and holder		1	0
5	Cossor valves to specification	3	1	6
	Connecting wire, flex, screws, etc.		1	5
	Kit B, including valves	£10	1	0

Any component supplied separately.

Kit A, as above Specification, but without valves	£6	19	6
or 12 monthly payments of		12	6
Kit B, as above Specification	10	1	0
or 12 monthly payments of		18	6
Kit C, as above Specification, with valves and "ACE" Brand Super Cabinet in Walnut	10	16	6
or 12 monthly payments of	1	0	0

AC.—DC. TWO.

1	"ACE" foil covered chassis		3	0
1	Telsen Coil No. W.216		7	0
1	J.B. .0005 mfd Slow Motion condenser No. 1046		7	6
1	R.I. Parafeed Coupling Unit		11	9
1	J.B. .0003 reaction condenser		2	6
1	R.I. smoothing choke Type DY 22		17	6
1	Dubilier fixed condenser type 620 .0002 mfd		1	3
1	Dubilier fixed condenser type 670 .0001 mfd		1	0
1	Dubilier fixed condenser type LEG 2 mfd ...		4	0
1	Belling Lee Twin Fuse holder with fuses ...		2	6
1	Belling Lee terminal block			6
2	Belling Lee terminals			6
1	Hellesens Electrolytic block condenser 8-8-1 mfd		7	6
1	Graham Farish type LMS Binocular HF Choke		4	6
2	Clix airsprung 5-pin chassis mounting valve-holders		2	6
1	6-pin chassis type valveholder		1	6
3	Erie resistance 1,000, 25,000 and 250,000 ohms		3	0
1	Bulgin Toggle Switch type S.80		1	6
5	Brackets			9
	Flex, connecting wire, screws, etc.		1	9
	"ACE" KIT A.	£4	2	0
3	AC.-DC. Valves to specification	£2	11	9
	"ACE" brand consolette cabinet in Antique Oak		1	7	6
W.B.	PM. 6 Microlode Moving Coil speaker		1	12	6
	"ACE" Kit A, as specification		4	2	0
	or 12 monthly payments of			7	6
	"ACE" Kit B, as specification, including valves		6	13	9
	or 12 monthly payments of			12	3
	"ACE" Kit C, as specification, including valves and consolette cabinet		8	1	3
	or 12 monthly payments of			15	0
	Westinghouse A.C. Mains Superhet. Blue print, constructional details and price list of official kit. Post Free			1	3
	Scott-Taggart S.T.400 "ACE" Kit A ...		4	15	0
	or 12 monthly payments of			8	9
	Block 120 Volt H.T. accumulator, 5,000 ma/hrs capacity		3	15	0
	or 12 monthly payments of			7	0

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Old sets rewired and modernised.
Send full details of your present set and state approximate amount you are prepared to spend and we will give you free advice and quotations.
We stock everything connected with Radio, Component parts—Speakers—Manufactured Receivers—Mains Units, etc. **Cash, C.O.D. and Easy Terms.**
TRADE SUPPLIED

"TUNING COILS" by "Photon"

IN the preceding "Photon" article we dealt with the tuning-coil in the open, and demonstrated a simple method of calculating the inductance.

We are now ready to consider the question of the potted coil. Firstly it may be stated that when a coil is "potted" the whole field is virtually confined to the space within the "pot." Owing to the high A.C. frequency and the fact that the pot provides what is really a short-circuited secondary very little of the magnetic field can escape from the pot, in fact the amount of the external field is negligible; that is what the pot is for—to prevent interference. The form of the field is consequently totally different from when the coil is in the open; it is *not* as shown in Fig. 1 (as has sometimes been represented), but as shown in Fig. 2. The lines of force must form closed curves without passing through the wall of the pot; obviously this restriction of the field results in a greater reluctance and lowering of the inductance; the latter must evidently be restored to its required value by the use of more turns, and it is this need for more turns, and consequent increase in the ohmic resistance, that is the price paid for potting the coil..

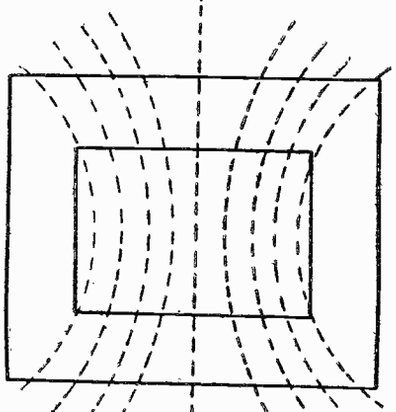


Fig. 1.—The broken lines represent the magnetic field about an "open" coil.

It is not possible to calculate the inductance with any degree of accuracy unless the pot be *designed* to make calculation easy; this will be best illustrated by one or two examples. Let the pot be laid out on the basis that there is a constant flux area "flow and return"; then the internal diameter of the pot will be $\sqrt{2}$ times the diameter of the winding. And to avoid any ambiguity at the ends let the area be designed so that the flux area is at all points the same; this is as drawn in Fig. 2. Then the length of the magnetic path may be taken as that indicated by the heavy line, namely the mean; we call this l_3, and, let N equal the number of turns, and D be the diameter of the winding as before, then the mean magnetic flux per c.m^2 will be:—

$\frac{0.4\,\pi\,N}{l_3}$ the total flux $\frac{0.4\,\pi^2 N\,D^2}{4\,l_3}$ and the inductance $\frac{0.1\,\pi^2\,N^2\,D^2}{l_3 \times 10^8}$ henries

or $\frac{N^2\,D^2}{l_3 \times 10^2}$ μh (approx.).

It is evident that the field is unnecessarily cramped by a pot of the proportions given. Thus, if we take the case of the numerical examples given in the preceding article the diameter of the pot is: 5 c.m. $\sqrt{}\times 2 =$ 7 c.m., and the length of the path denoted by l_3 is 12 c.m. Taking the number of turns as before—65 we have:—

$N^2 = 4{,}200$
$D^2 = 25$
$l_3 = 12$

$$\text{Inductance} = \frac{4200 \times 25}{12 \times 10^2}\ \mu\text{h}$$

= 88 microhenries instead of 200 for the same coil un-potted. To restore the inductance to its old value we shall require to increase the number of turns to 98, and assuming that both coils are closely wound a finer wire has to be used and the resistance has been increased in the relation of 1 to 2¼.

Take another example. Let the pot diameter be twice that of the winding, then the return path is three times the area of the "Core." We are now reduced to the position of having to indulge in a little guess-work. If we consider the flux as being distributed uniformly we can assess the reluctance of the return field external to the winding as being one-third that of that internal to the winding, and thus it may be represented by adding to l (the length of the winding), $\frac{1}{3}$ making a total 1.33 l. We have now to provide an addendum, as already done in the case of the coil in the open, to represent the reluctance of the external field not otherwise accounted for. This will depend upon the clearance between the end of the winding and the end of the pot. The conditions are not prescribed with sufficient exactitude to enable this addendum to be stated as a definite or precise quantity. The same factor is therefore taken as in the coil in the open, namely, 0.45 D.

If we pot the coil, given as a numerical example in the previous article, under these conditions, we have inductance

$$= \frac{4200 \times 25}{6.25 \times 10^2} = 168 \text{ microhenries.}$$

If as before 200 μh is the inductance required, the turns have to be increased from 65 to 71.

The actual inductance may be varied by increasing or diminishing the length of the pot, and thereby giving a greater or less clearance; so the constructor has two strings to his bow, if the inductance does not come out quite exact he may either lay on or cast off one or two turns or alternatively he may vary the length of the pot, in order to make the correction.

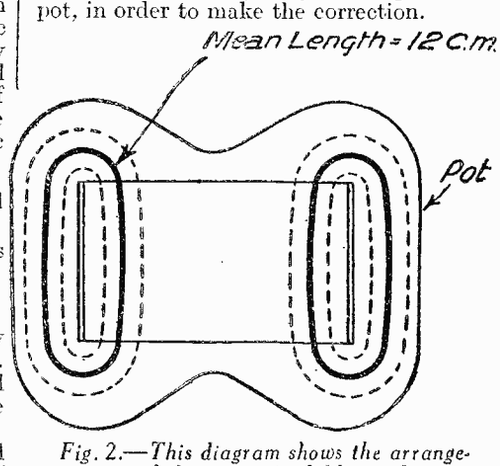


Fig. 2.—This diagram shows the arrangement of the magnetic field round a "potted" coil.

THE MANCHESTER RADIO EXHIBITION

(*Continued from page 164*)

suppressor, full-vision tuning scale, tone control and a master switch having four positions for putting the set on to either wave-range, or bringing the pick-up into circuit.

All the famous R.I. components such as transformers, chokes, etc., are shown, as well as the latest R.I. product, an iron-core coil having a unique permeability trimming device. The coil has a core of "Micrion," a material which has been specially developed for Messrs. R.I.

STAND No. 47, New Hall
RADIALADDIN, LTD., 46, Brewer Street, London, W.1

THIS firm specialises in the supply of new receivers and components, for which old ones are taken in part exchange. The system has operated very successfully in the past, and Messrs. Radialaddin's slogan "New Radios for Old" is very apt. Visitors who contemplate the purchase of a new set and who have some unwanted apparatus on hand cannot do better than consult the attendants on this stand.

STAND No. 113, Gallery
RADIOMES, LTD., 129-131, Bridge Street, Warrington

STAND No. 111, Gallery
362 RADIO VALVE CO., LTD., Stoneham Road, London, E.5

A COMPLETE range of valves is now made by this firm and all are sold at really competitive prices. Perhaps the one which appeals most strongly is an all-metal battery valve; this is the first of its type to be placed on the market. A Class B valve costing only 9s. is also an interesting line.

STAND No. 5, Main Hall
REPRODUCERS & AMPLIFIERS, LTD., Frederick Street, Wolverhampton

A LARGE number of loud-speakers of every type is to be seen on this stand, and the models range from the "Type 50" balanced armature unit to the latest "Victor" P.M. moving coil at 70s. An instructive feature is the display of sectionally-cut speakers of the different types; these models enable the buyer to see exactly how the speakers are built up.

STAND No. 15, Main Hall
SIEMENS ELECTRIC LAMPS & SUPPLIES, LTD., 38, Upper Thames Street, London, E.C.

THE centre of this exhibit is the range of "Full o' Power" high-tension batteries. These are made in four distinct types for outputs of 7, 10, 20 and 30 milliamps maximum respectively. The two larger types are especially suitable for use with Class B receivers, but there is also a more compact double-capacity battery which will be preferred where space is limited.

There is also on view a complete set of Siemens batteries of all types and sizes.

STAND No. 100, Gallery
SOVEREIGN PRODUCTS, LTD., 52-4, Rosebery Avenue, London, E.

A MOST extensive range of small components of various types is shown here. Included in this are coils, eliminators, mains transformers, chokes and condensers. An entirely new line which will be of especial interest to all constructors is a permeability tuner. This is a neat component built into a small bakelite container and fitted with an operating knob and slow-motion dial; it is, of course, one of the first permeability tuners to be introduced to the British market.

STAND No. 38, New Hall
STANDARD TELEPHONES & CABLES, LTD., 364, Grays Inn Road, London, W.C.

THIS firm is showing four new receivers; two of these are A.C. superheterodynes, whilst the third is an S.G.-Detector-Pentode battery set, and the fourth, a two-valve console A.C. receiver fitted with a P.M. moving-coil speaker. All these receivers are supplied with "Micromesh" valves.

STAND No. 87, Gallery
TANNOY PRODUCTS, LTD., Dalton Street, West Norwood, London, S.E.27

THIS firm specialises in power amplifiers for public address work and similar purposes, so it is not surprising to find that they have on show all kinds of amplifiers with output ratings from 5 to 100 watts. Some of the smaller units are suitable for use in the home when perfect quality reproduction is aimed at. All the instruments are really well designed and reflect good workmanship and sound construction.

STAND No. 31, Main Hall
ULTRA ELECTRIC, LTD., Erskine Road, Chalk Farm, London, N.W.3

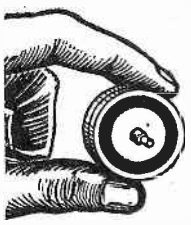
THE receivers here exhibited represent the latest in both circuit and practical design. Many of the larger models are provided with automatic volume control and other 1934 refinements. Special attention has obviously been paid to the cabinet work and this is very smart and in good taste. Ultra "Tiger," "Leopard" and other "animal" receivers are well known and will repay careful examination.

STAND No. 77, Main Hall
VARLEY (OLIVER PELL CONTROL), LTD., 103, Kingsway, London, W.C.2

MESSRS. VARLEY have on show a number of entirely new lines in addition to their excellent components which are being continued unaltered from

(*Continued on page 169*)

MICROPHONE BUTTONS 1/-



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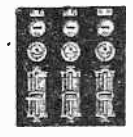
A.C.—D.C.



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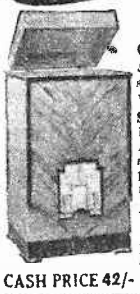

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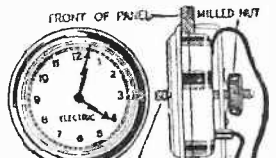

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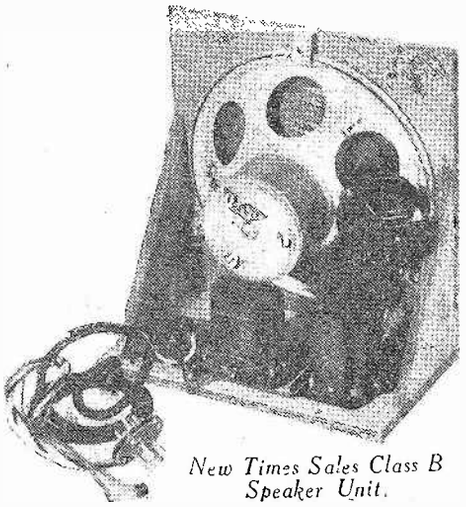
TABLOID TECHNICALITIES

1.—A.V.C.

THESE letters stand for Automatic Volume Control, a term which is being increasingly used in connection with modern receivers. The term is not strictly correct as the arrangement only comes into effect at certain pre-arranged conditions. In general, the arrangement is carried out by utilising the signal voltages passed on by the detector to vary the bias on the H.F. valves. It is well known that a current passing through a resistance results in a voltage drop across that resistance, and, therefore, we may arrange a signal of a certain value to pass though a resistance of a certain value so as to provide a biassing voltage on a variable-mu H.F. valve. Any reduction of signal strength passed through this resistance will reduce the bias on the H.F. valve and so increase the magnification of that stage, resulting in a louder signal being passed to the detector. Conversely, an increased signal will pass more bias to the valve, and so reduce its sensitivity. Modifications of this broad principle are introduced by utilising special diode valves for biassing purposes, and also by arranging that the controlling effect of the H.F. stages does not operate until a certain signal intensity is reached. In this condition it is known as Delayed Automatic Volume Control.

New Times Sales Class B Speaker Unit

The illustration shows a neat Class B unit and loud-speaker, already mounted on a baffle for inclusion in any type of cabinet. The loud-speaker is of the permanent magnet type, with matching transformer fitted to the substantial metal chassis, and this is, in turn, coupled to an



New Times Sales Class B Speaker Unit.

efficient Class B output choke. A tone-control condenser is fitted across the primary sections, to eliminate some of the higher frequencies and so give a slightly richer effect to music. The values chosen appear very suitable and certainly avoid the rather high pitched tone which is generally noticeable with Class B working. The three transformers are all at angles with one another to avoid interaction. A multi-way cord is fitted to the unit, and this is provided at its end with a combined valve-holder and plug which fits into the output valve of an existing receiver. The present output valve is then plugged into the top of the adaptor and so connects the unit in circuit with the batteries, etc. On test results were very good indeed, full volume being obtained, and no alterations having to be made to the set with which it is used. It is marketed by New Times Sales, 56, Ludgate Hill, E.C.4, at 59s. 6d. with valve.

A Problem Solved

DOES the A.C.-D.C. Universal receiver appeal to you? Perhaps you would like to build this receiver, or one of the other interesting designs which have been published in these pages, but are prevented from taking advantage of the improved results which are obtained from these modern receivers because you already have a receiver which is giving good results, and you do not feel like scrapping it. There is, however, no need to go on using your present set and envy the man who can build an up-to-the-minute receiver, as your position has been considered and your requirements met by Partex Radio, Vulcan House, 56, Ludgate Hill, E.C.4. This firm specialises in the part exchange of existing apparatus in order that new receivers, or sets of parts for receivers, may be obtained. It should be unnecessary for us to point out the immense advantages which may be obtained by the scheme. No doubt many readers have already attempted to dispose of an old set to a friend, or perhaps have advertised it in a local paper, but without success. All these difficulties are removed when you can go to a firm and state that you desire the parts for such-and-such a receiver, and that you have a receiver, in good working condition, which you wish to dispose of. A really good allowance is then made for the old set, and you are able to obtain the parts for the new receiver without any further trouble.

We would urge all our readers who are desirous of taking advantage of this scheme to write without delay to Partex Radio at the above address for full details.

Stop Press News

BATTERY DOUBLE-DIODE

USERS of battery receivers will be interested to learn that a double-diode will shortly be available for them. This is a Mazda product, and full details and reports will be given when available.

STAND-OFF INSULATOR

FROM Messrs. Ward and Goldstone comes the announcement of a neat stand-off insulator listed at 9d. This will find many uses in short-wave receivers, as well as for arranging an aerial or earth wire in the experimental workshop.

HEAVY DUTY H.F. CHOKE

AN ingenious H.F. choke, especially designed for mains use, has been received from Messrs. Ward and Goldstone. Priced at 7s. 6d., this is a most substantial component rated to carry the full mains voltage in D.C. sets, with a minimum voltage drop. Full details to be given later.

THE MANCHESTER RADIO EXHIBITION

(Continued from page 167)

last year. One of these is the latest "Nicore" iron-core tuning coil, another is the "Nicore" H.F. choke, whilst a neat and extremely compact automatic volume control unit will appeal to a great many visitors.

Besides the components there are some wonderfully up-to-date receivers, chief among which is the four-valve mains superhet. Another well-designed set is the five-valve superhet radiogram which has automatic volume control as well as many other modern features.

STAND No. 74, Main Hall
VINCE'S DRY BATTERIES, LTD., Garford Works, Garford Street, E.14

"LION" high-tension batteries are the main features on this stand and they are shown in great variety. These are low in price and are claimed to have a longer life than most batteries. An interesting point is that the tapping sockets are arranged on the side of the batteries instead of on top, and by this means the variation of voltage is simplified.

There are also other dry batteries of various types and the visitor can see them being made by means of up-to-date machinery which has been specially installed on the stand.

STAND No. 63, Main Hall
WESTINGHOUSE BRAKE & SAXBY SIGNAL CO., LTD., 82, York Road, King's Cross, London, N.1

ALTHOUGH the full range of Westinghouse metal rectifiers are exhibited the new Westinghouse superheterodyne kit set will probably claim most of your attention here. The complete set is on view on a revolving turntable so that it can be examined with ease. It has many novel features and employs automatic volume control which is provided by means of a "Westector." Broadsheets giving full constructional details are available and are being obtained in great numbers by home-constructors.

Two entirely new metal rectifiers are being shown. One of these is the type H.T.12, which gives an output of 200 volts at 30 milliamps and is to supersede the older H.T.6 and H.T.7; it costs 17s. 6d. The second is the type H.T.13, which has been specially designed for Class B and Q.P.P. use; it is the same price as the H.T.12.

STAND No. 101, Gallery
WHARFEDALE WORKS, LTD., 62, Leeds Road, Bradford

THIS firm has only recently been formed, but they are showing some extremely good permanent-magnet moving-coil speakers. These are reasonably priced and are worthy of careful examination.

STAND No. 62, Main Hall
WHITELEY ELECTRICAL RADIO CO., LTD., Victoria Street, Mansfield

THE famous W.B. moving-coil speakers are shown here, and the new "Microlode" types are proving extremely popular. These latter are provided with a multi-ratio transformer and two selector switches. By moving the switch arms any ratio can be obtained to match either ordinary triode, pentode, Class B or Q.P.P. output stages. The largest "Microlode" is the type "P.M.1.A." which is priced at £6; the "P.M.2A." comes next at £3 19s. 6d.; the next is the "P.M.4A." (of which fifty were recently given away in the PRACTICAL WIRELESS competition) and costs £2 2s., whilst the "baby" in the range is the type "P.M.6A." at £1 12s. 6d.

Any of the W.B. speakers can be obtained fitted in beautiful cabinets of excellent acoustic design.

STAND No. 51, Main Hall
WINGROVE & ROGERS, LTD., Polar Works, Old Swan, Liverpool

MANY new types of "Polar" condensers are to be seen here, notable among which is the "Star Minor." It is made in either "single" or multi-ganged type and may be obtained with one of three alternative drives. The latter, which may be bought separately if desired, are of the latest full-vision type, and have straight, curved and semi-circular scales respectively. All three are the same price, namely, 7s. 9d.

Other new lines include short-wave condensers of very low-loss type.

STAND No. 84a, Gallery
WRIGHT & WEAIRE, LTD., 740, High Road, London, N.17

THE coils, chokes, switches, potentiometers, etc., which have been made by Messrs. Wright & Weaire and sold under the trade name of "Wearite" during the past several years, require no introduction to our readers. The latest products of this progressive firm include a range of "Nucleon" tuning coils and H.F. chokes; these are, of course, iron-cored components of the latest type.

Also on this stand there are a number of really good Class B components and mains transformers. All of them are distinctly well made and of handsome appearance.

STUDY ECONOMY

A SIMPLE H.T. ELIMINATOR

The diagram shows a simple, safe and effective H.T. unit for D.C. mains 150/250v. Smoothing is adequate, and the H.T. hum-free for sets using up to three valves. The "Fuseplug" rules out accidental short-circuits. R1 and R2 resistances shown for voltage dropping are suitable for 200/250v; for lower voltage mains reduce accordingly. A cover should be provided and the earth wire of set connected to E. terminal.

BULGIN COMPONENTS ILLUSTRATED

LF 16	*20H. AT 20 M.A. L.F. CHOKE*	*7/6*
P 25	*FUSE PLUG & FUSES*	*2/0*
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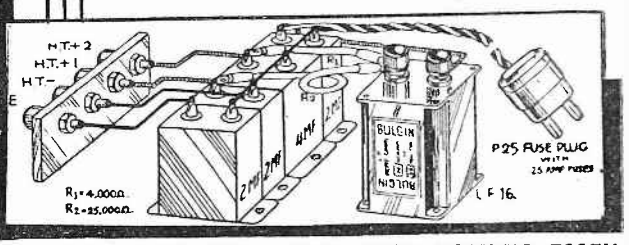

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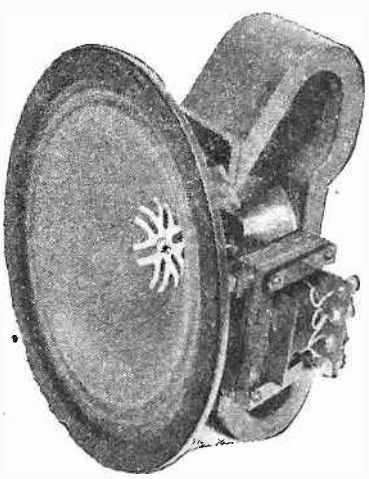

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Filament Circuit in D.C. Mains Sets

(Concluded from Page 88, September 30th Issue)

CONSEQUENTLY, the correct value in this case for the mains-resistance is 2,000 ohms. The next point requiring explanation is the necessity for the two "shunt" resistances which are shown in Fig. 3, connected directly across the filaments of the first two valves. It will be appreciated that as the anode current of the last valve passes down the filament lead it must also pass through the filaments of the other two valves, unless we provide for it an alternative path. The shunt resistances are this alternative path, allowing the anode current to pass round the circuit, but not through the two valve filaments.

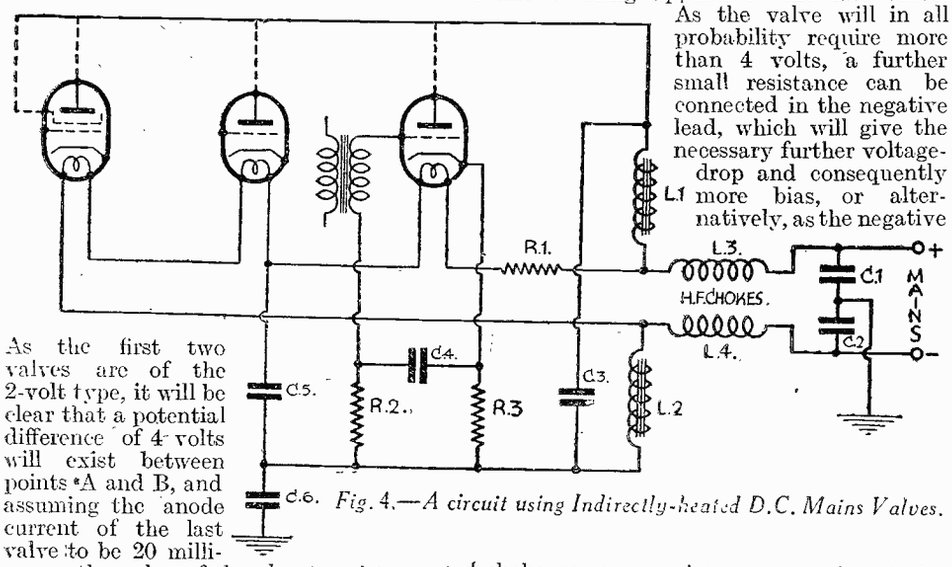

Fig. 4.—A circuit using Indirectly-heated D.C. Mains Valves.

As the first two valves are of the 2-volt type, it will be clear that a potential difference of 4 volts will exist between points A and B, and assuming the anode current of the last valve to be 20 milliamps, the value of the shunt resistance is arrived at by dividing the voltage difference by the current, thus :— $\frac{4}{.02} = 200$ ohms.

A further point to be borne in mind is that the filament of various valves of the same type, even though the *average* rating will be 20 ohms (in the case of the 2v .1 amp type) may, individually, vary quite considerably, and may be anything between 18 and 22 ohms. Consequently, if a valve has to be replaced for any reason, a voltmeter should be connected across the filament terminals to ensure that it will actually be running at two volts. Obviously, if the filament resistance of the replacement valve is *less* than that of the original valve, the total resistance in circuit will be somewhat less, greater current will be permitted to flow, and the valve may be over-run, causing it to lose emission much more quickly than it normally would. On the other hand, if the new valve has *greater* resistance, then less current will flow, and the valve will be slightly under-run, causing perhaps distortion and generally unsatisfactory results. Furthermore, it will be appreciated that any fluctuation in the mains voltage will cause a similar fluctuation in the voltages applied to the filaments, which are not, of course, designed to withstand any such fluctuations, and in order to avoid premature deterioration due to this cause a special regulator lamp can be connected in series with the mains resistance, which will take care of a considerable mains-voltage fluctuation permitting only the correct voltage to enter into the filament circuit.

Providing for Grid-bias

Grid-bias must, of course, be provided for, and fortunately this is a simple matter as the voltage-drop across any ohmic resistance in the negative side of the filament circuit can be utilized for the purpose. As has already been pointed out, the resistance of the filaments causes a potential difference of 4 volts between points A and B in Fig. 3, and, therefore, if the grid return lead is taken to point A, the grid of the output valve will automatically be 4 volts negative in respect to the filament—in other words, 4 volts bias is being applied to the last valve. As the valve will in all probability require more than 4 volts, a further small resistance can be connected in the negative lead, which will give the necessary further voltage-drop and consequently more bias, or alternatively, as the negative choke possesses resistance, a portion of the choke winding can be tapped off and used for obtaining further bias as shown in Fig. 3.

Now indirectly-heated D.C. valves differ from the battery valve, in that whereas in the latter the filament is also the cathode, in the former the cathode is a separate element which encloses a separate heating element called the "heater." When the heater is connected to an irregular supply it becomes hot, and transmits its heat to the cathode, causing it to emit electrons in a steady stream. Obviously, if the heater—fed from an irregular supply—were itself allowed to emit, the electron stream would fluctuate in sympathy with the fluctuation of the supply current, thus causing considerable hum. As this type of valve is designed for an irregular filament heating current, there is obviously no point in smoothing this supply, and therefore the smoothing chokes are connected in the H.T. circuit only, and not in the L.T. circuit as in the case of battery valves. This difference is apparent from Fig. 4, which shows the skeleton circuit of a three-valve set using indirectly-heated valves. The heater circuit is connected directly to the mains (through H.F. chokes perhaps, as will be explained later), but a breakdown resistance must still be used, its value depending, of course, on the characteristics of the valves used.

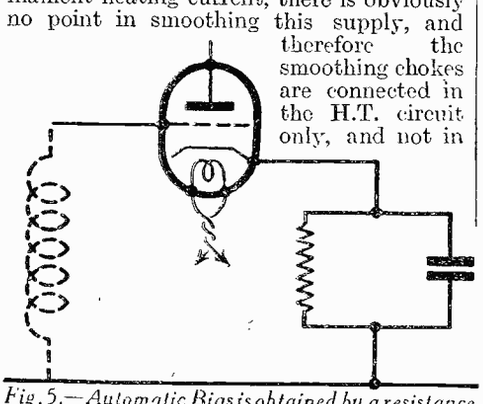

Fig. 5.—Automatic Bias is obtained by a resistance and condenser in the cathode lead.

Screening the Detector Stage

As the current in the heater circuit is unsmoothed D.C., stray couplings are likely to be present, the results being particularly unpleasant in view of the fact that the H.F. ripple found on D.C. mains is usually at a much higher frequency than that found on A.C. mains. The detector stage is always the most troublesome in this respect, but the difficulty can be minimized either by wiring the heaters in such a manner that the detector valve is last in the negative end of the chain, or if this is not practicable, a 2 mfd. condenser can be connected, with entirely satisfactory results, between the detector heater and the negative or earth line as shown in Fig. 4. The detector stage is also particularly prone to hum pick-up, etc., and it is usually advisable to carry out the wiring of this stage in "screened" wire, or, in exceptional cases, it might even be found necessary to enclose the entire detector stage, with its associated components, in a separate screening-box, earthed, of course.

Another difficulty frequently encountered in such a set is the presence of H.F. currents superimposed on the mains which, if allowed to get into the receiver, may cause reduced selectivity, modulation hum, etc. The smoothing chokes are, of course, designed to deal with low frequencies and, consequently, they do not offer much opposition to these unwanted currents, and the only satisfactory method of keeping these out of the set is to use a special high-frequency choke in each mains lead before the L.F. smoothing chokes, as shown in Fig. 4. An earth wire connected between two 1 mfd. condensers shunted in series across the mains may be advantageous, but this depends entirely upon local conditions, and can only be determined by experiment. In fact, no definite rule can be laid down regarding earthing a D.C. set, as in some instances the earth connection tapped on to the mid-point of the two condensers may be better than the ordinary earth connection through a condenser to the negative side of the set, or in some instances, the set will operate much better with no connection to earth at all! It will be appreciated that one side of the mains is already earthed by the supply-company, but even if the negative main is not earthed, a very large capacity exists between this main and earth, which is effectively in parallel with the smoothing choke, rendering the use of a local earth unnecessary. If an earth wire to the negative side of the set is used, it must be remembered that this side of the set is in direct connection with the supply main and, consequently, it is essential to isolate the mains from earth by utilizing a fixed condenser as shown in Fig. 4. Reverting for a moment to the matter of keeping out H.F. currents, it may be mentioned that this subject assumes particular importance in the case of a superheterodyne set. H.F. currents in such a circuit may be responsible for introducing whistles throughout the tuning

(Continued on opposite page)

FILAMENT CIRCUIT IN D.C. MAINS SETS

(*Continued from previous page*)

range, these whistles being of a nature such as would render the set almost entirely useless.

As in A.C. design, automatic grid-bias can be arranged for by connecting resistances in the cathode leads as shown in Fig. 5. As the anode current of the valve must pass through any resistance in its cathode lead, voltage is developed across the resistance and a difference in potential exists between each end of it. Therefore, by taking the grid-return lead to the bottom end of the cathode resistance, the grid is automatically negative in respect to the cathode to the extent of the voltage dropped across the resistance. A small condenser—usually 1 mfd.—should in each case be shunted across the cathode resistance in order to provide a low-impedance path to earth for any unwanted H.F. or L.F. currents which may be present in the circuit. The formula for calculating cathode resistance values is: $\frac{\text{Grid-bias voltage required}}{\text{anode current in milliamps}} \times 1{,}000$. In the case of a valve requiring 10 volts bias with an anode current of 15 milliamps, the formula becomes:

$$\text{Resistance} = \frac{10 \times 1{,}000}{15} = 666 \text{ ohms.}$$

Universal Valve for A.C. or D.C. Mains

The third type of valve, namely, the "universal" Ostar Ganz valve, is a form of indirectly-heated valve, the heater of which is designed to work directly from any supply, whether A.C. or D.C., without the necessity of a mains-transformer or a voltage breakdown resistance, thus permitting the construction of a receiver which will operate from either D.C. or A.C. mains without alteration or adjustment. Such a receiver is, of course, an attractive proposition to a constructor who, although now on D.C., shortly expects to be changed over to A.C., but it is not essential to use the special universal valve—ordinary indirectly heated D.C. valves can be used. The only unconventional point is the rectification of the supply for anode current when the set is connected to A.C. mains. This is, however, quite a simple matter if it is borne in mind that a metal rectifier offers very low resistance to current passing one way, and, consequently very little voltage drop will occur through this component with direct current passing through it. Under these conditions, the rectifier is naturally only an "ornament," but in any event, it does not prevent the passage of D.C. and does not reduce, to any appreciable extent, the voltage available for the anode circuits. When the set is connected to A.C., however, the rectifier comes into its own and converts the alternating current to a pulsating unidirectional current which, after smoothing, is suitable for the anodes of the valves. It will be appreciated that in such a circuit the smoothing must be exceptionally comprehensive, partly due to the fact that only half-wave rectification is employed. It is necessary to point out that a "universal" receiver of this type does not comply with the various electrical regulations when connected to A.C. mains, as in the absence of the usual mains-transformer the set is, of course, connected directly to the mains. This can be overcome quite simply by interposing a 1:1 transformer between the set and mains, removing it, of course, when using the set on D.C.

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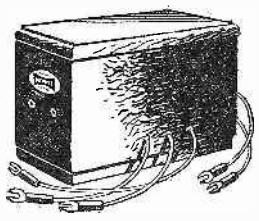

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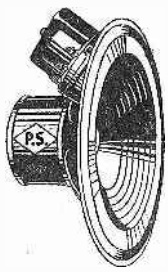

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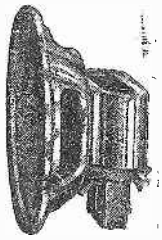

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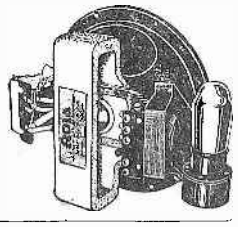

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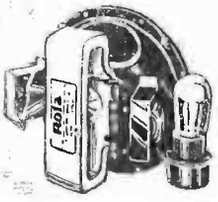

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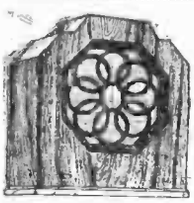

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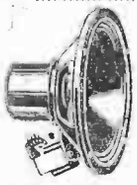

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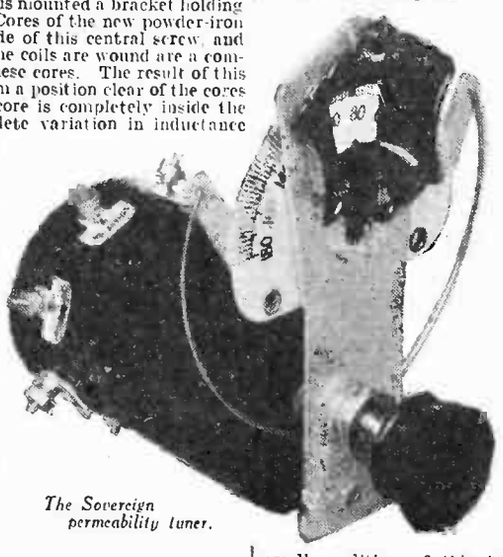
THE first permeability tuner to be received for test is illustrated below. This comes from the Sovereign factory, and is no doubt the forerunner of many similar tuners. As may be seen, it consists of an ebonite casing to which is fitted a number of terminals and a slow-motion drive. The latter works with a very small reduction, approximately 9 to 1. The actual mechanism is simple but very effective, and employs a coarse thread screw running through the centre of the assembly, upon which is mounted a bracket holding two separate windings. Cores of the new powder-iron are arranged on either side of this central screw and the formers upon which the coils are wound are a comfortable sliding fit over these cores. The result of this is that the coils travel from a position clear of the cores to a position where the core is completely inside the coil, thus giving a complete variation in inductance value. The sizes of the windings, cores, etc., have been chosen in conjunction with the pitch of the thread to produce the same effect as we have been used to experiencing when tuning a coil through the broadcast band with a .0005 mfd. tuning condenser. The spacing of the principal stations is quite effective, although on our particular coil a slight cramping was noticed in one part of the scale. For all normal purposes, however, the tuner will be found most effective, and will enable a very simple type of receiver to be built up in view of the fact that no tuning condenser is required. The price is 15/-.



The Sovereign permeability tuner.

WILBURN CONDENSER

A 2 MFD. fixed condenser has been received from Messrs. Wilburn and Co. This is of the type rated at 1,500 volt D.C. test, finished in the usual Wilburn pale green enamel. Substantial terminals are provided for connections, and the top is enclosed by a paxolin sheet, although the usual pitch is used below this to ensure that the condenser will be unaffected by damp, etc. On measurement, the actual capacity was found to be 1.92 mfds. which, of course, is very good. The type number is C.B. 7, and the condenser may be used in any mains equipment where the peak voltage is not likely to be exceeded. The price is 3/6d.

BRITISH RADIOPHONE I.F. TRANSFORMERS

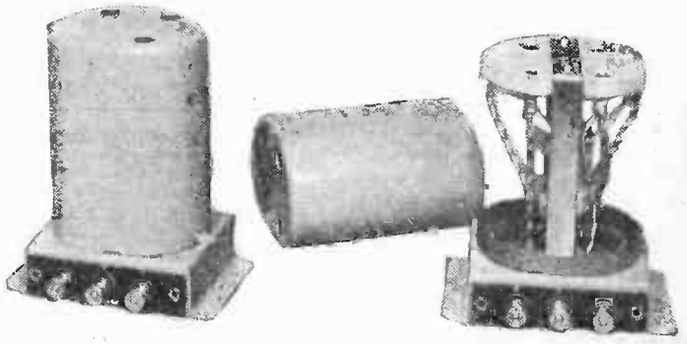
THE latest type of Intermediate Frequency Transformer to be produced by British Radiophone, Ltd., is illustrated on this page. It is a very substantially made unit, employing Steatite for insulation purposes. The primary and secondary windings are of the duo-lateral wound type, supported on a central column of paxolin. The positions are fixed to provide a suitable band-pass effect. A steel base, finished in the usual battleship grey cellulose is fitted, and paxolin strips are attached to each side of this for connection purposes. A separate earthing terminal is fitted and makes connection with the metal base and screening can. The trimming condensers are fitted at the top, on the Steatite moulding, and screw adjustments for these trimmers are accessible through holes in the top of the screening can. The transformers have the appearance of very high efficiency, and although we have not yet had an opportunity of testing them in an actual circuit, we have no doubt that they will come up to the usual high standard set by British Radiophone products.

WATMEL HYWATT RESISTANCE

A NEW type of resistance has been produced by Messrs. Watmel Wireless, and a sample has been received for test. It consists of a wire winding over a tube of heat-resisting material, the completed resistance being coated with an enamel of pleasing blue-grey. The specimen received was rated at 5,000 ohms, and on test it was found to be slightly higher than this figure, the error being well under two per cent. A test was arranged to ascertain the current-carrying capacity of the complete resistance, and it was found that at 20 m/A the rise in temperature was just discernible. At 80 m/A the resistance was too hot to touch, but no burn-out took place nor did the enamel flake. The resistance was then run continuously for twenty minutes at 30 m/A, and although a slight smell was given off the wire stood up to the strain admirably. It would appear from these tests that the resistance is admirably suited for incorporation in eliminators and mains receivers and will handle quite a considerable wattage without risk of breakdown.

NEW W/B SPEAKER

WE have already mentioned the good points of the W/B Microlode Speaker, and we have now received a smaller edition of this interesting device, in the form of a permanent-magnet moving-coil speaker with matching device fitted to the base. The cone and chassis is of the same size and material as the Microlode type P.M.4A, but the magnet system is somewhat smaller. The ordinary "U" type is employed with a central pole, and a small bracket is bolted to the magnet to accommodate the special tapped transformer. As in the case of the P.M.4A, two rotating arms are fitted with nine positions, and these may be turned to provide any one of seventeen different ratios. For this purpose two black terminals are fitted to the base, under which conditions the matching may be carried out for practically any type of output valve. When, however, push-pull or similar circuits are used, an extra connection is made to a red terminal situated between the two black ones, and the two arms are then adjusted symmetrically, providing only four ratios. The speaker was tested on a standard three-valve receiver and gave very good results. Speech was clean and crisp, with no trace of boominess, and music was of that forward type now associated with W/B speakers. Sensitivity was quite high for a speaker of this class, and the volume from a two-valver was ample, whilst on a four-valve it was possible to push volume to the limit without any trace of distress. The matching device was found most effective. As this speaker is only 32s. 6d., it will no doubt prove immensely popular.



The new British Radiophone intermediate frequency transformer with screen removed to show construction.

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.

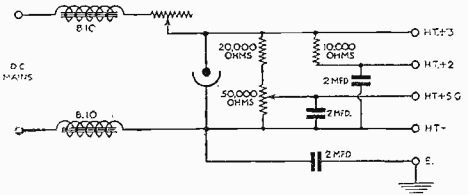
A Soldering Hint

SIR,—I read your replies to queries each week, and find them not only exhaustive and accurate, but written in an interesting manner.

But this week I noticed a reply which I think could be made a little more helpful to the reader (T. G., East Twickenham), who, like myself, two months ago could not make a soldered joint. However, I read various instructions for soldering, but *very, very* seldom could I manage to get the solder to run evenly. However, one evening I resolved to find out my difficulty. I was soldering various parts for experiment and I discovered the answer to my problem. I soon found that the solder would only melt where the iron was properly "tinned," and I noticed that a small "blob" of solder adhered on this part. If this "blob" is carefully applied to the part to be soldered, a neat job will result.—H. RATCLIFFE (Manchester).

Class B Eliminator

SIR,—I have taken your weekly book since its introduction, and I think it good value for a modest threepence. Some months ago you promised us a H.T. Eliminator using a neon tube. I am still waiting to see that, but I have been using one with the greatest of success for three months now, and find it is the only method in which either Q.P.P. or Class B will work



Circuit diagram of Mr. E. C. Hobday's eliminator.

properly, dry batteries proving unsatisfactory. The accompanying diagram shows the circuit. All materials are Ferranti, with the exception of the neon tube, which is a Cossor. There is absolutely no hum on my mains, which are very dirty and difficult.

What I should like to see in PRACTICAL WIRELESS is a battery-operated set with an Igranipak or similar unit with two variable-mu detector and Class B output with A.V.C. and tone control. I believe this could be done, and I for one would welcome any attempts made in that direction. Wishing you the best of success.—EDGAR C. HOBDAY (East Finchley).

The Fury Four

SIR,—I have built your Fury Four, and it's the best set I have yet constructed. Mr. Camm is to be congratulated as the Editor of PRACTICAL WIRELESS, and the Wireless Constructor's Encyclopædia, and I extend to him and his staff the best of good wishes. Hoping the new superhet, the Premier Super, is as good as the Fury Four.—H. WILLIAMS (Llanelly).

Epoch Radio—a Correction

SIR,—We have seen your interesting article in reference to our speakers in the edition of September 30th, and highly appreciate same. I would like a little correction to be made here, however. In the second column you state, "Messrs. Epoch were pioneers of permanent magnet moving coil speakers and produced the first efficient instrument of this kind in Great Britain (some eight or nine years ago, by the way)." The period you mention is only correct so far as development research is concerned, the first of our efficient instruments that we actually put on the market dates back only about six years ago.—EPOCH RADIO MANUFACTURING CO., LTD.

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT the super-regenerative receiver is one of the best arrangements for short-wave work.
—THAT if removal of the earth connection does not impair results it proves that the earthing system is inefficient.
—THAT signals should cease entirely when the coupling components between band-pass tuners are short-circuited.
—THAT if signals are still received when these components are shorted it proves the existence of stray couplings.
—THAT the latest type of intermediate frequency transformer employs a special coupling condenser between the two coils.
—THAT home-made screens should not be fitted to chokes, tuning coils, etc., unless the effect of these screens is fully appreciated.
—THAT a burnt-out L.F. transformer may be put to many uses in experimental apparatus.
—THAT the valve-makers' recommendations should be strictly adhered to when choosing the smoothing condenser for a mains unit employing a full-wave rectifying valve.

NOTICE.

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

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

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The very latest Radio sets, loudspeakers and kits supplied on the lowest monthly terms. Strict privacy. Prompt delivery. All carriage paid. Price list free.

FERRANTI CLASS B SPEAKER AMPLIFIER

This component when connected to any battery set greatly improves quality and increases the undistorted volume up to approx. 7 times without increasing H.T. consumption.

Moving-coil unit with valve. Cash price £4-4-0, or 8/- with order and 11 monthly payments of 7/8.

	Cash price	With order	Monthly payments
New BLUE SPOT 99 PM UNIT with transformer. (The finest perm.-magnet unit available.)	69/6	5/-	11 of 5/6
New LISSEN SKYSCRAPER ALL-WAVE 4 KIT, with valves	112/6	10/-	11 of 10/3
As above, but with cabinet	128/-	11/6	11 of 11/9
New BLUE SPOT 29 PM with transformer	32/6	5/-	6 of 5/-
New W.B. MICROLODE PM2A UNIT with transformer and special matching switch	27/-	5/1	5 of 5/1
New ATLAS MODEL CA25 H.T. ELIMINATOR, output 25 milliamps...	59/6	5/-	11 of 5/6
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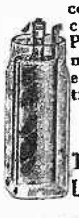
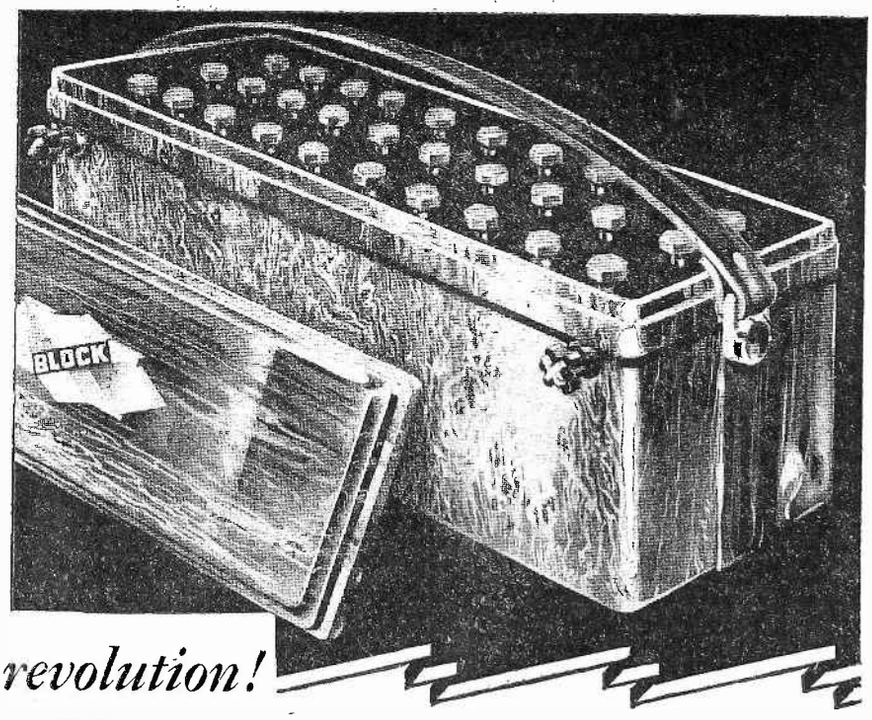
Many thousands of listeners in all parts of the country have banished the bugbear of costly H.T. by installing the wonderful Sac Leclanche Wet H.T., the permanent battery that lasts for years. The cells are self-regenerative and any slight current drop is made up when not in use. Popular Battery, 120 volts, No. 3 cell, 12,500 milliamps. Price, complete with chemical, etc., £2, carriage paid. Send for full particulars.



ALL SPARES FOR STANDARD BATTERIES SUPPLIED.

THE WET H.T. BATTERY CO., 26 Lisle St., London, W.C.2 'Phone: Gerrard 6121

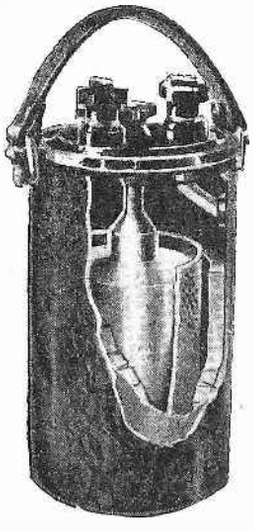


revolution!

Now★ YOU CAN GIVE UP *dry battery* EXPENSE

MANCHESTER STAND 54

★ PLATE-LESS-NESS REMOVES ALL OBJECTIONS TO H.T. ACCUMULATORS



This Block L.T. accumulator is no bigger than an ordinary 40 a.h. type, yet lasts twice as long per charge! As in all Block cells, its cylindrical negative is also the cell's container, the positive being a central column. No grids needed, therefore more "active material" and less weight; also its circular form ensures far more thorough action.

1. YOU endured the constant expense of dry batteries — because H.T. accumulators were so unwieldy. Or perhaps you put up with the existing type of accumulator?

2. To-day there is no need for either. The invention of the Block plate-less cell, with its double capacity, permits a H.T. accumulator that is half the usual bulk—60 v., 5,000 m.a.h. from a coloured bakelite casket hardly bigger than a dry battery!

3. Give up the old expense, the old nuisance. Give yourself the economy (and comfort) of H.T. in its modern, most perfect, cheapest form.

60 v. 5000 m.a.h. 14¾"x4⅝"x5¼" lid. Weight 16 lbs. **37/6**

30 v. 5000 m.a.h. 8-3/16"x4⅝"x5¼" lid. Weight 8 lbs. **21/-**

Double capacity L.T. 80 a.h. 2 v. **11/6**

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TAS/Bb 50

RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

SLADE RADIO

A talk on Cinematography was given by Mr. B. H. Gale, M.P.S., at the meeting held last week. In this he described the different sizes of films that are used and the cameras, also how the films are developed and printed. After this he dealt with the projectors and the question of magnification, etc. A number of Pathé films were shown, and also two of his own taking. The meeting proved interesting and was fully enjoyed by those present.—Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

KETTERING RADIO AND PHYSICAL SOCIETY

A very successful radio exhibition, sponsored by this Society, was held recently in the Central Hall, Kettering, at which nearly 9,000 people attended. In the main hall there was a fine show of receivers ranging from two and three-valve sets to superhets. A set which created a good deal of interest was fitted with the new iron-cored coils combined in a special circuit, giving increased selectivity, range, and amazing sensitivity. Besides wireless equipment there were many exhibits of interest to the amateur photographer, and the home-movie and television enthusiast. The trade was well represented and on these stands a comprehensive display of components and complete apparatus was to be seen. Music was relayed to the stallholders by a similar method to that used at Radiolympia, a powerful amplifier being installed in the balcony.—Hon. Sec., R. J. Pankhurst, 9, Shakespeare Road, Kettering.

RADIO, PHYSICAL AND TELEVISION SOCIETY

The following is a copy of a letter sent to old members of this Society:—

SIR,—It has been decided by the Committee of the late Radio and Television Society to recommence their activities under the name of the Radio, Physical and Television Society. The annual subscription will be as before, 10s. (5s. for Junior Members). Owing to the kind offer of Dr. C. G. Lemon, F.Ph.Soc. (Lond.), A.M.I.R.E., who, you will no [doubt remember, gave us several lectures in the past, it has been made possible to re-form the Society. The increased facilities and accommodation which we have now obtained from Dr. Lemon at his laboratory include permanently-installed 42-metre and 5-metre transmitters, together with all types of physical apparatus, X-rays, etc. The very latest type of Television reception will be demonstrated by our President, Major Oates. A lecture hall and workrooms are available, and facilities and assistance will be afforded for members to conduct their own research work. Lectures will be given from time to time by Dr. Lemon on physical subjects, including high frequencies and high-voltage discharges, electrochemistry, photo-electric cells, etc.

A very large percentage of the late members have decided to rejoin, and we shall be very glad if you will kindly fill in the enclosed post card to signify your personal intentions. The first meeting will be held on Friday, the 22nd inst., at 8 p.m. sharp, at Headquarters. We do hope you will rejoin as we can assure you that we have a fine programme for the coming winter months.—F. J. Bubear, Hon. Secretary, 67, Nassau Road, Barnes, S.W.13.

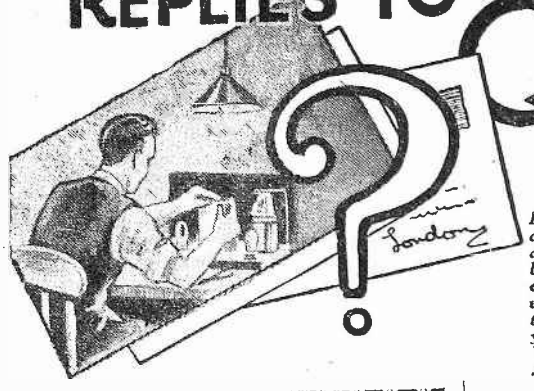
BEGINNER'S SUPPLEMENT

(Continued from page 154)

a loud-speaker is used for this purpose, and it is connected to the output valve in the manner shown in Fig. 26, so that all the current flowing from the high-tension battery to the anode of the valve must pass through its windings. First of all, we will assume the case of a "moving iron" loud-speaker, of which the general form of construction is shown in the sketch of Fig. 27. The armature is always attracted towards the permanent magnet, and when a steady current is passed through the windings the armature takes up a stationary position some little distance from the magnet. As the current is varied the armature is attracted more or less strongly. Imagine, now, a rapidly varying current (such as is produced by the signals) passing through the windings and you will realize that the armature will be set into vibration at the same frequency as the current fluctuations. As the armature vibrates, the cone naturally vibrates with it, and so causes the air vibrations which we know as sound.

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.

TESTING A RECEIVER

"My receiver has suddenly stopped working and I am rather keen on testing it out myself in order to find the fault. I do not, however, know how to set about the task, and I should like you to help me in this respect. Unfortunately I do not know sufficient about wireless to be able to tell you what is likely to be wrong, and all I can say is that the signals suddenly stopped; they did not fade away, but went suddenly in the middle of a talk. Do I need many instruments for testing?"—(W. G., Highgate).

It is a difficult task for a beginner to completely test a receiver, although by systematically going over it it is possible in many cases to locate the fault. A combined volt and milliammeter will do for the purpose, and the first job is to insert this in each anode lead in turn in order to ascertain that the valves are working correctly and that H.T., G.B. and L.T. supplies are all intact. Failure of any valve to give a correct current reading may be due to a broken anode circuit or the interruption of one of the battery supplies. These should not be difficult to trace out. If all anode currents are correct, the lack of signals must be due to a broken or otherwise interrupted grid circuit, and the various grid leads and components should be tested for continuity. The loud-speaker or 'phones should naturally be tested, and where it is not possible to employ a satisfactory instrument, the best method of testing is by means of substitution. There is no need for an exact replacement, but a resistance, condenser, or transformer approximately of the same value may be used in order to verify connections.

CHOOSING A VALVE

"I am making a one-valve set for an old person, and I am not certain as to which is the best valve to use. I intend to wind a coil of my own, using reaction and a loose-coupled aerial. Very loud signals are not desired, but the upkeep must be kept down, as I do not want her to bother with battery charging. 'Phones only will be needed. What do you advise?"—(R. H., Finchley).

In view of your locality you will have no difficulty in obtaining a really powerful signal from the local Brookmans Park transmitters. Therefore a valve taking little anode current should be used, combined with moderate amplification properties. Undoubtedly you cannot do better than use one of the so-called General Purpose types of valve, that is, one with an impedance between 10,000 and 20,000 ohms, and with an amplification factor between 15 and 30. A perusal of various valve manufacturers' lists, or an examination of Data Sheet No. 10 will no doubt help you to choose a valve for the purpose.

ALTERING A COIL

"The reaction control on my set is much too jumpy. As soon as I turn the reaction knob the set goes plump and no signals can be heard. I know it ought to come in smoothly, but I cannot get it. I think the coil has too much reaction on it, and I should like to take some of it off. How many turns would you advise me to start with?"—(T. V. C., Salford, Lancs).

We would not advise you to tamper with the coil at all. If you examine the circuit carefully you will probably find that the erratic reaction is not due to the reaction winding on the coil but is due to too great a voltage on the detector valve, or too large a reaction condenser. Try, first of all, reducing the H.T. voltage. If the receiver employs a decoupling resistance in the anode of the detector valve you can increase the value of this. If you have a spare reaction condenser of smaller value try the effect of using that. The coil should not be touched unless everything else fails to remedy the trouble, and we think you will find that it is due to the H.T. voltage. We presume that the normal values of grid leak and condenser are employed.

DATA SHEET No. 54

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

THE MORSE CODE.

LETTERS.

a	·—	n	—·
ä	·—·— (German)	o	———
á	··—·— (Spanish and Scandinavian)	ñ	——·—— (Spanish)
å	·——·—	ö	———· (German)
b	—···	p	·——·
c	—·—·	q	——·—
ch	————	r	·—·
d	—··	s	···
e	·	t	—
é	··—·· (French)	u	··—
f	··—·	ü	··—— (German)
g	——·	v	···—
h	····	w	·——
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j	·———	y	—·——
k	—·—	z	——··
l	·—··		

FIGURES.

1	·————	6	—····
2	··———	7	——···
3	···——	8	———··
4	····—	9	————·
5	·····	0	—————

INDOOR AERIAL

"I have read in the B.B.C. book that the indoor aerial should be arranged at least one foot from all walls, floors, ceilings, etc. Furthermore, I believe you have given these instructions in your pages at some time or another. You also advertise and recommend readers to use more than one type of indoor aerial which is made to stick on the wall or rest in the picture rail. I should like to know how you reconcile these two facts."—(A. L. W. P., Kingsbury).

On the face of it these are contradictory facts, but there are other factors which are taken into consideration. First of all, a really efficient indoor aerial, when it is intended to use a crystal receiver or some other type of low-powered set, should be arranged so that every possibility of loss is removed. In other words, it is necessary to ensure that every bit of energy possible is conveyed to the receiver for detection. This is what is meant when you are advised to use good quality wire supported on good insulators at least one foot from the walls, etc. On the other hand, the majority of homes to-day employ fairly high-powered receivers, or at least, one-valve sets. In these cases, the amplification provided by the receiver offsets the slight losses entailed by using a special metallic aerial close to the wall. The crystal receivers also are generally only used when the local station is situated fairly close, and therefore there is not the necessity to rely on a very good pick-up and almost any piece of wire may be slung up in a haphazard manner to receive the transmission.

LOUD-SPEAKER DEFECT

"I am troubled by a peculiar dizzy sound from my loud-speaker. On loud passages it seems to give a noise somewhat between a buzz and a whistle, a sound which is rather difficult to describe. Whilst I was looking at the speaker in order to try and find the cause of the trouble I noticed a small spark when the noise appeared. I wonder if you can suggest the reason for this, and also the cure?"—(P. R. M., Poldhu).

You do not state what type of speaker is in use, nor the type of set, but we would imagine that the speaker is a moving coil fed direct from the D.C. mains, and that the receiver also is fed from the same source. The speech coil has become loose or out of centre and is shorting against the pole piece, with the result that a partial short of the mains is being effected. If, however, ordinary apparatus is in use we should be glad to know in order that we may offer some alternative suggestion. In giving this additional information, let us know the make of the speaker, method of connection to the receiver, type of output valve, etc.

ADDING A.V.C.

"I have a powerful commercial receiver which uses two variable-mu H.F. stages and two L.F. stages. I get practically every station in Europe and the volume on most is terrific. I find, however, that when trying for some weak stations, with the volume full on, I suddenly come to one of the English or high-powered Continentals and the speaker gives a tremendous bang and I am afraid of damaging it. I think I could fit A.V.C. to this set to avoid this trouble, but am not quite certain of the connections. Could you give me the best method of fitting up the A.V.C. to this set."—(Y. A. L., Kilburn).

It would certainly be worth while to fit some form of automatic volume control to the set, and we do not think you could do better than purchase one of the new A.V.C. units which are now on the market. The Varley component is inserted in place of the H.F. choke at present in the anode circuit of the detector valve, and the Wearite is connected in a similar position, but the present choke is left in position. The instructions supplied with the components will enable you to connect the unit correctly.

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This coupon is available until Oct. 14th, 1933, and must be attached to all letters containing queries.
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LET us take your old Set or Components in **PART EXCHANGE** for New Season's Radio—**NEW KITS, NEW ACCESSORIES,** or **PART KITS**—in fact any **RADIO APPARATUS.** Best quotations and fullest allowance given. **Balance payable by Cash or H.P.** Send us your enquiry for quotation by return, stating apparatus you wish to dispose of and **NEW KIT, SETS** or **MISCELLANEOUS COMPONENTS REQUIRED. WE GIVE YOU MORE.**

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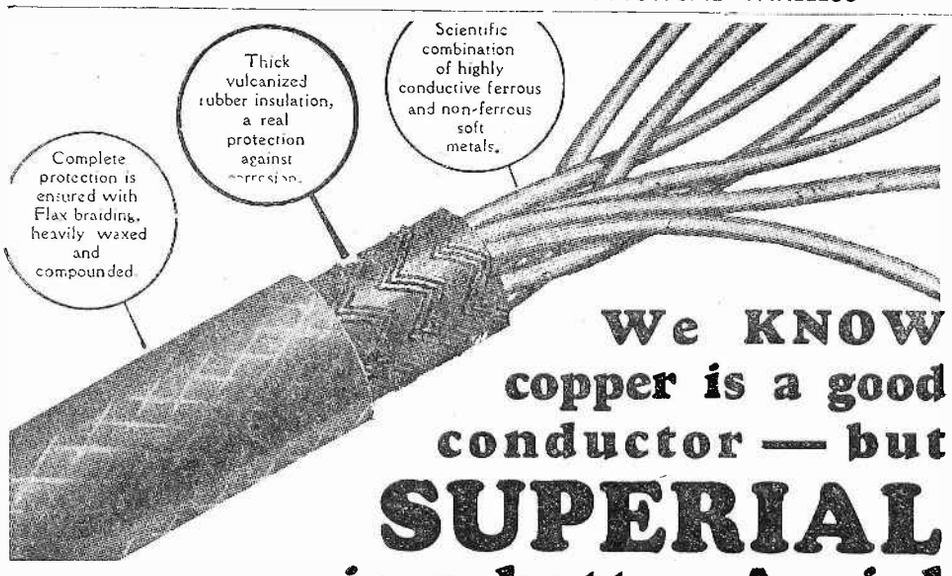

We KNOW copper is a good conductor — but SUPERIAL is a better Aerial

LOOK AT THIS POOR IMITATION

A piece of ordinary covered Aerial. The cheap cotton "covering" is not true insulation, neither is it a protection against corrosion or lightning. It quickly perishes on exposure, becomes unravelled and serves no useful purpose. Do not confuse it with vulcanized rubber insulation, which is a perfect protection.

Copper is a good conductor, but by itself, it is not the best aerial.

SUPERIAL takes advantage of the fact that the incoming signals travel along the skin or surface of the wire strands and not **through** them, and by utilising the conductive value of copper and combining it with other ferrous and non-ferrous metals of highly conductive value adds enormously to volume and selectivity.

SUPERIAL is the only truly **insulated** aerial. Do not confuse Insulation with "covering." Cotton "covering" cannot protect the aerial from corrosion or exposure after it has been in use for a short period. The thick vulcanized rubber insulation of SUPERIAL is a **perfect** and **permanent** protection. A further safeguard is the tough woven flax outer covering—heavily braided and finally compounded and waxed to resist every condition of weather—**hot or cold, all the year round for many years to come.**

TRY IT at our Expense and then you will know why it is so efficient.

£500 FREE LIGHTNING INSURANCE FOR 2 YEARS

BEWARE OF IMITATIONS
LOOK AT THE NAME AND THE BOX

THE AERIAL WHICH MADE BROADCASTING POPULAR
SUPERIAL
ELECTRON'S SUPER-AERIAL

100 FT. 3/6 75 FT. 2/6 50 FT. 1/9 25 FT. 1/-

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THE MULTITONE GUIDE TO CLASS B

A USEFUL handbook dealing with Class B amplification has just been published by the Multitone Electric Co., Ltd. The book is in two parts, dealing with theory and practice respectively, and these in turn cover such subjects as Class B transmission, Economy, Driver Transformers, Ensuring Good Quality and Stability, Concerning Sources of H.T. Current, Class B Circuit Design, and L.S. matching. Readers interested in the subject are advised to write for a copy of this handy booklet. The address is 95-98, White Lion Street, London, N.1.

WESTINGHOUSE METAL RECTIFIERS

WE have received a copy of a handbook, entitled "The All-Metal Way, 1934," which deals with the construction of H.T. battery eliminators and battery chargers embodying Westinghouse Metal Rectifiers. The book, which is primarily of interest to home constructors who prefer to build their own apparatus, deals fully with rectification, battery eliminator problems, mains conversion, and battery charging. There is also a section devoted to Westectors and their uses in various circuits. The book is well illustrated with diagrams which should be very useful to the home constructor. Copies of the handbook can be obtained for 3d. each, post free, from The Westinghouse Brake and Saxby Signal Company, 82, York Road, King's Cross, N.1.

MULLARD LOOSE-LEAF CATALOGUE

FOUR new perforated leaflets have just come to hand from the Mullard people for inclusion in their loose-leaf catalogue.

Leaflet No. V.R. 139, giving details of the new Mullard multi-mu screened pentode valve, type V.P.4, and *Leaflet No. V.R.* 138, describing a screened pentode valve, type S.P.4, should be inserted immediately before Leaflet No. V.R. 78/1A, describing valve type S.4.V.

Leaflet No. V.R. 136, giving particulars of the Mullard indirectly-heated screened-grid valve, type S.G.20, should be inserted immediately before Leaflet No. V.R. 137, describing valve type H.L.20.

The reduced price sheet should be inserted before the sheet already in the front of the catalogue, retaining the one that already appears.

TUNGSRAM BARIUM VALVES

A NEW departure in the construction of indirectly heated D.C. valves has been evolved by the Tungsram laboratories, which has resulted in a comprehensive range of these valves enabling the constructor to build almost any type of D.C. mains receiver. These valves will be found to be very economical in use, consuming a low filament current of 0.18 amps, or 40 watts on a 220-volt supply. In a folder we have received from Tungsram Electric Lamp Works (Great Britain), Ltd., 72, Oxford Street, London, W.1, full particulars and prices of the complete range of Tungsram valves are given. There is a valve for every purpose, and in the tables of characteristics for the power and output valves the output in milliwatts is given and also the anode conductance. The inclusion of these extra data will be helpful to the experimenter.

Replies to Broadcast Queries.

MAC (Muswell Hill): We can trace the following call-signs: (1) G6KA, Keith F. Hardie, 66, Ulverston Road, Walthamstow, E.17; (2) G6IIG, Portable call of G2RV, S. Higson, "Hebblecroft," Egremont Promenade, Wallasey, Cheshire; (4) G6KZ, W. McKenzie, 183, Great Junction Street, Leith, Edinburgh; (5) G6HB, G. M. Horn, 1, Hilton Avenue, Urmston, Manchester; (6) G6DU, J. McOmish, "Curracheen," Perth Road, Crieff, Perthshire; (7) G6LL, J. W. Mathews, 178, Evering Road, Clapton, London, E.5: (9) G6AA-G6AB, Durham and Northumberland Collieries Fire and Rescue Brigade, 854, Scotswood Road, Newcastle-on-Tyne; (11) G6QX, R. Jardine, "Remiencourt," Ardleigh Green Road, Hornchurch, Essex; (12) G5XL, H. P. Townhill, 27, North Parade, Lincoln; (13) G5RR, Portable call of G2WJ, R. L. Royle, "Cholmeleys," Beech Hill, Hadley, Barnet, Herts; (17) PAOEC, A. S. M. Rottier, Hoofdstraat 3, St. Jansstcen, Z.VI, Holland; (19) F8CA, Audureau, 29, Rue de Bretagne, Laval, Mayenne (France); (21) *F8VL* (P?) Caradec, 177, Rue Croix Nivert, Paris (XVe); (23) F8GG, Lerambert, 70, Rue Barrault, Paris (13e); (24) F8YQ, Le Joliff, Plabennec (Finisterre), France; (25) ON4FE, I. van Hool, 23, Avenue Secrétaire Meyer, Merxem, Antwerp (Belgium); (28) F8VH, Perrin, 13, Avenue des Tempiers, Epinal (Vosges) France; (29) F8SK, Dort, 1, Rue Delf, Bordeaux (Gironde), France.

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USUAL PRICE—TWOPENCE — NOW ON SALE

Geo. Newnes, Ltd.

Superhet Efficiency by Merely Changing Coils

MICRION

THE ONLY DUST IRON COIL With Adjustable Inductance

SUPERHET PERFORMANCE FOR

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STAND 65 MANCHESTER EXHIBITION

List No. B.Y 36. Actual size 2¾ ins. diameter, 3ins. high.

IMPEDANCE TUNING IS AN ENTIRELY NEW SYSTEM

which makes the advent of the "MICRION" Coil a milestone in the progress of radio development: it is the outstanding achievement of 1933/34.

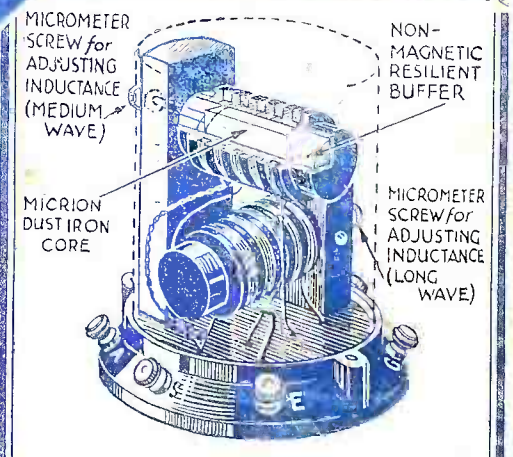
By substituting the "MICRION" Coil (or coils) for existing coils, your old set may be brought right up to date and given an almost unbelievable increase in selectivity and range.

PARTICULARLY DOES THIS APPLY TO CONSTRUCTORS WHO HAVE BUILT SETS WITH THE POPULAR DUAL-RANGE COIL

which although in its day giving truly remarkable results, is now superseded by the "MICRION" Coil, that is designed for modern broadcasting conditions which now render older coils obsolete.

The "MICRION" Coil replaces all existing coils without alteration of the circuit, and thus renders old sets modern without costly and difficult alteration to the circuit and calibration.

The point to remember is that this coil is being used by R.I. in all their mains and "Class B" sets. It is the secret of the success of the 1933-34 "Madrigal" Receivers, which have already won such unstinted praise from the Wireless Press throughout this country.



SEE HOW 'MICRION' ADJUSTABLE INDUCTANCE FUNCTIONS.

'MICRION' points of Superiority

1. "MICRION" is the only dust iron cored coil with a micrometer adjustment on both medium and long waves.
2. It can be used in any existing set without alteration of dial calibration.
3. It is the only coil of its type that gives such striking improvement of range and selectivity without demanding difficult structural alterations to the set.

ASK YOUR DEALER FOR FOLDER

The Advertisement of Radio Instruments Ltd., Croydon, Surrey. 'Phone: Thornton Heath 3211

P. W. Gift Stamp No. 54

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

THE MOST PROGRESSIVE CONSTRUCTORS' WEEKLY

Practical Wireless

3D.

Published every Wednesday by
GEORGE NEWNES LTD.
Vol. 3.——No. 56.
OCTOBER 14th, 1933.
Registered at the G.P.O. as a Newspaper

EDITED BY F. J. CAMM.

Building the ALL-WAVE UNIPEN

This Week's Special Features:

- MAKING INTERMEDIATE FREQUENCY TRANSFORMERS.
- THE LUXUS A.C. SUPERHET
- YOUR SET'S POWER SUPPLY
- THE VISOR-TELEDRUM
- SPECIAL BEGINNER'S SUPPLEMENT
- THE SUPERHET REALLY EXPLAINED
- CLASS B PROBLEMS CLARIFIED
- SCREEN-GRID DETECTORS ON THE SHORT WAVES
- MANY CONSTRUCTIONAL FEATURES, Etc.

RECEPTRU
FOR TRUE RECEPTION

—the wonderful new low loss lead in cable definitely eliminates crackle, background noises, mush and all man-made static. It improves selectivity and increases sensitivity. Get one to-day. You can fix it in less than five minutes.

OF ALL DEALERS *in lengths of 15 feet* 10/-
Longer sizes at proportionate prices.
BRITISH RADIOPHONE LTD., ALDWYCH HOUSE, LONDON, W.C.2

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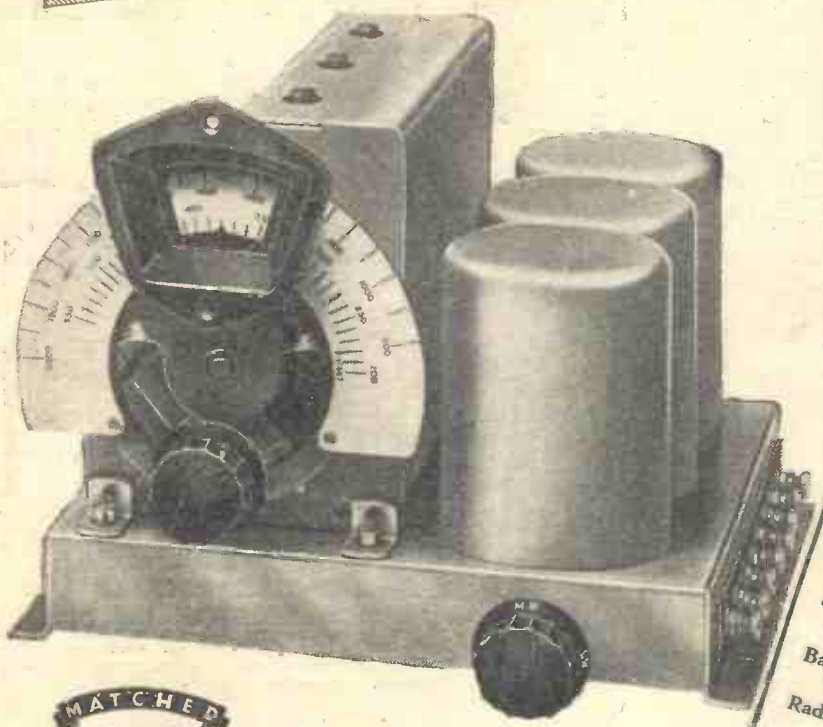
RADIOPHONE
MATCHED PERFECTION

CHOSEN BY THE Leading Designers



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The Superhet Radiopak specified for the "LUXUS A.C. Super FOUR" is a precision unit of the highest quality. Its selectivity is decidedly in the "super" class, accuracy being assured to within ½ of 1 per cent. You have only to balance out the stray capacities with the aid of the trimmers conveniently provided at the top of the unit to ensure permanent "matched perfection."

SPECIFIED EXCLUSIVELY for the "Practical Wireless" "LUXUS A.C. SUPER FOUR"

Band Pass Super-Het Radiopak Type 535B/½ meg 110 K.C. Price 75/-

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BRITISH RADIOPHONE LTD.

ALDWYCH HOUSE, LONDON, W.C.2 TELEPHONE: HOLBORN 6744

Purveyors of Electric Lamps By Appointment

Manufacturers and Purveyors of Electric Lamps By Appointment

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The name that means EXCELLENCE

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EDISWAN H.T. BATTERIES

1 *A brass cap tightly affixed to the carbon rod forms the positive connection.*

2 *The cell is sealed by means of a waxed washer over which paraffin wax is poured. This washer assists in centralising the sac in the cell.*

3 *An air space is left between the top of the sac and the washer to allow for the expansion of the electrolyte during discharge.*

4 *A substantial zinc container which forms the negative pole of the cell.*

5 *The sac consists of a highly efficient depolariser, tightly compressed round the carbon rod, the whole being securely wrapped and tied.*

6 *Electrolytic paste of a special chemical composition which fills the space between sac and zinc container and activates the cell.*

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You can get Ediswan Batteries in all standard sizes including portable types—Standard or Super Capacity—at the usual prices.

THE EDISON SWAN ELECTRIC CO. LTD.
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EDISWAN-the Better Service Batteries

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SOLDERED CONTACTS FOR BETTER RADIO

Soldered contacts give the best results.

Do your Soldering electrically.

ELECTRIC SOLDERING IS

SPEEDY. Switch on—ready in four minutes
CLEAN. No flame—hence no dirt
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ELECTRIC SOLDERING IRON

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Obtainable from Leading Stores, Radio Dealers, Electricians, Ironmongers, etc.

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AN INTERESTING GIFT

B.A.T. Best After Test

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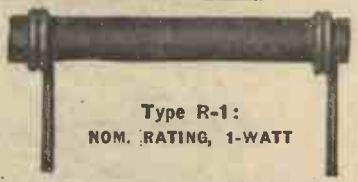

Type R-1:
NOM. RATING, 1-WATT

To prove the superiority of our "B.A.T." (Best—After—Test) **BRITISH-MADE FIXED RESISTANCES** (½, ¾, 1, 2, 3, and 5-WATTS) we will send Free and Post-Free to applicants mentioning this Journal, our **2-Colour Art Booklet, 2nd ENLARGED EDITION, 16pp., entitled :**

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A Complete Treatise, with Circuits, Simple Formulæ, Voltage-Dropping and Current-Carrying Charts, "ABAC," worked examples, etc. It tells you all you ought to know about the "mysteries" of Volts, Amps, Resistance Values and Watts-Dissipation as applied to the use of Resistors for Radio purposes. The edition is limited.

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Thirteen Lyons' "B.A.T." (Best—After—Test) Precision Fixed Resistances, Type R-1, 1-Watt, viz. :
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The All-Wave 'Unipen'

The ORMOND N°6 Slow Motion CONDENSER

Actual Size

Like all Ormond products, this condenser wins the approval of expert and amateur alike—the former for its incomparable performance, the latter for the fine value it represents.

The construction is of brass, and is very robust, the whole being a fine precision instrument. A slow-motion device, ratio approximately 9 to 1, is incorporated in the condenser and is controlled by the upper small knob, direct drive being obtained on the dial which is engraved 0 to 180 degrees.

"One-Hole" fixing. Complete with 2½" dial and slow-motion knob.

Cat. No. R/486. Capacity .0005. Price 6/6

Also available in capacities .00025 and .00035. Price 6/6

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POLAR CONDENSERS *for* SOUND DESIGN

Standardised by the leading set manufacturers and specified by the Technical Press because of
(*a*) Accurate Design;
(*b*) Robust Construction;
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Make certain that your set incorporates condensers which are manufactured by Specialists of *eleven* years' experience.

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WINGROVE & ROGERS, Ltd.,
188/189, Strand, London, W.C.2.
Works: Old Swan, Liverpool.
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The POLAR No. 2 S.M.

The well-known fast and slow motion condenser. Ball-bearing spindle. Rigid construction.

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POLAR TYPE 'C' S.W. CONDENSERS

Fast and slow motion. Double spacing. Silent in use. Fitted with Phosphor Bronze Balls.

.00025	.. ..	9/6
.00015	.. ..	8/6
.0001	.. ..	8/3

The POLAR DIFFERENTIAL

The condenser with an *insulated spindle*. Constructed with highest quality materials. Smooth action. Complete with Knob.

.0003, .00015, .0001 (each side) .. 3/-

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COLVERN FERROCART COILS

Made under licence from the patentee, Hans Vogt.

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SPECIAL G Type GANGED COILS

Complete with gramophone and wave change switch

Two Gang	.. ..	25/-
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Four Gang	.. ..	50/-

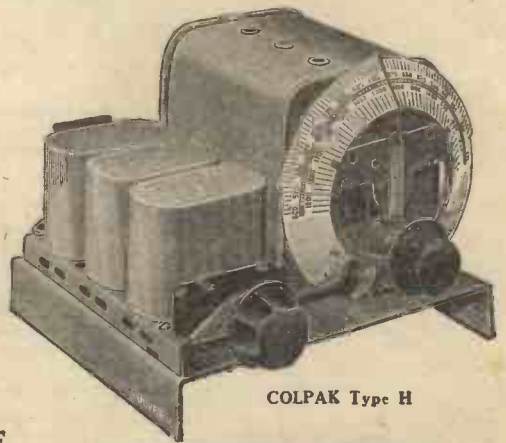
On and off Switch if required 1/6 extra. State if required for battery or mains receivers.

COLPAK Type H

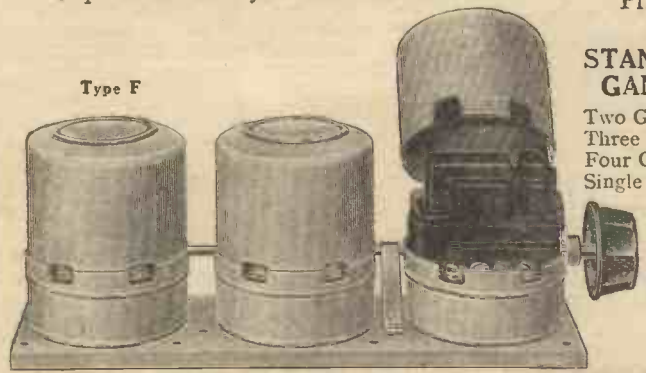
Comprising Ferrocart G type Coils, Tuning Condenser, Gramophone and on and off Switch (state if required for battery or mains receivers).

Coils can be supplied for 1 SGHF stage receivers with Band Pass filter or Band Pass filter and Oscillator Coil for Superheterodyne receivers.

Price 57/6



COLPAK Type H



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STANDARD Type F GANGED COILS

Two Gang	..	25/-
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Type F C 110 } 12/6 each
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With universal mounting bracket, limited capacity adjustment and band pass coupling controlled externally.

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NO OTHER KIT IN ALL THE WORLD CAN GIVE YOU

ENGLAND-EUROPE-AMERICA-AUSTRALIA

as this new All-wave "Skyscraper" does!

COMPLETE WITH FOUR VALVES £5·12·6

WORLD-WIDE NEWS AND ENTERTAINMENT for Home Constructors ONLY!

At last the day of All-World Radio has arrived, and you can build with your own hands the first receiver to give you not only England and Europe, but America and Australia direct. The Lissen All-Wave All-World "Skyscraper" 4 tunes from 12 to 2,100 metres. It brings two complete new wavelength ranges within reach of the ordinary listener—stations and programmes which before he was never able to receive—Ultra Short and Short-Wave transmissions from the ends of the earth. And remember you get these stations through Double-Balanced Pentode Output giving brilliant reproduction on a Moving-Coil Speaker—as much power as a Mains Set from ordinary high-tension batteries.

Lissen have made this All-Wave All-World Radio available to Home Constructors first, because it brings back the thrill of conquest to hear America and Australia *direct* on a set you have built yourself, it makes you an enthusiast to realise what a wonderful thing you have created!

When you see the Great Free Chart of the All-Wave All-World "Skyscraper" 4, which tells you how to build it and how to work it and why it gives such marvellous results, you will agree at once that it will be wise of you to build for yourself rather than buy a factory-assembled receiver which cannot give you these new and intriguing short-wave stations. The FREE CHART simplifies everything; there are pictures of every part, with every wire numbered, every hole lettered, every terminal identified. YOU CAN'T GO WRONG! But get the Chart and see for yourself—then build the Lissen All-Wave All-World "Skyscraper" 4, the SET THAT SPANS THE WORLD!

WITH WALNUT CABINET and MOVING COIL LOUDSPEAKER £8·2·6

The Thrill of Distance - the Satisfaction of Pioneer Achievement The Certainty of Success!

DOUBLE BALANCED PENTODE OUTPUT AND MOVING COIL SPEAKER!

GREAT LISSEN CHART MAKES EVEN THE ULTRA SHORT WAVES SIMPLE!

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Please send me FREE copy of All-Wave All-World "Skyscraper" Chart.
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LISSEN ALL-WAVE ALL-WORLD 4 "SKYSCRAPER"

THE LEADING AND MOST PROGRESSIVE RADIO WEEKLY

ROUND *the* WORLD *of* WIRELESS

Your Radio Tool Kit

IF you have not yet reserved your Radio Tool Kit, every tool of which has been specially designed by the Editor of PRACTICAL WIRELESS, and cannot be obtained in any other way, you should do so at once. You should bear in mind that the tools are high-class instruments which in the ordinary course would cost you at least 12s. 6d. Make up your mind to possess this handy case of instruments, which is a worthy companion to the Home Constructor's Encyclopædia. Don't use tools designed for schoolboys by schoolboys — and usually recommended only by them! Every reader of PRACTICAL WIRELESS knows good tools when he sees them—see page 187!

First All-Wave Set—The Facts

IT has recently been claimed that the first all-wave set to be offered to the home constructor by a wireless journal was described at the end of January, 1933. To this we would reply by pointing out that an all-wave set of excellent performance was described some months previous to the above date. Actually, an all-wave two-valve receiver, called the "Four Range Super-Mag Two," was fully described in the precursor of PRACTICAL WIRELESS, namely, in "The Practical Wireless Supplement," dated October 22nd, 1932. This was, to the best of our knowledge, the very first all-wave set to be offered to the home constructor.

Following our policy of BEING FIRST, we also published a constructional article dealing with the FIRST all-wave set *to use iron core tuning coils*; this was in PRACTICAL WIRELESS dated August 19th, 1933.

To the above remarks we need add no comment!

A New Departure of Interest to Every Reader Next Week!

CONTINUING our policy of being *original* (and most worth-while innovations owe their inception to us) next week we are starting a series of articles entitled "The Progressive Experimenter." This series will mark a new departure in wireless construction since they will describe in detail the construction, so that you study design (as you build) of an eminently modern battery receiver, which can be built up in easy stages. We shall commence by describing the construction of an ultra simple two-valve set, and in later articles it will be explained how additions and modifications can gradually be made until a de-luxe four-valver is eventually completed. At every stage of the constructional work numerous experiments will be described which can be carried out by those who build the instrument. This novel scheme will provide every reader with a ready and most inexpensive means of gaining a thorough knowledge of all branches of wireless in a most interesting manner.

One of the chief features of the idea is that at every stage of the experiments the constructor will be in the possession of a complete receiving outfit. Another important point is that not a single component will be discarded from beginning to end of the "course."

This series has been very carefully and specially prepared by Mr. Frank Preston, and will represent an entirely new departure in radio journalism. PRACTICAL WIRELESS ALWAYS LEADS, and we are sure that this new series will appeal very strongly to our readers. No enthusiastic wireless amateur or experimenter can afford to miss "The Progressive Experimenter."

SERVICE.

This paper, which is world renowned for the originality of its policy and ideas, and the energy and enthusiasm with which it caters for the home constructor, has become the accepted standard by which others are judged.

Every worth-while development is first brought to the notice of home constructors through the pages of PRACTICAL WIRELESS. We do not deal with new developments until such are available to the public.

We specify only those parts used by our designers; our specifications may therefore be absolutely relied upon.

We guarantee every receiver described in our pages to perform in the manner claimed, and take an interest in every receiver built from our descriptions.

Our staff are all *experienced and enthusiastic* men with wide experience in every branch of radio.

PRACTICAL WIRELESS was the first journal to collect the available knowledge into one volume—the Wireless Constructor's Encyclopaedia—and to supply it for a purely nominal sum to regular readers.

Our additional new laboratory, made necessary by the continued expansion of our circulation and hence of our readers' requirements, is now in full operation.

Forthcoming events in PRACTICAL WIRELESS will prove of the greatest possible interest to home constructors. We have many original and far-reaching ideas to place before our readers.

Our Pocket Tool Kit—specially designed for those who take a pride in building sets correctly—is further evidence of our service to readers.

PRACTICAL WIRELESS is the LEADING CONSTRUCTORS' Weekly, which Leads and Shows the Way, and sets the Standard, Style and Pace!

Mexico Copies Lucerne

THE Conference held by delegates from the United States, Canada, Mexico, and Cuba at Mexico City, with a view to an agreement in regard to the allotment of wavelengths to their respective broadcasting stations, has been adjourned *sine die*. The results have been far from satisfactory and agreement has only been reached on minor points. According to a report, the Conference failed owing to a demand made by Mexico for the allocation of six of the ninety-six channels available to broadcasting transmitters on the United States border. Most of these studios have been banned by the Federal Radio Commission as they make a speciality of publicity in the English language for makers of quack remedies and fortune-telling "sharks."

Monte Ceneri Again on the Air

FOLLOWING an overhaul of the transmitter, entailing the suspension of broadcasts and tests on various wavelengths, the Swiss Lugano station is again transmitting programmes on 1,145 metres. Considering the exceptionally mountainous character of the country, Switzerland considers that a long wave channel is a necessity and it is hardly likely that the authorities will abandon this channel without a struggle. Listeners are apt to believe that the broadcasts heard emanate from Italy as the Italian language is used, but it must be borne in mind that Switzerland possesses a population speaking, according to district, three different tongues, namely, French, German, and Italian. In consequence, they are served by three different high-power stations.

Closing Down of Eiffel Tower

ALTHOUGH it had been originally planned by the French Posts and Telegraphs to take over the Eiffel Tower

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

broadcasting station, it has now been decided to close down its entertainment broadcasts on January 1, 1934. It will be retained by the military authorities for official work only.

To Replace Witzleben

THE 100-kilowatt Berlin station, which is being erected on the old artillery ranges near the German capital, is now nearing completion. It will be testing towards the middle of November. It is hoped to have it ready for the regular daily broadcast programmes in time for Christmas.

Winter Time

WITH the return from British Summer Time to Greenwich Mean Time (winter time), we must remember the differences which exist between our clock readings and those used on the Continent. Most of the European countries, such as Germany, Scandinavia, Italy, Austria, Switzerland, and so on, which adopt Central European Time (coinciding with B.S.T.), do not make any summer alteration, and consequently are now one hour *ahead* of us. Eastern European time, which covers part of Russia (Leningrad, etc.), Estonia, Latvia, Finland, Bulgaria, Romania, and Turkey, represents two hours advance on G.M.T. Moscow, further east, spells another hour, so the midnight chimes must be tuned in at 9 p.m. G.M.T. Spain, Portugal, Algeria, and Morocco make no alteration and adopt G.M.T. throughout the year. Holland will still be twenty minutes in front of us and Reykjavik (Iceland) one hour behind. This change over, as the days grow shorter, must also be borne in mind by short-wave listeners in their search for transatlantic broadcasts.

Radio Tananarivo

THE Madagascar Posts and Telegraphs have increased the power of the FIU2 (Tananarivo) transmitter to 500 watts and regular broadcasts are now made daily on 52.7 metres (5,693 k/cs). The best time to search for this station is between G.M.T. 18.00—19.00; Madagascar local time being three hours ahead of G.M.T. As it is a French colony, the concerts close down by the playing of the *Marseillaise*. Signals from this station—a matter of 5,780 miles distant from London—have been picked up by amateurs in Northern France.

Wanted, One Radio Pirate!

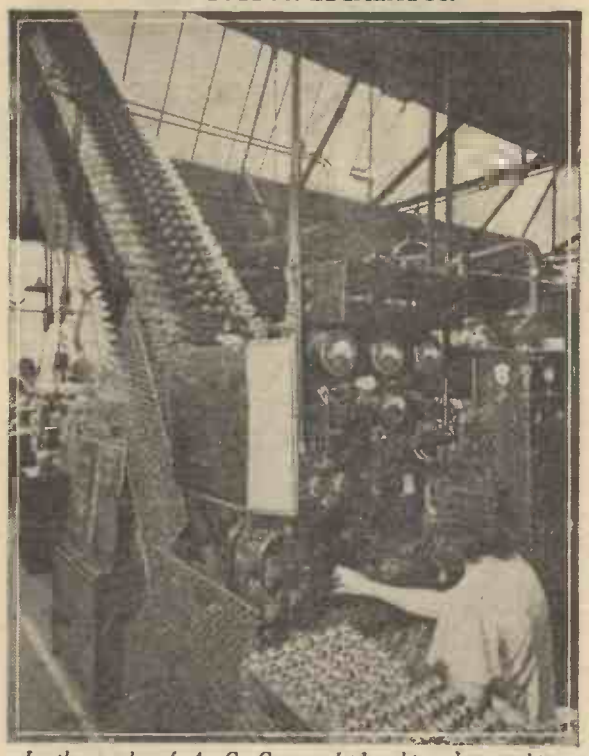
THE small Brussels (Schaerbeek) broadcasting station, having complained to the authorities that an illicit transmitter has marred the reception of its broadcasts, a reward of one thousand Belgian francs has been offered to trace the identity of the culprit.

Soviet Broadcasts Verboten

IN Frankfurt-am-Main (Germany) listeners have been warned that if they tune in the Moscow or Leningrad transmissions to hear anti-Nazi propaganda, they will be deemed to have attended Communist meetings. The penalty for this infraction of the law is no less than immediate arrest and internment in a prison camp. In addition, wireless receivers are confiscated.

INTERESTING and TOPICAL PARAGRAPHS

THE COSSOR ESCALATOR



In the works of A. C. Cossor, Ltd., this robot machine "getters" the valves and then runs them with anode and grid voltage to stabilize the characteristics before testing.

Hilversum and Huizen

ACCORDING to their usual practice, these two studios have made their quarterly exchange of transmitters. The Hilversum programmes are now heard on 296.1 metres, and those from Huizen through the more powerful 50 kilowatt Kootwijk station operating on 1,875 metres.

A Police Radio System

AS in other countries, the authorities in Great Britain are considering the establishment of a police radio system throughout the land. The scheme comprises a number of wireless transmitters installed in important centres and by which communication could be secured with all members of the mobile police. There already exists an International Police network which includes the larger European capitals, such as London, Paris, Berlin, and Vienna. In the United States most cities and towns of any magnitude already possess special transmitting and receiving apparatus, working on wavelengths between 100 and 200 metres, which enable police headquarters to remain in constant touch not only with their divisional stations but with their special flying squads.

Wireless Telephony for Short Sea Traders

TESTS are being carried out by the London and North Eastern Railway at Parkeston Quay, where the station has been equipped with special wireless telephony apparatus for communication with steamers plying between that port and Holland and Belgium.

Blackmail by Radio

AN Austrian paper reports that the authorities are endeavouring to locate a "pirate" broadcasting station situated somewhere in the neighbourhood of Oradea Mare, a town ceded by Hungary after the War to Romania. So far the transmissions have been directed to notabilities of the district, and threats have been broadcast to disclose scandals affecting their families unless money is sent to certain places stipulated by the announcer. The police have not been able to trace the criminals using these typical gangster methods.

The Transmission of Thought

THE supposition that a man's thoughts are transmitted by electro-magnetic vibrations has induced the Italian Professor Cazzamalli to study the question seriously. He would appear to have established the possibility of recording these radiations, as according to statements published in the Italian Press, he has been able to capture these vibrations through the medium of a specially constructed ultra-short-wave receiver. More detailed information regarding this new discovery will be awaited with interest. If the theory is proved correct, the explanation of thought transference is an easy matter, and records made in this manner would, at times, prove very enlightening.

SOLVE THIS!

Problem No. 56

Brown decided to build the All-Wave Two described in a recent issue of this Journal. He decided that the receiver would be improved by completely screening the parts, using a metal panel and metal cabinet. He therefore mounted the parts on an aluminium panel and fitted the entire receiver into a neat metal cabinet. He found, however, that when the batteries were joined up the fuse blew, and when one of a higher rating was used no reaction could be obtained on either waveband. Signals were also very weak on the normal broadcast band. What had he overlooked? Three books will be awarded for the first three correct solutions opened. Address your envelopes to The Editor, PRACTICAL WIRELESS, Geo. Newnes Ltd., 8-11, Southampton Street, Strand, London, W.C.2. All envelopes should be marked Problem No. 56, and should reach here not later than Oct. 16th.

SOLUTION TO PROBLEM No. 55.

The grid circuit of the L.F. valve was broken due to one terminal of the secondary of the L.F. transformer becoming loose. The terminal was tightened up and the connection made sound again, when the receiver functioned properly once more.

The following three readers succeeded in correctly solving Problem No. 54, and books have been despatched to them:—

R. Stickler, 105, Partridge Road, Llwynypia, Glam., S. Wales.
C. Holt, 11, Pool Street, Bolton, Lancs.
J. C. Malster, 28, Chalfont Green, Edmonton, N.9.

The Superhet

A Simple Explanation of the Superheterodyne Circuit which will Enable even the Beginner to Understand its Apparent Complications. By W. J. DELANEY

WHY has the superhet lost the popularity which it once enjoyed? There are two reasons. Firstly, the use of terms such as frequency changer, intermediate frequency amplifier, separate oscillator, and similar names frightened the non-technical and gave the circuit an apparent air of mysterious complications.

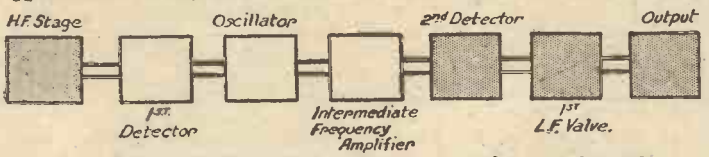


Fig. 1.—Diagrammatic representation of a 7-valve superheterodyne receiving circuit.

It made the ordinary amateur think that the receiving circuit bearing the name superheterodyne was only for the advanced technician, and consequently he did not trouble to examine it. Secondly, many experts openly proclaimed that the quality of the superhet was inferior. Good loud-speaker results could not be obtained, they said. Therefore, the superhet was relegated to the background because manufacturers could not sell the necessary coils, etc., and very few amateurs were interested in it. It spite of this, however, it was definitely employed in many research laboratories, and even by the B.B.C. for certain relay purposes. The improvement in valves and coil design has led to a revival of the circuit, and it can now be quite definitely stated that the quality of a superhet can be equal, even if not better than the majority of ordinary circuits, and it is even simpler to handle than many two-valve sets. This latter feature is due to the fact that a superhet can be "one-knob tuning," and a volume-control is the only other fixture apart from the necessary on-off and wave-change switches. Actually there is nothing out of the ordinary in the circuit, and I propose to show in this article just how the superhet follows standard practice, and how the mysterious terms which are given to its different functions are really no more complicated than the circuit arrangement. I hope that this will lead many to take up the circuit, because it is certainly the circuit of the future, as it is the only one which will give perfect separation to stations working with the allotted wavelength separation.

The Circuit

To commence with I will take a complete superhet circuit, and not one wherein one valve is employed for dual purposes. This will make the working clearer and avoid complicated terms. In Fig. 1 is a diagrammatic representation of a seven-valve superheterodyne, with each separate stage represented by a box. The first point to impress upon the reader is that some of these boxes carry names familiar to you in ordinary receivers, namely H.F. amplifier, detector, L.F. amplifier and output stage. These are exactly the same as are used in any ordinary receiver and consequently need no explaining. They do not differ in the slightest degree, either in construction or the manner in which they function. These stages are shaded in the sketch, and it will be seen that there are only three stages left, and it is these which I will explain. Before going on with the explanation I would like once again to stress that the shaded portions may be taken from any circuit of normal design and would be replaceable in the superheterodyne. Thus, the H.F. stage is employed as an amplifier for very weak or distant signals; the second detector operates on the normal grid leak or anode bend arrangement, and the L.F. stage is used to enable a sufficiently loud signal to be passed to the output stage for the satisfactory operation of the loud-speaker. There is thus left the I.F. stage and the first detector and oscillator. To simplify matters I will take the I.F. stage first.

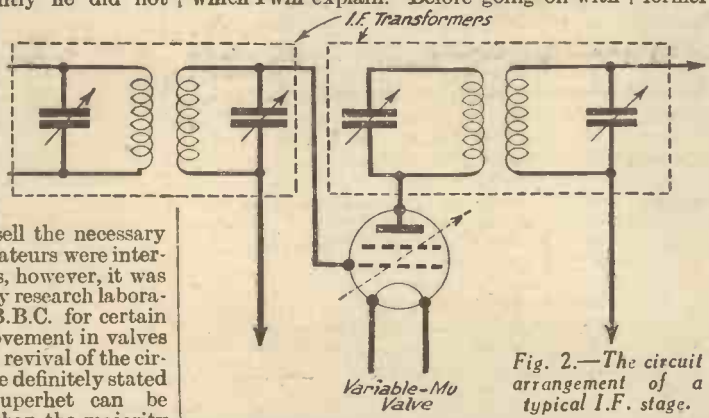


Fig. 2.—The circuit arrangement of a typical I.F. stage.

The Intermediate Frequency Amplifier

Its name should enable its function to be understood, but for the non-technical it may be described simply as a standard H.F. amplifier, the tuned circuits of which are fixed to work at one wavelength only (Fig. 2). There are no tuning condensers to be manipulated, and the H.F. transformer which is included in its grid circuit is designed to work at a wavelength of usually just over 2,000 metres (or 110 to 125 kilocycles). Now, as we wish to receive stations working on all sorts of different wavelengths, how can we use such a fixed amplifier? Obviously, we shall have to make all our stations equivalent to 2,000 metres or so, and this is where the first part of the superhet circuit comes in. To enable us fully to understand the principle it is essential to work in kilocycles (or frequency) in place of the customary wavelengths (in metres), and the reason for this will be seen as we go along. The London Regional station works on a wave-length of 356 metres, which is a frequency of 843 kc/s. Now, as we must turn this to 110 or 125 kc/s to enable our I.F. stage to work on it, we must obviously change the frequency to that figure. This is the function of the first detector and oscillator, and the combination is known as the "frequency changer." I shall deal with this in the next article.

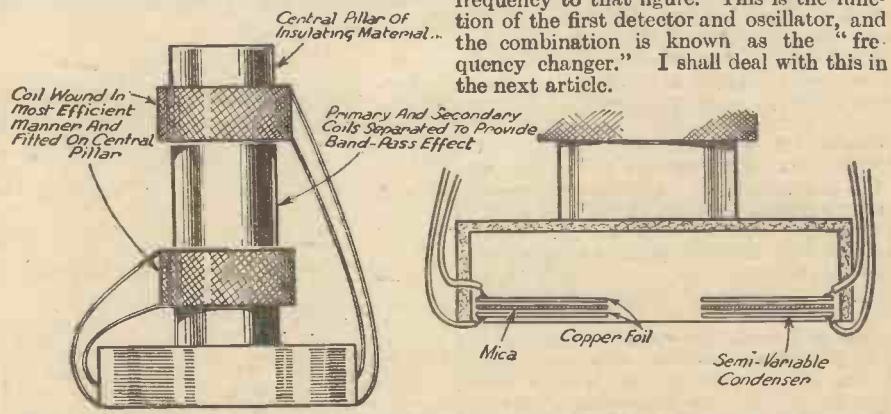


Fig. 3.—How the intermediate frequency transformers are built up. The small semi-variable condensers are adjusted to provide accurate tuning of both primary and secondary. In some cases this is done at the factory, and in others a small adjustment is allowed for.

Making Your Own Intermediate Transformers

In This Article the Author Explains How the Constructor Can Build Efficient Components at Little Cost

By N. A. KAYER

THE keen constructor likes his set to be as far as possible his own work, and experiences pleasure from building up his own components before assembling them to form the complete receiver. One component which is usually regarded as one to be bought ready-made is the intermediate frequency transformer of a superheterodyne receiver, and although when the very best results are required in the way of true band-pass selectivity it pays to use a factory-constructed article, it is quite a simple job to build an I.F. transformer which will give satisfactory results. Since two or more transformers are required in a complete receiver, considerable economy can also be effected by making them at home. The instructions given here show how to make an I.F. transformer for the standard frequency of 110 kc/s, and by making up transformers to this specification, any experimenter who has wanted to try out a superhet circuit, but who has been deterred by the cost of the transformers, can be assured of success.

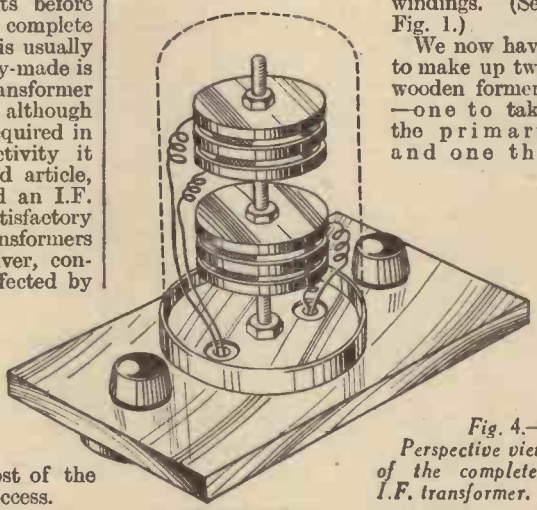


Fig. 4.—Perspective view of the completed I.F. transformer.

Details of Construction

The transformer is shown mounted on a wooden baseboard, and when constructing a receiver it will be found convenient to use one board on which all the transformers can be mounted. A screening box is required; this should preferably be an aluminium or copper can about 4in. high and 2½in. diameter, but an ordinary tin may be used; if this is done, it should be somewhat larger, in order to keep the sides of the tin well away from the transformer windings.

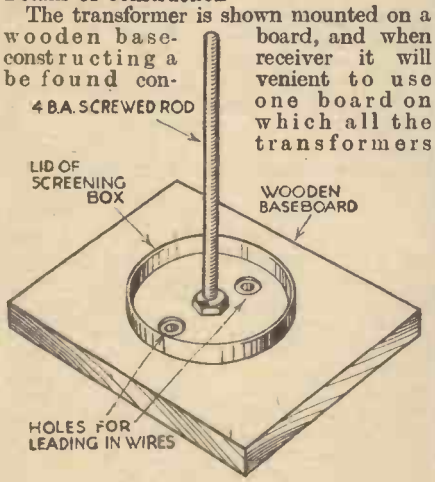


Fig. 1.—Method of attaching lid of screening box to baseboard.

The lid of the screening box should be laid on the baseboard, and three 5/32in. holes drilled right through both, one in the centre of the lid and the others nearer the edge. A piece of 4 B.A. screwed brass rod about 3½in. long is then passed through the central hole and nuts placed above and below, so as to bolt the lid of the screen to the baseboard, leaving the screwed rod projecting above the board. The other holes are for leading wires in to the can from below, for making connection to the windings. (See Fig. 1.)

We now have to make up two wooden formers—one to take the primary and one the secondary winding. Each former is built up from discs cut out from ⅛in. plywood; for the complete transformer, six discs of 1⅝in. diameter and four of 1½in. are needed; a 5/32in. hole has to be drilled exactly through the centre of each, and the discs are then carefully smoothed off on a piece of fine sandpaper, after which they can be assembled and glued together in the manner shown in Fig. 2. To clamp them together in their proper positions while the glue is setting, a 4 B.A. screw should be passed through the central hole, and a nut threaded on it and tightened up.

Winding the Coils

This will give a pair of formers, each consisting of a bobbin provided with two slots ⅛in. wide and ¼in. deep, in which we have to wind the transformer coils. A fine hole should be drilled in one of the outer discs of each bobbin to form an anchorage for the winding; this is also shown in Fig. 2. For winding the coils, gauge 36 enamelled copper wire should be used; having anchored one end of the wire by threading it through the hole just mentioned, leave a short length projecting to which a lead can afterwards be soldered, and proceed to wind 250 turns into the slot—this will nearly fill it; then pass the wire across to the other slot, and, *taking care to continue winding in the same direction*, wind 250 turns into this, finishing off by looping back a turn to prevent the wire springing off. This leaves us with a coil of 500 turns altogether. A layer of insulating tape may be wrapped round the edge of the bobbin to protect the winding. The other bobbin should then be wound in exactly the same manner.

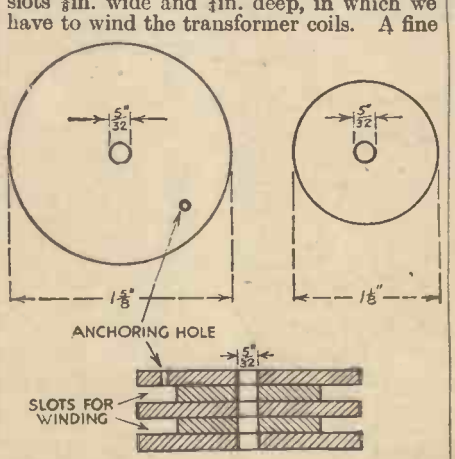


Fig. 2.—Showing wooden discs and method of assembly.

The two bobbins next have to be slipped on to the 4 B.A. rod, and fixed by nuts at a distance of about ⅛in. apart, is indicated by Fig. 3, which shows a section through the completed transformer. It will be seen that two trimmer condensers are mounted on the baseboard; these should be mica dielectric condensers of 0.0005 mfd. capacity, and each is jointed across one of the windings; these connections are clearly shown in Fig. 3; they should be made with flexible wire, since in adjusting the band-pass action and selectivity of a complete receiver, it is necessary to move the two bobbins together or apart, so that stiff wire connections would obviously be unsuitable.

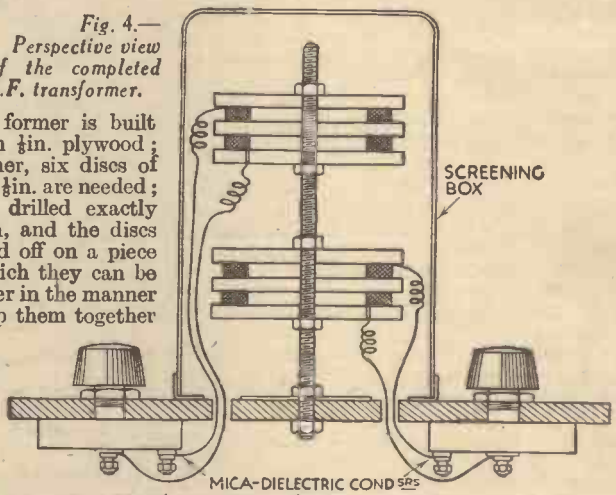


Fig. 3.—Section of complete transformer.

This completes the transformer; in use, the two terminals of one trimmer condenser (it is immaterial which) become the primary terminals, and those of the other condenser the secondary.

50 TESTED WIRELESS CIRCUITS

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OUR REGULAR TELEVISION FEATURE

The VISOR-TELEDRUM

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc., A.M.I.E.E.

I HOPE I may be excused if I parody a well-known phrase by saying that "To look or not to look" is surely one of the vital problems of the present day amongst an ever-growing band of radio enthusiasts.

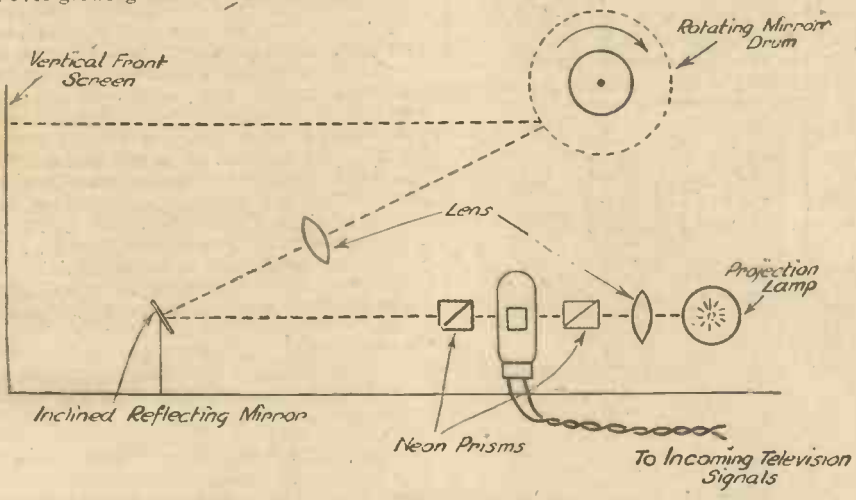

Fig. 2.—The schematic arrangement and light beam path of the Visor-Teledrum.

Television, as a subject, has been very much in the news, and although many of the stories which have got abroad appear to clothe some of the immediate developments in a shroud of mystery, this is really far from being the case.

The Facts

What are the *facts* as we know them to-day? Well, first of all, there is the present television service provided by the B.B.C., using the standard Baird apparatus, the vision signals being broadcast by the London National station on a wavelength of 261 metres, while the accompanying sound emanates from the Midland Regional station on a wavelength of 398 metres. The transmissions are of half an hour's duration, and take place on Monday, Tuesday, Wednesday, and Friday nights, starting at 11 p.m. Now these programmes have a definite entertainment value, and the interested amateur will be amply repaid for any time and money he expends in building apparatus so that he can look in.

If there is any further incentive needed by the reader who cannot quite make up his mind, then here are the other facts. Although the images which can be seen now as a result of the B.B.C. service are extremely good, the *nature* of the entertainment is limited in its scope. This arises primarily from the reason that on the medium waveband European convention restricts the sideband available for any form of radio signal to 9 kilocycles. For sound this is, theoretically, quite satisfactory, but for television signals to conform to this same restriction only thirty scanning lines can be used at the transmitter and the receiver, while the number of pictures per second presented to the eye is kept at twelve and a half. The former limits the amount of detail and scope of scene or subject which can be portrayed on the television receiver screen, while the latter brings about a trace of flicker.

Fig. 4.—A recent photograph of the present form of Baird Grid Cell or Light Valve.

The Ultra-short Waves

Fully cognisant of these facts, the television authorities have been developing both transmitting and receiving apparatus which will give flickerless images (25 pictures per second) complete with a wealth of detail, this last named resulting from the use of 120-line and in many cases 180 or even 240-line scanning. Details of apparatus of this character were furnished in a Tele-Talkie article of mine which appeared in PRACTICAL WIRELESS dated September 30th. The only way in which images of this character can be transmitted is *via* the ultra-short waves, and the B.B.C. are conducting experiments on these very short wavelengths, but *no time schedule of the transmissions or official statement has been published so far concerning this work or the firm or firms involved.*

Completely independent of B.B.C. activities, however, the Baird Company have rented one of the Towers of the Crystal Palace for a period of four years, and work is already well advanced for ultra-short-wave experiments from this ideal situation. I mentioned this in the article referred to above, but I now learn that to start with, the wavelength of 6.05 metres will be used for the transmission of the television signals, and occasionally for sound, while at other times the accompanying sound will be transmitted on 155 metres. When the installation is complete vision signals will be seen on 6.05 metres and the associated sound on 6.20 metres. The important point I am leading up to, however, is that the first television signals should be on the air early in October, and these, to start with, will be of the standard 30-line, vertical scanning 7 by 3 ratio, 12½ pictures per second.

All amateurs possessing ordinary thirty-line television receivers can therefore participate in this wonderful pioneer work provided they have a radio receiver which will tune on the ultra-short waveband and are within the range of the signals. This last-named factor is a very doubtful quantity at the moment, and here the amateur can help by making known whether he can receive and synchronize the television signals on his receiver.

The Visor-Teledrum

First of all, then, the reader will want a *reliable* piece of television apparatus, either of the disc or mirror drum type. I have dealt with the former in my Tele-Talkie series, and this article is to serve the purpose of introducing the mirror drum design, to which I have been devoting a great deal of time recently so as to be sure

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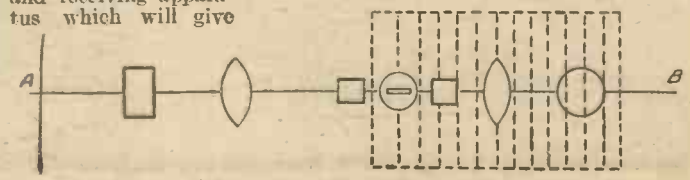

Fig. 3.—A plan view of the apparatus depicted in Fig. 2.

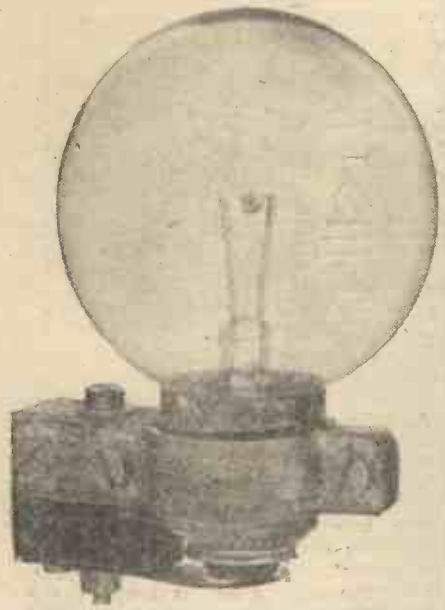

Fig. 5.—The spiral type of 100-watt bunched filament projection lamp used in the Visor-Teledrum.

(*Continued from previous page*)

that readers would have a piece of trouble-free apparatus. In addition, I am now testing out a special ultra-short-wave adaptor, which I can present to readers and thus enable them to be in the van of progress as far as television is concerned. I shall have more to say about this adaptor in an early issue, so let me now deal with the piece of television apparatus which I have called the Visor-Teledrum.

The only complete mirror drum equipment which is on the market is the Baird apparatus shown in Fig. 1. This is the projector which is included in the complete "televisor" marketed by that company, and in consequence is a factory-built job designed for housing in a cabinet top of relatively narrow compass. The optical path and angles between some of the components has therefore had to be made to conform to certain limits, and a jig-drilled baseplate becomes necessary.

Flexible Apparatus

To give the amateur a little more scope, and also to make the apparatus more flexible, I have therefore made the optical side of my machine keep to a prescribed centre line. This will perhaps be made clearer by a reference to Fig. 2, which shows an elevation of the bare essentials which have been included, and to Fig. 3, which is a plan view of the Fig. 2 apparatus.

The "signal analyzer," projection lamp, lenses, reflecting mirror, rotating thirty mirrored drum are all lined up optically to be vertically over A B, while the dotted line in Fig. 2 indicates the path of the mean light ray beam at any one instant of the complete operation.

Now what are the main items which are being included in this new piece of apparatus? First of all, we shall have the "signal analyzer," projection lamp, and one lens mounted as a complete unit, called the Baird Grid Cell unit. Readers will no doubt recall that I dealt at length with light modulation devices for television in PRACTICAL WIRELESS dated September 2nd, so there will be no need to go over the ground again.

An Important Point

In Fig. 4, however, is seen a new photograph of the latest form of the Grid Cell (or light valve) alone, and in Fig. 5 is a view of the special type of bunched filament, 100 watt projection lamp which I am using in conjunction with the unit. These two components, together with the Nicol prism combination, have the important property that when the incoming radio television signals are passed on from the wireless set to the pair of grid cell leads, the steady beam of light from the projection lamp is modulated in such a manner that the resultant light variation is almost proportional to the light scanning analysis which produced the signal originally at the transmitting end with the aid of the photo-electric cells.

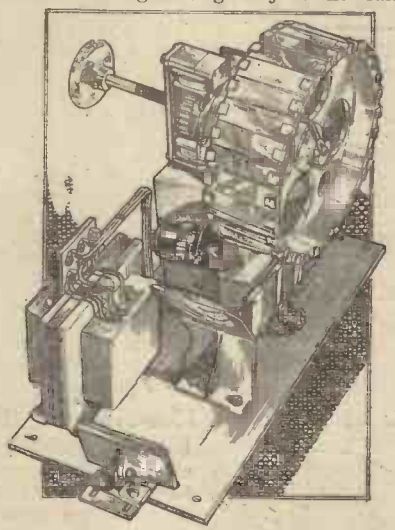

Fig. 1.—The new Baird Televisor. The arrangement of the mirror-drum, the new light valve, the lens, and the synchronizing coils can be seen clearly from this illustration.

Let me here once more emphasize the importance of having a light modulation device which is not an amateur-built-up component. Only specialists can carry out this side of the work efficiently, and although I know of many cases where cells have been made up at home, the results from the brightness and image point of view have been very disappointing, and I am anxious that readers shall not find this the case with the Visor-Teledrum.

Mirror Drum Action

To resume our description of the apparatus, the resultant beam of light, which is now varying in intensity, passes in a straight line to an inclined mirror set at such an angle that the ray is reflected slightly upwards and focused on to the mirrors of the drum. As each mirror picks up the light area thrown on to it, it in turn reflects the beam and makes the resultant small area traverse vertically upwards across a front screen as shown. Each mirror on the drum, instead of being parallel with the axis about which it revolves, has a slight "cant," the angle difference between each successive mirror being of the order of one-sixth of a degree for a thirty-mirrored drum.

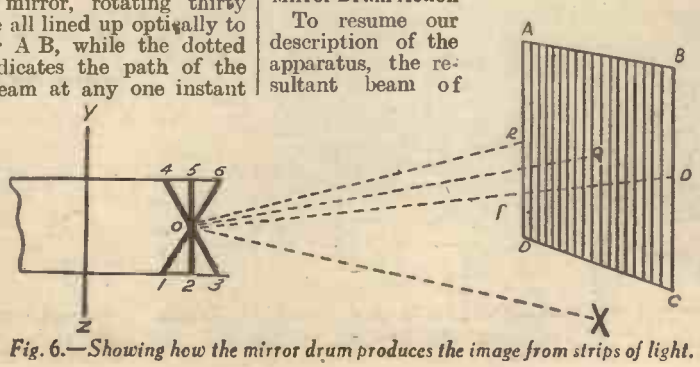

Fig. 6.—Showing how the mirror drum produces the image from strips of light.

This accurate positioning of the mirrors is essential in order to build up the image area in thirty vertical strips of light, each strip being transmitted on the screen to the immediate left of its neighbour. The action is a little difficult to show diagrammatically, but perhaps Fig. 6 will help matters. Imagine a beam of light emanating from the point X and striking the mirror 1, 6, which we will suppose is mounted at the angle shown. The light will be reflected in the path OP, striking a screen ABCD placed in its path, and if the drum is turned slightly we can imagine the light spot travelling upwards and creating the strip of light against the edge CPB. A similar state of affairs exists for mirror 2, 5, which can be parallel to the drum axis YZ, and creates the vertical strip of light through Q as a result of drum movement. Finally, we have the scheme repeated for mirror, 3, 4, giving the strip of light against the edge DRA. Of course, the angles of the mirrors with reference to the drum axis ZY have been exaggerated when compared with the actual apparatus, but this is really how the image area is built up on the vertical front screen shown in Fig. 2.

Correct Speed

Another very important feature with this apparatus is the motor which is driving the drum at its prescribed speed of 750 revolutions per minute. It is of the universal type, that is to say it does not matter whether it is fed from D.C. or A.C. mains. It must be of a type designed to run at constant speed. To assist the motor in maintaining its correct speed, automatic synchronizing gear is included as part of the equipment. When the appropriate coils are fed with signals of the correct strength, the whole apparatus will be maintained in synchronism, and beyond a slight tendency to float occasionally, that is move up or down slightly when certain changes are taking place at the transmitting end, principally during the transition stage from close up images to extended, or vice versa, the image will be steady for the period of use.

Framing and phasing of the image so that it is centrally disposed in the screen is done very simply by moving round a single knob at the side of the instrument. The motor is mounted in special trunnions, and the knob movement revolves the motor in its cradle, thus altering the relative position of the synchronizing gear and the drum so as to move the image bodily either up or down, as the case may be.

In its final design I am sure the amateur will find that he has a piece of apparatus which will provide him with endless hours of interesting work, quite apart from the entertainment derived from the programmes now broadcast. Obviously, to obtain the *best* results it must be worked in conjunction with a first-class wireless receiver, and I shall deal with this side of the question at the same time.

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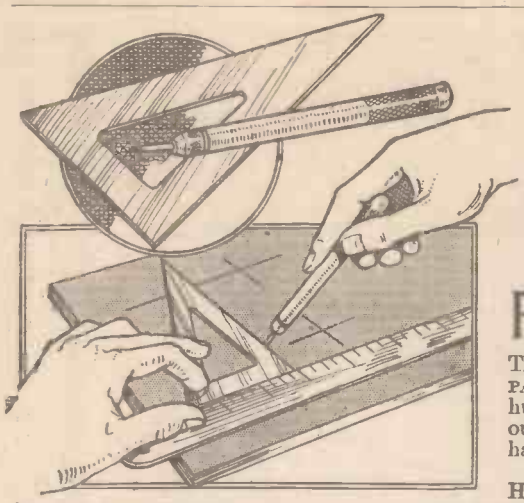
A Worthy Companion to The Wireless Constructor's Encyclopaedia.

By the Editor.



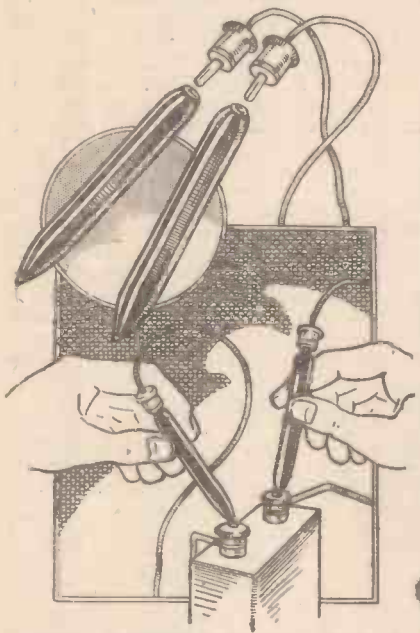
An accurate steel square and an accurate rule—necessary for good work.

PRACTICAL WIRELESS *always* leads the way in introducing *fresh* ideas to the home constructor! The WIRELESS CONSTRUCTOR'S ENCYCLOPAEDIA, of which considerably over one hundred thousand copies have been sent out, was one service we performed which has earned world-wide appreciation.

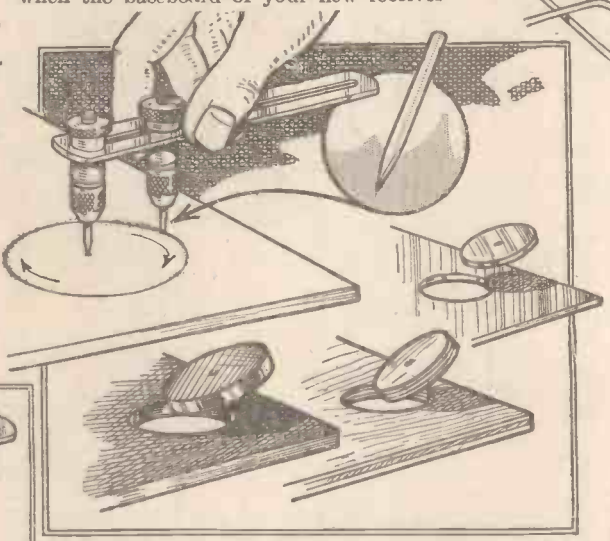
Now it has a worthy companion—the HOME CONSTRUCTOR'S POCKET TOOL KIT, containing *high-class tools*, specially designed for readers of this paper.

A bad workman blames his tools, with justification, when he has (perhaps on the advice of another bad workman) purchased inferior tools.

It is well-known, except perhaps by schoolboys and the "anything-will-do" amateur, that you cannot do good work with inferior tools. For example—the cheap rule sold for a few pence at most popular stores is made on a "No Guarantee of Accuracy" basis. As a fact, it will be found that every one of such cheap rules is from 3/16ths inch to 3/8ths inch longer than standard in a 24-inch length. If you use one of these rules don't be surprised when the baseboard of your new receiver fails to enter the cabinet! A cheap plane with a soft (not steel-faced) iron *may* get you out of the difficulty!

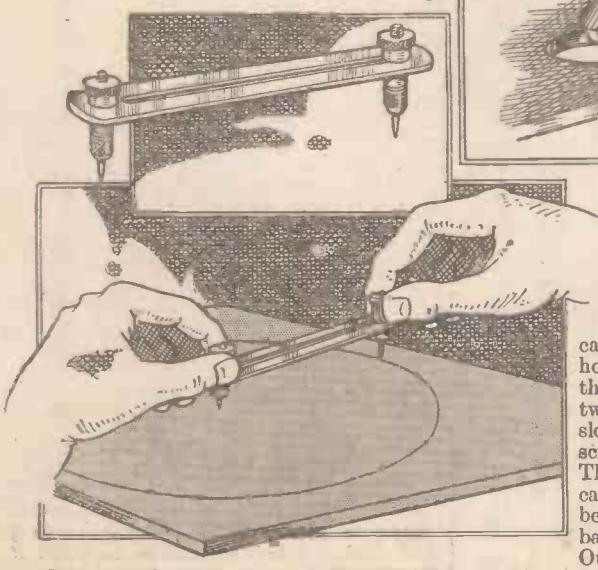


Special insulated test-prods. Note the wander-plug arrangement for the flex—another "Practical Wireless" idea.

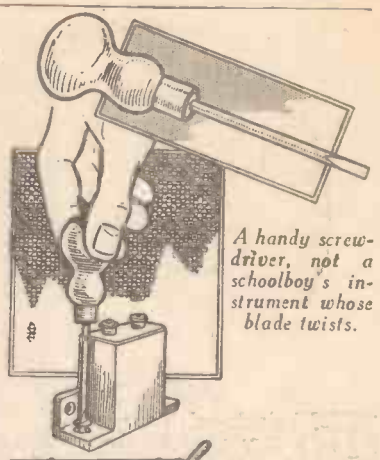


You can't do this with a coping saw! This illustration shows only one use for our universal trammel.

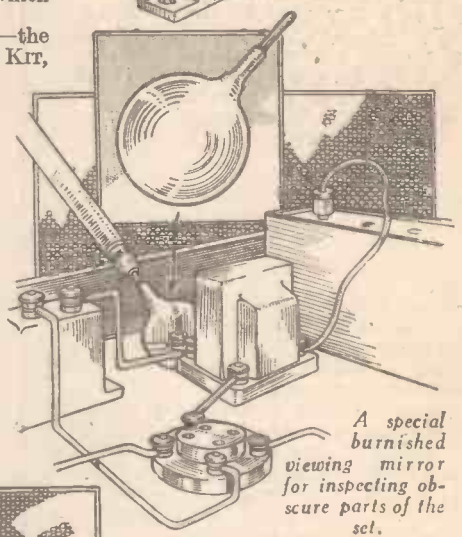
Such tools are intended for schoolboys' carpenters' outfits, and for those who make holes with a red-hot poker. Similarly, the blades of cheap screw-drivers merely twist, break off, and do not fit the screw slot, hence the mutilated condition of the screws in many amateur-constructed sets. The coping-saw, sometimes recommended, cannot, owing to its small radius of swing, be used to cut circular holes in panels or baseboards greater than 8 inches in length. Our trammels, however, may be used on any size of panel or baseboard.



You can't buy these trammels at a sixpenny stores!

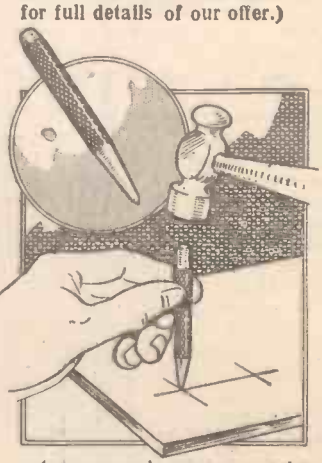


A handy screw-driver, not a schoolboy's instrument whose blade twists.

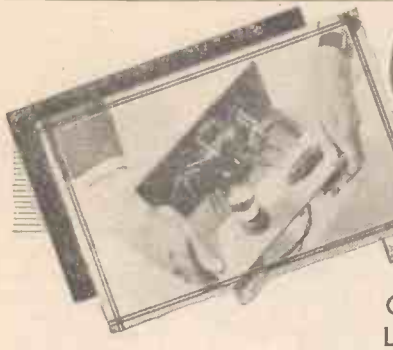


A special burnished viewing mirror for inspecting obscure parts of the set.

Our Pocket Tool Kit contains **high-grade tools** (the retail price of the accurate Chesterman rule alone is 11d.), and includes a pair of neatly designed test-prods, an accurate steel square, a chuck-ended scriber, a pair of universal trammels, neat screw-driver, polished metal viewing mirror, and a steel centre punch. The kit could not be purchased in the ordinary way for less than 12s. 6d. Yet you may reserve one for a nominal sum. **(See page 143 of our issue dated Oct. 7th for full details of our offer.)**



An engineer's centre punch—not a dangerous foreign product which "flies" when struck.



The ALL-WAVE Unipen

Constructional Details of a Single-Valve Pentode Receiver Which Will Give Loudspeaker Reception and Which Can Be Used on Four Different Wavebands

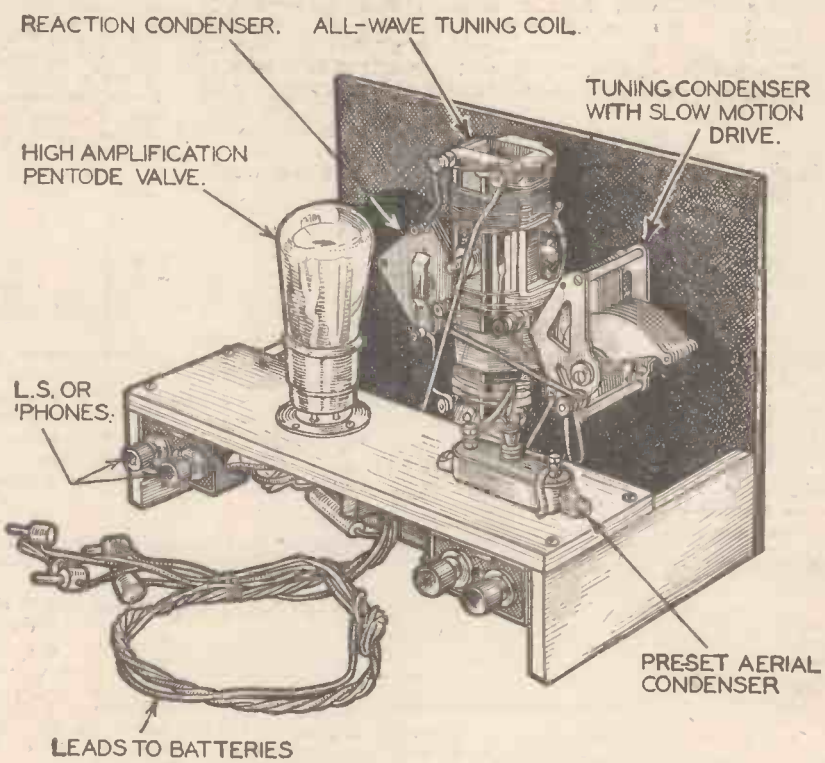
By FRANK PRESTON, F.R.A.

THE single-valve receiver is not very widely used at the present time, principally because it is not generally capable of operating a loud-speaker. Additionally, a two- or three-valve set can be obtained so cheaply that the smaller instrument is neglected. Despite these points, the ultra-simple single-valve receiver has much to recommend it. It can be built very easily by the veriest tyro, and provides a good stand-by to the set normally employed for broadcast reception; it requires the very minimum battery power, so that it can often be run from batteries which are no longer of any use for a larger set, and its cost need be no more than thirty shillings or so.

The little set illustrated on this page employs only one valve, but it is rather in the nature of a "super," since it has been designed to work a loud-speaker at fairly close range, and is fitted with an all-wave tuning unit that covers all the most important wavelengths between 14.5 and 2,000 metres. It is so designed that it can be made up in a very short time, and since only fifteen connecting wires are used, no constructor could possibly have any difficulty.

Easy to Make—and Guaranteed

You will see that although the set is so simple, it has been designed with the same care as all the more pretentious PRACTICAL WIRELESS receivers, and I might add that it is covered by the very same *guarantee*. Although intended mainly for the person who has not previously attempted the construction of a wireless receiver, the "Unipen" will appeal very strongly to more experienced amateurs who wish to make a reliable short-wave set. The "Unipen" can be used on the wavelength ranges of from 14.5 to 40 metres, 32 to 90 metres, 200 to 550 metres, and 900 to 2,000 metres. In addition to its use as an ordinary receiver, however, the set can also be employed as an efficient short-wave adaptor. The method of connecting it to cover the latter purpose will be described later.



Our artist examines the Unipen—and gives his "inkression" of it.

What the "Unipen" Will Do

Intending constructors will probably wish to have some idea of the capabilities of the set, so some mention of the results to be obtained will be appreciated. First and foremost the set is designed to give really good reception on the shorter wavelengths, and, if carefully operated, 'phone reception can be obtained from practically any station in the world. A number of stations on the broadcast bands can also be brought in at comfortable strength on the 'phones, whilst the local, if within some ten miles or so, will often provide respectable loud-speaker results. Simplicity of operation is a great feature, and all the four wavelength ranges can be brought into use by the simple process of rotating a switch knob. There is, of course, only a single condenser to tune, and reaction is easy to manipulate by means of a second control. The degree of selectivity afforded is ample for any normal requirements and is under complete control, since a selectivity switch is included in the tuner, in addition to the pre-set condenser wired in series with the aerial lead.

Simplicity of Construction

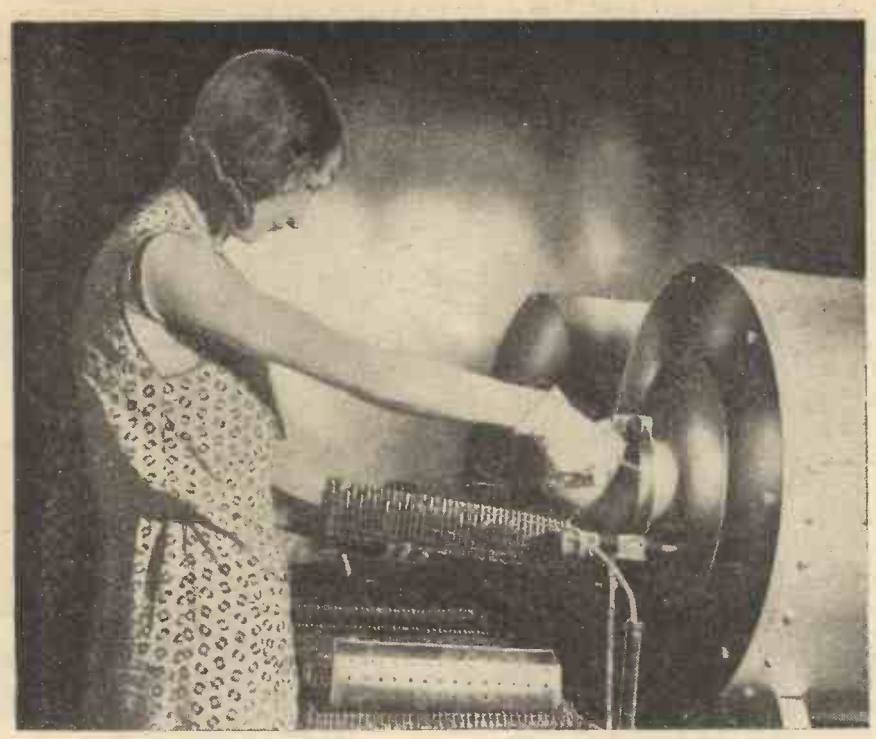
Anyone who has previously made a receiver will require no instructions regarding the construction of this one, since the drawings are self-explanatory. For the benefit of those who decide to make this their first set, however, a few brief notes will cover the subject. Perhaps it should first be mentioned that the set is built on the chassis system, just as are all PRACTICAL WIRELESS designs; this has the advantage of simplifying the wiring and making for increased efficiency.

The first step is to purchase all the necessary components, of which a list is

(*Continued on page 191*)

LIST OF PARTS REQUIRED FOR THE UNIPEN

One Becol Ebonite Panel, 10in. by 7in.
One British General All-Wave Tuner.
One Ormond .0005 mfd. Tuning Condenser with Slow Motion Dial, type No. 6.
One Graham Farish, .0003 mfd. "Litlos" Reaction Condenser with Black Knob.
One British Radiogram Push-Pull Switch.
One Clix 5-pin Valve-Holder, Standard Chassis Mounting Type.
One Polar .0003 mfd. Pre-Set Condenser.
One T.C.C. .0003 mfd. Fixed Condenser, type 34.
One Lissen 3 megohm Grid Leak, with Wire Ends.
One British Radiogram Short Wave H.F. Choke.
One Bulgin "Midget" H.F. Choke.
One Bulgin Dial Indicator.
One Coil Bulgin "Quickwyre."
Two Belling Lee Terminal Mounts.
Four Belling Lee Terminals, type "R."
Three Belling Lee Wander Plugs: marked "H.T.—," "H.T.+," "H.T.+2."
Two Belling Lee Spade Terminals: marked "L.T.—" and "L.T.+."
Few Yards Lewcos Rubber Covered Single Flex.
One Piece 5-ply 10in. by 3in.
Two Pieces 5-ply 6in. by 2in.
Approximate Cost of above—£1 11s. 6d.
One Cossor Type "220 H.P.T." Pentode Valve.
One Lissen 60-volt High Tension Battery.
One Exide Type DFG 2-volt Accumulator.
One Pair Peto-Scott 'Phones.
One R. & A. Type "50" Loud-Speaker Unit (if required).



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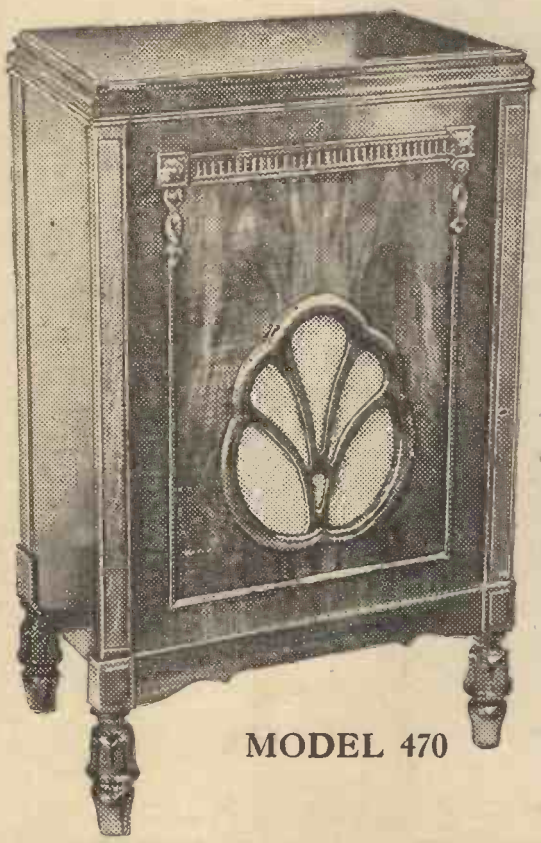
THE LITTLE DOG IN "His Master's Voice" trademark carries a graphic message to all intending purchasers of radio. He listens — and cannot believe that what he hears is not reality. Apply the same test to any "His Master's Voice" radio instrument . . . LISTEN, just listen—for it is by that test that every "His Master's Voice" instrument has been made for a quarter of a century.



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To the Gramophone Co., Ltd.
(Dept. P.W.), 100 Clerkenwell Road, London, E.C. 1.
Send me full details of Model 470 and complete list of "His Master's Voice" Radio.

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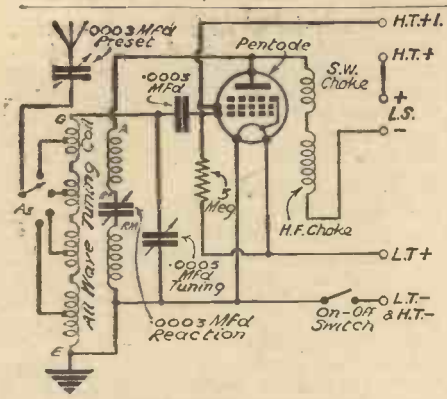
"His Master's Voice"

"TRUE-TO-LIFE"

RADIO

The Gramophone Co., Ltd. (Dept. P.W.), 100 Clerkenwell Rd, London, E.C.1 (Prices do not apply in I.F.S.)



Theoretical circuit of the Unipen.

(*Continued from page 188*)

given elsewhere. Remember that you must get the *exact* parts; alternatives will only lead to trouble and will invalidate the guarantee.

You can now make the 1in. hole in the 10in. plywood strip, to receive the valve-holder. Next assemble the three pieces of five-ply which form the chassis, and mount the necessary components on it. The panel calls for attention next, and this should be drilled according to the drawing reproduced on the next page. After drilling, attach the tuner, condensers, and switch, and then screw the panel to the chassis.

Point-to-Point Wiring Instructions

After the parts are all assembled the wiring can be commenced. As was mentioned before, there are only fifteen wires, and these can be traced on the wiring plan. Still further to simplify matters, though, I will give you, in words, the point-to-point connections. They are: Connect terminal "1" on the valve-holder to the right-hand (looking from the back) terminal of the on-off switch; terminal "2" on the valve-holder to the lower terminal on the S.W. choke; terminal "4" on valve-holder to .0003 mfd. fixed grid condenser; top terminal on S.W. choke to one terminal on the "Midget" choke; second terminal on "Midget" choke to "L.S.—" terminal; terminal on tuner marked "Reaction Fixed" to upper terminal on reaction condenser; terminal "Reaction Moving" to lower terminal on reaction condenser; "Earth" terminal on tuner to end terminal on tuning condenser; end terminal on tuning condenser to terminal "E," and also to right-hand terminal on switch; terminal "Anode" on tuner to lower terminal on S.W. choke; terminal "Grid" to side terminal on variable condenser; side terminal on variable condenser to fixed grid condenser; "Aerial" terminal on tuner to left-hand terminal on pre-set condenser; other terminal on pre-set through a hole in the chassis to terminal "A." That completes the normal wiring, which is carried out in "Quickwyre," and it only remains to connect up the grid leak and the flexible battery leads. The former is joined by its own wire ends between terminal "3" on the valve-holder and that terminal on the grid condenser which connects to terminal "4" on the valve-holder. Of the battery leads, those with plugs "H.T.—" and "L.T.—" attached are twisted together and connected to the left-hand terminal on the switch, the "H.T.+" lead goes to the "L.S.+" terminal, the "H.T.+1" lead is joined to terminal "5" on the valve-holder, and lead "L.T.+" is taken to terminal "3" on the valve-holder.

It should be mentioned that the valve holder terminals are numbered from "1" to "4" in clockwise order, starting with the filament terminals nearest to the panel; the centre terminal is number "5."

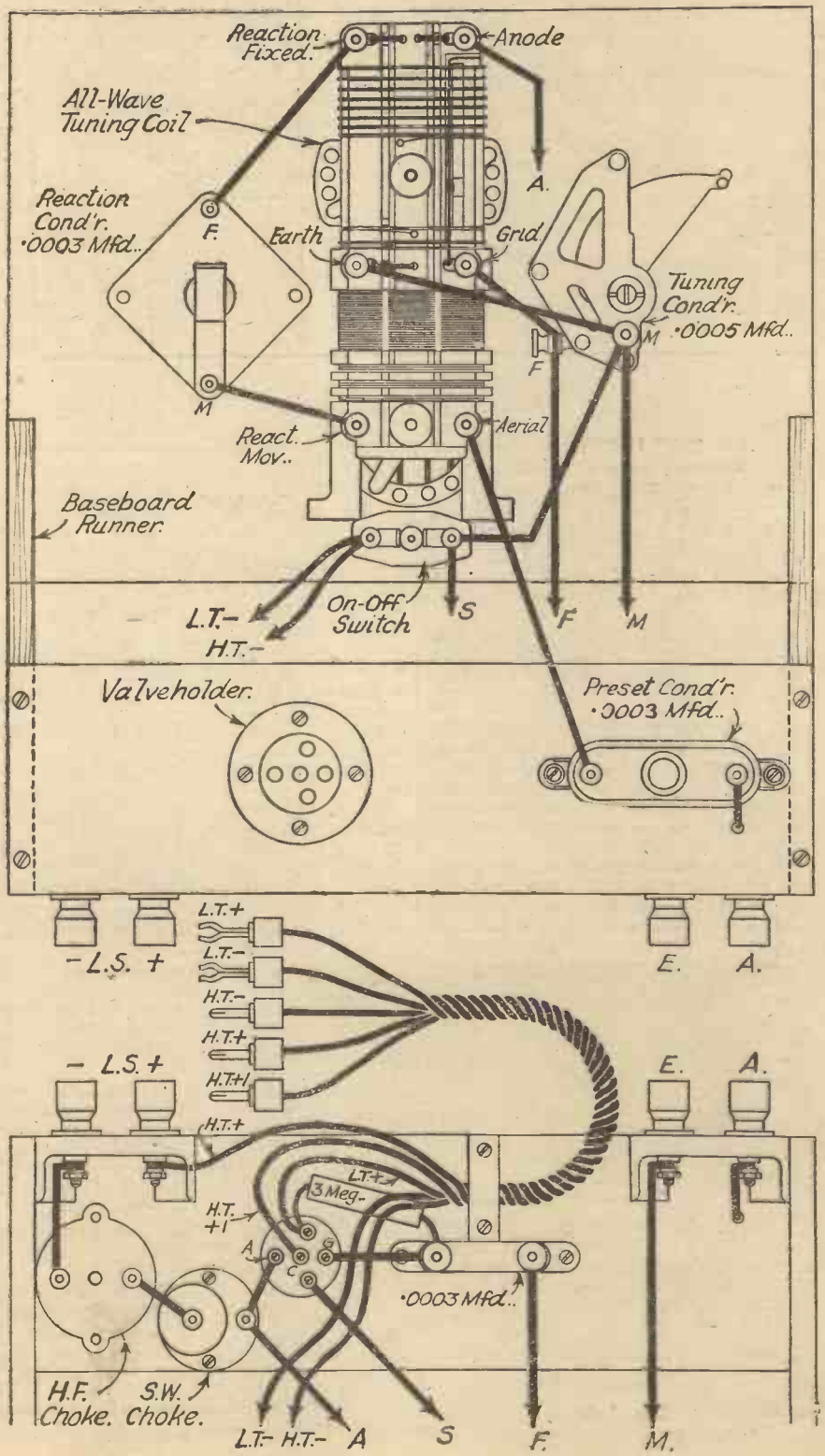
For the sake of neatness the flexible leads are all twisted together and secured to the underside of the chassis by means of a small wooden "bridge."

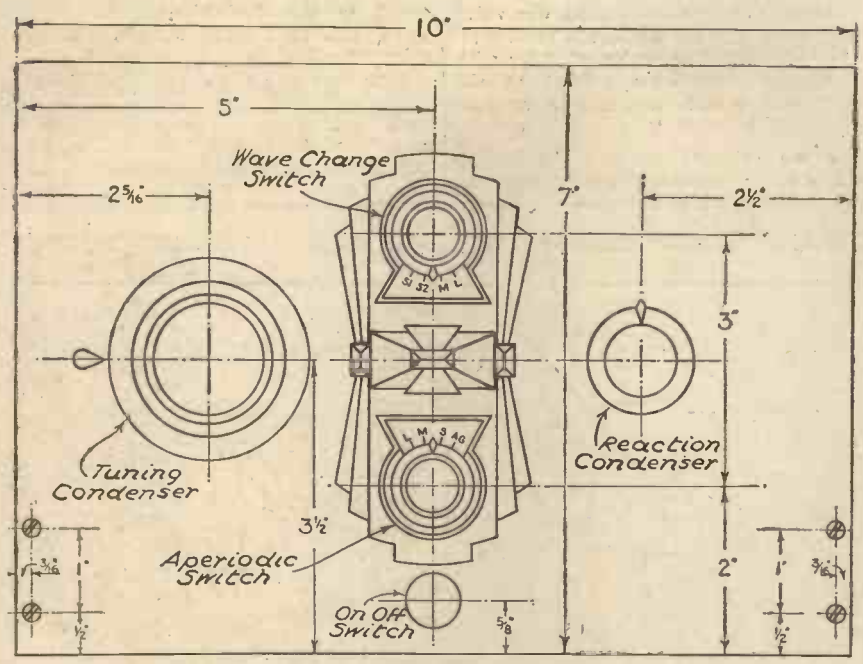
Connecting the Batteries

Now that you have completed the constructional work, the receiver can be connected up to the batteries and given its first trial. Put plug "H.T.—" into the negative socket on the high-tension battery,

(*Continued overleaf*)

TOP AND SUB-BASEBOARD WIRING DIAGRAM OF THE UNIPEN





Panel lay-out of the Unipen.

THE UNIPEN

(*Continued from previous page*)

plug "H.T.+" into the 60-volt socket and plug "H.T.+1" into the 36-volt socket. Join the L.T. leads to the negative and positive terminals respectively on the accumulator, and connect the aerial and earth leads to the appropriate terminals. Whether you intend to use a loud-speaker or not, the set should first be tried with head-phones, of which the red and black leads should be connected to the positive and negative loud-speaker terminals.

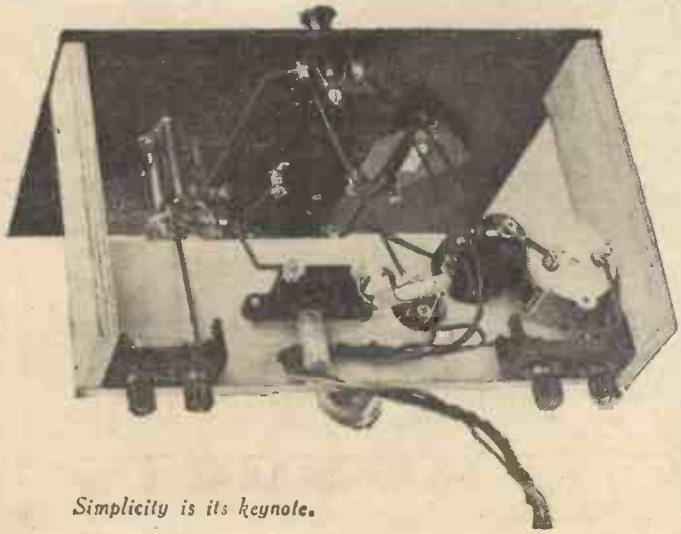
Tuning Instructions—The Selectivity Control

Screw down the knob of the pre-set condenser, set the upper pointer on the tuner to the "M" (medium wave) position and turn the lower pointer to "AG." Turn the reaction knob to its central position and switch on. If you now rotate the tuning condenser the local station will soon be heard. It can be brought up to maximum strength by increasing the reaction, but care should be taken that the set is not allowed to oscillate, since it *can* cause interference with nearby receivers if used carelessly. If a whistle is heard the reaction condenser should immediately be slacked off.

If your aerial is fairly near to a transmitter you will probably find that selectivity is poor and signals can be heard over several degrees of the tuning dial. In that case the lower pointer on the tuning unit should be turned to the "M" position. This will make signals slightly weaker, but they should still be quite loud enough for the 'phones. A number of other stations can be tuned in by rotating the tuning dial slowly and occasionally altering the reaction setting so that a faint "breathing" sound can be heard in the 'phones the whole time. When signals are heard it might be necessary to reduce the amount of reaction to make them quite clear.

Long-wave reception is just the same as on medium waves, except that the two tuning pointers should be opposite the "L" marks. As on medium waves, if a little extra volume is required and selectivity is not an important matter, it can be obtained by setting the lower pointer to "AG."

When a loud-speaker is to be used it should be connected to the terminals previously used for the 'phone leads. Unless signals from the 'phones can be heard several feet away, the set will not give satisfactory results on a speaker, but when they are sufficiently loud a sensitive speaker of the balanced armature type (that mentioned in the specification has been found to be the best for this set) will afford pleasing reproduction.



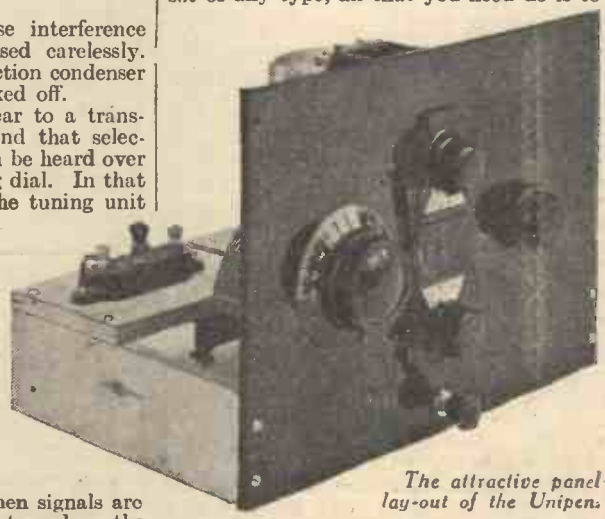
Simplicity is its keynote.

On the Short Waves

To receive short-wave signals the pre-set condenser knob should be unscrewed about four turns, the lower tuner pointer set to "S" and the upper one turned to either "S1" or "S2" according to whether the 14.5 to 40 or 32 to 50 metre range is required. Tuning will then be the same as for the broadcast bands, except that it must be carried out much more slowly, using the slow-motion tuning condenser knob only. It is more important than ever on the short waves that the reaction control should be adjusted until the faint "breathing" sound is heard. The set is most sensitive in this condition and stations can easily be brought in which otherwise would never be heard. If it is found that oscillation cannot be obtained on any particular part of the tuning scale, or if oscillation starts with a sudden "plop," the pre-set condenser should carefully be adjusted.

The Unipen as a Short-Wave Adaptor

To use the "Unipen" as a short-wave adaptor in conjunction with a broadcast set of any type, all that you need do is to join the loud-speaker terminals together with a short length of wire and insert plug "H.T.+" into the anode socket of the detector valve-holder, after removing the valve. The same batteries will be used for both the adaptor and the receiver, of course.



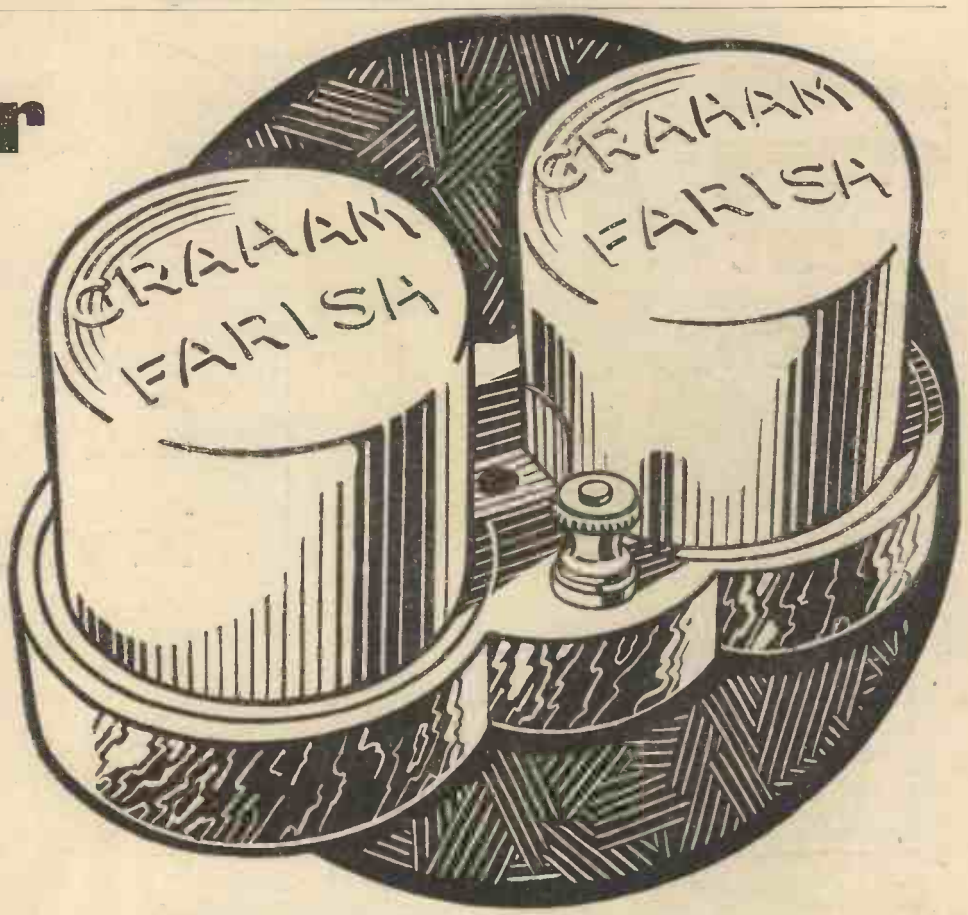
The attractive panel lay-out of the Unipen.

Next Week

Next week I will give a test report on the set and tell you the positions of the tuning condenser at which the more important stations are to be heard. In the meantime you can proceed with the constructional work in the knowledge that the set cannot fail to give really splendid results.

It is very unlikely that you will experience any difficulty in making the "Unipen," or in operating it either, but if you do, remember that the set is Guaranteed, and you are entitled to our Free Advice in regard to it. Simply address your letter in the usual way to the Editor, and remember to enclose the "Free Advice Bureau" Coupon, which you will find on the "Queries and Enquiries" page of this issue.

Superior at every point



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Single Screen
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A small but efficient screened choke which will be found satisfactory in use in all types of circuits where the extra high efficiency of the L.M.S. Twin Screened Choke is an unnecessary extravagance. Suitable for long, medium and short wavelengths. PRICE **2/6**

Ensure a safe and efficient Aerial and Earth. The new **AEROFICIENT KIT** provides all you need. Complete, **6/6.**

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the very latest in high-frequency practice, embodying the advantages of the binocular with the screened type. Its efficiency on long and medium wavelengths is of a very high order, while it may satisfactorily be employed for wavelengths as low as 12 metres.

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From every point of view

the 'Alpha' *leads*

With ordinary speakers, chassis distortion or damage affects the diaphragm, and may cause the speech coil to foul the gap.

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Diaphragm and speech coil are mounted to a pressed steel member which is secured to the centre pole piece of the magnet by a single nut. Accurate centring of the speech coil in the gap is thus assured, resulting in permanent and trouble-free operation.

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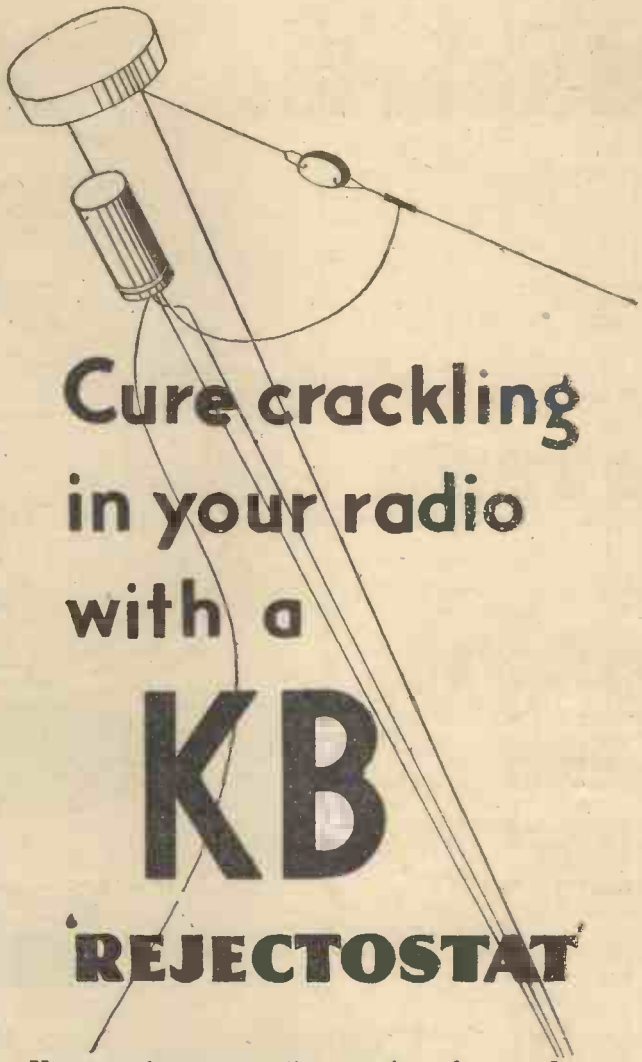

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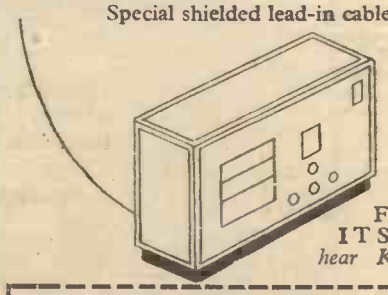

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YOUR SET'S POWER SUPPLY

Further Practical Advice for the Beginner on the Choice and Maintenance of L.T., H.T., and G.B. Supplies

(Concluded from page 103, September 30th issue.)

IT has already been explained how an H.T. battery is made, so we can now consider how it functions. When it is in circuit chemical action between the carbon, sal-ammoniac and zinc causes a voltage to be developed between the positive and negative elements. But as current is drawn from the cell the same chemical action produces a certain amount of hydrogen gas which attaches itself to the carbon rod in the form of small bubbles. Hydrogen is an insulator and so the cell would soon cease to operate were it not for the manganese dioxide which absorbs the gas.

Provided that the current does not exceed a certain amount, the hydrogen will be absorbed as quickly as it forms and consequently the cell will continue to operate until the sal-ammoniac electrolyte is spent, or the zinc container corroded away. But if the current load were too great the hydrogen would not be absorbed quickly enough and so the cell would either cease entirely to function or would deliver only a small voltage due to the "internal resistance" created by the hydrogen. This explanation should make clear the reason for different capacities of H.T. batteries obtainable. When a higher current is required for a big set the cells must be larger so that sufficient manganese dioxide can be accommodated to absorb the hydrogen as rapidly as it accumulates. It should be clearly understood that a battery using larger cells does not give any greater voltage, for the latter is governed entirely by the nature of the electrodes and electrolyte, and not by their size or bulk.

Three Sizes of H.T. Batteries

It should now be clear why we have three sizes — standard, double and triple capacity — of high-tension batteries. The first type is capable of giving a steady output of 6 to 7 milliamperes, the second of 12 milliamperes and the third, of some 20 milliamperes. Quite naturally, the larger capacity batteries are more costly but when the H.T. consumption is in excess of about 7 milliamperes their much longer life more than compensates for the extra initial expense.

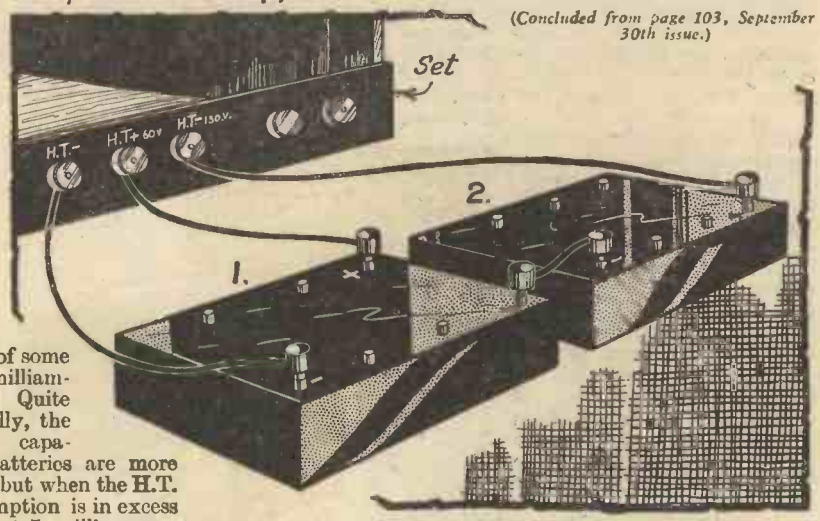

Fig. 5.—This sketch shows how two 60-volt H.T. batteries can be wired in series to effect an economy.

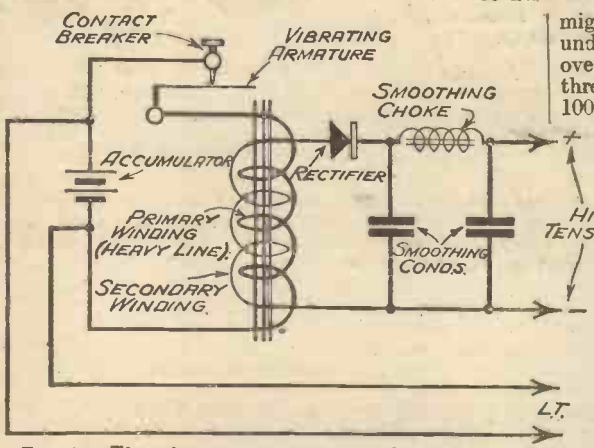

Fig. 6.—The schematic arrangement of the battery superseder.

I always find difficulty in persuading people that the larger batteries are really an economy, so if by chance you feel unconvinced let me give a few actual figures. I will not state the results of numerous laboratory tests I have made in respect to the life of batteries of different capacities, because, although these satisfy me, they might not appeal to you as much as tests under normal working conditions. Just over a year ago a friend who had made a three-valve S.G. receiver told me that his 100-volt standard capacity batteries had lasted no more than eleven weeks each on an average. He had tried three different makes and had paid approximately ten shillings for each battery. We measured the H.T. current consumption of the set and found it to be exactly 9 milliamperes, whereupon I advised the use of a triple-capacity (some makers refer to them as super-capacity) battery of similar voltage and costing a guinea. He was somewhat reluctant to act on my advice but did so eventually, and the larger battery lasted just short of nine months! I leave it for you to calculate the saving. Please bear in mind that I am not financially interested in the sale of batteries, and I recommend the larger types because I know that they are a definite economy for any except the smallest set. If you are in doubt as to the type of battery most suitable for your set, just measure the current consumption when using a battery which is up to full voltage by connecting a milliammeter in series with the negative lead as shown in Fig. 4.

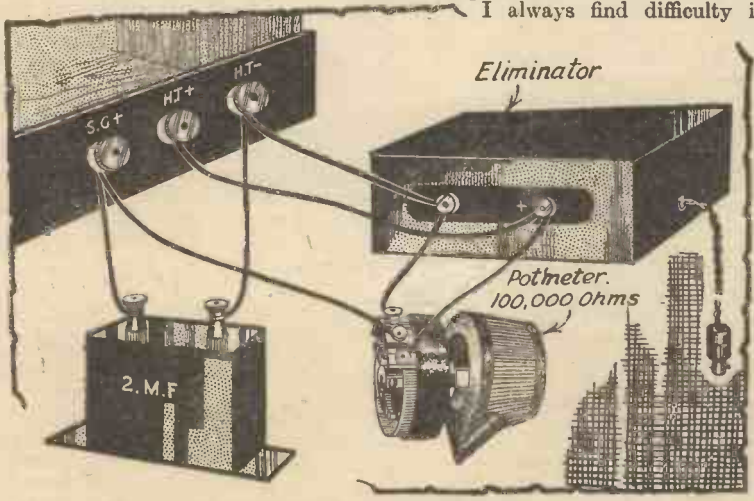

Fig. 7.—The method of obtaining the required S.G. potential from an eliminator not fitted with a special tapping for this purpose.

Using Two Batteries in Series

With a receiver in which there is more than one H.T. + tapping, and where one or two of them require only 60 volts or so, the lower half of the battery is subject to a higher load than the other and so runs down more quickly. This is wasteful, because it becomes necessary to replace the battery before a portion of it has become exhausted. In such cases as this it is more economical to use two 60 or 66-volt batteries connected in series instead of a single one of higher voltage since one of them can be replaced separately

(Continued on page 196)

YOUR SET'S POWER SUPPLY

(*Continued from page* 195)

and the other kept in service until it becomes properly exhausted. A sketch of the connections required is given in Fig. 5.

"Shelf" Life

There are not many more points to be observed in regard to the use of a high-tension battery, but it should be mentioned that moderate temperature and humidity are both conducive to longer life. If the battery is allowed to get too warm, the electrolyte evaporates to a certain extent, whilst dampness or extreme cold have a deleterious effect. These things are not of great importance in this country, where we enjoy temperate (?) climatic conditions, but in the interests of economy they should not be entirely overlooked. It should also be remembered that all types of dry battery run down after a certain length of time (probably a year to eighteen months) even if they are not used at all. The deterioration is due to evaporation of the electrolyte and corrosion of the zinc cell containers. For this reason it will be clear that it is unwise to buy batteries from a small shop where they may have been in stock for a long time.

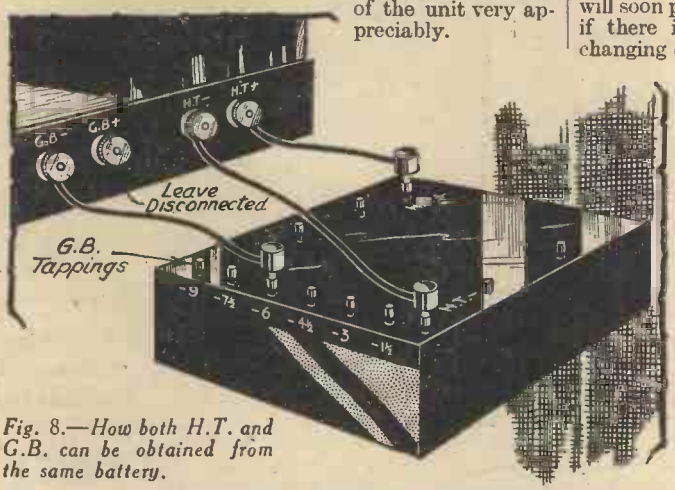

Fig. 8.—How both H.T. and G.B. can be obtained from the same battery.

Other Forms of H.T. Supply

High-tension accumulators are not used extensively, but they do provide an economical source of supply when using a large set having a consumption in excess of 20 milliamperes or so. No special mention need be made of their correct use since the same rules apply as in the case of low-tension accumulators, except that the construction is of such a form that recharging is not necessary at intervals of less than two months, always provided that the cells do not run down more quickly than this. As the usual capacity is 2,500 milliampere hours, they will supply a current of 25 milliamperes for 100 hours.

Another type of H.T. accumulator is built up from a number of nickel and steel plates and uses an electrolyte of caustic potash. It is thus rather different from the normal accumulator and does not require so much attention. The cells are all connected to a switch so that they may be put in parallel and charged from a 6-volt accumulator of the normal type. The current taken from the accumulator is quite small and tappings can be taken from a 2-volt section to provide the normal L.T. supply.

A kind of H.T. supply unit which dispenses with the need for a dry battery or mains supply is known as a Battery Superseder. This is a form of eliminator which can be fed from the L.T. accumulator whilst the latter is being employed for its normal purpose of heating the valve filaments. The principle upon which the instrument operates will be understood by reference to Fig. 6. Low-tension current (of about 1 ampere) is fed to the primary winding of a high-ratio step-up transformer through a make-and-break. This results in a higher voltage (100 or so) of alternating current being obtained across the ends of the secondary winding and the current is rectified and smoothed in just the same way as the A.C. supply from the lighting mains. When using an eliminator of this type its current consumption must be added to that of the valve filaments when deciding on the most suitable capacity for the low-tension accumulator.

Mains Eliminators—Choosing a Suitable Type

High-tension eliminators for use from the lighting mains can be obtained in innumerable different types, so the beginner will often be at a loss to know how to make a choice. The principal deciding factors are the maximum voltage and current required by the set, and these items naturally affect the price of the unit very appreciably.

Assuming that the set is of the most popular three-valve S.G.-Det.-Pen. type, it will require at least 120 volts at a minimum of 15 milliamperes, but it always pays to obtain a unit which will have a little "reserve." By so doing it will never be overloaded, and consequently it should last for ever (or nearly so). In addition, there will be "power in hand" for the time when you wish to add another valve, as you most certainly will if you are of an experimental turn of mind. So long as you are going to use battery valves, a maximum voltage of 150 is all that is required, and the appropriate maximum current rating for two-, three-, four-, and five-valve sets can be taken as 12, 15, 25 and 30 milliamps respectively. Next you must decide on the number of tappings required. Personally, I prefer to have only two, one giving the maximum voltage, and another a variable zero to 80 volts supply, which is suitable for feeding the screening grids of S.G. and V.-M. valves.

When using an eliminator of this type it is, of course, necessary to employ decoupling in the set itself. I consider this the neatest and most satisfactory system, but if you already have a set fitted with two or three H.T. terminals it is best to obtain an eliminator with, say, one fixed and two variable tappings, so that the optimum voltages can be obtained under any circumstances.

Screening Grid Potential

At this juncture it ought to be pointed out that the H.T. for the screening grids should always be taken from a potentiometer, and *not* from a variable resistance. This is always arranged for in eliminators specified as having an S.G. tapping, but where a different type of instrument is in use, the screening grid potential can be provided by connecting a 100,000 ohm wire-wound potentiometer between the negative and one positive eliminator terminals, as shown in the sketch of Fig. 7. Connection to the S.G. terminal of the set is made from the centre terminal or slider of the potentiometer and a 2 mfd. fixed condenser *of at least* 600 *volts D.C.* test is connected between the slider and H.T. negative to act as a by-pass.

Trickle Charger

When buying an eliminator for a battery set, it is always well worth while to obtain one fitted with a trickle charger so that the accumulator can be charged at home at practically no cost. The extra expense of the trickle charger is very slight, and it will soon pay for itself. On the other hand, if there is some likelihood of eventually changing over to A.C. valves, an eliminator should be bought which contains, in addition to the H.T. supply, terminals giving 4 volts, 4 amps A.C. The latter will not be required whilst battery valves are in use, but may be left disconnected until they are needed.

Voltage of "Fixed" Tappings

A point which often confuses the beginner is that "fixed" voltage tappings on eliminators are usually specified as giving, for example, "100–120 volts at 5–3 milliamps." This means that the voltage will be the lower figure when the load is 5 milliamperes, or the higher one when the current is only 3 milliamperes. Intermediate voltages will obtain when the current consumption is between the maximum and minimum values. In such cases it will be fairly safe to assume an average voltage (110 in the example quoted) if the actual current consumption of the set is not known, but it can be found as shown in Fig. 4, by connecting a milliammeter in series with the tapping concerned.

Switching On the Eliminator

When using an A.C. eliminator with a battery set it is very important that the L.T. should be switched on *before* the eliminator, and switched off *after* the eliminator. This is to ensure that there will always be a current load on the H.T. supply, which will prevent the voltage rising to a high figure and causing damage to receiver components.

Grid Bias

The grid bias supply is just as important as the H.T. and L.T., in fact, from the point of view of economical running it can be even more so. G.B. batteries are cheap but, used correctly, they can considerably increase the life of both the H.T. battery and the valves. As an example, I give the following figures which show the high-tension current consumption of a typical small power valve when receiving an anode voltage of 120 and various values of grid-bias voltage.

Anode Voltage=120

G.B. Voltage	Anode Current
15	8 m.a.
12	11 m.a.
9	14.5 m.a.
6	17 m.a.

The G.B. voltage recommended by the makers for this valve is twelve, but it works quite well at 15 volts and an economy can be effected by operating it at the latter voltage. When the voltage is reduced the current consumption goes up rapidly, and results are not improved.

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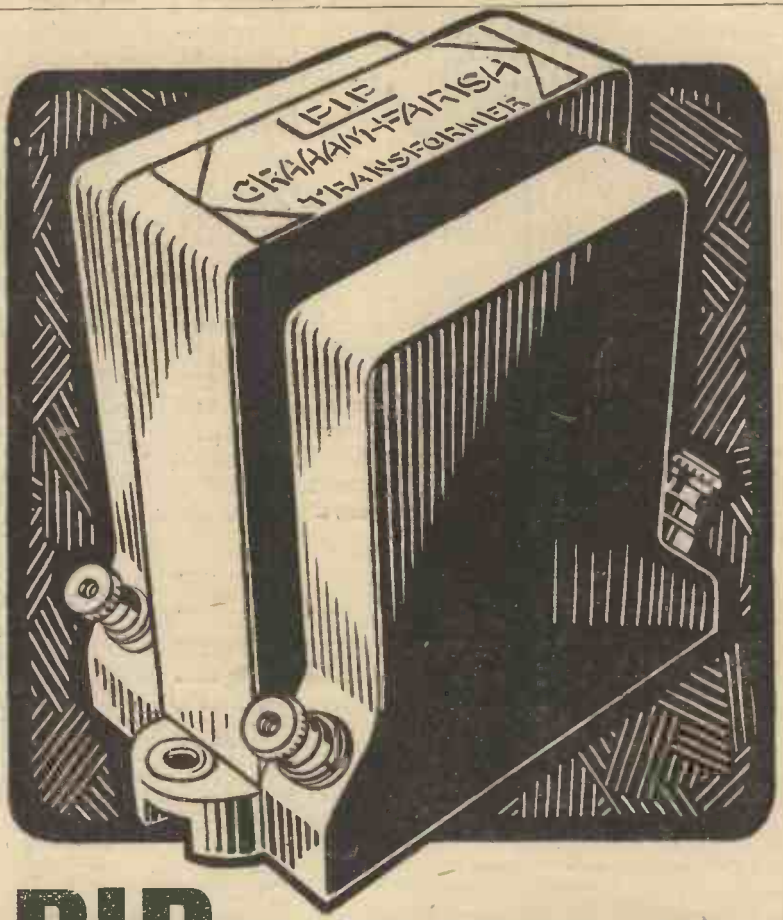

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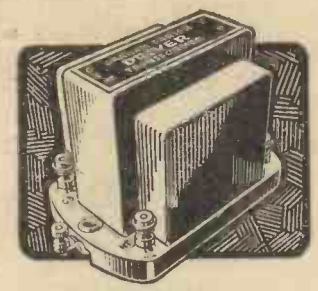

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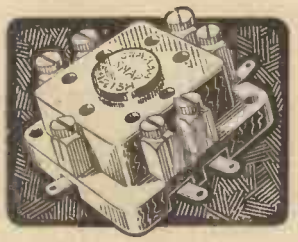

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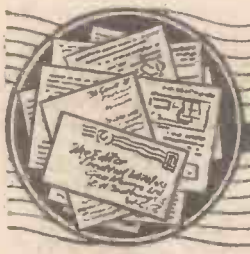


READERS' WRINKLES

THE HALF-GUINEA PAGE

A Novel Trimmer for 2-Gang Condensers

HOW many wireless constructors have experimented with home-made ganging devices for two individual similar

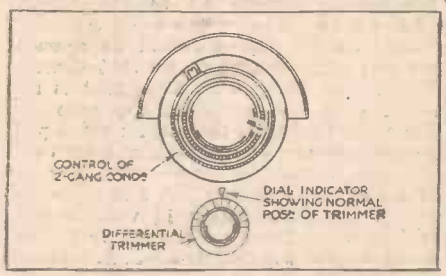


Fig. 1.

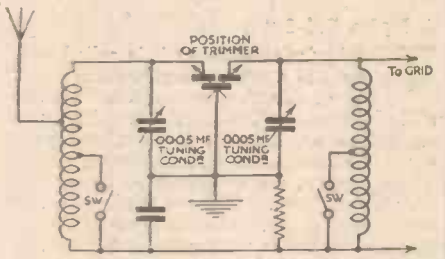
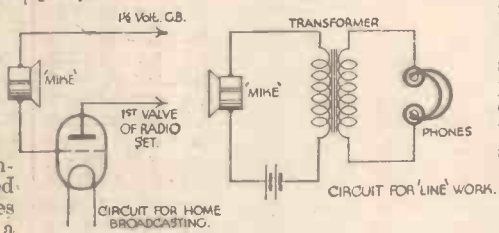


Fig. 2.—A trimmer for 2-gang condensers.

condensers? Very often some difficulty is experienced owing to damping at the ends of the tuning scale, due to the presence of aerial capacity in the aerial coil; this may occur whether an aerial tuning condenser be in the circuit or not. This may be even more apparent over the long than the medium-wave band. A very simple device may be utilized to balance up the two tuned circuits by incorporating a very small capacity differential condenser (built up type), so that the fixed vanes are in parallel with the fixed vanes of the tuning condensers. To obtain a very low capacity for this trimming device it is necessary to remove the majority of the vanes and leave, say, only one vane upon each side of the modified differential condenser. The accompanying sketch (Fig. 1), and typical circuit diagram (Fig. 2), will thoroughly explain the arrangement to be adopted. It is advisable to use an engraved control knob for the trimmer, to indicate the position of the vanes, and this should be at "normal" when the trimmer inserts equal capacities into both tuned circuits. Thus, after the initial tuning operation of the main tuning control, the final adjustment may be easily accomplished by moving the trimmer slightly to "normal."—WM. A. HARRISON (Liverpool).

THAT DODGE OF YOURS!

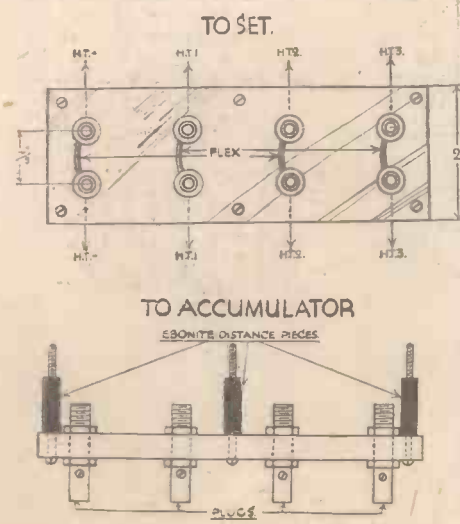
Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best wrinkle submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending 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.



Circuit diagrams showing uses for a simple microphone.

Plug Connectors for H.T. Accumulators

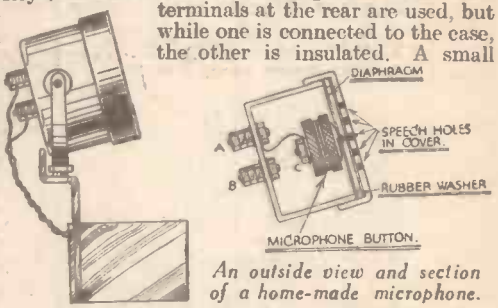
THE following dodge may be found useful for those readers who possess an H.T. accumulator. It is usual to have two batteries of 50 or 60 volts placed one above the other, consequently when making adjustments or alterations to the set the top crate has to be taken off in order to remove the plugs from the lower half of the accumulator. To overcome this inconvenience I made up the gadget shown in the sketch. The parts required are: a piece of ebonite 2in. wide of a length to suit the number of plugs and sockets fitted; one plug and socket for each lead going to the accumulator; one piece of ebonite tube; six suitable screws for fixing, and a length of flex. The plugs and sockets are then fitted, as shown, each pair being connected together with a piece of flex. The leads coming from the set are connected to the sockets on one side of the ebonite, and the leads from the accumulator to the other side. The ebonite tube is then cut up into six pieces, the length of these depending on the length of the sockets. Then all one has to do to disconnect the H.T. supply is to pull out the plugs. It is also useful for making voltage and current measurements, as may readily be seen.—J. W. Box (London, W.C.1.)



Plug connectors for H.T. accumulators.

A Home-made Microphone

THE following description of an efficient home-made "mike" may prove interesting to other readers. The two main items are a small "button" microphone and an old headphone. The inside, comprising the magnets and coils, is removed from the headphone. The two terminals at the rear are used, but while one is connected to the case, the other is insulated. A small hole should be drilled in the centre of the original diaphragm, which is then fitted on to the spindle of the microphone button. From the terminal C, at rear of button, take a short wire to A, the insulated terminal. The circuit is completed through the microphone to the diaphragm, to the case, and from thence to terminal B. A rubber band was used as a washer between the diaphragm and the screw cover. The whole job was then mounted on a small baseboard, the arm connecting the original headphone to the headband being used as a bracket. The microphone will be found to be very efficient, and can be used in a variety of ways, two of which are shown in the circuit diagrams.—G. R. BENNETT (Cowes, I. of W.)

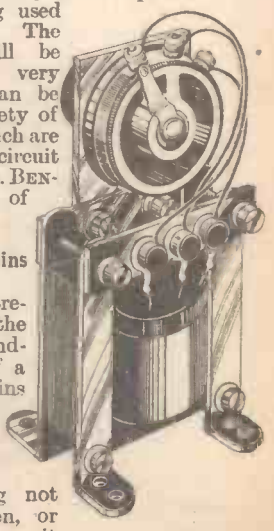


An outside view and section of a home-made microphone.

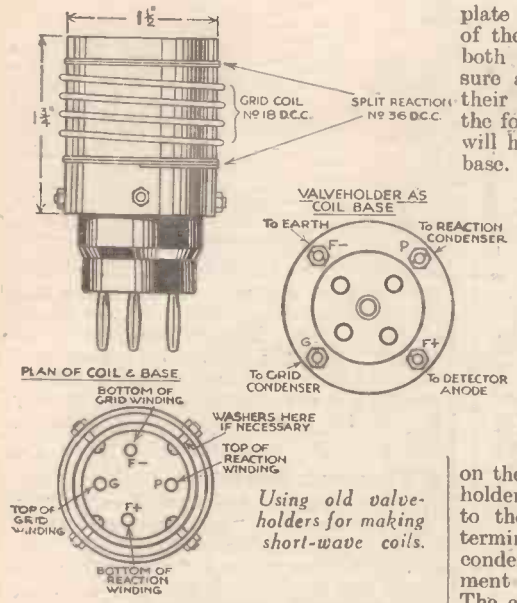
Reducing Mains Hum

AS the centre-tap of the 4-volt L.T. secondary winding of a home-made mains transformer is not always the correct electrical centre, due to the winding not being quite even, or some other cause, it

(Continued overleaf)



An arrangement for reducing mains hum.



Using old valve-holders for making short-wave coils.

often repays the constructor to try connecting a low resistance potentiometer across it, and to use the sliding contact to find an artificial centre tap which will definitely reduce mains hum.

An old wire-wound potentiometer, in which the wire element has developed a defect, should be re-wound with about 3yds. of No. 32 S.W.G. Eureka wire, the old winding being first removed. When finished, it can be replaced in the case, the connections being made as before. If the potentiometer is then mounted on a small piece of fibre or ebonite, and a small hole made just below it, it can be conveniently secured to the now unused centre tap terminal on the transformer, as shown in the sketch. The two ends of the resistance winding are connected across the 4-volt secondary winding, the slider arm being taken to the same connection as the centre tap terminal was originally.

As the resistance of the potentiometer is about 24 ohms, the current passed at 4 volts is approximately 1/6 ampere, which is insufficient to cause undue heat, and will not place much extra load on the transformer; actually it is less than 1 watt. —H. G. SLADE Malta).

Plug-in Short-Wave Coils from Old Valve Bases

CONSTRUCTORS who possess a junk-box as well as an economical tendency may find this hint useful. The only materials required are, an old valve base, a piece of bakelite former about 1¾in. long, a valve-holder, 4 small bolts, a short length of No. 18 and No. 36 D.C.C. wire, and a few washers. The four legs on the valve base are drilled to enable the wire to be entered and soldered in position. Next four holes are drilled in the former and valve base, to take the bolts, as shown in sketch. The valve base need only be entered inside the former sufficiently to allow the bolts a firm hold on both. The space between the valve base and the former may be filled with washers on the bolts. These preparations being completed, the winding is commenced. The top end of the grid winding is taken down inside the former and soldered to the grid leg on the valve base, the bottom of the grid turns is soldered to the filament negative leg on the base. The top of the reaction turns is taken to the plate leg on the base, and the bottom of the winding to the other filament leg, both being soldered as before. Make sure all connections are well soldered to their respective valve legs, then put in the four bolts, and screw up tightly. This will hold the coil firmly against the valve base. The valve-holder is now secured on the baseboard, and is utilized as a coil-holder, the grid terminal being connected to the grid condenser, filament negative terminal to earth, plate terminal to reaction condenser fixed vanes, and the other filament terminal to detector valve anode. The coil is now plugged in, and the aerial clipped on to the top of the grid winding.

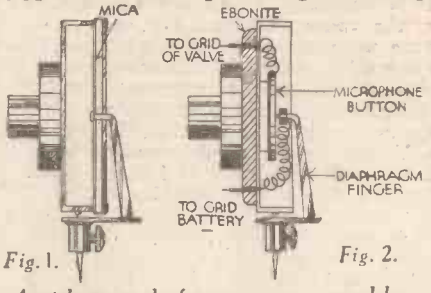


Fig. 1. *Fig. 2.*

A pick-up made from a gramo. sound-box.

Constructors will probably want to vary the range of their coils, but the details of the ones I have made may prove useful.

The first coil consisted of four turns of No. 18 D.C.C. as grid winding, and four turns of No. 36 D.C.C. as reaction winding, the turns in each winding being kept about twice the thickness of the wire apart. The reaction winding was divided to ensure smoother reaction, and was wound about an ⅛in. above and below the grid turns. This coil covered a waveband of about 15 to 35 metres. The second coil was made in a similar manner, with eleven turns grid and eight turns reaction winding, the reaction winding being divided as before, four turns on top of grid turns and four below. This coil covered a waveband of about 30 to 80 metres. Both coils were used in conjunction with a .00025 tuning condenser, and a .00015 reaction condenser. The accompanying sketch gives details of all connections.—B. W. HOPE (Sunderland).

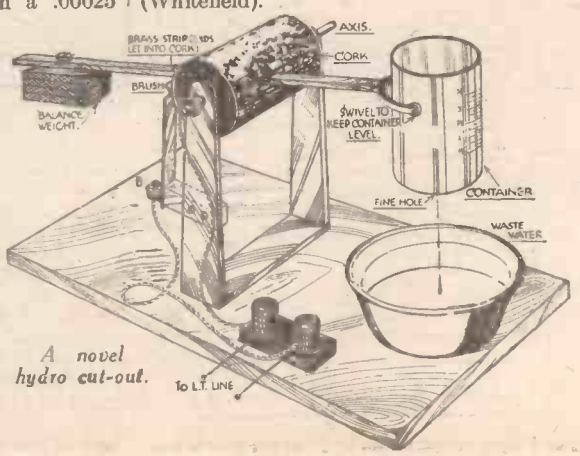
Making a Pick-Up From a Gramo. Sound-box

WIRELESS set owners who also possess a gramophone may be interested to know how I made a pick-up at little cost. All that is required is a microphone button, a piece of thin ebonite, and a little Chatterton's compound. Fig. 1 shows the sound-box of the gramophone. First of all, carefully take the sound-box apart, and unscrew the stud from the diaphragm finger which is screwed to the centre of the mica. The mica, rubber gaskets and stud are not required. The piece of thin ebonite is now shaped to suit the back of sound-box, as in Fig. 2. It can be fixed in position with screws or Chatterton's compound. The microphone button is fixed exactly in the centre of sound-box, at the back, with the two leads of thin insulated copper wire attached, as shown. The diaphragm finger is cleaned at the tip, and carefully soldered with a neat spot of solder to the screw which is in the centre of the "button." Two holes should next be drilled through the ebonite and case for the leads, and the socket screwed on to the ebonite at the back. Lastly, the small adjusting screws on the stylus should be screwed up just tight enough to prevent chatter. To use the pick-up on a set that is not fitted with pick-up terminals, take off the aerial lead from the set, fix valve pins to the ends of pick-up leads, and take out detector valve. Put one valve pin in grid socket of valve-holder, and the other pin in the G.B. battery 1½ volts socket. If loud tone needles are used, very little needle scratch will be heard.—J. A. MOYLER (Islington).

A Hydro Cut-Out

THE hydro cut-out, as it is called, consists of a see-saw arrangement made of wood and scraps of tin. At one end of the see-saw is a suitable weight, heavy enough to weigh down the canister when empty; at the other end is the canister in which enough water is poured to allow it to weigh down. This is made of either aluminium or tin. If a tin is used it should be painted inside with enamel to prevent rust. A fine hole is then made in the bottom, small enough to allow only a continuous drip of water to pass through.

Water is then poured into the canister, thus weighing it down and making contact with the brush, which is fixed to the upright strip of wood on the inside. A large cork, to which a strip of brass is attached, is fixed on to the spindle, and this makes contact with the brush when the canister is filled with water. When the canister has emptied itself, contact is broken as the brush then rests on the bare cork. A break is thus made in the L.T. leads, which are connected to two terminals on the baseboard, as shown. Experiments can be made to find out exactly when the "switching off" will take place, and markings are then made on the side of the canister, enabling one to know how much water to pour in.—K. WILLIAMSON (Whitefield).



A novel hydro cut-out.

Mullard Master Valves are chosen by discriminating radio enthusiasts in greater numbers than any other type of valve. That is because previous results have shown them superior in design, construction and performance. Today three million aerials lead down to Mullard Master Valves—and three million aerials can't be wrong.

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Arks

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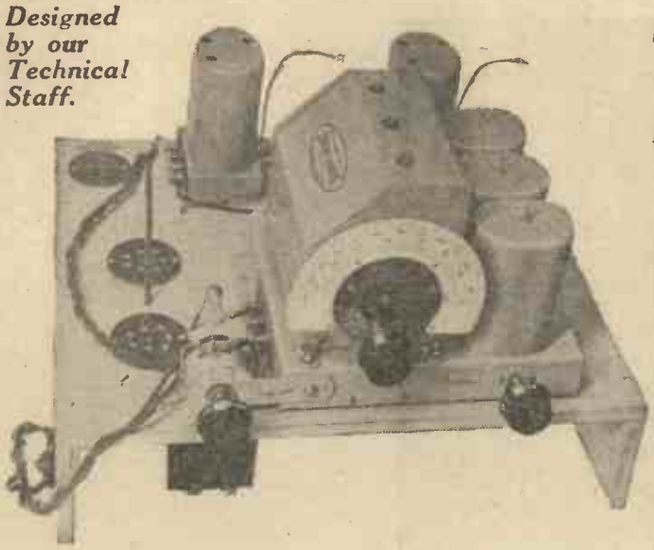
THE LUXUS A.C. SUPE

A High-class, Four-valve Mains Receiver, Emp[illegible]ing Automatic Volume Contro[illegible] Valve, and the New H.F. Pentode. The [illegible]ains Portion Will Be Dealt

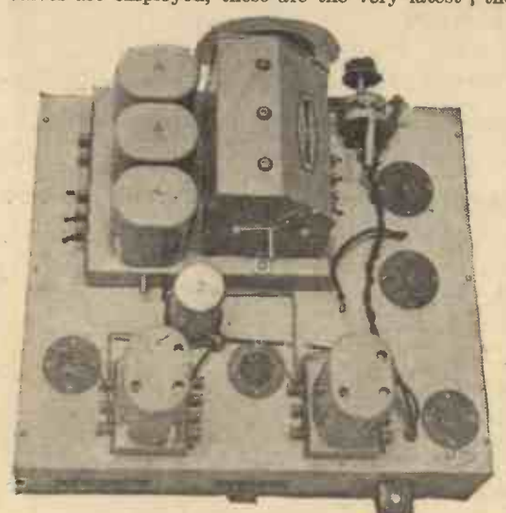


Three-quarter front view of the A.C. Superhet showing the professional appearance of our latest receiver.

IN the past, all the receivers which have been produced by PRACTICAL WIRELESS have been built at the very minimum of expense, consistent with efficiency. That is to say, when the design has been considered, the various components have been chosen so that the essentials of the particular design could be incorporated with as small an outlay as possible. In no case has efficiency been sacrificed in order to cheapen the cost of a receiver. On the other hand, no expensive component has been chosen if a cheaper one was available which would give the same results. Many letters have been received from readers asking for cheaper receivers, and, on the other hand, many readers have asked for what might be termed a luxury receiver. That is, one which employs really up-to-date ideas and gives practically the very best that can so far be obtained in a home-constructed receiver, expense being no object. For these the present receiver has been produced. It is not cheap. It does, however, employ principles which can be said to be really modern, and although only four valves are employed, these are the very latest valves which have been released. The circuit, too, is absolutely new, and there will be seen to be many novel features in it. Apart from the fact that the circuit is of the superhet type, automatic volume control is incorporated, and two of the latest high-frequency pentodes are employed together with a duo-diode-triode.

The Circuit

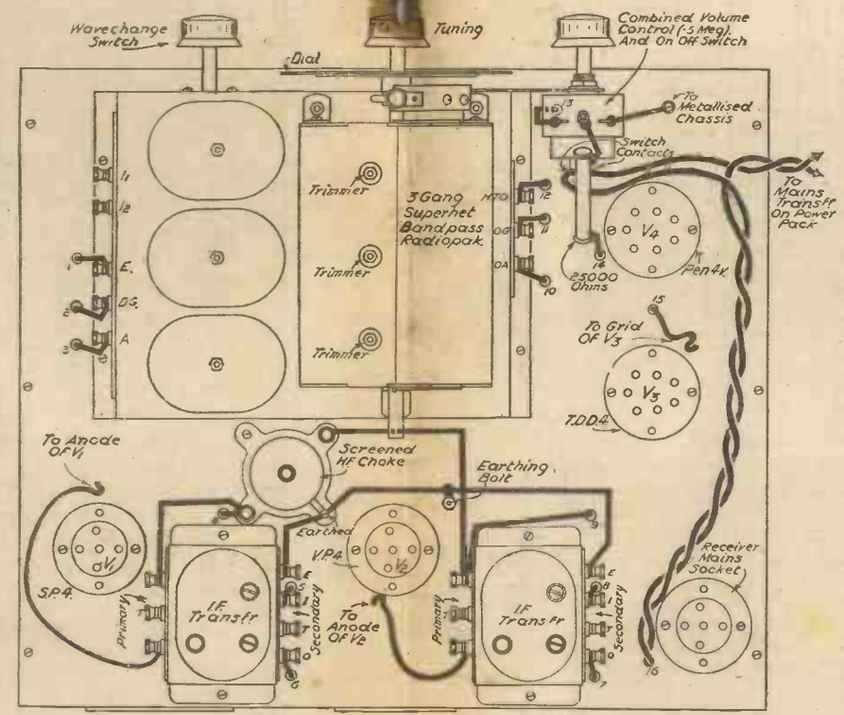
Before going any farther, perhaps the circuit should be explained for the benefit of those to whom such details appeal. Band-pass tuning circuits are employed between aerial and first valve, which is an H.F. pentode acting in the double capacity of first detector and oscillator. The band-pass coils and the oscillator coil are built up on a single unit with the three-gang condenser, the whole being obtainable with tracking condenser, etc., included. This is a British Radiophone product, and the efficiency is of the very highest order owing to the fact that the three separate circuits are factory matched and already adjusted when built into the set. On the same assembly is a potentiometer for volume control purposes, ganged with an on-off switch. I.F. transformers manufactured by the same firm are employed to couple this first valve to the I.F. valve and also in the next stage. The I.F. valve is a variable-mu H.F. pentode, and the bias is set to a pre-arranged value and then acted upon by the A.V.C. circuit. There is thus no manual volume control on the H.F. side. The third valve is a duo-diode-triode connected in a very unconventional manner. It will be seen that one diode acts as a rectifier whilst the other diode performs the function of A.V.C. The anode is kept at a constant potential, whilst the cathode performs the functions usually devoted to an anode. It is coupled, *via* a fixed condenser, to the volume control potentiometer which forms one part of the resistance-capacity coupling between the duo-diode-triode and the output pentode. Included in the cathode lead is a special hum stopper, and it will be seen from the circuit diagram that the voltage is obtained independently. The output valve, a Mullard Pen. 4 V., gives an output of approximately 2 watts. The mains unit is built up on a separate chassis, and this is coupled to the receiver chassis through the medium of a multi-way lead and a plug. The speaker is of the energized type, the field winding serving as a smoothing choke. So much for the circuit.

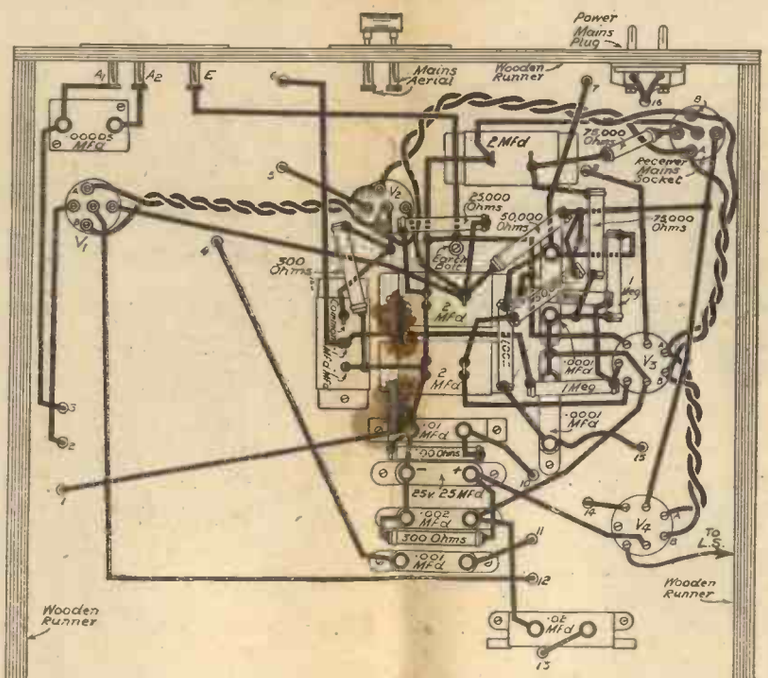


Top view of the A.C. Superhet.

Construction

As the coils, condensers, etc., are already assembled as a complete unit, the construction is reduced to a very simple operation. The valve-holders should be mounted first, then all the sub-baseboard components. Note very particularly the position of the

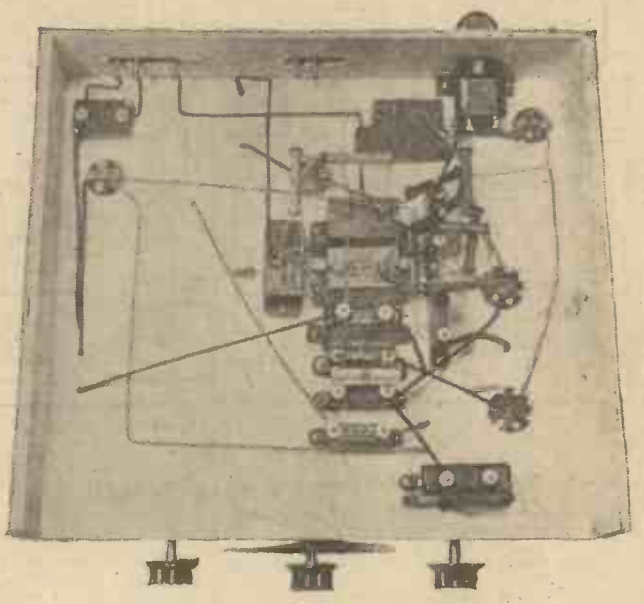




Top and sub-baseboard wiring diagram of the A.C. Superhet. The mains portion will be dealt with next week.

ERHET

ol, Duo - Diode - Triode
With Next Week



View of the sub-baseboard wiring.

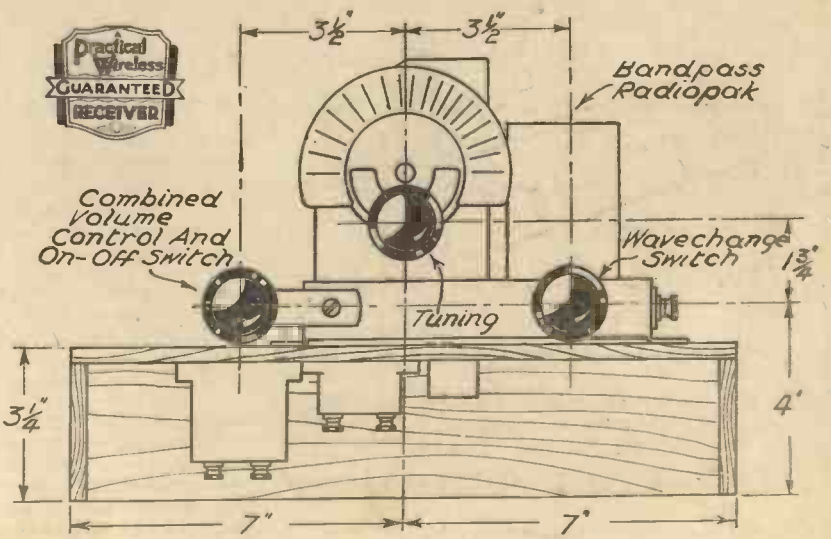
small .25 mfd. electrolytic condenser. It is essential that the negative terminal of this is joined to the common earthing lead. Although the chassis is of the metallized type it is provided with a separate earthing lead so that it is absolutely certain that a good earth return is obtainable. For this purpose two bolts will be seen in the chassis, and connections are made to these through the medium of soldering tags. There are a number of soldered connections, and in order to prevent trouble at a later stage, care should be taken to ensure that these connections are soundly made. As each joint is soldered, pull at it in various directions in order to make sure that it is not "dry soldered." Leave the band-pass unit until last in order to avoid the extra weight when turning the chassis about to make various connections. There are very few wires, and the wiring diagram will make all points quite clear. There are no difficult points in any part of the circuit.

The Mains Unit

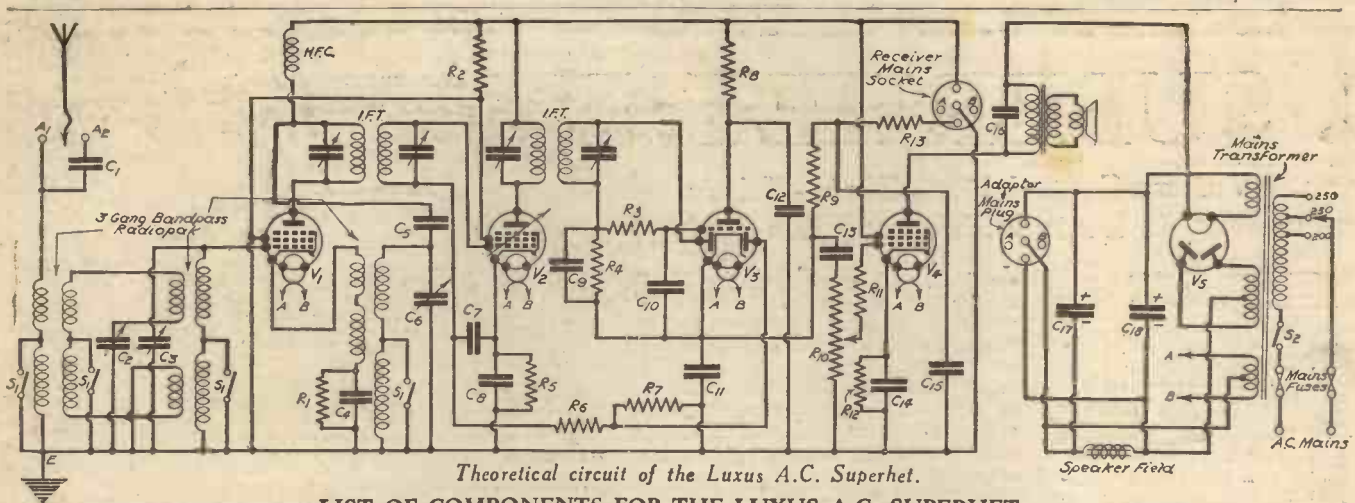
The mains unit should next be made up, this may be carried out from the theoretical, or you may wait for full details next week. There are one or two special points to be attended to, and, therefore, you should only undertake this if you are fully capable. Particular care should be paid to the connections to the pins of the connecting-plug in order to ensure that the correct potentials will be applied to the receiver when the chassis is connected. The flex from the on-off switch should be joined to the input sockets on the mains transformer in accordance with the voltage of the mains. It will be noted that a mains aerial socket strip is fitted to the experimental receiver, and the connections for this device will be described at a later date.

Testing Out

Plug the valves into the sockets in accordance with the markings shown on the wiring diagram, and test out the receiver before inserting it into the cabinet. Make certain that the switch is in the "off" position, and then connect to the mains. Switch on, and after an interval of about thirty seconds a faint hum should be heard from the speaker. Turn the volume control farther towards the right (clockwise) and then rotate the tuning dial until the local station is heard. On the original receiver it was found that the trimmers on the band-pass unit and the I.F. transformers required no adjustment whatsoever, but this may have been due to a lucky setting of the various parts, and each receiver should be tried in order to make certain that no adjustment is required. On no account rotate the trimmers as though you were winding up a clockwork mechanism. Only the slightest turn should be required in either direction, and it is best to set the volume control to a position where the station can only just be heard, and then adjust the trimmers to maximum volume. If any increase is obtained, reduce volume again on the volume control. Practically every worthwhile European station may be heard on this receiver, and the A.V.C. device will take care of any fading.



Front view showing control positions.



Theoretical circuit of the Luxus A.C. Superhet.

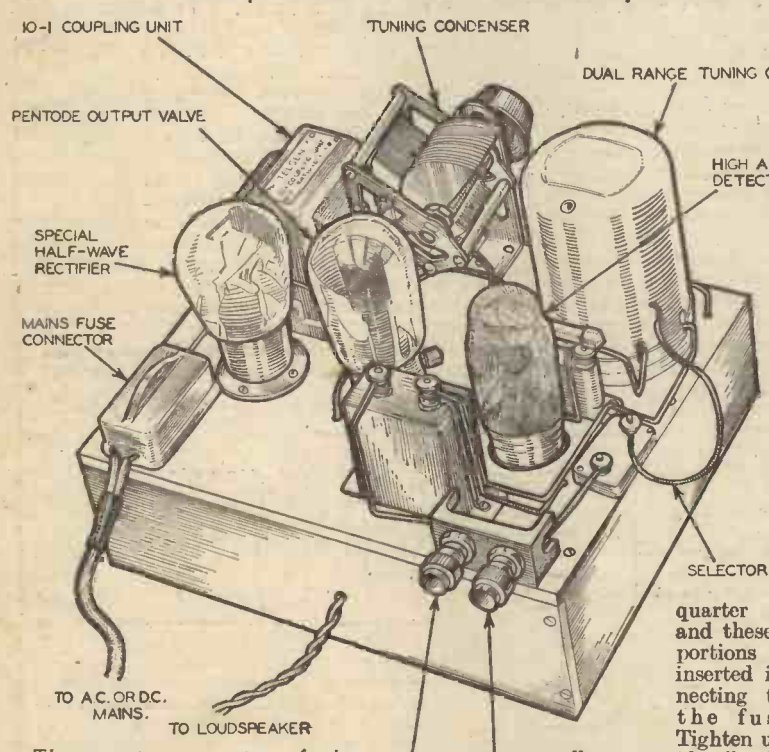
LIST OF COMPONENTS FOR THE LUXUS A.C. SUPERHET.

One Superhet Radiopak with 500,000 ohm Potentiometer (British Radiophone).
Two I.F. Transformers (110 kc/s) (British Radiophone).
One Aerial-Earth Socket Strip (Clix).
One Mains-Aerial Strip (Clix).
Three 5-pin, one 4-pin, two seven-pin chassis type Valve-holders (Clix).
One Screened H.F. Choke (Amplion).
Three 2 mfd. fixed Condensers, type 65 (T.C.C.).
One .1+.1 mfd. fixed Condenser, type 87A (T.C.C.).
One .02 mfd. fixed Condenser, type 25A (T.C.C.).
Two .01 mfd. fixed Condensers, type 80 (T.C.C.).
One .001 mfd. fixed Condenser, type 34 (T.C.C.).
Two .0001 mfd. fixed Condensers, type 34 (T.C.C.).
One .002 mfd. fixed Condenser, type 34 (T.C.C.)
One .25 mfd. Electrolytic Condenser, type 511 (T.C.C.)
One .00005 mfd. Fixed Condenser, type S (T.C.C.).
Two 8 mfd. Electrolytic Condensers (Dubilier).
Thirteen 1 watt Resistances: two 300 ohm, one 1,000 ohm, one 25,000 ohm, two 50,000 ohm, two 75,000 ohm, one 100,000 ohm, one 250,000 ohm, three 1 megohm (Claude Lyons).
One Mains Transformer, type 804 (Heayberd).
One Mains Connector, type F.15 (Bulgin).
One 5-pin Plug, type P.3 (Bulgin).
One Metaplex Chassis, 14ins. by 12ins. (Peto-Scott).
One Metaplex Chassis, 8in. by 12in. (Peto-Scott).
One Luxus Cabinet (Peto-Scott).
One Energized Speaker, type E.8, 2,500 ohms (Epoch).
Three Coils "Quickwyre" (Bulgin).
Screws, soldering tags, flex, mains plug, etc.
One S.P.4 Valve (Metallized) (Mullard).
One V.P.4 Valve (Metallized) (Mullard).
One T.D.D. 4 Valve (Metallized) (Mullard).
One Pen. 4V. (Mullard).
One 442 B.U. Valve (Cossor).

Further Notes on THE A.C.-D.C. TWO

FULL CONSTRUCTIONAL DETAILS WERE GIVEN LAST WEEK.

A Simple Universal Receiver Which May Be Used on Either A.C. or D.C. Mains



Three-quarter rear view of the A.C. - D.C. Two.

THE earth connection in this receiver runs from the condenser bracket, *via* the chassis, and a simple junction is thus made. Connection to the mains is obtained direct from the fuse-holder. For this purpose obtain a length of flex long enough to reach from the receiver to the nearest mains point, and fit a plug to the end. The opposite end should be bared for no more than a quarter of an inch, and these short bared portions should be inserted into the connecting terminals on the fuse-holder. Tighten up the screws well to avoid all risk of their being pulled out and so blowing the house fuse, and make certain that the switch on the receiver is "off." Flexible leads are provided for connection to the loud-speaker, and these are brought through a small hole in the rear of the chassis. A further short length of flex must be fitted to the positive supply for connection to the side terminal on the pentode valve-base.

Testing Out

Plug the special detector valve (D.130) in its holder, and the pentode (P.T.3) in the centre socket. The special half-wave rectifier (E.G.50) is then inserted in the remaining socket, and the aerial and earth joined to the two terminals bearing these markings. Connect the aerial flex to Terminal No. 8 on the coil, set the wave-change switch to medium waves, reaction at zero, and switch on the mains switch. Switch on the receiver, but do not be disappointed if you hear nothing from the speaker. The valves which are used take at the very least 30 seconds in order to heat up, and until this length of time has elapsed you will not even hear the faintest trace of hum from the set. If you are using D.C. mains, and nothing is heard after this period of time, it will be necessary to reverse the plug in the mains socket. On A.C. this does not apply, and failure to hear any sound after 30 seconds will indicate that something is wrong, either with the wiring or one of the components. The heaters of the valves may be seen to glow if the heating circuit is complete, and if the rectifier is glowing, you should also be obtaining the high-tension supply. The circuit is so hum-free that you may not realize that the set is "alive," and therefore, after the half-minute interval, the tuning dial should be slowly rotated until the local station is heard. It should be unnecessary to employ reaction, although this is very useful for strengthening weak or distant stations. These are the only two controls, so that there is nothing difficult in the handling of the receiver. The change from medium to long waves is accomplished by rotating the switch on the Telsen coil, and if you mount the small indicating plate which is supplied by the makers of this coil, you will not be in doubt regarding the band for which the receiver is adjusted. The flexible lead from the small .0001 mfd. condenser should be joined to terminal 6 or 8, whichever gives best results in your district.

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1 TELSEN Tuning Coil, Type W216	7 0
1 J.B. .0005 mfd. tuning condenser with slow motion drive, type 1046	7 6
1 TELSEN 10/1 coupling unit	12 6
1 R.I. Smoothing Choke, type D.Y.22	17 6
1 PETO-SCOTT specified Cabinet	15 0
1 set of Valves as specified	£2 11 9

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PETO-SCOTT D.C.—A.C. OAK CONSOLETTE. In Handsome Figured Oak Hand French Polished. Cash or C.O.D. Carriage Paid. **15/-**

As above but in the white, unstained and unpolished, 12/6.

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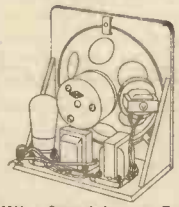
ALL THE RAGE

PETO - SCOTT "CLASS B" SPEAKER AMPLIFIER



KIT Complete Kit comprises B.V.A. Class B Valve, Peto-Scott Permanent Magnet Moving-Coil Speaker, B.R.G. Driver Transformer and Input Choke, Seven-pin Valve-holder, Peto-Scott Baffle and Baseboard Assembly, all necessary Wires, Screws and Plug-in Valve Adaptor, with full-size Diagrams and Assembly Instructions. CASH or C.O.D. Carriage Paid, £2/15/0, or Kit Complete with "Class B" valve. Send only **6/-**

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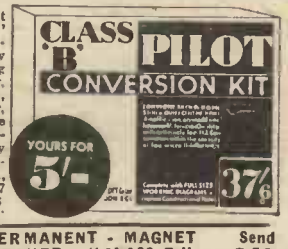

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By "PHOTON"

THE RADIO-GRAM.—TO BE OR NOT TO BE.

THE writer was recently asked to advise a friend on the purchase of a radio-gram. His advice was—Don't. This may come as a shock to those who have recently indulged their fancy to the tune of fifty guineas—perhaps more or perhaps less—in the acquisition of a large and imposing piece of furniture capable of "all the stunts," and which so far as the gramophone is concerned may be just as useful ten years hence as it is to-day, but which so far as concerns the radio side may be obsolete in twelve months time.

Speaking without a tinge of exaggeration, it is a mystery to the writer why the combined instrument has acquired such a vogue; one may pardon the *nouveau riche* for buying the latest and most expensive instrument with self-changing mechanism, the magazine of which his butler loads for him daily! He knows that if there should be something better next season he has only to put his hand in his pocket and have that, passing the previous year's model on to one of his dependants or poor relations; it may even do duty as a wedding present. But many of these expensive combination instruments are bought by those who can ill-afford the money and even make their purchase on the deferred payment system, or, as it is sometimes called, the "never-never."

The main disadvantage of the combined instrument has already been stated; a few changes in the broadcasting system—as, for example, one or two new giant stations, or technical improvements in the components that go to make up a wireless receiver—may render the radio reception part of the instrument obsolete. On the other hand, if instead of a single combined instrument the purchaser elects to go in for an electric gramophone as an entirely separate instrument, and keep his radio receiver for radio reception, he not only has two strings to his bow—that is to say neither instruments being temporarily indisposed will deprive him of entertainment—but also he can change or remodel his radio receiver to keep up to date at comparatively small expense. Also the instruments can be made to do duty in different rooms; or the electric gramophone may be taken away on a holiday, without occupying too much space in a small car.

It may be argued that any intelligent amateur could make the necessary modifications to the radio part of the combined instrument to bring it up to date; but these remarks are not directed to the intelligent amateur; he is rarely at sea or in the wrong, he can usually look after himself.

The writer would, by choice, subdivide the "electrical entertainment equipment" more completely. Namely, in his opinion, the speaker or speakers should be separate from the set or amplifier (this has been discussed in a previous "Photon" article). The receiving set should be a self-contained unit fixed where protected from cold and damp, and where there is easy access to an aerial. The gramophone and its amplifier are best separate but mounted by preference in a simple cabinet of portable construction which may also contain the speaker, so long as the latter is so placed as not to give rise to "pong." Since a two-valve amplifier is usually adequate, this trouble is not likely to be serious.

Although not an admirer of ordinary (mechanical) gramophone quality of reproduction, it seems a mistake to do away with the possibility of using the gramophone in the old-fashioned way; it is quite useful when trying a record over or listening to a linguaphone record, and it saves "juice." A cabinet gramophone or good portable with a pick-up added makes a perfectly good job, and more often than not is there awaiting conversion without a penny being spent. The writer has a gramophone dating from about 1912, with a pick-up added a few years ago, which so far as its function is concerned is doing as well as the most up-to-date and extravagant instrument; the records do not change themselves, it is true, but there are two aspects of that. The writer recently called on a friend who had just purchased a 100-guinea instrument; it was turned on, and it went on and on, record after record; an operatic selection was followed by a third-rate comedian, then a Beethoven sonata, and after that a "slap-stick" entertainment or a comic song. To put a self-changing record radiogram in cabinet complete into the hands of the average man who would buy such an article is in its results very like putting a Webley and Scott automatic into the hands of a small boy.

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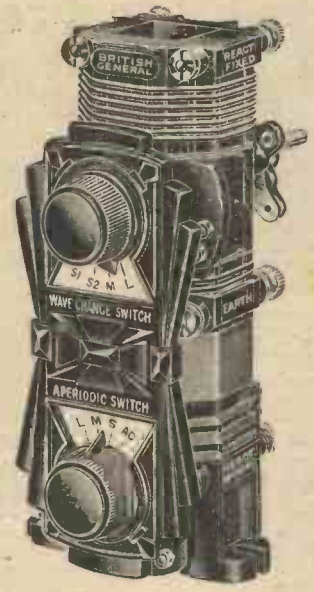

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THE BEGINNER'S SUPPLEMENT

HOW YOUR RECEIVER WORKS.—(Conclusion)

(*Continued from page 174, October 7th issue.*)

The Moving-coil Speaker

THE function of a moving-coil loud-speaker is somewhat different and can best be understood by making reference to the sectional sketch of Fig. 28. A powerful cylindrical magnet (which may be of either the permanent or energised type) is surrounded at one end by a coil of wire attached to a cone. The anode current is passed through the latter coil, which thus becomes what might be termed an air-core electro-magnet. Variations in current cause the coil's magnetic field to be strengthened and weakened in turn, with a result that the coil is attached towards, or repelled from, the permanent magnet. In this way the cone is set into vibration and creates sound waves corresponding exactly with the fluctuating currents passing through the coil.

Matching the Speaker and Valve

There is yet another point to consider. We saw in regard to the preceding valves that the impedance in their anode circuit must bear a definite relationship to the impedance of the valve, if maximum efficiency were to be obtained. The very same thing applies to the output valve and, generally speaking, the loud-speaker should have an impedance equal to twice that of the valve in the case of a triode, or something like one quarter in the case of a pentode. It is customary nowadays, however, for valve manufacturers to state the most suitable anode impedance under the heading of "optimum load." A little difficulty arises here, though, because the impedance of a speaker varies a good deal according to the audio frequencies with which it is dealing. For example, a fairly typical moving-iron speaker might have an impedance of 2,000 ohms at 100 cycles, and of so much as 5,000 ohms at 2,000 cycles; we must therefore assess the impedance at an average frequency such as 256 cycles (corresponding to middle C). This is obviously a compromise, but it is the best we can do, and as a result we are bound to sacrifice a little efficiency at frequencies higher, and lower, than the average. In practice, it is found that the losses introduced in this way are not very great and are usually less than those arising from other sources. Fortunately, the impedance of a moving-coil speaker does not vary to any great extent with changes in frequency, and thus its response to the whole of the musical scale is more uniform.

Avoiding "Saturation" of the Speaker Magnet

There are objections to connecting a speaker directly in the anode circuit in the manner shown in Fig. 26, and it is becoming more and more usual to feed it in some other way. The main objection in so far as moving-iron speakers are concerned is that the steady anode current is often so great as to "saturate" the permanent magnet, making it incapable of responding properly to current fluctuations. When this occurs the speaker becomes less sensitive and also produces serious distortion.

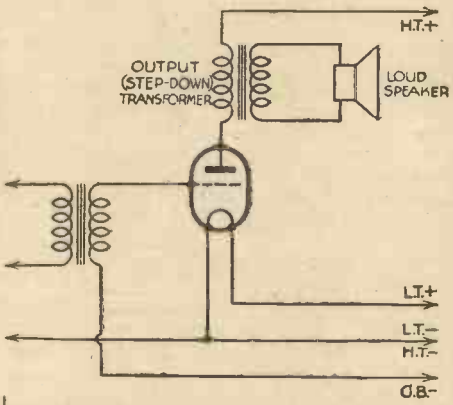

Fig. 30.—Matching the speaker and output valve by means of a step-down transformer.

Choke-capacity Coupling

The simplest way of overcoming the latter difficulty is to connect the speaker on the "choke-capacity" system illustrated in Fig. 29. The choke now carries the steady high-tension current, but prevents the fluctuating audio currents from passing through it. They are therefore diverted through the fixed condenser C (which should have a capacity of from 1 to 4 mfd.) to the loud-speaker. Thus the loud-speaker has to deal only with the comparatively small audio currents, which it can do without there being any danger of magnet saturation. In using an arrangement such as this, both the choke and speaker should have impedances equal to the optimum load of the output valve.

An Output Transformer.

Another difficulty which presents itself when a moving-coil speaker is employed is that it is impracticable to make its impedance sufficiently high to "match" any type of valve when connected directly in the anode lead, or even through an ordinary choke and condenser. As a matter of fact, most present-day moving coils have an impedance of from 2 to 20 ohms, so that if they were placed in either of the positions mentioned they would give practically no response to the signals. The solution to this difficulty is found in the employment of an output step-down transformer wired up as indicated in Fig. 30. The transformer has a larger number of turns on its primary than on its secondary winding, and as a result the primary impedance is much greater than that of the secondary. For example, suppose the secondary were made to have an impedance of 10 ohms and were connected to a moving-coil speaker of similar impedance, the primary could be made to match the output valve by suitably proportioning its number of turns. Actually the primary impedance is proportional to the *square* of the turns ratio, so that if the above transformer had 20 times as many turns on its primary as on the secondary, its primary impedance would be equal to 20 squared multiplied by 10, or 4,000 ohms. It can thus be seen that any loud-speaker may be matched to any output valve by means of a suitable transformer. By reversing the above calculations we get the equation:—Transformer Ratio is equal to the square root of the Optimum Load of the Output Valve divided by the Impedance of the Speaker, or in simpler terms:

$$\text{Ratio} = \sqrt{\frac{\text{Optimum Load.}}{\text{Speaker Impedance.}}}$$

This particular subject was fully dealt with on page 332 of PRACTICAL WIRELESS, No. 7, under the heading, "The Loud-Speaker and the Output Stage," so there is no need to pursue it further in this article.

We have now followed the path of a signal from the time it reaches the receiving aerial until it emerges from the loud-speaker in the form of sound, and I hope that the explanations given will have been of assistance if only because they form a starting point for a further study of the principles upon which our receivers work. Even though the subject has been treated as briefly as possible it has required the expenditure of some seven thousand words to explain what happens in a simple wireless receiver during the tiniest fraction of a second.

TABLOID TECHNICALITIES

2.—AUTOMATIC GRID BIAS.

WHEN a current flows through a resistance a difference of potential occurs across it. The value of this P.D. is ascertained by multiplying the ohmic value of the resistance by the amperage of the current. This principle may be turned to account in order to provide the bias necessary for valves operating either as H.F. or L.F. amplifiers. In the case of valves of the indirectly-heated type, the grid is connected to the negative of the high-tension supply, and the cathode is made positive in respect to the grid by the amount of voltage required to negatively bias the grid. The anode current of the valve is therefore passed through a resistance which is connected in the cathode lead. With battery-operated receivers the resistance is joined between the H.T. negative terminal and earth. In this case the total anode current of the receiver must be used in working out the value of the resistance, and not the anode current of the individual valve. Where more than one valve has to be biased the resistance may be provided with tapping points.

For the SHORT WAVE ENTHUSIAST

Points to be Borne in Mind in Order to Ensure Maximum Results

By K. E. BRIAN JAY

THE screen-grid valve as a detector has become increasingly popular in broadcast receivers lately, not only in superhets, but also in simpler arrangements, as several excellent designs which have appeared in this paper have testified, but its merits in this position have been less widely acclaimed for short-wave receivers. Actually, the screen-grid valve makes a very sensitive short-wave regenerative detector, where it has several advantages over the orthodox triode. The main difficulty in putting this type of valve to work is the necessity for a very high impedance load in the anode circuit; in order to obtain maximum amplification from any valve the load in the plate circuit must have an impedance several times greater than the internal resistance (anode impedance) of the valve, but the internal resistance of the screen-grid valve is so high (anything from 300,000 to 1,000,000 ohms) that it is difficult to contrive a load of sufficiently high impedance to get the theoretical maximum output without at the same time greatly reducing the H.T. voltage available at the anode owing to the voltage drop across the load. Choke coupling offers the best solution, since a very high impedance can be obtained with a small D.C. resistance, provided the inductance of the choke is high enough; a 300-henry choke, for example, has an impedance to currents of 5,000 cycles frequency of about 940,000 ohms. However, this form of coupling has the disadvantages of high cost of the choke and no voltage step up obtainable, as with a transformer. Unfortunately, transformer coupling in its simplest form cannot be used efficiently because even the best transformers have too low a primary inductance; the only way of overcoming this defect is to use either choke or resistance feed of the transformer. Choke feed is best, because of the small voltage drop across the choke, but it is, of course, expensive; however, for those who would like to try it, a circuit diagram is given in Fig. 1. Ch. is the choke, coupled to the transformer by the .01 mfd. mica condenser C_2; R_3 is a 10,000 ohm decoupling resistance, and C_3 a 1 to 2 mfd. decoupling condenser.

Quite good results are obtainable by using an ordinary L.F. transformer as a choke, the two windings being joined in series; it is necessary to ensure that the windings are in the right sense or their inductances will cancel instead of augmenting each other; the terminals P and GB are joined together, and the remaining two regarded as the terminals of the choke; if the amplification is not satisfactory, the connections to one of the windings should be reversed. Fig. 2 shows the resistance-fed arrangement in which the choke Ch. is replaced by the resistance R_6; a slight modification to the transformer connections is also suggested in this circuit, which gives an increased step-up ratio over the Fig. 1 arrangement; this connection is applicable to either method of coupling. The higher the resistance of R_6 the nearer the load impedance approaches the theoretical best, but its value is limited by the H.T. voltage available; with 120 volts no great advantage was noticed by going beyond 100,000 ohms, although some people may prefer to use as much as 250,000 ohms; actually very good signals have been obtained with as little as 50,000 ohms. Either of the foregoing circuits may be modified to simple choke or resistance coupling by removing the transformer and connecting C_3 straight to the grid of the L.F. valve, the bias being applied by a 2 megohm grid-leak. The author's preference is for resistance coupling, because it seems quieter and less prone to threshold howl; but this may merely be an idiosyncrasy of the particular valves used.

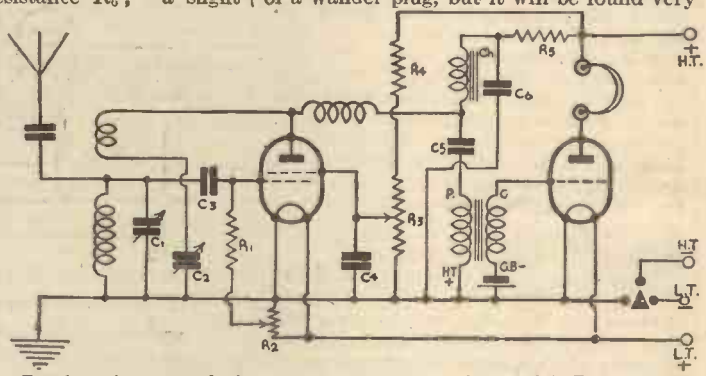

Fig. 1.—A very good short-wave circuit using choke fed L.F. coupling.

Voltage Adjustment

Turning now to the detector itself, the connections are seen to be the same as for a triode detector, except for the screen grid; this is supplied by a potentiometer consisting of a 50,000 ohm fixed resistance R_4, and the 50,000 ohm variable potentiometer R_5, the latter being by-passed by the mica or non-inductive condenser C_4, whose capacity may be anything from .01 to .1 mfd. It may be thought that the variable potentiometer is unnecessary when using batteries for H.T., since the voltage can be quite closely adjusted by means of a wander plug, but it will be found very well worth while to have a continuously variable source of screen-grid voltage, since the performance depends very largely on the nice adjustment of this potential. Note that a three-point filament switch is provided to prevent the screen-grid potentiometer from running the H.T. battery down when the set is switched off, as it would do if the ordinary two-point switch was used. The screen-grid volts should be kept low, especially if resistance coupling is used, because it will be found that as they approach the same value as the plate the tendency to thres-

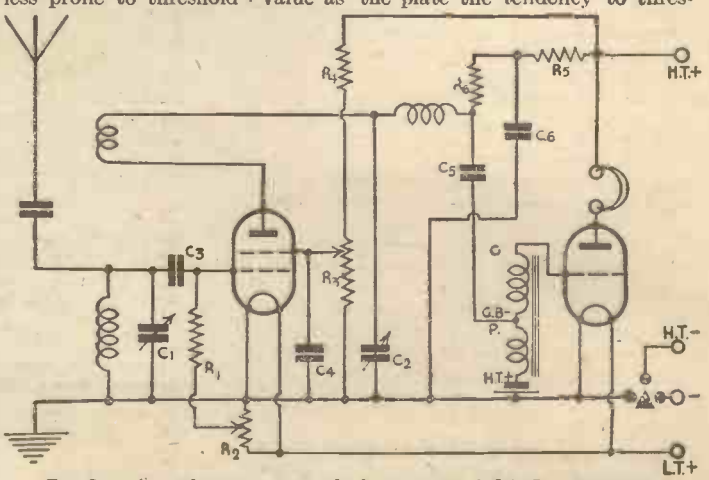

Fig. 2.—A similar circuit in which resistance fed L.F. transformer coupling is used.

hold howl will be accentuated, until a point is reached where the valve refuses to oscillate. The voltage needed will be between 20 and 50, depending on the H.T. voltage and the value of the resistance, a 100,000 ohm resistance limiting the screen volts to about 30 and a 250,000 resistance to about 20.

Reaction Control

The method of reaction control shown in Fig. 1 is the usual modified Reinartz arrangement, while Fig. 2 shows the slight alterations needed to try out throttle control. Either method is very satisfactory, a suitable value for C_2 being .0002 mfd.; it will be noticed that there is very little detuning caused by the reaction control on wavelengths above about 35 metres, and probably careful screening would give similar immunity on very much shorter waves. Variation of the screen-grid potential offers another very smooth adjustment of reaction; in this case R_3 becomes the reaction control, and C_2 is replaced by a fixed condenser of from .0002 to .0003 mfd. capacity. Resistance control of reaction by a variable resistance in the H.T. lead to the plate has also been tried, by making R_5 a 50,000 ohm variable component, but it was not found easy to obtain good control over a large wavelength range without frequent adjustment of the screen-grid potential; smoothest control by this method was obtained with a coupling resistance of 250,000 ohms, but the method was not at all well behaved when choke coupling was used.

Coil Sizes

With regard to the coil sizes it will probably be found that an extra turn is necessary on the reaction coil compared with the coil used with a triode detector, and that the longest wavelength obtainable with a given grid-coil will be slightly reduced owing to the smaller grid-filament capacity of the screen-grid valve. Reaction control will be found very smooth, and probably the 400-ohm potentiometer R_2 will not be needed to obtain good results, but it is just as well to have it "in case." If back lash shows up in the reaction adjustment a slight reduction of the screen-grid potential will remove it. Any screen-grid valve should be satisfactory, preference being given to metallized types; if instability is experienced with valves of high mutual conductance, increasing the value of the decoupling resistance R_5 and possibly the condensers C_4 and C_6 should eliminate it.

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2	3 6	4 0	9 0	13 0
3	5 0	6 0	—	—
4	5 6	7 0	17 6	25 0
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Our Views on Receivers

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The new Philips receiver Type 634A

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It is often imagined that a superheterodyne is essential if one is to obtain the extreme degree of selectivity demanded by the present broadcasting conditions—the results obtained from the set under review completely and entirely disprove this idea. Although the "Superinductance" set has been in use for some weeks and has been tested on aerials of various types and lengths, we have not at any time found a single station which could not effectively be eliminated by a movement of the tuning dial equivalent to the recognised separation of 9 kilocycles.

Great Sensitivity

But that is not the only feature of the set, for its sensitivity and station-getting powers are more than remarkable; even when used on a 15ft. indoor aerial we found not the slightest difficulty in bringing in twenty-odd stations at real "programme" strength. Testing on a reasonably good outside aerial 25ft. high, we were able to receive every worth-while European transmitter at such a volume level that it was of true entertainment value. During daylight hours, when long-distance reception is impossible with most receivers, stations can be received all round the dial.

Automatic Fading Compensation

Yet another praiseworthy feature is the inclusion of an automatic fading compensation device. This is similar to automatic volume control, but does not pretend to equalize the volume from all stations. Instead, its object is to keep the volume level constant between comparatively narrow limits. In this it succeeds entirely, and we found that such stations as Fécamp, Rome, and Barcelona, which frequently fade out entirely in the district where the set was tested, were maintained at practically uniform strength for hours on end. Unlike what happens with most A.V.C. equipped sets, there was no noticeable trace of varying "mush" to counteract the benefit gained by the anti-fading control.

Good Quality and Absence of "Background"

The quality of reproduction leaves nothing to be desired, and is better than that afforded by any type of five-valve receiver we have had in use. Also, the entire absence of second channel interference (which is considered as a necessary evil of the superhet) is a strong point in favour of the "Superinductance" and goes a long way towards making listening the real pleasure which it should be. The set in question gives an output of just under two watts, and the tone is full and well balanced. Incidentally, however, there is a three-position tone control provided so that the pitch can be varied to suit individual tastes. When taking advantage of the full output—and this is ample to fill a small hall—we found reproduction most pleasing when the control was in the "bass" position, but on reducing volume to that normally required for "domestic" purposes reproduction was more "brilliant" with the control in the "treble" position. It will be quite clear from this that the tone control is a very useful fitting and one which will be appreciated by users of the set.

Simple Control

As can be seen from the illustration on this page, the arrangement of the tuning controls is very neat, and there are only two knobs on the front of the cabinet; the tone control, which is only required occasionally, is at the back. The right-hand knob operates the condenser scale when rotated, and by pulling it out or pushing it in, the long or medium wavebands are brought into use.

Novel Tuning Scale

The tuning scale is one of the most important features of Philips receivers and is quite unique. Actually, it consists of two separate scales which rotate together, but at different speeds. The inner scale is marked off on the outer edge into sections marked from "A" to "L." On a concentric circle wavelengths from 800 to 2,000 metres are indicated in every hundred metres. On a third concentric circle the wavelengths from 200 to 600 metres are shown, in this case 50-metre divisions being used. A mask, which is operated by pushing or pulling the tuning knob, covers the range of wavelengths not in use. The outer scale serves as a micrometer and is divided up into a number of 100-degree sectors, one of which covers every wavelength division of the inner scale. Thus, whilst the inner scale is moved from "A" to "B" or from "400" to "450," the outer one moves through 100 degrees. By this system the dial readings for any station can be logged with extreme accuracy. As an example of the readings obtained it might be mentioned that the setting for London Regional is E.21, and for Rome, H.25. Besides being dead accurate, this system has the distinct advantage that it can never become obsolete no matter what wavelength "shuffles" might be made by the broadcasting authorities. To facilitate the location of stations the makers supply a card with the receiver with the dial readings for more than a hundred stations. The card fits very conveniently into a slide formed between the two feet on the base of the set; it is normally out of sight, but can be withdrawn in a second by means of a silk cord attached to it.

We should mention in passing that the dial readings for any station are not affected in the least by a change in the aerial arrangement and hold good no matter what the conditions under which the set is operated.

Sensitivity Switch

The left-hand knob on the set operates as a combined on-off switch, volume control, and noise suppressor switch. By turning it through the first few degrees of rotation the mains switch contacts are "closed," whilst further rotation produces an increase in volume. When this knob is pushed in, the noise suppressor arrangement is in circuit, and although the set is not quite so sensitive, any background noises which might be present when using the receiver "full out" are entirely removed. With the switch in this position every station which is tuned in can be relied upon to provide really good reproduction perfectly free from any trace of hiss or crackles.

By pulling out the knob the sensitivity of the instrument is increased and a greater number of stations can be tuned in. But if atmospheric conditions are not good there is more likelihood of "noises" being heard. As a matter of fact, we found that any station that was required could be heard perfectly when the set was working in its less sensitive condition; this shows the very adequate "reserve" that this instrument possesses. On the other hand, it was found that the background noises that could be heard when the set was operating at its peak efficiency were very slight indeed, being even less noticeable than those frequently found with a mains receiver of far less powerful design than this one. We would, in fact, go so far as to say that the "Superinductance" instrument proved itself to be remarkably free from parasitic noises of every type.

An Interesting Circuit

To the more technically-inclined reader the circuit arrangement will be of especial interest, due to the fact that it is right up to date and incorporates several novel features. Briefly, it comprises four valves and a rectifier; the first two are Mullard S.4VB screen grids, and they are followed by a Mullard S.D.4 single diode-tetrode detector-amplifier, and a Mullard PM24A power pentode. A Philips type 1821 valve is employed as a full-wave rectifier. A band-pass tuner is used in the aerial circuit, whilst specially-designed H.F. transformers couple together the screen-grid and detector valves.

In order to prevent "sideband cutting," which would spoil the quality of reproduction, the third and fourth tuned circuits are deliberately detuned by a predetermined amount from the true resonant frequency.

Automatic Fading Compensation

Automatic fading compensation (actually a form of A.V.C.) is obtained by applying the bias voltage developed by the diode-tetrode detector to the grids of the preceding valves. This scheme works very well in practice, and we found that fading was almost entirely overcome.

Provision is made for connecting a pick-up in the detector circuit, and sockets for this purpose are provided on the back of the receiver. The normal volume control operates just the same, whether gramophone reproduction or radio reception is being enjoyed.

Uniform Sensitivity

One very important feature of the Philips "Superinductance" circuit is that the receiver is designed to be equally sensitive at every point on the tuning range. This unusual but laudable result is achieved by ganging a potentiometer with the tuning condenser; it is so arranged that the stage gain of the H.F. stages is gradually and automatically reduced as the wavelength is decreased.

Another unusual point that strikes one on examination of the circuit is that there is not a single smoothing choke in the power supply system; the smoothing—which is as efficient as anyone could wish for—is effected entirely by a carefully arranged network of resistances and condensers. The method is certainly ideal, although it has to be scientifically worked out to enable it to function so satisfactorily as it does in the case in question.

We would conclude this report by emphasizing that the Philips 634A "Superinductance" receiver is perfectly safe, and gives astoundingly good results. Moreover, at the price of 16 gns., it represents as good value as any instrument of comparable quality on the British market.

A D.C. Version

It should be mentioned that Messrs. Philips produce a D.C. version of the same receiver, styled the 634C, and this is claimed to be the finest receiver ever produced for use on direct current mains. The same general circuit arrangement is followed as in the A.C. model, but to enable the same signal output to be secured two power pentodes are used in parallel for the output stage.

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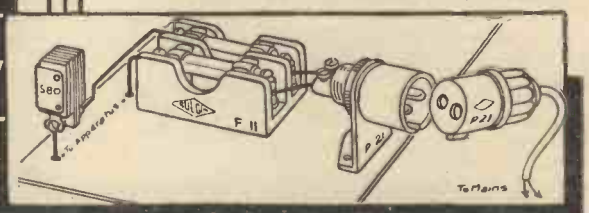

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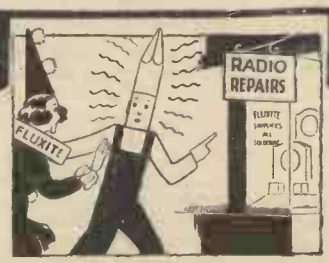

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CLASS B PROBLEMS CLARIFIED

A practical article in which this method of amplification is simply explained. By W. B. C. Richardson

OF the many recent developments in the radio world, there is perhaps none which has caught the popular imagination more than Class B amplification.

During the past few months much has been said about it in the radio Press, while many designs for receivers employing this form of output have appeared. This has all contributed to the interest it has aroused, but nevertheless, as with all new ideas, there is still some doubt in the minds of many as to its exact nature and application.

At the recent exhibition at Olympia there were many inquiries to confirm this. Questions as to quality, H.T. current consumption, use of eliminators, etc., were frequently being made. Therefore, for the benefit of those who are still rather hazy on the subject, we shall endeavour here to make clear the exact merits and demerits of the system.

Efficiency the Keynote

Primarily, of course, the object of class B is to provide generous volume from a battery set for a modest consumption of H.T. current. "Mains volume at battery cost" is a slogan which describes the system very aptly.

In order to answer some of the queries just referred to let us consider a typical three-valve battery receiver with one screen-grid valve, detector, and a power or pentode output valve, and see what difference it would make to add Class B. As it is, a set of this description will consume about 10 to 15 milliamps of high-tension current. This consumption will be to all intents and purposes constant. That is to say, the set will use the same amount of current whether the signals received are loud or quiet. The output of such a receiver may be something like 100 or 200 milliwatts according to the type of output valve used. This will give quite sufficient volume for a small or medium-sized room.

If greater signal strength is desired, it is no use trying to obtain it by screwing up the reaction control. Admittedly, this may give a bigger voltage swing to the grid of the output valve, but owing to the fact that the output valve will be worked beyond the straight portion of its characteristic curve the signals will be distorted. This is quite apart from any distortion introduced in the earlier stages. The total sound emitted may be slightly greater, but it will be a noise rather than a faithful reproduction of the items being broadcast.

Apart from Class B, the usual remedy in such a case would be to add another L.F. stage, using a super-power valve. This would, of course, increase the undistorted output. However, the total high-tension current consumed would be increased by that taken by the additional valve. It would now be perhaps, 20 or 30 milliamps. This would be all the current flowing even during pauses in the programme. It is something like having to run the engine of a car "all out" whether the car is going fast, slow, or even standing still. Obviously, this arrangement is not efficient when you compare the power fed in with the power given out.

On the average there are only short periods in the programme when the full power is required. Nevertheless the full power-handling capacity must always be available because of these periods.

H.T. Current Proportional to Signal Strength

With Class B, this wastefulness is largely overcome because the anode current of the most extravagent of all the valves in the set, namely the output valve, is proportional to the signal strength. In place of the super-power valve, we use a special Class B valve which consists of two complete valve elements mounted in one bulb. It is really two valves in one. They are connected in push-pull as shown below. They are high amplification triodes. Being connected thus in opposition means that when an alternating current is applied to their grids, one valve operates during one half-cycle, and the other during the other half-cycle. Before any signal arrives, the anode current through each valve is very low, but on applying a fluctuating voltage to their grids the anode current of each valve will rise alternately. During one half-cycle the anode current in the one valve rises and falls while the other remains at its quiescent figure of about 1½ or 2 milliamps. During the other half-cycle the anode current of the other valve rises and falls and the first valve remains quiescent.

It is clear that with this system the total anode current of the Class B valve is proportional to the signal strength. At zero grid volts (as when no signals are being received), it is only about 3 or 4 milliamps, whereas for a large grid swing (corresponding to a strong signal), it rises to a very high figure. In this way it is possible to obtain a *peak* output of 1.5 to 2 watts, while the *average* anode current is comparatively low. Actually during the loud passages the anode current of the Class B valve may rise to 40 or 60 milliamps, but, as previously stated, in the whole programme these passages are comparatively few. There are many less heavily modulated periods, and also a great number of definite pauses when only the quiescent current of a few milliamps is flowing. This is why the *average* anode current is quite modest.

Now let us see what the average anode current of the whole set is going to be. Firstly, there is the screen-grid valve taking, say, 5 milliamps plate current, plus ½ milliamp on the screen. Then comes the detector using about 2 milliamps. Next the first L.F. valve, or as it is called in the case of Class B, the "driver" valve. The type of valve used here depends on the particular Class B valve chosen. These latter are now made in two types. The smaller or economy type gives an output of about 1½ watts, and needs a driver valve of the H.L. type to precede it, while the larger type gives 2 watts output and requires a small power valve as a driver. Assuming that we use the H.L. valve, that will take something like 1½ milliamps. Lastly comes the economy Class B valve, the average consumption of which will be about 5 or 6 milliamps. The total consumption of the set, therefore, will be of the order of 15 milliamps, a figure which is well within the capacity of the ordinary double size H.T. battery. Using the larger output Class B valve with its appropriate driver, so as to obtain a 2 watts output, will increase the total consumption to about 20 to 25 m.a.

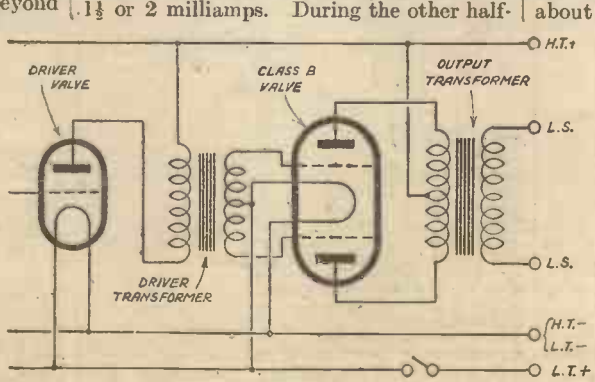

Diagram showing how a Class B valve is connected up.

Battery Eliminators and Class B

From the above it will be seen that as regards H.T. consumption the Class B arrangement compares very favourably with the old S.G., Det., and 2 L.F. arrangement, while as regards output it is definitely superior. In other words the efficiency of Class B is greater.

That this efficiency is due to the fact that the anode current of the Class B valve varies in proportion to the signal strength immediately brings us to the question of using battery eliminators with this class of output. Many constructors

(Continued on facing page)

(*Continued from previous page*)

having battery sets working from eliminators have asked if it is possible to change over to Class B and still use their eliminators. In some cases (not all) the answer is "No!" Since the anode current fluctuates over such a wide range the voltage of the eliminator will rise and fall. It is a simple case of the working of Ohm's law. The greater the current, the greater is the voltage drop. The average small eliminator is rated to supply about 25 milliamps, whereas the current taken by a Class B receiver may rise at times to 60 or 70 milliamps. During these periods the voltage of the eliminator would drop very considerably and frightful distortion would result. It might be thought that the use of a larger eliminator, one rated at say 60 milliamps, might solve the problem, but here again a moment's reflection will show that fluctuations of voltage will still occur. For instance, when the receiver is in the quiescent state with a low current consumption the H.T. voltage will *rise* to an abnormal figure.

The Question of Economy

If we consider the peak output obtainable compared with the average H.T. current consumption of Class B, there is no doubt that the system is economical, but at the same time we must not overlook the fact that the fullest advantage is only to be obtained when the system is fully extended. If only moderate volume is required there is no object in installing Class B. In fact, a single L.F. stage employing a high efficiency pentode will probably give all that is desired. A change to Class B would mean the scrapping of the pentode and the purchasing of both a driver and a Class B valve besides a driver transformer and output transformer. If mains volume is required then Class B is the best proposition, but on the other hand it will not bring up very weak stations. It does not take the place of an extra H.F. stage.

Regarding quality of reproduction. This is of a high order especially when the system is fully extended, but some distortion is noticeable on weak signals or during periods of only slight modulation. In this connection it should be noted that a run-down H.T. battery can cause considerable distortion owing to its high internal resistance. This causes a large voltage drop during the loud passages.

Matching the Speaker

One point affecting quality is the correct load for the output. The majority of designs for Class B receivers include an output transformer or choke for matching the output valve and the speaker, but in some cases circuits are published which do not include either of these components, the valve being connected direct to the speaker. In this case the receiver is intended to be used with a speaker with special tappings for Class B. This is, of course, specified by the designer along with the other components. The W.B. Microlode is an example of such a speaker. This fact is mentioned as some readers might be tempted to build up such a receiver and, instead of buying the specified speaker, to attempt to work it from an old speaker they have by them. Obviously the valve and speaker would not be matched and distortion would result. If it is particularly desired to retain an old speaker then the correct procedure is to use a suitable Class B transformer or choke.

One reason why a speaker with a high resistance (not high inductance) should not be connected directly across the output is because the variations in anode current with Class B are much greater than with ordinary circuits. A high resistance in the anode circuit means a large voltage drop during the heavy current or loud passages compared with a small drop during quiet passages. This naturally tends to reduce the anode current during the loud parts and increase it during the quiet parts, so tending to bring the volume to one monotonous level. This is why output chokes and transformers for Class B are designed with low resistance windings.

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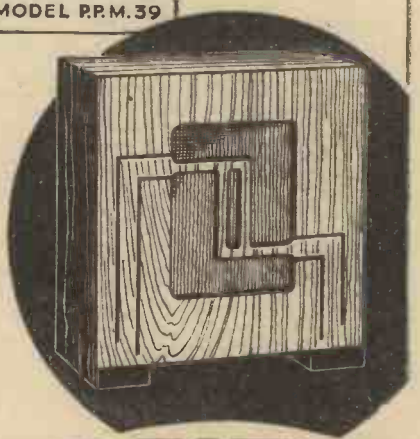

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By O. C. UHTHOFF

The Why and the Wherefore of Measuring Resistances.

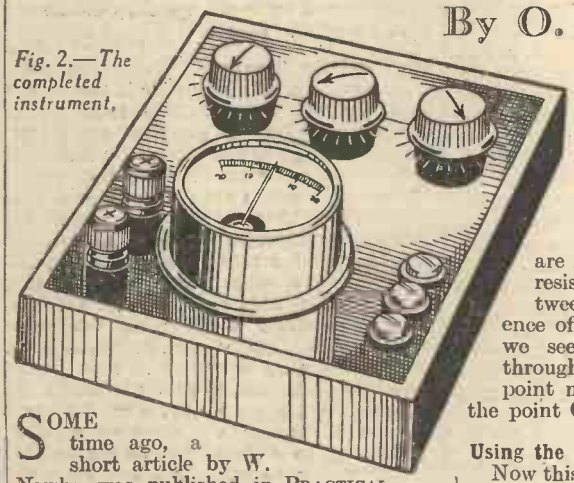


Fig. 2.—The completed instrument.

SOME time ago, a short article by W. Newby was published in PRACTICAL WIRELESS, which described a simple piece of apparatus for measuring unknown resistances. It was stated that it was based on strictly scientific principles. Wouldn't most of you who do not understand these principles welcome a simple explanation of them? The accompanying diagram, Fig. 1, shows the theoretical circuit of the above-mentioned apparatus, which is known as Wheatstone's bridge. When the current is switched on, a position somewhere along the resistance XZ can be found, such that when the sliding contact is placed there, no current will flow through the galvanometer G. Why this is so I am going to try to explain in as simple a manner as possible.

Suppose we have fitted up the apparatus, and have found that at a point Y no current flows through G. It should be mentioned at this point that G corresponds to the earphones in the apparatus, XZ to the resistance winding of the potentiometer, XO to the unknown resistance, and OZ to the known fixed resistance. Some of the current will flow through the circuit XOZ, and the rest will flow through XYZ. Further, the current flowing through R_1 will have the same value as that flowing through R_3; and the current flowing through R_2 will have the same value as the current flowing through R_4. This is, of course, only true when the slider is set at the point Y.

Ohm's Law

Now when a current flows through a resistance, a voltage exists between its ends, and from Ohm's law it is seen that this voltage drop is equal to the product of the current flowing through the resistance in amps, and the resistance in ohms. Ohm's law is usually written $I=\frac{E}{R}$ The result above is obtained by multiplying both sides of the equation by R, which gives E, the voltage drop, $=RI$, the product of the resistance and the current. Since some current flows through XOZ and some through XYZ, the voltage drop across the circuit XOZ must be equal to the voltage drop across the circuit XYZ, as the extremities of these two circuits are in electrical contact of negligible resistance. A current will flow between two points if there is a difference of potential between them; thus we see that since no current flows through G at the setting Y, the latter point must be at the same potential as the point O.

Using the Bridge

Now this is where the mathematics comes in, but it is quite simple to follow.

Let the current flowing through R_1 and R_3 be I; and let the current flowing through R_2 and R_4 be I_2.

We have seen that O and Y are at the same potential, thus the voltage drop along R_1=the voltage drop along R_2, because the other ends of R_1 and R_2 are at the same potentials.

$$\therefore \text{From Ohm's law, } \begin{matrix} R_1I_1=E_1 \\ R_2I_2=E_1 \end{matrix}$$

where E_1 is the voltage drop in question. Since both the left-hand sides are equal to E_1, they are equal to each other,

$$\therefore R_1I_1=R_2I_2$$

Dividing both sides by I_1R_2, we get

$$\frac{R_1}{R_2}=\frac{I_2}{I_1}$$

By exactly similar reasoning, we also get the result

$$\frac{R_3}{R_4}=\frac{I_2}{I_1}$$

Since both the left-hand sides are equal to $\frac{I_2}{I_1}$, we get

$$\frac{R_1}{R_2}=\frac{R_3}{R_4};$$

or, multiplying both sides of the equation by R_2,

$$R_1 \text{ (unknown resistance)}=\frac{R_2\times R_3}{R_4}$$

(*Continued on page 224*)

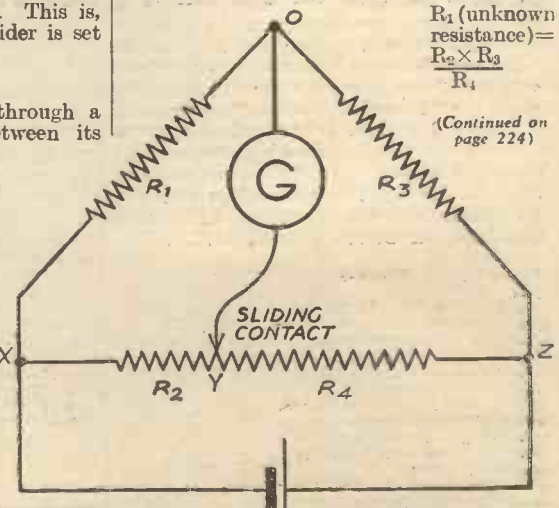


Fig. 1.—The theoretical circuit of the bridge.

RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

AMATEUR TELEPHONY TRANSMISSION ON 5 METRES

Amateur stations G6KA and G5NC are conducting nightly telephony transmissions on the 5-metre wave-band, with inputs of 15 and 10 watts respectively. The times of the transmissions are as follows:—

G6KA—23.00 to 23.30 G.M.T.
G5NC—23.30 to 24.00 G.M.T.

Reports on these transmissions will be extremely welcome, particularly as they are being carried out after dark. Would any listener hearing the above stations kindly report to G6KA, c/o The Incorporated Radio Society of Great Britain, 53, Victoria Street, London, S.W.1, and in respect of G5NC, to H. Osborne, 77, Barrett Road, Walthamstow, London, E.17. All reports will be duly acknowledged.

THE BEC RADIO SOCIETY

This Society commenced a new session on Thursday, September 28th, 1933, and extends a cordial welcome to all new technical and non-technical members. The syllabus for the coming session includes instructive and interesting weekly lectures, demonstrations, debates, and reviews on new apparatus, etc., by qualified radio engineers and representatives of leading radio houses, experiments in television, and the formation of a short-wave receiving and transmitting section, and visits to places of appropriate interest. Meetings are held every Thursday, at Bec School, Beechcroft Road, London, S.W., from 7.45 to 9.45 p.m. The fee for the term (twenty-six weeks) is 5s. For further particulars apply to The Hon. Sec., Mr. A. L. Odell.

BURTON-ON-TRENT AMATEUR RADIO SOCIETY

At the meeting of the above Society, held on Tuesday, September 19th, at the Wheatsheaf Hotel, Station Street, Mr. C. A. Bradbury, BRS 1066, gave a very interesting talk on his experiences on the short waves. He explained how he caught the DX fever and built a three-valve S.W. receiver; since that day he has never looked back, having heard in all eighty-seven countries in all corners of the world. After a very interesting talk various questions were asked by members, and these were ably answered by the lecturer. The Society holds its meetings on the first and third Tuesdays of each month, and anyone interested is assured of a cordial welcome at the above address. Full particulars of membership, and a syllabus of lectures, can be obtained by application to the Hon. Secretary, W. A. Mead, G5YY, 189, Burton Road, Burton-on-Trent.

INTERNATIONAL SHORT-WAVE CLUB (LONDON)

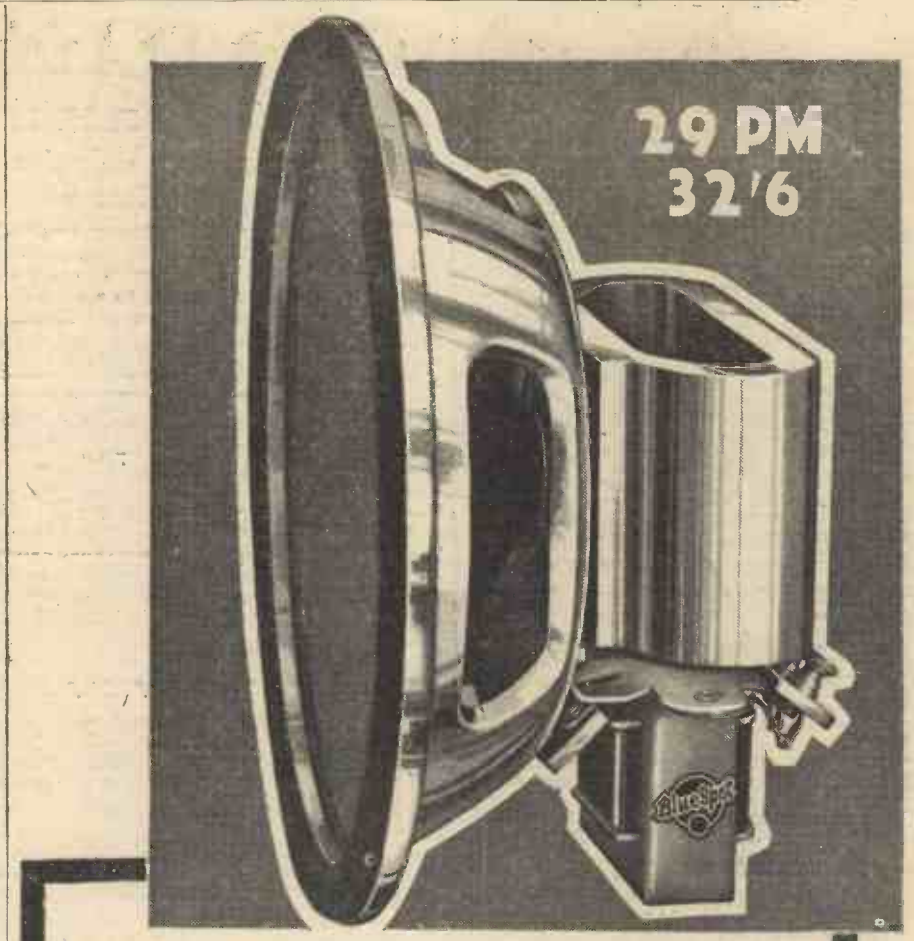
The London Chapter of the International Short-Wave Club celebrated its first anniversary at its meeting, held on Friday, September 29th, at the R.A.C.S. Hall, Wandsworth Road, S.W.8. The first half of the evening was given to short waves, Mr. L. H. Fitz-Gibbons, A.M.I.R.E., giving a lecture, in which he described and demonstrated several receivers, including an A.C. Eelex short-wave adaptor on which many short-wave stations were heard. Particular mention must be made of the extraordinary reception of W2XAD on 19.56 metres, which filled the hall. The second half of the meeting was given to the ultra-short or quasi-optical waves, the members being highly interested in a demonstration of 5-metre apparatus, which was given by Messrs. L. F. Reading, 2ATI, H. Bruce, 2AXA, and J. E. Hunter, 2BJN. Secretary, Arthur E. Bear, 10, St. Mary's Place, Rotherhithe, London, S.E.16.

HACKNEY RADIO AND PHYSICAL SOCIETY

At our opening meeting of the Winter Session, which was exceptionally well attended, Mr. Ellis gave a lecture on "Modern Super-Hets." In opening his talk he first spoke on the considerations which must be given to a circuit when designing a receiver for use throughout the country. This part of the talk was followed by a general outline of the function of each stage in a super-het receiver, and particular attention was given to the automatic-volume control. After the lecture, two receivers of a well-known commercial make, one an eight-valve, and the other a four-valve, were demonstrated, and although our hall is notoriously bad for good reception, both sets behaved in a remarkably efficient manner. Details of future meetings will gladly be given to local readers of PRACTICAL WIRELESS who care to apply for particulars. A. F. Rogerson, Hon. Secretary, 19, Sewdley Street, Clapton, E.5.

SLADE RADIO

A lecture, "Cathode ray oscillograph, and its application to Radio circuits," was given by Mr. G. Parr at the meeting held last week. A demonstration was given covering all the points of the lecture and it was seen how bias on the plates was used to centre the beam. A.C. wave form was seen and half-wave rectification; also speech frequencies by using a microphone and a radio receiver. The lecture proved to be one of exceptional interest. Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.



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Cheap Cabinet Finishing

By F. H. HOUGHTON

An Economical and Effective Method of Covering a Radio Cabinet with Grained Cloth

THERE are, no doubt, many readers who may be contemplating the construction of a radio cabinet but are at a loss with regard to a suitable finish. Even with the ready-made French polishes now obtainable it is a difficult job for the amateur to obtain a really first-class finish. Hence this article, which explains a method of finishing a cabinet in a cheap but effective manner by covering it with Rexine or similar grained cloth.

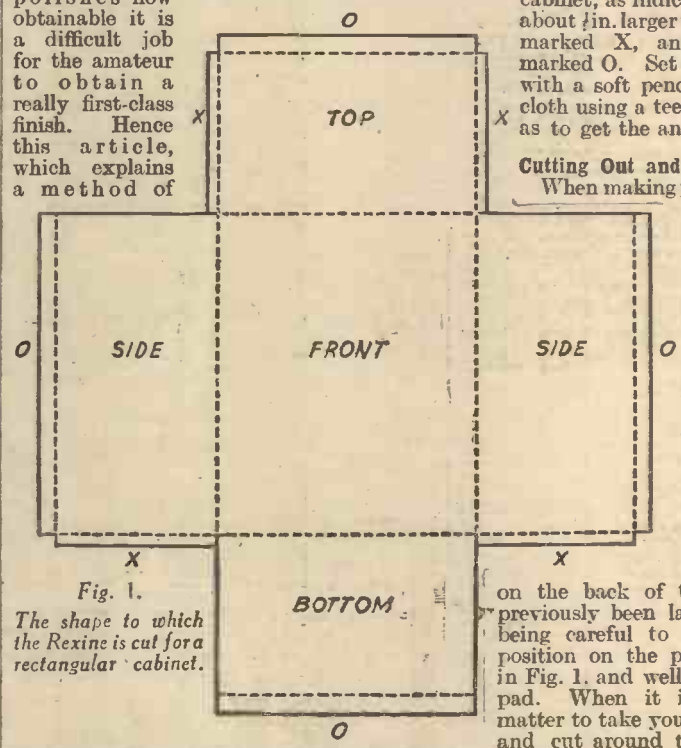

Fig. 1. The shape to which the Rexine is cut for a rectangular cabinet.

It is not my intention to describe the actual construction of the cabinet, except to say that deal is an easy wood to work in, besides being cheap and easily replaced if mistakes are made; if it is well dovetailed at the angles and at least ¼in. thick, it should be quite suitable for covering, and will make a very strong job, especially where batteries are contained in the cabinet.

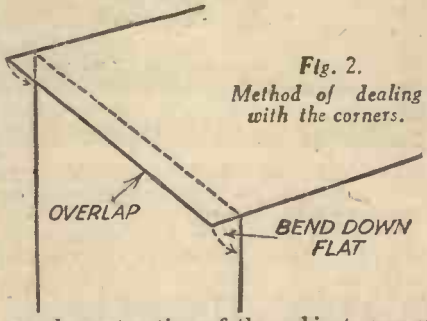

Fig. 2. Method of dealing with the corners.

Tools Required

The only tools required for covering the cabinet are a sharp pointed knife, scissors, a large, flat brush for glue (good Scotch glue), and a large, flat board to work on. A word about the Rexine—choose a cloth that is not too thick but yet of good quality. Endeavour to cut the cloth in one piece to cover the whole cabinet, as indicated in Fig. 1, allowing about ¼in. larger than the cabinet where marked X, and 1in. larger where marked O. Set the measurements out with a soft pencil on the back of the cloth using a tee-square, if possible so, as to get the angles correct.

Cutting Out and Glueing

When making your cabinet do not fix the front fret yet, but having cut out the cloth, prepare the glue in the usual way in a glue-pot, or, failing that, in a stone jar in a sauce-pan of water, and when it is melted add hot water until it is about the consistency of milk. Now cover the front fret with a thin coating of glue all over except for about ¼in. all round the edge, and place it down on the back of the cloth, which has previously been laid on a flat surface, being careful to get it in its correct position on the portion marked Front in Fig. 1, and well flatten it out with a pad. When it is dry it is a simple matter to take your sharp pointed knife and cut around the edges of the fret whilst it is laying flat on the board.

After cutting round the fret apply a little stain on the edges of the wood to match the cloth and to cover the cut edges of the cloth as well. Now fix the fret into place in the cabinet with small nails or screws fixed in the ¼in. margin left round the edges, after which the remainder of the cabinet can be glued. The 1in. strips will be found to come at the back, where they can be turned over the edge of the cabinet and secured. After gluing the cloth down an overlap of ¼in. will be seen, as in Fig. 2, and the best way to treat these corners is to bend down the overlap flat to the side and cut through the two thicknesses with a sharp knife, using a straight edge about ¼in. from the edge, as in Fig. 3. Remove the two strips A and B and glue and stick down the flap, when a perfectly matched joint should result. Treat the four corners the same.

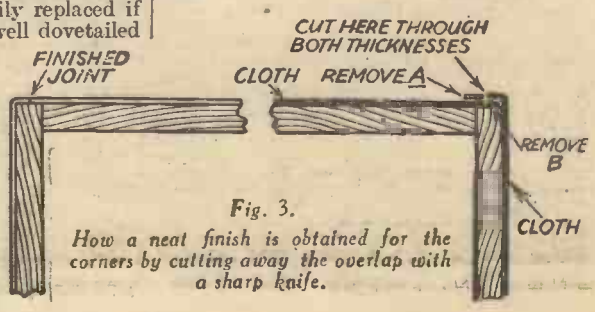

Fig. 3. How a neat finish is obtained for the corners by cutting away the overlap with a sharp knife.

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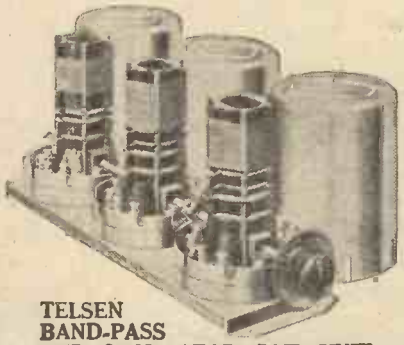

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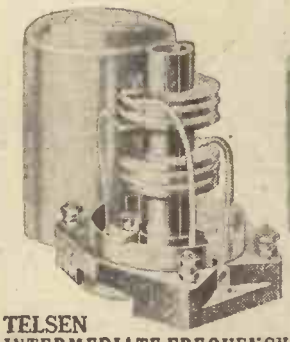

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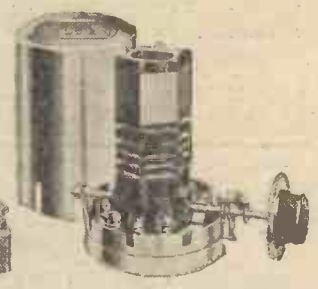

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A USEFUL TEST APPARATUS

For Quickly Determining the Value of Resistance or Capacity for Any Particular Purpose.

By H. J. HARVEY.

THERE are many instances when the constructor wishes to connect a resistance or condenser in circuit temporarily, and this is usually achieved by the crude expedient of connecting two pieces of wire to the condenser or resistance, leaving same to dangle nowhere in particular, with possible danger to the valves or H.T. battery. The object of the apparatus described is to provide a ready means of determining the most suitable value of resistance or capacity required for some particular function, so that the correct component can be purchased and fitted permanently in the set.

Constructional Details

Obtain a small wooden box, such as an instrument case, or crystal-set box, a panel to fit, a sufficient quantity of sockets, a plug for same, three terminals, and, if you do not happen to possess a discarded switch arm complete with studs, a visit to the local junk shop will no doubt result in one being obtained cheaply.

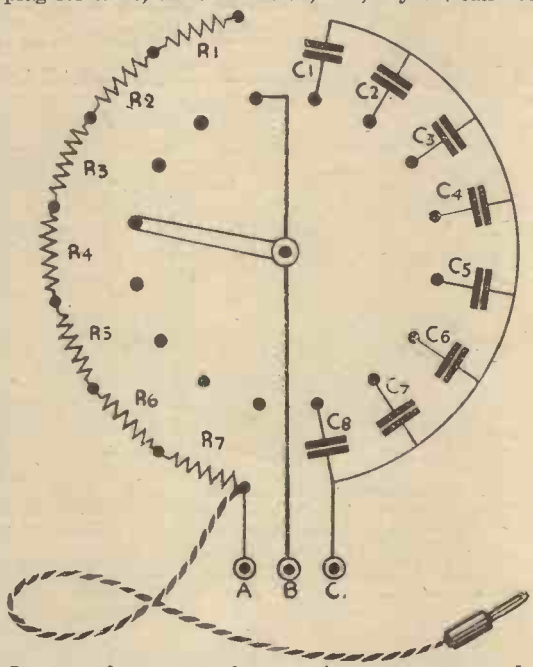

Diagram of connections for a simple test apparatus, and table of resistance and capacity values.

R1 - 2,000Ω
R2 - 3,000Ω
R3 - 5,000Ω
R4 - 10,000Ω
R5 - 15,000Ω
R6 - 25,000Ω
R7 - 40,000Ω

C1 - .0001
C2 - .0002
C3 - .0003
C4 - .0005
C5 - .001
C6 - .002
C7 - .005
C8 - .01

The actual lay-out, number of resistances and condensers, and choice of values, can be left to individual requirements, but a handy combination is depicted in the diagram. Referring to this you will observe that on the left-hand side the switch arm is capable of selecting any resistance from 2,000 ohms up to 100,000 ohms—the sum total of all the resistances—with the plug in the bottom "dead" socket, the value of resistance being across the terminals A B. Any individual or consecutive series of resistances can be obtained by inserting the plug in a suitable socket relative to the switch arm, *i.e.*, the resistance across the terminals will be the sum of the resistances remaining between the stud the switch arm is on and whatever socket the plug is inserted The best plan is to mount the sockets opposite the corresponding studs and mark the resistance values against them.

Capacity Test

And now to deal with the capacity test. You will note that on the right-hand side of the diagram the same switch arm is capable of being moved to the various studs, in series with which are condensers of different capacities. The capacity, according to which stud the switch arm is moved, is placed across the terminals B C. By moving the switch arm so that it connects across two studs, the resultant capacity across the terminals will be the sum of the capacities indicated, a pair of leads with spring clips, of course, making the necessary external connections.

If desired, a plug and set of sockets can be used as the main selector in lieu of the switch arm and studs, but apart from being more convenient, the switch arm method has the added advantage of being able to conveniently parallel the condensers in the manner described in the preceding paragraph.

Apart from the ability to determine a required resistance or capacity necessary for some particular circuit, this apparatus is useful in the location of faults, as the leads from it can be applied across suspected resistances and condensers, or a variety of capacities can be applied to certain sections of the circuit to cure instability, improve tone, etc.

Of course, with regard to decoupling resistances it is best to have the correct resistance, not that which might appear on the surface to be the most suitable. This is done by dividing the difference between the H.T. voltage required by the valve and the available H.T. voltage by the normal anode current flowing at the correct voltage, the result being multiplied by 1,000. In the case of bias resistances, divide the bias voltage required by the valve by the current flowing in the anode circuit of the valve in question and multiply by 1,000.

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BAD QUALITY—ITS CAUSE AND CURE

By J. EVANS

A Practical Article Which Deals With This Subject in Simple Terms.

DISTORTION caused by defective components has been fully dealt with in recent issues of PRACTICAL WIRELESS, and therefore does not call for further discussion. Bad quality is, however, often due to a haphazard choice of components, or to inaccurate circuit design. It is surprising the number of details that have to be considered when designing even the simplest of receivers; unless a constructor has a thorough knowledge of his work, it is therefore very much wiser for him to strictly adhere to the specification of reputable designers, otherwise his labours will almost invariably be rewarded by the provision of, perhaps, ample volume, but a very questionable quality of reproduction.

The average home-designed receiver is of the two or three-valve variety, having a detector followed by one or two L.F. stages, either transformer or resistance coupled. This type of receiver will therefore be dealt with in detail, and a final word of advice will be added concerning H.F. amplifiers.

Detector Distortion

The leaky grid detector, which is commonly used nowadays, although very sensitive to weak signals, is rather easily overloaded. The symptoms of overloading are: accentuation of the top notes, and sometimes (more especially when an H.F. stage is used) double peak tuning. The latter is indicated by a weakening of the signal strength when the condenser is tuned exactly to the transmitter's wavelength, with comparatively louder signals on each side of this position. To avoid overloading, the detector should preferably be preceded by a volume control (a .0003 variable condenser, connected between the aerial and aerial terminal of the set, will prove satisfactory), and the voltage actually applied to the plate of the valve should be at least 40 volts. If there is a resistance—decoupling, parallel feed, or R.C.C.—between the detector plate and its H.T. lead, the voltage should be increased, because a voltage drop occurs across this resistance; if the resistance exceeds 20,000 ohms, 120 volts may safely be applied. The detector grid-leak of a broadcast band receiver should not exceed 2 megohms (a larger value may be used for short-wave work), and the grid condenser should be chosen to suit the grid-leak resistance. The values recommended are indicated in the accompanying table.

Resistance Capacity Coupling

Modern moving-coil speakers respond faithfully to frequencies between approximately 50 and 6,000 cycles. If one of these speakers is employed, it should therefore be ascertained that the L.F. couplings are also capable of providing a moderately even amplification between these two frequency extremes, otherwise an inferior speaker might as well be used. When using resistance-capacity coupling, the values of the coupling condenser, grid-leak, anode resistance, and detector valve impedance are to a certain extent interdependent. If too high a value of grid-leak is chosen, the grid charge, when a strong signal is received, cannot leak away in time, and a choked effect is produced in the speaker. If the grid-leak has too low a value, the low notes will be passed to earth and bass reproduction will consequently be poor. If the anode resistance has a very high value, the voltage drop across it will be so great that the detector anode will be starved, and on the other hand, if its value is too low, the low notes will be passed to earth via the battery or the decoupling condenser. Again, if the coupling condenser has too low a value, the low-notes will not be able to pass to the grid of the L.F. valve. The values indicated in the table are therefore recommended: these will provide approximately 90 per cent. amplification at 50 cycles. An experienced designer may, however, vary them to suit the frequency response desired, and therefore the reader should not condemn the receiver because the component values do not exactly coincide with those given in the table.

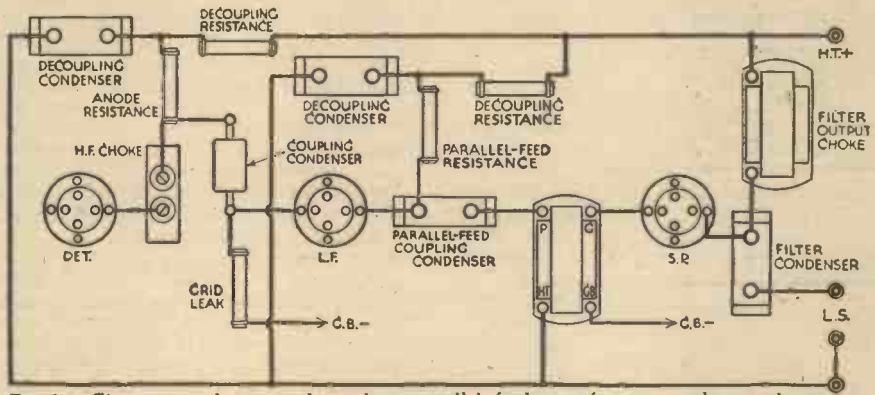

Fig. 1.—Showing anode circuit decoupling, parallel feed transformer coupling, and choke filter output.

Transformer Coupling

The coupling between the L.F. valve and the power valve will probably be a transformer having a ratio between 3 and 5/1 (a higher ratio is not recommended). Transformers usually have a bad inductance regulation, or in other words, their inductance is considerably reduced as the direct current passing through the primary winding is increased. This inductance must be high, preferably 50 henries or more, otherwise the bass notes will be attenuated and reproduction will sound tinny. This is the reason for the fairly general adoption of the parallel feed method of transformer coupling; with this system the direct current passes through the parallel feed anode resistance, whereas the signal current finds the path through the coupling condenser to the transformer primary easier—direct current cannot pass through a condenser. The anode resistance must not have too high a value, otherwise, as in the case of the detector, the voltage actually applied to the valve plate will be greatly reduced. On the other hand it must not be too low, or the bass notes will be passed to earth via the battery. A resistance having a value of approximately one and a half times the valve impedance is recommended.

Output Stage

If a small power valve is used in the output stage (*e.g.*, 215P), from the writer's experience, best results will be obtained with a good balanced armature (cone) speaker. This may be connected directly in the anode circuit, between the valve plate and the H.T. lead, but it is advisable, however, to use a choke filter output arrangement as shown in the accompanying diagram. If a super-power valve is employed, the use of a choke filter becomes more of a necessity, because the anode current is greater, and if this is passed through the speaker windings, apart from the fact that the windings are liable to burn out, the voltage drop across them will be so great that the actual voltage applied to the plate of the output valve will be too low.

When a super-power valve (or a large pentode) is used in the last stage, a moving-coil speaker will give better quality than the cone type, provided the preceding stages are well designed. The primary terminals of the output transformer attached to the speaker should be connected to valve plate and H.T.+ respectively. If best results are to be obtained, the speaker should be correctly matched to the valve; when purchasing a moving-coil speaker, it should therefore be ascertained that its output transformer has the correct ratio for use in conjunction with the output valve of the receiver. The ratio should be approximately equal to the square root of twice the valve impedance divided by the speaker speech coil impedance. Incorrect matching, and the use of too small a power valve, account for most of the distortion experienced with moving-coil speakers.

Overloading

We will now assume that the component values have been checked, and corrected where necessary, and that quality is quite satisfactory on moderate strength stations, but deteriorates considerably when volume increases beyond a certain level. This form of distortion is due, in practically all cases, to valve overloading. If careful adjust-

(Continued overleaf)

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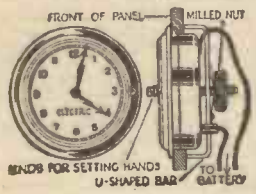

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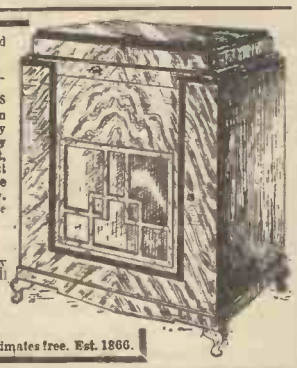

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BAD QUALITY—ITS CAUSE AND CURE

(*Continued from previous page*)

ment of the grid bias voltages in accordance with the valve manufacturers' instructions does not improve matters, the valves should be replaced by those having a lower impedance—e.g., an L.F. in place of a H.L. valve, and a S.P. in place of a P valve. The bias voltages must then be altered to suit the new valves, of course.

Back Coupling

Valve overloading having been remedied, it will be found that the receiver will now give very satisfactory results for a month or two, and then quality will gradually deteriorate, and in some cases a continuous whistle or a popping noise will be set up as soon as the L.T. is switched on. This indicates that the H.T. battery is run down and has developed a high internal resistance. When the low-frequency currents from the anodes of the three valves pass through this battery resistance on their way back to the filaments, a voltage is naturally developed across it, and, since the battery is common to all valves, the currents set up by this voltage are fed back through the first and second valve anode circuits, thereby opposing or assisting the legitimate low-frequency currents existing therein. When the battery is badly deteriorated, the internal resistance becomes so great that the feed back currents, if assisting the L.F. currents, cause L.F. oscillation (whistle, howl, motor-boating). If, on the other hand, they oppose the L.F. currents, amplification will be reduced; this reduction will, however, differ at various frequencies, thereby causing suppression of some musical notes and accentuation of others—that is, pronounced distortion.

This annoying trouble may be eliminated by providing a separate return path for the legitimate anode circuit signal currents. This is accomplished by placing a resistance or choke in each H.T. lead, and connecting a large condenser between the valve end of this and L.T.—. The diagram shows the anode circuits of a three-valve receiver fully decoupled. The normal decoupling values are indicated in the table, but these may be increased if the anode voltage available is over 150, in order to automatically drop the H.T. voltage to that actually required by the valve plate.

Eliminators

Numerous inquiries are received from constructors who are surprised to find that motor-boating occurs when an eliminator is substituted for a battery. Eliminators usually have a high internal resistance, and therefore cause instability in the same way as the aforementioned run down battery. When a battery is replaced by a mains unit (D.C. or A.C.), it is therefore essential that the receiver anode circuits be effectively decoupled, if best results are to be obtained.

H.F. Currents in L.F. Circuits

If distortion occurs after all the foregoing instructions have been carefully followed, it will probably be found that H.F. currents are being passed into the L.F. amplifier. This is usually indicated by tinny reproduction, but sometimes to the extent of a continuous very high-pitched whistle, and is most prevalent in receivers employing one or more H.F. stages.

To eliminate this type of distortion, a good H.F. choke should be connected between the detector plate and the first L.F. coupling, and unless the reaction condenser is of the differential type, a fixed condenser having a value between .0001 and .0005 should be connected between the detector plate and L.T.—(the capacity should not exceed .001, otherwise the high notes will be passed to earth, and reproduction will lose its crispness). As a further precautionary measure, a resistance of approximately 100,000 ohms may be connected between the G terminal of the L.F. transformer and the grid of the succeeding valve.

H.F. Stage

If an H.F. stage is used, the anode and screen circuits should be decoupled in the same manner as the L.F. circuits, but as H.F. currents are now being dealt with, the values of the condensers and resistances may be lowered; the normal values are indicated in the Table.

S.G. H.F. Stage.		*Detector.*	
Coupling Con. .0001–.0005.	Decoupling. 1,000 ohms .5mfd.	Grid leak .25–2 meg.	Grid Con. .0001–.0003.

First L.F. Stage (R.C.C.)			
Coupling Con.	Leak. Detector.	Anode Res.	Decoupling.
.02	.2 30,000 (HF)	75,000	25,000/2mfd.
.01	.5 40,000 (RC)	100,000	30,000/2mfd.

First Stage (Transformer).				
Coupig. Con.	Transfmr.	Detector.	Parall. Feed Res.	Decoupling.
5–1mfd.	3/1	15,000 (GP) 25,000 (HL)	25,000 30,000	15,000 2mfd. 15,000 2mfd.

Second Stage (Transformer).				
		L.F. Valve.		
1–2mfd.	3–5/1.	10,000 (LF) 15,000 (GP)	15,000 20,000	5,000/2mfd 10,000/2mfd.

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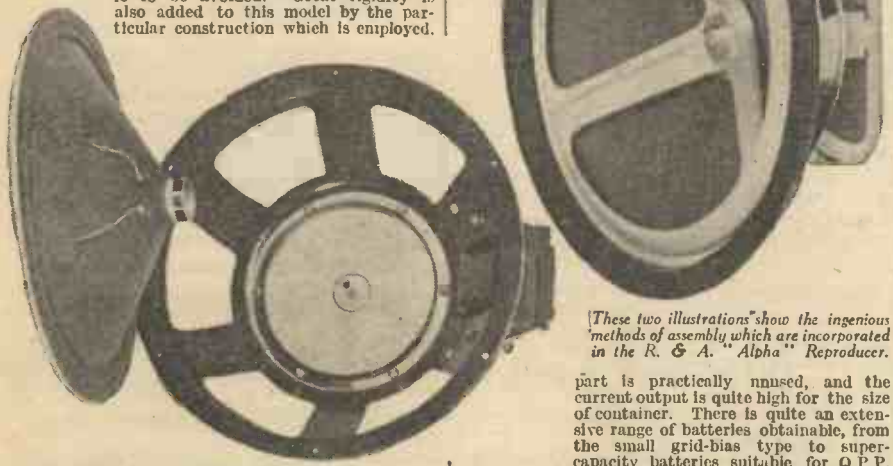
FACTS & FIGURES

Components tested in our Laboratories

R. & A. REPRODUCERS

AMONG the many ingenious features which form part of the make-up of the well-known R. & A. loud-speakers, the novel form of assembly included in the Alpha model is illustrated below. This particular model costs 52s. 6d., and has an overall diameter of just over 10in. As with all types of R. & A. speakers, a correctly-designed and accurately-built input transformer is fitted. The design of the speech coil, diaphragm, and method of centring is such that adequate response is obtainable over all parts of the musical scale, and, in addition to rich bass notes, the highest trills on the piccolo, for instance, are reproduced with a remarkable clarity and forwardness. The particular model which is illustrated will be seen to have a neat device for ensuring that the speech coil is accurately centred, and that it cannot move in any direction but the correct "piston-like" backwards and forwards action, which is essential if all damping and distortion is to be avoided. Great rigidity is also added to this model by the particular construction which is employed.



These two illustrations show the ingenious methods of assembly which are incorporated in the R. & A. "Alpha" Reproducer.

B. R. G. PUSH-PULL SWITCHES

THE assembly of the push-pull switches, manufactured by British Radiogramophone Co., Ltd., shows one or two interesting features. The main portion is of black bakelite, shaped according to the particular type of switch. Thus the two-point switch employs an elliptical moulding, whilst the three-point has a disc-shaped moulding. A one-hole fixing bush of the usual type is moulded into this portion of the switch, and thus it is possible to lock the switch perfectly tightly to the panel without the risk of the whole switch becoming loose upon the bush. The plunger is of the usual type, fitted with a pear-shaped end, of which half is of ebonite and half of metal. This engages in phosphor bronze contacts, which are sufficiently strong to ensure perfect action over a long period. The friction ensures that they are cleaned each time the switch is operated, and there is a very definite "on" position. The switch may be obtained in two-point or three-point at a cost of 1s. 3d. or 2s. respectively.

HELLESENS BATTERIES

TEN shillings is quite a reasonable price to pay for a high-tension battery of 108 volts, and when to this you add the fact that the battery has an exceptionally long life, the cost is really quite low. The illustration shows the Hi-Life battery produced by Messrs. Hellesens, and this is of the type designed to give a really good current output, whilst remaining convenient in size. There are, of course, plenty of foreign batteries obtainable at a much lower figure, but in most cases it will be found that the massive-looking battery is built up with small cells and the case filled with pitch, or else the contents of the individual cells are of such a nature that the current taken must not exceed a few milliamps if the battery is to last for long. In the Hellesens battery every point has received careful attention, both from the point of view of purity of the chemicals, etc., which are employed, and from the method of assembly. There is no risk of premature demise in one part of the battery, whilst the major part is practically unused, and the current output is quite high for the size of container. There is quite an extensive range of batteries obtainable, from the small grid-bias type to super-capacity batteries suitable for Q.P.P. or Class B receivers. All those readers who are interested should write for a copy of this firm's price list and details of the batteries. The address is Hellesens, Ltd., Hellesens Works, Morden Road, South Wimbledon, London, S.W.19.

One of the range of Hellesens' H.T. Batteries.

NEW MULLARD HIGH-VOLTAGE OUTPUT VALVE

WHEN reporting upon new valves, and when dealing in articles with quality amplification, etc., we often use the term "maximum undistorted output." We have mentioned, for instance, that for *real* quality an undistorted output of about 5 watts is necessary. Many listeners wonder why this is so, when the usual two-volt power valve only delivers an output of round about .3 or .4 of a watt. The explanation is, of course, that while over a very large proportion of programme time a certain programme strength is radiated, 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.

A popular valve of this type was the Mullard D.O. 25, which has been a firm favourite with many. This valve, however, requires a low tension supply at 6 volts, which is often inconvenient in view of the fact that most standard mains transformers give only a 4-volt L.T. supply. The Mullard Company have now brought out a new large output valve, D.O. 26, which may be considered as a 4-volt version of the D.O. 25. Its published data are as under :—

Filament Voltage	.. ..	4.0 v.
Filament Current	.. ..	2.0 a.
Max. Anode Voltage	.. ..	400 v.
Optimum Load	.. ..	4,000 ohms.
*Anode Impedance	.. ..	600 ohms.
*Amplification Factor	..	3.8
*Mutual Conductance	.. ..	6.3 mA/Volt.

* At Anode Volts 100 and Grid Volts zero.

With 400v. high tension the D.O. 26 requires a negative grid bias of 92 volts, and takes an anode current of 63 mA. It will handle maximum input signals of 65 volts R.M.S.

UNIVERSAL H.F. PENTODES

MESSRS. TUNGSRAM ELECTRIC announce some new H.F. pentodes produced especially for inclusion in universal midget sets. These are of slightly lower efficiency than the previous models and, consequently, are likely to be more stable, thus rendering the construction of extremely compact receivers more certain. A further change is noticed in the grid connection which is now brought out at the top of the valve.

Stop Press News

V.M.C. MAINS UNITS

FROM the V.M.C. Radio Company we have received details of some interesting Mains Units which are guaranteed against breakdown under fair usage for two years from date of purchase. Prices and ratings are very satisfactory and we hope to give a test report on one of these in an early issue.

NEW DUBILIER CONDENSERS

IMPROVEMENTS in the well-known Dubilier condensers are announced. An exhaustive range of tubular high-voltage condensers with wire ends may be obtained from 1s. upwards, and a complete range of cylindrical non-inductive condensers in metal cases, with an ingenious screw-on base are also obtainable. The base is provided with two screw holes so that it may be fixed to a baseboard, when the condenser may be screwed into it. Changes may thus be readily made in experimental circuits.

MULLARD VALVE RELEASED

THE Double-Diode-Triode valve, type T.D.D.4 recently announced by the Mullard factory is now generally released, and will be found of great utility in receivers incorporating automatic volume control.

TUNGSRAM AUTOMOBILE VALVES

TWO new automobile valves are now added to the Tungsram range. They are H.F. Pentodes similar to types 57 and 58 of the standard A.C. American range, having 6.3 volt .3 amp. heaters. The electrodes are internally screened, thus doing away with the necessity of screening the valve. The grid connection is brought out to the top in the usual American fashion.

MICROMESH TUNOGRAPH

THE Standard Telephone Company have introduced a new idea in the Micromesh Tunograph. This is, in effect, a miniature cathode-ray oscillograph, and is used in order to show when a receiver is accurately tuned to a station. The filament current is .85 to 1 amp. with a voltage of .5 to .6 volts. Maximum plate voltage is 180.

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Fit an Eelex Short-Wave Convertor to your present set. You can receive America, Russia, Australia, South Africa, etc.

Bring your set up to date. Sample the joys of short-wave reception by fitting an Eelex Short-Wave Convertor to your present set and add 70 extra stations to your log. Only a moment to fit. This remarkable invention enables you to receive stations between 16 and 190 metres. You can double the enjoyment of your wireless with an Eelex Short-Wave Convertor fitted to your present set—no alterations necessary. Makes your set a Super Het. Send for booklet EE7 giving complete particulars.

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Phone: Metropolitan 0314/5/6.

(*Continued from page 216*)

If XZ is a *uniform* resistance graduated in suitable units, it is only necessary to know the ratio of the lengths XY and YZ. Thus if XY is 4 units and YZ is 8 units, the ratio of the resistances R_2 and R_4 will be $\frac{1}{2}$, or $\frac{1}{2}$.

Hence $\frac{R_2}{R_4}=\frac{1}{2}$, and we know the value of R_3, therefore we know the value of our unknown resistance R_1.

Lastly, as the formula was unfortunately omitted from the original article, I will say that R_1, R_2, R_3, and R_4 correspond to B, EF, A, and FD respectively, taking the terminal of the battery in direct contact with B as the negative one. It does not, however, matter which way round the battery is connected. The formula therefore becomes :—

$$B=\frac{EF\times A}{DF}$$

Actually either A or B may be the unknown resistance, provided the other is known. The accuracy of the result will largely depend on the type of galvanometer used. Probably a voltmeter or ammeter will be more convenient if at hand than headphones, as in the former case the circuit is kept closed all the time, and the continual making and breaking as in the case of headphones is not part of the procedure. As, however, resistances of critical value are seldom needed in wireless sets, the greater accuracy obtained by using a meter instead of headphones is perhaps unnecessary. Fig. 2 shows the complete apparatus.

Making Granular Cored L.F. Transformers

AN extremely efficient substitute for stalloy laminated cores for L.F. transformers and chokes may be made from material obtainable from practically any engineering workshop or service garage, and sometimes from a chemist; namely, soft-iron filings. The construction of such a transformer or choke is extremely simple, the usual requirements being a tin-plate or other metal container, sufficient iron filings to fill it, and suitable windings, the primary being two and three thousand turns, wound on a card former with an internal diameter of about ¾in. or 1in., of suitable gauge wire, the secondary being made in the correct proportion with respect to the transformer ratio. The primary and secondary are wound side by side, and the ends brought out with thicker wire and labelled, the completed winding then being well taped *all over*. It is essential that this should be well done, otherwise iron filings might enter and upset the insulation. A layer of iron filings should then be put in the tin and slightly tamped down. A wooden block, about ½in. deep, is placed on top of this layer, the coil supported on top of this block, and the whole filled in with filings under moderate pressure. It is essential for the efficient working of the component that the filings should be soft. If any doubt is felt on this point, the filings should be heated to a red heat, and allowed to cool very slowly. A choke or transformer constructed in this manner will be found to have a practically constant inductance through a large range of variation of current through its primary, provided that a reasonable amount of filings, about ¾lb., is used.—NORMAN ROLLASON (Canterbury).

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A resistance that will not break down, one that will stand high overloading, is moisture-proof and noiseless.
The Hywatt is a definite advance in Resistance manufacture.
Due to its *wire* element it is unchangeable in operation, has a much closer tolerance than the carbon type, and a *fixed* resistance value.
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Price: Made in all values, from 1 to 50,000 ohms, 1s.

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THERE IS A BLUEPRINT FOR EVERY "PRACTICAL WIRELESS" RECEIVER.

SEE PAGE 215

RESERVE YOUR POCKET TOOL KIT WITHOUT FURTHER DELAY!

SEE PAGE 187

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THE LEADING CLASS B COMBINATION SPEAKER
(Adaptor & Unit Combined)

GET MAINS VOLUME from YOUR BATTERY SET

Enjoy the same perfect performance, colossal volume and increased sensitivity as you would get in a good-quality all-mains set, by connecting this superb EPOCH "Class B" Combination Speaker to your battery set. The EPOCH, which combines a complete "Class B" adaptor and high-class Cobalt P.M. Unit, can be easily fitted without any alteration being made to your present set and at very little extra H.T. cost.

SEND ONLY 5/- deposit for 7 days' trial, if satisfied, pay further 5/- at once, then 8 monthly payments of 7/6. Cash 62/-. (Supplied complete with "Class B" Valve and full instructions.)

THE FAMOUS EPOCH 'CLASS B' ADAPTOR

ONLY 5/- DOWN

If you already have a moving-coil speaker and wish to incorporate Class B amplification, the EPOCH "Class B" Adaptor is ideal for this purpose. It converts your set to "Class B" without any alteration whatever. (Supplied complete with "Class B" valve.)

for 7 days' trial, if satisfied, pay further 5/- at once, then 8 monthly payments of 5/-. (Cash 45/-.)

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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.

From a Reader in Singapore

SIR,—I have been a local subscriber to PRACTICAL WIRELESS from its very first issue. Like the hundreds who have praised such a publication, may I warmly congratulate you in bringing out a paper which is so eagerly sought for in this part of the East by every individual who takes an interest in wireless literature. Personally, I feel you have dominated the heart of every amateur by such a fine publication. Wishing you and your co-workers every success.—O. A. FILMER (Geylang, Singapore, Straits Settlements).

An Australian Reader's Thanks and Suggestions

SIR,—Although I have been a reader of PRACTICAL WIRELESS for less than three months I am following the example of many others by dropping a line to wish this periodical the success which it so richly deserves.

I have, however, one small grumble, and that is the consistent manner in which you neglect this part of the world in your news columns. Of course, I realize that the overwhelming majority of your readers reside in England, but surely they would occasionally appreciate a brief résumé of wireless progress in Australia. And without wishing to boast I think I may safely say that wireless in Australia is developing in a distinctive fashion and is not just merely following in the footsteps of the older countries.

As an instance of our divergence from English practice I may mention that in Australia the "all-electric" is the rule rather than the exception.

I think the average reader would be interested in the A and B class system of broadcasting. The A class stations are owned and operated by the Commonwealth Government and obtain their revenue from the 24s. a year licence fee; incidentally they are not allowed to transmit advertisements; the B class stations on the other hand are owned by private companies and obtain their revenue entirely from advertisements. In passing you will be amused to hear that a friend asked me if sets equipped with "this class B amplification would receive A class stations also?"

In conclusion, I really think that if you were to insert a paragraph or two in the news page occasionally it would make your Australian readers feel a more personal interest in your excellent paper.—C. E. COWAN (Perth, W. Australia).

Automatic Coil Winder and Electric Equipment Co., Ltd.

SIR,—It is probable that many of your readers may be numbered amongst those who are suffering disappointment through an unforeseen and unavoidable delay in executing their orders for the "Avo-Minor," the new combination testing instrument which is being advertised in your journal. Our client has therefore asked us to explain that the delay has been occasioned entirely by a demand so overwhelming that all the carefully-laid plans for production have been unable to cope with the situation. We should be obliged if you will advise your readers that everything possible is being done to speed up production without detriment to the efficiency and accuracy of the instrument. Orders are being, and will continue to be, executed in strict rotation, and it is hoped that production will soon be abreast of the demand so that orders can be dealt with immediately on receipt.—THE NATIONAL PUBLICITY CO., LTD. (JOHN GOLDMAN, General Manager).

RESERVE YOUR TOOL KIT WITHOUT DELAY
See Page 187.

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT a single mains output valve will shortly be obtainable capable of delivering an undistorted output of over 3 watts.
—THAT some of the high-frequency pentodes now obtainable have the anode connection made to the top of the glass bulb, whilst others have the grid connection made to that point.
—THAT an electric-bell wiring system will often provide a very good temporary aerial.
—THAT a short length of wire running parallel with the bell wires will provide a ready alarm to be heard through the wireless receiver when the bell is situated some distance away.
—THAT the extra wire should be twisted round the aerial lead-in.
—THAT a clear glass valve which is turning black, or a silvered bulb which is developing a rainbow effect, is probably nearing the end of its useful life.
—THAT resistances should not be permitted to make contact with the terminals of other components, as some types of resistance are "alive" on the outside.

NOTICE.

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

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

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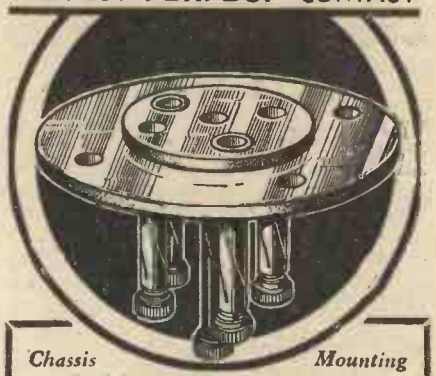

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It contains full descriptions of
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ROLA F6 —PM—23—Class B 49/6
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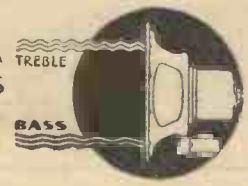

OPPORTUNITIES *for* TRAINED RADIO MEN

Practical Correspondence Courses by the Technical and Commercial Radio College

Mr. R. H. Bradley, Director of Studies, Technical and Commercial Radio College.

AMONG the many thousands of letters I receive there is always a large number from readers (and the fathers of younger readers) asking for my opinion and advice as to the opportunities in radio as a profession.

The radio profession can be likened to a very large tree with many branches, well laden with an abundance of rich fruit. But it is seldom that the plums are to be had for the asking, or merely as a result of a keen interest in radio. Some men have reached the fruit by laboriously climbing the tree; the majority who have picked the plums have used a ladder. And the name of the ladder is "Knowledge."

The radio industry is not simply a business in which commercial ability alone is sufficient. It was created by men with a sound knowledge of electrical engineering, and its phenomenal progress has been made possible by the efforts of men who have studied radio thoroughly, and have never ceased to add to their knowledge. It is doubtful whether any other industry has progressed so rapidly or has been so dependent on technical knowledge and research.

Even on the purely "business" side of the industry, where technical knowledge is not so important, the men who understand the products with which they are dealing are much better equipped for success than their less knowledgeable competitors.

The importance of a thorough knowledge, and the difficulties of obtaining trained men with the right sort of knowledge, have been responsible for the formation of the Technical and Commercial Radio College.

The College has been founded by men who are more than technicians. They not only know radio as a technical subject, but they also know what sort of training is necessary to the man who would succeed. Their activities have covered a remarkably wide range of technical and commercial subjects and they are certainly very well equipped to undertake the responsibility of training others.

Courses of Training

The Technical and Commercial Radio College offers two courses of training by correspondence. One is a Complete Technical Course and the other Technical and Commercial. Every word has been written by the organizers of the College, and by experts chosen for their specialized knowledge. The Courses are right up to date, whilst supplementary lessons are added whenever new developments make such additions necessary.

From an examination of the Prospectus. and the information that has been given me regarding the aims and organization of the College, it is evident that the whole field of modern technical and commercial radio has been covered most thoroughly and the lessons prepared from first-hand knowledge and practical experience. It is a feature of the technical section that all the preliminary electrical theory has been written from the radio point of view and, whilst thorough. has been kept as brief as possible, so that the student may reach the real "meat" quickly, without the necessity of wading through many chapters of wearisome and out-of-date theory.

Wide Range of Lessons

Apart from the purely technical theory, there are lessons dealing with actual receiver construction, manufacturing, installation, maintenance, servicing, salesmanship, demonstrating, advertising, radio journalism, mail order, inventing, patenting, and other subjects, whilst personal advice and supplementary instruction are given to students in subjects in which they are particularly interested.

There is no doubt that the Courses have been prepared in a most masterly fashion by men who know what they are writing about, and how to impart their knowledge to others. I am consequently quite satisfied that any of my readers who enrol as students of the Technical and Commercial Radio College and study conscientiously will be well equipped to turn their knowledge to practical advantage.

The Principals of the College are in constant touch with leaders in the radio industry and can, therefore, effect introductions which can be of the greatest assistance to students. A recommendation from the College direct to an employer is not only a guarantee of the student's training but also confirms his determination to qualify for a good position. The student is assured that the College will use its influence to the utmost to help him to succeed.

Any reader of this Journal who is anxious to enter the radio profession or to make money in his spare time; any father who does not know what to do with his son; any radio "fan" who is keen on enjoying his hobby to the fullest; cannot do better than write for a prospectus of the College to: The Director of Studies, The Technical and Commercial Radio College, Lloyds Place, Blackheath, London, S.E.3.

The fees are most reasonable and can, if desired, be paid by monthly instalments.

L.N.

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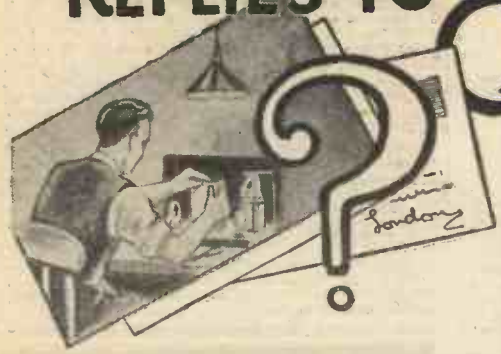
REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff



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.

CHOOSING A LOUD-SPEAKER

"I am at present using a three-valve battery receiver with a pentode in the output stage, and this drives a balanced armature loud-speaker. The speaker is now rather defective and I wish to buy a new one of the moving-coil type. My difficulty is in deciding the type to buy, since I hope a little later on to add Class B to the set. If I obtain a speaker of the pentode type it will not match the Class B valve, and on the other hand it would appear that a Class B speaker would not match the pentode. I appreciate that I could use choke-capacity coupling, but that would add to the expense. Is there any simple way out of the difficulty?"—G. K. S. (Preston).

Your problem is not really so difficult of solution as you imagine, since a Class B speaker can almost invariably be used successfully with a pentode by connecting to the two outside terminals only. When you change over to Class B the third terminal can be used in the ordinary way. We might also mention, however, that speakers are now made which are fitted with multi-ratio transformers, so that they can accurately be matched to any type of valve merely by altering the positions of two rotary switch arms.

CONNECTING A MICROPHONE TO A RECEIVER

"Being desirous of using my wireless receiver as an amplifier for use with a microphone for speaking from one room to another, I have tried connecting the microphone (a perfectly good hand type instrument) to the pick-up terminals, but results have been very disappointing. Can you please tell me if I have connected up wrongly, or what is likely to be the cause of my unsatisfactory results?"—H. L. (Slough).

Your unsatisfactory results with the microphone were no doubt due to the fact that it was connected directly in the grid circuit of the amplifying valve. The resistance of the microphone would be so low as virtually to short circuit the grid and filament of the valve, and so render it almost inoperative. You should connect the microphone through a suitable step-up transformer having a ratio of about 100 to 1; actually, the ratio depends to a certain extent upon the characteristics of the microphone, but the figure mentioned is a fairly average one.

It is, of course, necessary to apply a voltage to the microphone by connecting a battery in series with it and the primary winding of the transformer.

AUTOMATIC GRID BIAS

"Wishing to provide automatic grid bias for my battery receiver, I have read the various articles on this subject that have appeared in 'Practical Wireless' and also in another wireless periodical. In so doing I have found what appears to be a contradiction, and as one paper must be wrong, I would like to know which it is. In 'Practical Wireless' it is explained that the value of the bias resister is found by dividing the grid bias voltage required by the total anode current of all the valves in the receiver; in the other paper, a statement is made that the resistance value is obtained by dividing the bias voltage by the anode current of the valve to be biassed. Will you please give me your ruling on this matter? So as to avoid any misunderstanding, I enclose cuttings from articles printed in 'Practical Wireless' and in the other paper concerned."—M. L. (Bath).

You have rather "tripped up" in reading the two articles to which you refer, since one relates to a battery receiver and the other to a mains set. The PRACTICAL WIRELESS article you mention is perfectly correct, and refers to any type of battery receiver. The idea is that since the bias resistance is in series with the high-tension negative lead the voltage drop is that caused by the total amount of current flowing through it. In the case of a mains set using indirectly heated valves, the bias resister is inserted in the cathode lead and therefore only handles the current passed by the valve whose bias it provides.

DATA SHEET No. 55

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

MORSE CODE II—PUNCTUATION.

Full Stop	·· ·· ··
Semi-colon	— · — · — ·
Colon	— — — · · ·
Comma	· — · — · —
Interrogation	·· — — ··
Exclamation	— — ·· — —
Brackets	— · — — · —
Inverted Commas	· — ·· — ·
Underline	·· — — · —
Hyphen	— ···· —
Erase (or Error)	·· ·· ·· ··
Preliminary Call	— · — · —
End of Message	· — · — ·
All Stations	— · — · ▲ — · — · —
Received Signal	· — ·
Wait	· — · · ·
Break Sign	— · · · —
Understood	· · · — ·
Is it Correct?	·· — · —

TONE CONTROL WITH Q.P.-P.

"In a recent article in 'Practical Wireless' it was mentioned that the best position for the tone control in a Class B receiver is across the primary winding of the driver transformer. I am using a set with Q.P.-P. output and have a tone control across the outside terminals of the loud-speaker. Would it be correct to alter this to the arrangement recommended for Class B?"—L. S. (Hackney Wick).

It would certainly be possible to make the alterations you suggest, and we think that you would obtain a somewhat greater signal output by so doing. When the tone control is connected across the speaker terminals it reduces the intensity of some of the high notes which have been amplified by the output stage. This is obviously wasteful, and by transferring the control to a position prior to the last stage the high frequencies are suppressed before they are finally amplified.

INSTABILITY WITH MAINS SET

"My three-valve A.C. set has become very unstable and oscillates as soon as I turn the volume control full on. Can you suggest anything that may be broken down and is causing the trouble?"—A. L. A. (Bury St. Edmunds).

There are a number of components which could give rise to the trouble, and without further more complete details we cannot help you very much. One point, however, which should receive attention before the receiver is examined is the earth connection. This may have become dry or broken due to the continued fine weather, and a bad earth connection often causes H.F. instability. If, however, you find this is in order, perhaps you could give some data regarding the receiver's performance in order to locate the fault.

METAL CHASSIS ADVANTAGES

"I notice in all your new receivers you are using a metallized wooden chassis. In addition, all the latest commercial receivers employ aluminium or steel chassis. I should like to know whether there is any advantage in this construction, apart from the ease of assembly (by bolts) which the factories are able to carry out. You use ordinary wood screws and take separate earth connections, and I do not, therefore, see what you gain."—T. G. (Hull).

The principal use of the metal chassis, whether metallized wood or all-metal, is screening. If you examine our receivers, or those manufactured by any of the well-known firms, you will find that the various components are arranged in such a manner that coupling between H.F. and L.F. portions of the receiver are reduced to a minimum, or altogether avoided. Obviously, there is no need to screen such items as fixed condensers or metallized resistances, but all components possessing inductance should be screened in the interests of stability. In most commercial receivers the metal chassis is also used as a common H.T. negative lead, and a number of wires thereby saved. In our receivers this practice is also adopted, but we ensure perfect earth returns by adding certain additional leads. You must realize that an unsoldered joint may corrode and so produce a poor contact, and therefore, we do not rely entirely upon a connection with the chassis metallized surface.

NON-INDUCTIVE CONDENSERS

"I have recently taken to pieces a fixed condenser which was marked non-inductive. I was surprised to find that this consisted of the usual roll of paper foil and insulating medium. I thought perhaps it was rolled in two directions in order to negative the inductance, but I found that it was one continuous roll from start to finish. Could you tell me how this type of condenser is made non-inductive?"—N. V. (Gatley, Cheshire).

In the early types of paper condenser a connecting lead was taken from the two electrodes at each end only. In the modern non-inductive paper condenser you will find that connecting links are provided at practically every turn when the condenser is rolled, and that by so doing the inductive turns are short-circuited. The method varies in different makes of condenser, but the principle is the same as soldering a lead along the bared turns of a coil of wire.

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HIGGS SUPERHETS

THE high standard of excellence to which modern receivers have reached is well displayed in a new season's booklet issued by Higgs (Great Britain), Ltd., Hove, Sussex. The new range of superhet receivers and radiograms listed embody all the most recent developments, including a new automatic volume control which prevents the second detector overloading, and overcomes fading to a great extent without impairing sensitivity to any appreciable degree. The Super-A model is a six-valve superhet for operation on A.C. mains, and the Super-B is a six-valve class B receiver for battery operation. The Super-C is a five-valve superhet receiver for operation on either A.C. or D.C. mains, while the Super-D is a five-valve model for operation on D.C. mains only. In the radiogram section there are the Console and the Pedestal models, the latter being fitted with an automatic record-changer. The prices of the receivers range from 18 gns. to 20 gns., and the radiogram from 27 gns. to 31 gns. The automatic record-changer is listed at 8 gns.

"A CITY OF SOUND"

A VERY interesting little booklet, bearing the above title, and written by E. P. Leigh-Bennett, has reached us from The Marconiphone Co., Ltd. It begins with a simple story of the romantic beginnings of radio, Marconi's early experiments, and a fascinating account of its progress up to the present day. Following this is a brief account of a visit to the Marconiphone Works at Hayes, Middlesex. The reader is taken through a modern power house, he is introduced to the big 800-ton presses, coil-winding machines, the intricacies of record making, and many other interesting operations carried out in these busy works. In the last few pages of the book full particulars are given of the new 1934 models of Marconiphone radiograms and receivers. The latter range in price from 4 gns. to 22 gns., and the radiograms range from 23 gns. to 50 gns. There is also the new Marconi Pick-Up and two Cabinet Speakers, one a moving-coil model, priced at £5 10s., the other a smaller moving-coil instrument priced at £3 3s. This booklet can be obtained upon application to the Publicity Department, The Marconiphone Co., Ltd., 210-212, Tottenham Court Road, London, W.1.

CLAUDE LYONS PRODUCTS

CONSTRUCTORS and experimenters will find much to interest them in the new 48-page catalogue issued by Claude Lyons, Ltd., of 76, Oldhall Street, Liverpool. Some new forms of the well-known "Clarostat" variable resistances are introduced in an improved range of continuous wire-wound potentiometers, and also some ultra-high resistance graphite potentiometers. The latter are very suitable for volume control circuits where currents of the order of 1 milliamp or so are carried. Another useful component listed is the "Humdinger" for balancing out "hum" in A.C.-operated receivers. A full range of "B.A.T." fixed resistors are also listed. Although small, they are of particularly robust construction, are non-inductive, non capacitative, and are proof against burning out by overloads even up to 500 per cent. Full ranges of switches and ganged condensers are listed and also a new range of mains transformers and chokes. Another new line is a range of "B.A.T." microphones. There are several models of both single and double-button instruments, hand cases, desk and floor stands, and many accessories of interest to the experimenter. Also included in the list is the well-known "Diehl" motor and "Audak" electro-chromatic pick-up, which are of special interest to radiogram enthusiasts. We have also received from this firm a copy of their well-known little booklet, entitled "Ohms Law Without Tears," in which are given various circuits, simple formulæ, voltage-dropping and current-carrying charts, and worked examples. In fact, it tells you in simple language all you ought to know about the "mysteries" of volts, amps, resistance valves and watts—dissipation as applied to the use of resistors for radio purposes. Copies of either of these useful booklets can be obtained from the address given above.

BRITISH GENERAL COMPONENTS

A USEFUL range of high-class components is shown in the latest folder just to hand from the British General Manufacturing Co., Ltd., Brockley Works, London, S.E.4. An all-wave tuner, having a range of 14.5 to 2,000 metres, and suitable for either aerial, anodé or tuned-grid circuits, has its coils wound on a special low-loss former. It is listed at 9s. 6d. Another compact and efficient component for the home constructor is a dual-wave screened coil, selling for 7s. 6d. This coil is particularly suitable for ganging, and the aerial tapping is automatically changed when switching from long to medium wavelength. Among the other components listed are a "parallel fed" transformer coupling unit, a high efficiency screened H.F. choke (covering wavebands from 150 to 2,000 metres), band-pass filter coils, L.F. transformers, and a condenser ganging device. This useful device, which is priced at 2s. 6d., has been produced after much experiment and research, and enables the constructor to efficiently gang two condensers of the same or different make. In addition, there is an ingenious flexible coupling, suitable for coils or condensers, which effectively gets over the difficulty of coupling the ends of two spindles, even if they are not in correct alignment. The price of this handy little component is only 9d. All home constructors should make a point of writing to the address for a copy of this new season's folder.

Replies to Broadcast Queries

R. S. S. (Sligo): G6YU, J. Hanson, "Abbeydore," Wyken Avenue, Wyken Grange, Coventry, Warwickshire; G2GF, P. E. A. Griffiths, 12, Glencoe Mansions, Chapel Street, Brixton, London, S.W.9; G6VB, V. P. P. Blake, Aslockton, Nottingham; G2BK, regret, cannot trace.

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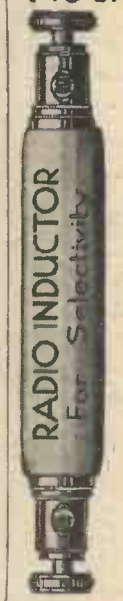

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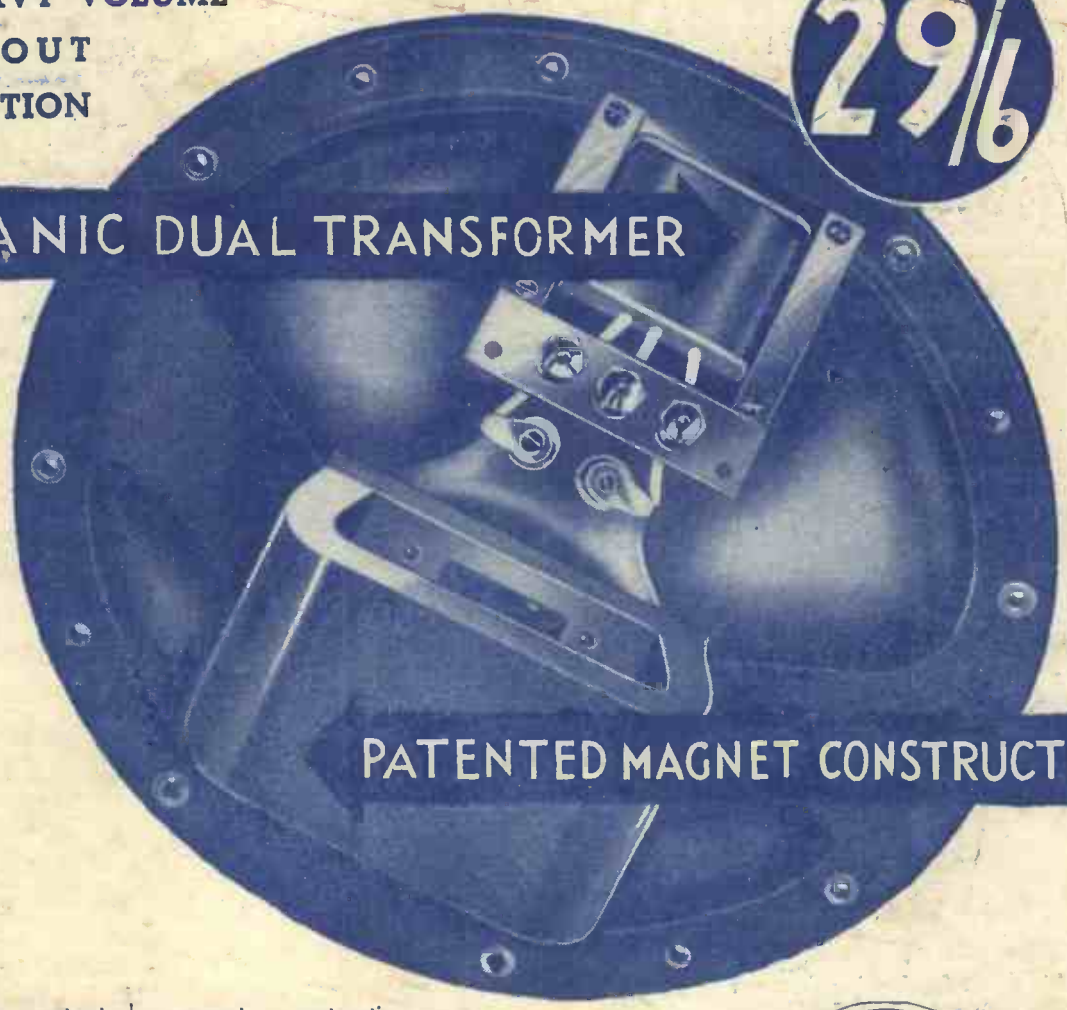

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THE ORBIT—THE STAR SET OF THE SEASON!

Practical Wireless

3D.

Published every Wednesday by
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OCTOBER 21st, 1933.
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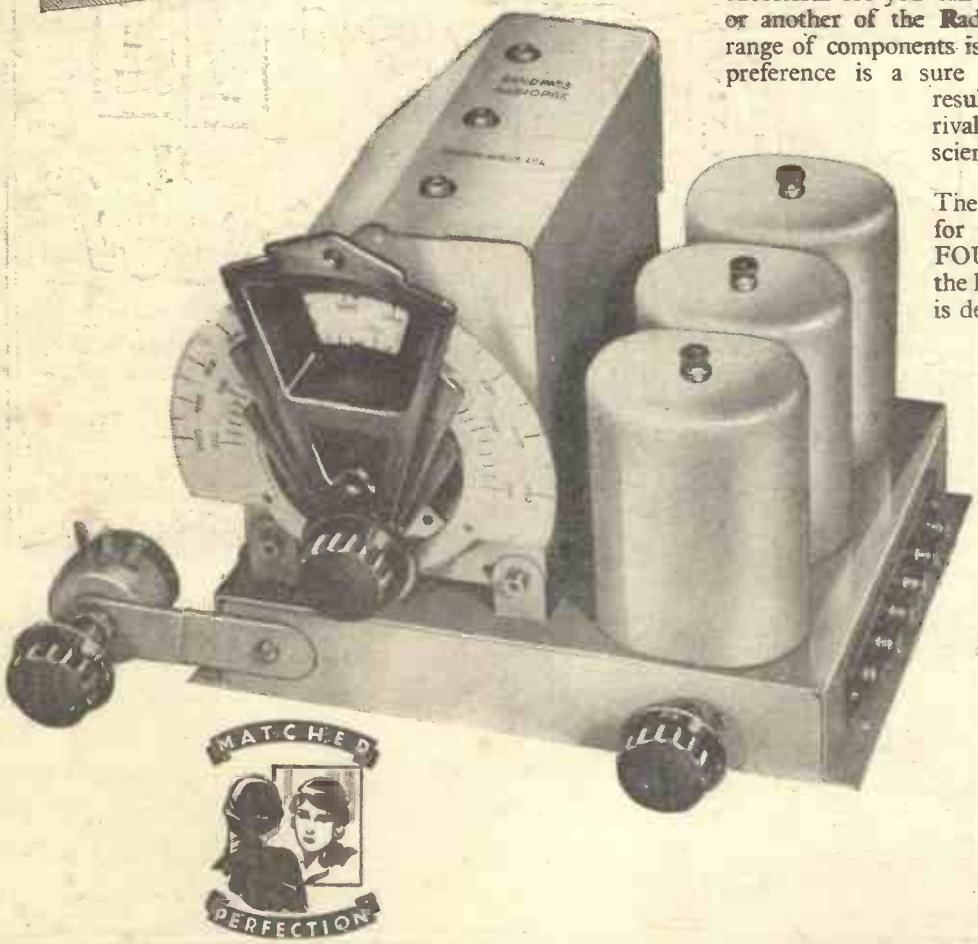

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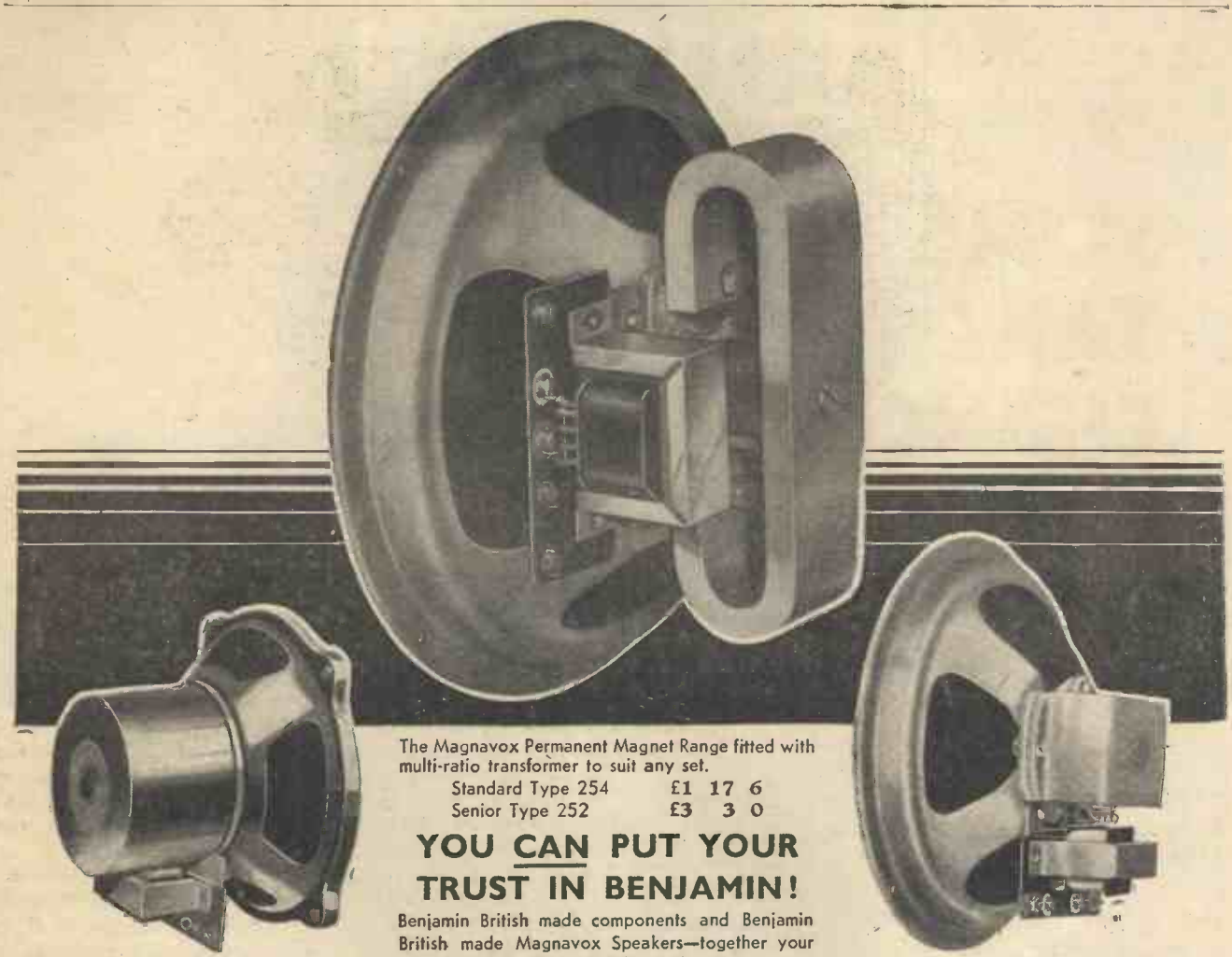

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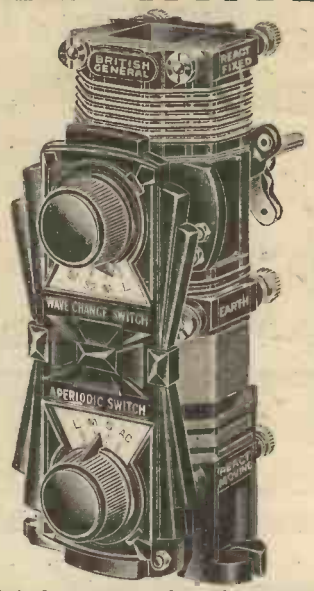

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When you see the Great Free Chart of the All-Wave All-World "Skyscraper" 4, which tells you how to build it and how to work it and why it gives such marvellous results, you will agree at once that it will be wise of you to build for yourself rather than buy a factory-assembled receiver which cannot give you these new and intriguing short-wave stations. The FREE CHART simplifies everything; there are pictures of every part, with every wire numbered, every hole lettered, every terminal identified. YOU CAN'T GO WRONG! But get the Chart and see for yourself—then build the Lissen All-Wave All-World "Skyscraper" 4, the SET THAT SPANS THE WORLD!

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ALL-WAVE ALL-WORLD "SKYSCRAPER" 4

READ ABOUT THE "ORBIT" ON PAGE 249.

EDITOR:
Vol. III. No. 57 || F. J. CAMM || Oct. 21st, 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

The FIRST Two-Pentode Set

WE trust that regular readers will again excuse the use of our valuable space in order to point out that the FIRST HOME-CONSTRUCTED RECEIVER EMPLOYING AN H.F. PENTODE AS A DETECTOR, followed by a pentode output valve, was designed in our laboratories and described in this journal in April last (The A.C. Twin). We mention this for the benefit of new readers, *and also in reply to a statement in a contemporary* which claimed the honour when describing such a circuit *in September!* As we have so often mentioned — PRACTICAL WIRELESS loses no time in placing details of latest developments before its readers!

Home Construction Holding Its Own

THERE are many amateurs who believe that the art of home-construction is dying out. A recent census was taken by a well-known weekly, and it shows that no less than 25 per cent. of the receivers in use in 25,000 homes are home-constructed. A further illuminating fact was that over 50 per cent. of the receivers in use were not more than two years old, which means to say that home-construction is still being pursued with great interest. The advantages of making your own set have often been set out in these pages, and it is very gratifying to see that so many listeners take such a keen interest in the hobby, and we take great pride in the fact that we have played no small part in the fostering of this interest.

Queries and Enquiries

MANY readers are omitting to send stamped addressed envelopes for postal replies. In every case where a postal reply is desired a stamped addressed envelope *must* be enclosed.

B.B.C. Chamber Concerts

THE B.B.C. announces three series of Chamber Concerts, to be given in the Concert Hall of Broadcasting House at 8.30 p.m. on alternate Fridays, from October 20th to December 15th, and again from January 19th to April 20th. Series A comprises the four concerts on October 20th, December 1st, February 2nd, and March 16th. The concerts of Series B and Series C follow these at intervals of a fortnight each.

The Busch String Quartet plays quartets by Haydn, Reger, and Beethoven at the first concert; in the second Lionel Tertis and Solomon give a programme of viola and pianoforte music, which includes the first performance of Bliss's new Viola Sonata and Violin Sonatas by Mozart and Delius, which Tertis has transcribed for viola.

In the third concert, on November 17th, the London String Quartet play quartets by Brahms and Beethoven, and the Hugo Wolf Serenade. Continuing Series A on December 1st, the Kolisch String Quartet play quartets by Mozart and Beethoven, a set of Variations by Krenek and Five Movements by Webern. The programme on December 15th is a piano recital by Myra Hess, in a concert in which Mozart, Beethoven, Bach, Schumann, and Ravel are all represented.

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THE ORBIT
EMPLOYS AUTOMATIC FADING COMPENSATION
Reliability—Quality—Station-Getting—All at Low Cost!
Read about our
New Transfer Print System
(*Prov. Patent No. 24584/33*)
SEE PAGE 249

Talk on Early Railways

ON October 31st, Mr. Maurice Smith, a Northampton engineer, gives a talk from the Midland studio on "How the Midlands obtained its Railways." The pioneer venture was the Leicester-to-Swannington, which was built by the Stephensons and opened in 1832.

Orchestral Concert from Belfast

MENDELSSOHN'S Violin Concerto in E minor, played by Eda Kersey, is the principal work to be included in the Orchestral Concert in the Ulster Hall, Belfast, on November 4th. During the same concert well-known movements from Tchaikovsky's popular Fourth Symphony will also be performed, including the fascinating Pizzicato. Mr. E. Godfrey Brown will be the conductor of the Belfast Wireless Symphony Orchestra.

"Modern Sound Pictures"

AN interesting programme of piano music is that for the recital which Arthur Roberts will give for Midland Regional listeners on October 31st. He calls it "Modern Sound Pictures." Among sounds represented by the composers are those of the towing path (John Ireland), the vodka shop (Arnold Bax), and the hurdy-gurdy man (Goossens).

Birmingham Philharmonic Orchestra

PART of the symphony for string orchestra by W. H. Reed, leader of the London Symphony Orchestra, was heard at the Hereford Festival this year. The first broadcast of the whole work will be given on October 30th by the Birmingham Philharmonic Orchestra, conducted by Johan Hock. In the same programme is Bach's concerto in C for two pianos and string orchestra: Beatrice Hewitt and Tom Bromley will be the pianists.

Broadcast Oratorios

A FURTHER programme of favourites from the Oratorios, under the title "In Quires and Places where they Sing," will be given for West Regional listeners on October 22nd, by Mary Hamlin (soprano), Kenneth Ellis (bass), the Choir of the Cardiff Musical Society and the Western Studio Orchestra. Mary Hamlin has ancestors on both sides of the Channel. She was born at Exeter of Devonshire parentage and descended from the Welsh Princes of Powys on her mother's side.

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

Broadcasting in Greece

THE construction of a wireless station in the neighbourhood of Athens has been definitely decided upon by the Greek Government; the transmitter will at first be used mainly for aviation services, but outside these hours will be placed at the disposal of the authorities for the broadcast of programmes.

The Future Power of Radio Alger

FOLLOWING the example set by France, Algeria has passed a broadcasting law by which in future listeners to *Radio Alger* will contribute towards the upkeep of the station and cost of programmes. This annual revenue will permit the authorities to install a high-power transmitter, of which the construction is to be begun without further delay. Although not yet definitely fixed, it is expected that the station will be working on 75 kilowatts in March or April, 1934. Three million French francs have been voted to defray the cost of the new plant.

A Little-known Broadcaster

ALTHOUGH Antwerp (Belgium) has possessed a station for six years, it is seldom that any reference is made to it. In the near future, however, we may hear more about it, as its power, hitherto only 300 watts, is being increased. *Anvers Radio* broadcasts on 229 metres (1,344.6 kc/s), and for most of the transmissions the Flemish language only is used. The call is *Hier Antwerpen*, with occasionally a French translation: *Ici Radio Anvers.*

On British Lines

APPARENTLY when the new Abu Zabal (Cairo) station is brought into operation the service will be run on much the same lines as ours, as the programmes are to be solely of an entertaining and educational character. All publicity will be barred. The station will be testing shortly on 483 metres; its power is 20 kilowatts.

Forbidden to Broadcast

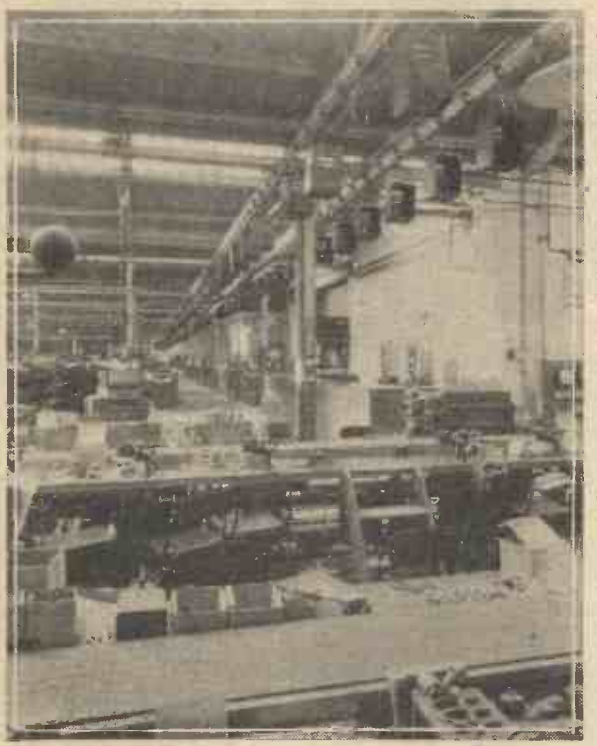
RADIO Vitus, Paris, which has recently completed the building of a high-power station at no great distance from the French capital, has been forbidden to broadcast through it. According to the new law, no private concern may bring new stations into operation nor may the existing ones be worked at greater power than that for which the licence was originally granted.

A Novel Interval Signal

WJSV, a Washington broadcasting station, proposes to use as an identification call the scream of the blue eagle. As attempts to secure a sound film of the bird in its native haunts has failed, the engineers have commissioned a well-known American bird imitator to study the cry and later to broadcast it personally from the studio. If this is successful, an electrical record will be made of his performance and the imitation scream will be used at the beginning and at the end of every broadcast; after which, we take it, the hard-working artist personally gets the bird!

INTERESTING and TOPICAL PARAGRAPHS

HOW IT IS DONE BY FERRANTI



A view of part of the highly-organized Ferranti works at Hollinwood, Manchester. Such organization has resulted in the high quality for which Ferranti components are world-renowned.

Alternate Programmes for Denmark

TOWARDS January, 1934, we may expect to hear two programmes from Copenhagen, namely, one of a national character through the Kalundborg high-power station, and a regional entertainment from a new 25-kilowatt transmitter which is being erected between the capital and Röskilde. The latter will be broadcast on 255.1 metres (1,158 k/cs). The site of the new station has been carefully selected, inasmuch as although it will provide good reception to Copenhagen listeners, it will be placed at a sufficient distance to prevent any interference with the capture of foreign programmes. In a recent census taken regarding the class of entertainment preferred by subscribers to the system, some 90 per cent. of the replies made it clear that the relay, or the direct reception of entertainments from neighbouring states, were greatly appreciated.

All Above 100 Kilowatts

OF the South American States Mexico is likely to prove a severe competitor, at least, in respect to broadcasts of her northern neighbour, and the Texas stations anticipate considerable interference with their transmissions. At Matamoros, on the borders of the Gulf of Mexico, three high-power stations are being erected, namely, XEM, 500 kilowatts (454.6 metres), XEN, 150 kilowatts (422.3 metres), and XETM, 150 kilowatts (355 metres); these may be used for publicity, and the greater part of the broadcasts will be in the English language. Two big plants are being installed at Villa Acuna, on the Texas frontier: XEF and XER, working respectively on 450.9 metres and 407.9 metres; both rated at 500 kilowatts. It is also stated that a similar transmitter will be built at Monterey (XET, 434.8 metres), and that XENT, already operating at Nueva Laredo on 270.1 metres, will boost its power to 150 kilowatts. Surely a nation of giants! There should be little difficulty during the coming winter of placing Mexico on our log as easily as we do other trans-atlantic broadcasts from Canada and other parts of the North American continent.

Midland Composers' Concerts

THERE will be two Midland Composers concerts in the near future—Joseph Engleman on October 31st, and Sir Herbert Brewer on November 4th. Joseph Engleman, a Birmingham native, is a self-taught composer, whose best-known works are light suites for orchestras. He had a ballet-suite performed a few years ago, Dr. Adrian Boult conducting. His son, who is the pianist at a Birmingham theatre and a frequent broadcaster, gives a recital of his works. The Brewer concert is by the Midland Studio Chorus, conducted by Edgar Morgan, and consists of seven of this famous composer's part songs.

"Kaleidoscope"

ONE of the most haunting plays ever broadcast was *Kaleidoscope*, representing the life of a man from the cradle to the grave. Listeners to the National programme will hear the revival on October 27th, and it will be heard by Regional listeners on the following evening. Selected pieces of prose and verse are superimposed on the dialogue of the play, and music is used as an actual character.

SOLVE THIS!

Problem No. 57.

As he was anxious to obtain a fairly high degree of selectivity, Parker decided that he would use a receiver with a frame aerial. He therefore paid a visit to the local radio store and purchased a five valve set and a frame aerial. On his return to his apartment he joined the frame aerial across terminals A and E, and switched on. He found, however, that instead of sharp tuning the results were just the opposite, the local station spreading over many degrees. Furthermore, he soon found that the aerial had no directional properties at all. Why was this? Three books will be awarded for the first three correct solutions opened. Address your envelopes to the Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2, and post to reach here not later than Oct. 23. All envelopes should be marked Problem No. 57.

SOLUTION TO PROBLEM No. 56.

Brown had overlooked the fact that the reaction condenser was joined between the two reaction coils, and therefore it should have been insulated from the metal panel, which, of course, was earthed through the medium of the moving vanes of the tuning condenser.

The following three readers correctly solved Problem No. 55, and books have been forwarded to them:—

D. Morgan, 31, Symonds Road, Preston, Lancs.; E. J. Moore, 11, Briton Road, Stoke, Coventry; J. F. B. Amrehn, 33, Lupton Street, Tufnell Park, N.W.5.

This is the First of an Entirely New Series of Articles which will Show how Every Reader can Obtain a Thorough Understanding of the Working of a Receiver by Actual Experiment. Theory has been Ignored and the Complete Scheme is Essentially Practical.

By FRANK PRESTON, F.R.A.

THERE is an old saying that "experience is the best tutor," and this is particularly true in regard to wireless. One could read every handbook published on the subject and still acquire far less practical and useful knowledge than by spending but a fraction of the time building and experimenting with a simple receiver. I have for a long time had in mind a scheme by which any interested constructor, be he a beginner or not, could build for himself a wireless set rather on the idea of an expanding bookcase. The main point was that at every stage of the experiments the apparatus should be capable of providing good broadcast reception. It was also decided that, if possible, not a single component should at any stage of the progressive constructional experiments have to be discarded. I have thus devised what is, I think, a new system of wireless self-instruction which will not only prove entertaining, but will be inexpensive and never-ending. The final object is the production of a perfectly up-to-date and really efficient four-valve receiver, but we shall start (I say "we" because I hope you are going to follow through the series with me) by making the simplest possible two-valve set. The original instrument will be entirely devoid of "frills" or unnecessary "extras," but will at the same time be a set capable of providing broadcast entertainment. It will gradually be added to, and the additions will be made in such a way that should any reader at any time wish to proceed no farther with the experiments he may simply stop, and without making any alterations he will be in possession of a good receiver.

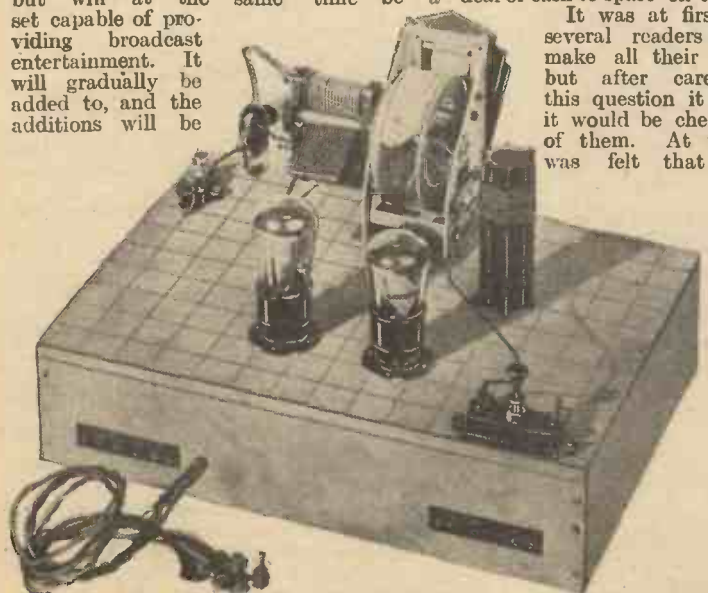


Fig. 2.—A view of the receiver as seen from the back; you can see the positions of all the components mounted on top of the chassis.

Inexpensive Experiment

The initial cost of parts will be only about thirty-six shillings, and the extra components required from time to time will be bought in easy stages, so that the whole scheme will be of particular attraction to those many readers who have not a great deal of cash to spare on their hobby.

It was at first considered that several readers might prefer to make all their own components, but after carefully considering this question it was decided that it would be cheaper to buy most of them. At the same time it was felt that the constructor who wished to carry out all the many experiments which I shall describe would not be able to find time to make the components as well. As a result I shall only ask you to make the tuning coils. This work will not occupy too much time and will facilitate the carrying out of a few of the most important tests in regard to selectivity.

Modern Constructional Methods

A good idea of the appearance of the experimental receiver in its initial form can be gathered from the photographic illustration on this page, whilst the drawings and sketches will make the constructional details quite clear. It will be at once apparent that a metallized wooden chassis (of the kind popularized by PRACTICAL WIRELESS) is employed and that the design throughout is thoroughly modern. At first glance it would seem that the chassis is much larger than is required, but it must be remembered that it was chosen to accommodate eventually a high-class four-valver. Incidentally, the final model has already been designed and made up, so that every reader can rest assured that if he wishes he will be able to graduate to a sound and efficient set of the more powerful type.

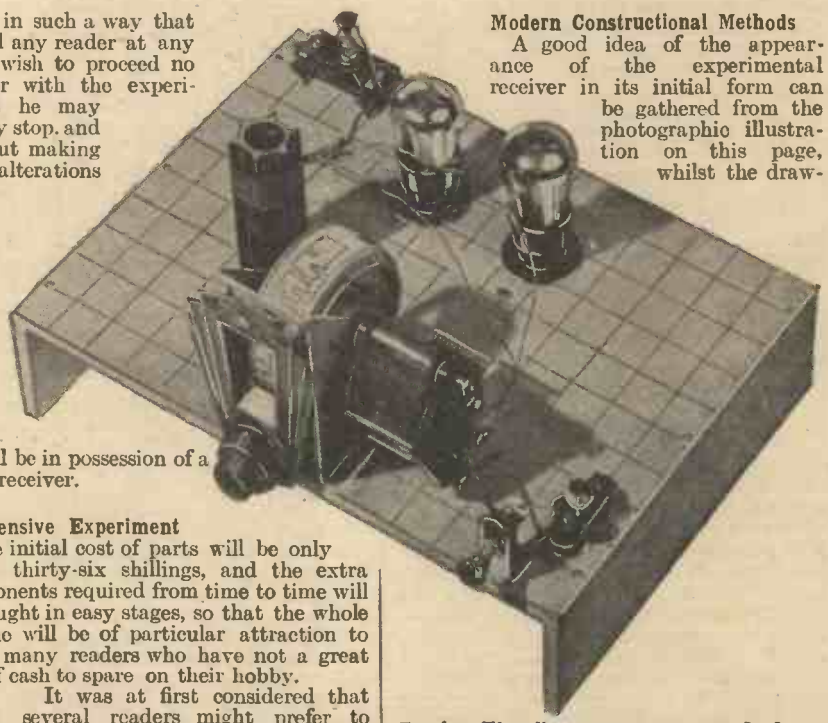


Fig. 1.—This illustration gives a good idea of the set ready for the preliminary experiments.

No Circuit Diagrams to Worry You

Another feature of this "course" (if that name does not sound too scholastic) is that circuit diagrams will in most cases be dispensed with, their place being taken by easily-read sketches and attractive drawings. It is my sincere hope that every PRACTICAL WIRELESS reader who is new to the science, or who has not previously given thought to the "whys and where-

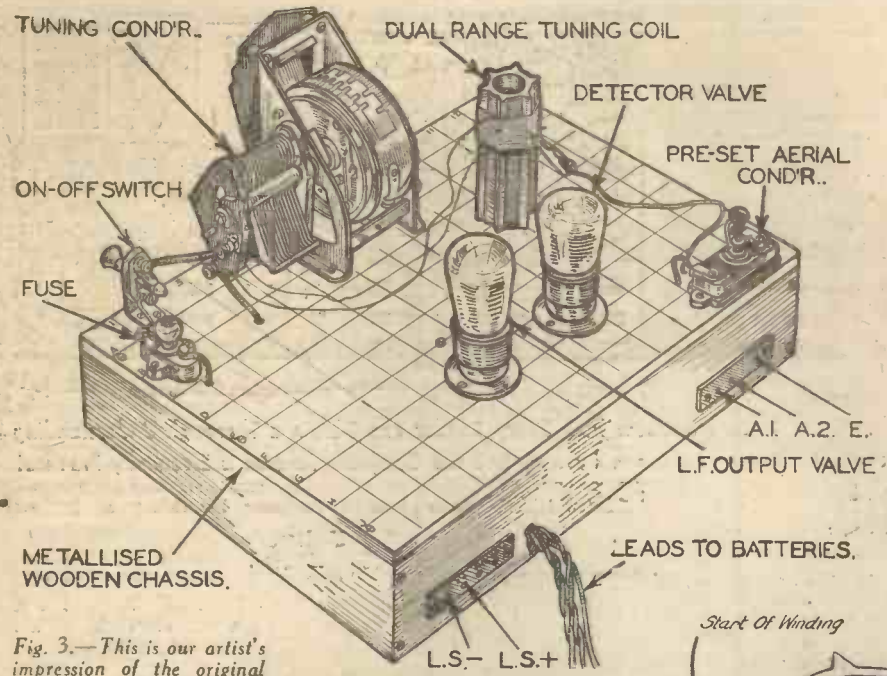


Fig. 3.—This is our artist's impression of the original receiver. The names will enable you to recognize the components.

fores " will follow the series of experiments that are to be described. If he does, he cannot fail to teach himself a considerable amount, and will very soon become a true wireless " fan."

But let us get down to work. A list of the necessary parts required is given elsewhere, and these must be obtained before we can proceed. Make certain that you are supplied with the exact components specified in order to prevent any possibility of trouble at a later stage.

The first job is to drill the " Metaplex " chassis to receive the valve-holders and terminal socket strips. The exact position of these holes is indicated on the wiring plan, and the diameter of those for the valve-holders is 1in. Rectangular or oval holes are used for the terminal strips; they can be made in the three-ply back of the chassis, either by means of a chisel or a brace and ½in. bit. The holes are 1½in. long by ½in. wide and the strips just cover them without the metal sockets coming in contact with the wood. Next attach the .0003 mfd. pre-set condenser in the position shown, mount the valve-holders, L.F. transformer, fixed grid condenser, and the component bracket. The on-off switch can then be screwed to the bracket, after which the drum drive for the condenser should be attached. To fasten the .0005 mfd tuning condenser (which *must* be of the " right-hand " pattern) to the latter, the set screw in the hollow spindle of the drive must be slacked off, and the large nut on the condenser must be removed. The bush can then be secured to the framework of the drive. After that you should set the dial to zero and turn the moving plates of the condenser so that they are fully out of mesh; it then only remains to tighten up the set screw when the condenser can be correctly operated by means of the larger knob on the drive assembly.

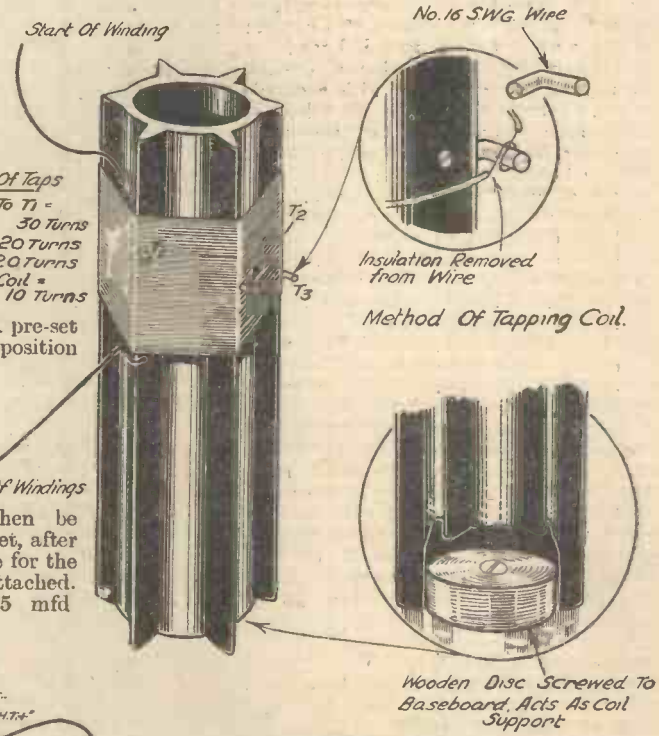


Fig. 4.—All constructional details for the tuning coil may be obtained from the above sketch.

Simplicity of Wiring

Up to this stage we have assembled everything except the tuning coil, and we shall find it easier to wire up before making that component. There are really very few wires to deal with, so it is unlikely that any difficulty will be met with here. To simplify matters, however, you might find it worth while to cross out with a pencil line each wire as it is dealt with. The wire specified is insulated, but the covering can be pushed back with the fingers to leave a sufficient length of bare material for making into a loop to fit the appropriate terminal. It will be clear from the illustrations that the grid leak is supported by the wiring, not being fastened to the chassis in any way. The battery leads consist of suitable lengths of single flex, to the ends of which are attached the appropriate wander plugs and spade terminals. For the sake of neatness, all these leads are passed through a quarter-inch hole made through the back of the chassis.

There is one little point which should be clearly explained in connection with the wiring; that is, that there is no wire connection between the on-off switch and the filament terminals of the valve-holders. This connection is, however, made through the metallized chassis and a ¼in. 4B.A. bolt which is passed through it. The bolt and also the wires going to it are shown quite clearly in the wiring plan.

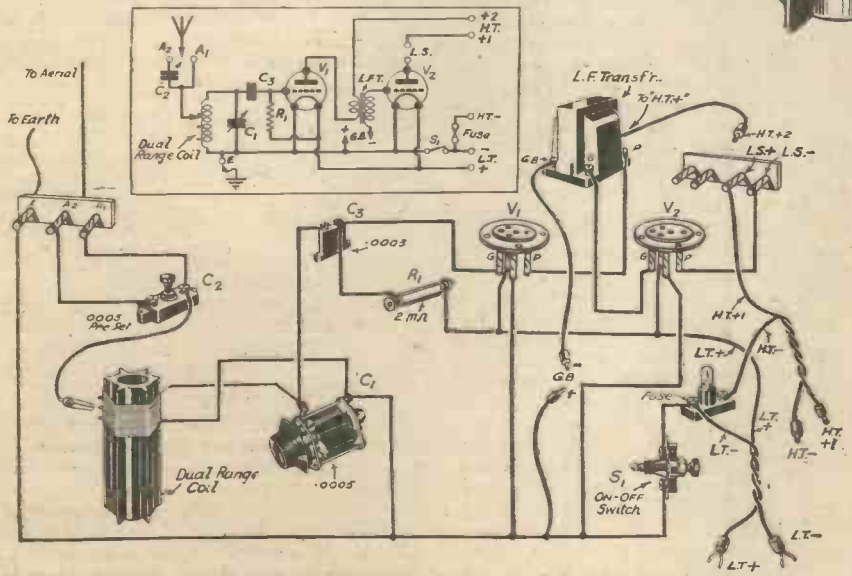


Fig. 5.—Here you have a pictorial circuit diagram, whilst the corresponding theoretical circuit is shown inset. By comparing the two you will be able to improve your knowledge of circuit diagrams.

THE PROGRESSIVE EXPERIMENTER

(Continued from previous page)

Making the Tuning Coil

Now that the set is all ready except for the tuning coil, we can turn our attention to that component. We shall not make a complicated one at first, but will construct the simplest possible type which will enable good reception to be obtained on the lower broadcast waveband (between about 200 and 500 metres). The usual long-wave winding, as well as the reaction winding, will be ignored until a later stage is reached.

Our tuner consists essentially of a 4 in. length of 1¼in. six-ribbed ebonite coil former wound with a total of eighty turns of 84-gauge wire. For the purpose of some of our experiments in connection with selectivity, tappings will be taken after thirty, fifty, and seventy turns. The method of procedure is as follows: First make a small notch with a sharp knife at a distance of ⅛in. from the end of each rib. Next make a 1/32in. hole through one of the ribs at the same distance from the end of the former. Pass the end of the wire through this and lightly tie a knot, leaving a length of about 8ins. of wire for making subsequent connection. Commence to wind on the wire by placing the first turn in the slots previously made, and then continue to wind on thirty turns, keeping them as close together as possible. Now make another 1/32in. hole through a rib in line with the end of the last turn. In this wedge a short length of bared connecting wire and bend it over until it projects straight out from the former. Carefully scrape the cotton insulation away from the thinner wire near the end of the thirtieth turn and connect this to the

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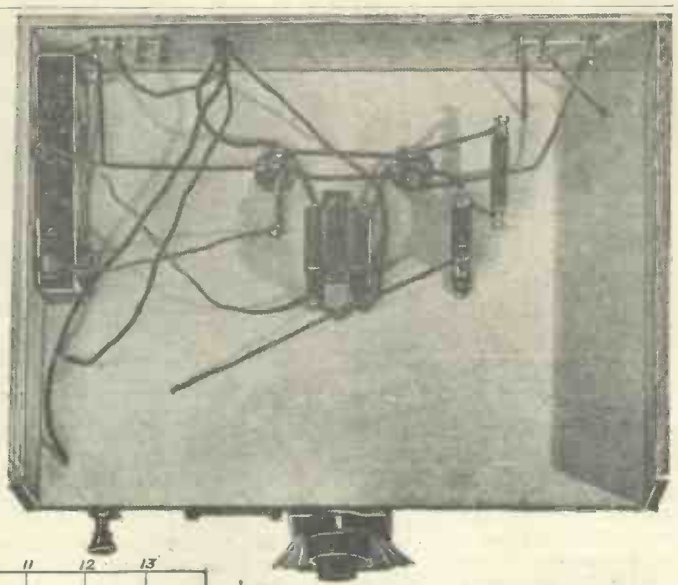
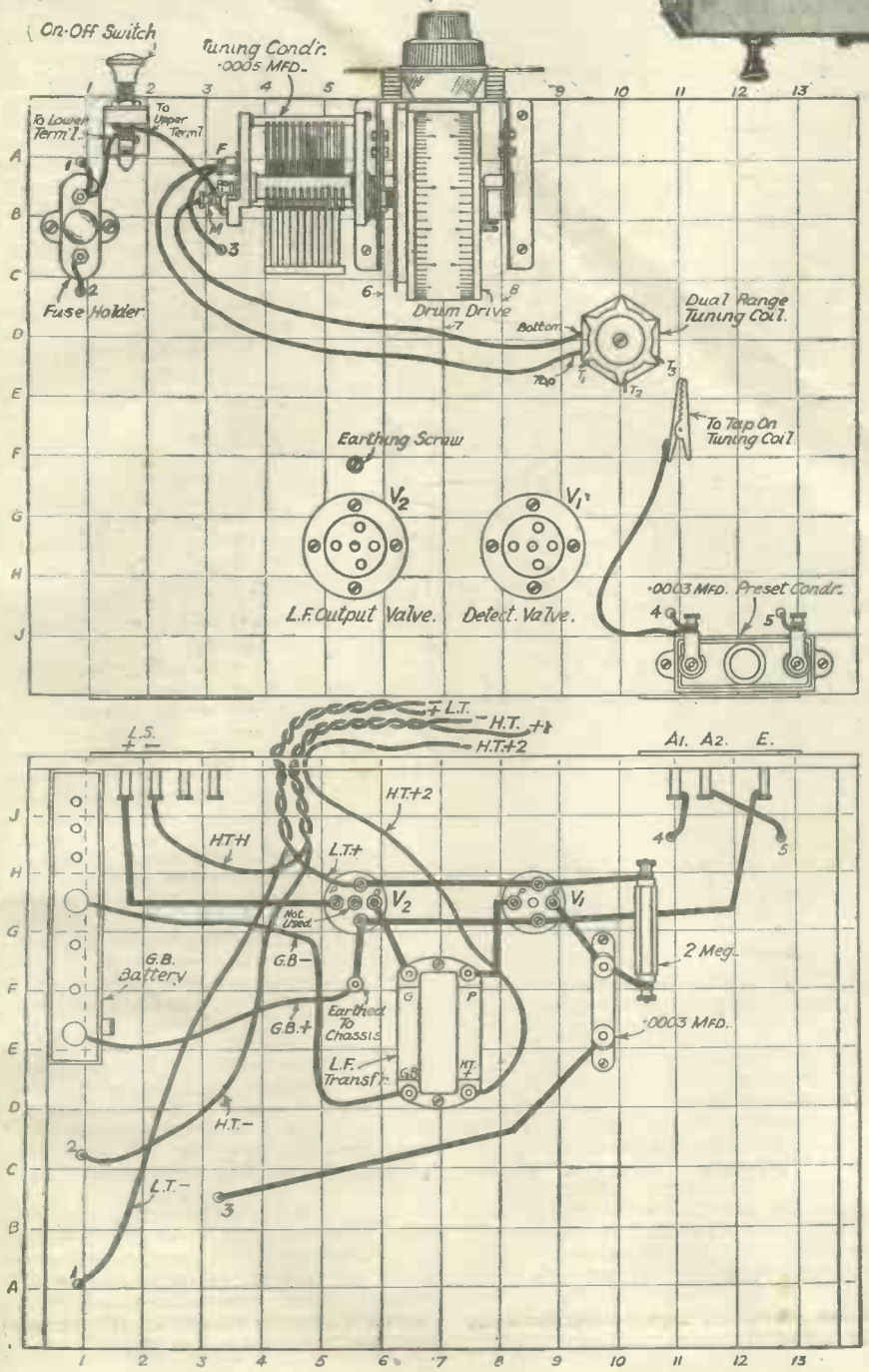


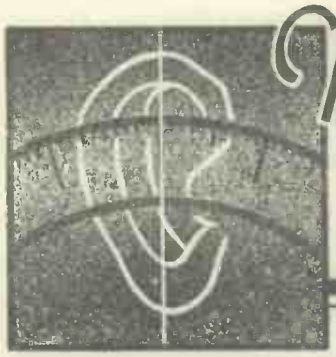
Fig. 6.—The under-chassis wiring and component arrangement is clearly shown in this photographic illustration.



LIST OF PARTS REQUIRED FOR THE ORIGINAL SET

One Peto-Scott Metaplex Chassis, 14in. by 10in. by 3½in. deep.
One Telsen Drum Condenser Drive, with 100-degree scale.
One Telsen Right-hand Logarithmic Condenser, with Compensator.
One British Radiogram On-Off Switch.
One British Radiogram Component Bracket, type No. 22.
One Graham Farish "Pip" 3:1 L.F. Transformer.
One "Goltone" .0003 mfd. Pre-Set Condenser.
One T.C.C. .0003 mfd. Fixed Condenser, type 34.
One Graham Farish 2 megohm "Ohmite" Grid Leak.
One Bulgin Baseboard Mounting Fuseholder, with 100 m.a. Fuse.
Two Clix Valveholders, baseboard mounting type, one 4-pin and one 5-pin.
Two Clix Chassis Socket Strips, one marked "A1," "A2" and "E," the other marked "L.S.+," "L.S.—," and "Pick Up."
One length 1¼in. diameter 6-rib Ebonite Coil Former.
One ounce Lewcos 34 s.w.g. d.c.c. Wire.
Nine Belling Lee Wander Plugs, marked "A.," "E.," "L.S.+," "L.S.—," "H.T.—," "H.T.+1," "H.T.+2," "G.B.—," and "G.B.+."
One Bulgin Crocodile Clip.
One Bulgin Grid-Bias Battery Clip, type No. 5.
One length Bulgin "Quickwire."
One length flex, screws, etc.
One Cossor Type 210H.F. Valve (metallized).
One Cossor Type 220 P.A. Valve.
One Lion 9-volt Grid-Bias Battery.
One Lion 120-volt H.T. Battery.
One Lissen type LN2009 2-volt Accumulator.
One W.B. "Microlode" Loud-speaker, type P.M.6.

Fig. 7.—By following these under and above chassis views you should find no difficulty in mounting the components and carrying out the wiring. The chassis is divided up into one-inch squares to simplify the location of the various parts.



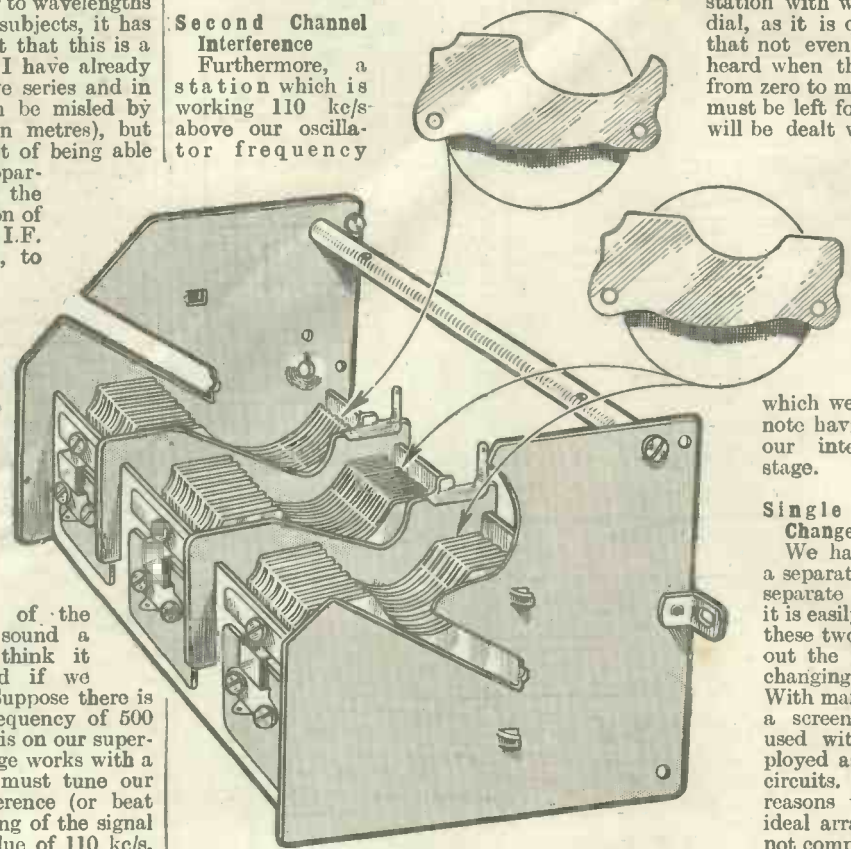
The Superhet

In this Second Article on the Working of the Superheterodyne Circuit, the Principle of Frequency Changing is Dealt with and Second Channel Interference explained

IN the first article of this series I explained how the Intermediate Frequency Amplifier carried out amplification at a fixed frequency, to which all received signals have to be changed. The question of frequencies and wavelengths is a very vexed one, and although it is customary for us in this country to refer to wavelengths when dealing with various subjects, it has been repeatedly pointed out that this is a rather troublesome thing. I have already explained, in the short-wave series and in other articles, how you can be misled by thinking in wavelengths (in metres), but nowhere is the great benefit of being able to think in frequencies so apparent as when dealing with the frequency changing operation of the superheterodyne. The I.F. stage is, we have decided, to work on a frequency of 110 kc/s. This is a wavelength of 2,727.2 metres. Now the changing of our signal into the intermediate frequency is carried out by having one valve (the first detector) to rectify the beat produced by the signal and a voltage set up by a second valve which is arranged to oscillate continuously. The coils in this oscillator are tuned to a frequency which differs from our signal by the frequency of the I.F. stage. This may sound a little complicated but I think it will be better understood if we take an actual example. Suppose there is a station working on a frequency of 500 kc/s, and we wish to hear this on our superhet circuit. As the I.F. stage works with a frequency of 110 kc/s we must tune our oscillator so that the difference (or beat note) produced by the mixing of the signal and the oscillator has a value of 110 kc/s, which means to say that the oscillator must be tuned to 610 kc/s or 390 kc/s. In other words we tune the oscillator to a frequency 110 kc/s above or below the signal frequency. If this example is expressed in metres we would have a most confusing array of figures. We should say that we wish to hear a station working on a wavelength of 600 metres, and we adjust our oscillator to 491.8 metres or 769.2 metres, thus producing a beat note of 2,727.2 metres. You see now the advantage of the kilocycle working? (Wavelengths in metres are converted to frequencies in kilocycles by dividing 300,000 by the number of metres.) Well, to get back to our superhet circuit, we have found that we have to tune the oscillator coil so that we produce in that circuit a frequency which differs from the frequency of our required signal by the frequency of the I.F. stage. The first point which will occur to the thinking reader is that there should thus be a possibility of hearing a station working on the wavelength to which the oscillator is tuned.

Second Channel Interference

Furthermore, a station which is working 110 kc/s above our oscillator frequency should also be heard. That is to say, if we adjust our oscillator to 610 kc/s in order to hear a station on 500 kc/s a station working on 610 kc/s might leak through the receiver, whilst it is practically certain that a station on 730 kc/s would beat with our oscillator in the same manner as our required station. This actually does happen in the superhet and is known as Second Channel Interference. Furthermore, harmonics may cause whistles in the following manner. If our local station is very close, and we are tuned to a station which is 55 kc/s lower than the local (55 is, of course, half of 110), the local may be received sufficiently strongly by the first detector for beats to be set up which will cause interference. This can happen at practically every harmonic of 110 kc/s. There is, however, no need to think from this that the superheterodyne will only tune in a station with whistles all round the dial, as it is quite easy to ensure that not even one whistle can be heard when the control is turned from zero to maximum. That point must be left for a later article, and will be dealt with when discussing the input circuits of the superhet. At the moment we are dealing with frequency changing, and we have now seen that the process consists simply of arranging an oscillating circuit so that it produces, with the signal which we wish to hear, a beat note having the frequency of our intermediate frequency stage.



This illustration shows a three-gang condenser, with the top inset showing the special oscillator shaped plates.

Single Valve Frequency Changers

We have referred so far to a separate detector valve and separate oscillator valve, but it is easily possible to combine these two valves and so carry out the process of frequency changing in one single stage. With mains operated receivers a screen-grid valve may be used with the cathode employed as part of the tuning circuits. There are certain reasons why this is not an ideal arrangement, but I will not complicate matters by discussing these now. A pentode valve may be employed in a similar manner, one of the grids playing an important part. More recently, the Pentagrid (or Heptode) has been developed to fulfil the same purpose, and with this reduction in the number of valves certain improvements have been effected in the circuit, but the principle remains exactly the same.

Aligning the Oscillator

A most interesting point which arises when considering the modern superhet (which employs a ganged condenser for tuning all the circuits) is the alignment of the oscillator, or, in other words, the correct

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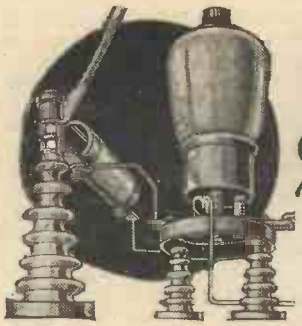

An Untuned H.F. Stage on Short Waves

A Practical Article Explaining its Advantages and How it Eliminates Dead Spots from the Tuning Range. By K. E. BRIAN JAY.

THE use of a screen-grid H.F. stage is not common in short-wave receivers for several reasons, the chief being the belief that the advantages to be obtained are not as great as the extra complications, especially as a second tuning control would be introduced and most people find one quite enough! This is a perfectly sound argument, of course, but the additional tuning control can be eliminated by leaving the H.F. stage untuned, and the extra valve will still be worth while even although its full capabilities are not exploited. The chief advantages of an untuned screen-grid stage are the removal from the tuning range of dead spots, due to aerial loading, and a certain amount of amplification, resulting in louder signals; it may seem that this is not much to get for the extra cost of a valve, but, unless economy of battery current is very important, it is well worth while.

A suitable circuit is shown in Fig. 1. The grid circuit of the screen-grid valve consists simply of the high-frequency choke Ch_1, the aerial being connected directly to the grid end of this choke, while the high-frequency valve is coupled to the detector by the second H.F. choke Ch_2 and the coupling condenser C_1; the rest of the circuit is standard. The sizes of the first two chokes are rather important; Ch_1 is smaller than the average short-wave H.F. choke, only about 80 turns or so of number 36 d.s.c. wire on a ⅜in. diameter

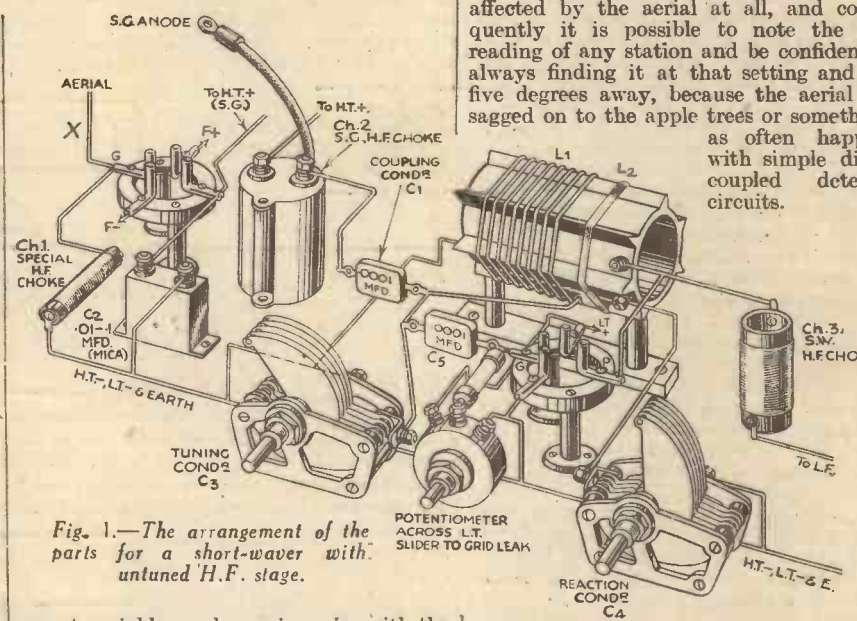

Fig. 1.—The arrangement of the parts for a short-waver with untuned H.F. stage.

preset variable condenser in series with the aerial (at the point marked X) should cure the trouble. It is sometimes recommended that a resistance of from 100,000 to 250,000 ohms is used in place of the choke Ch_1:

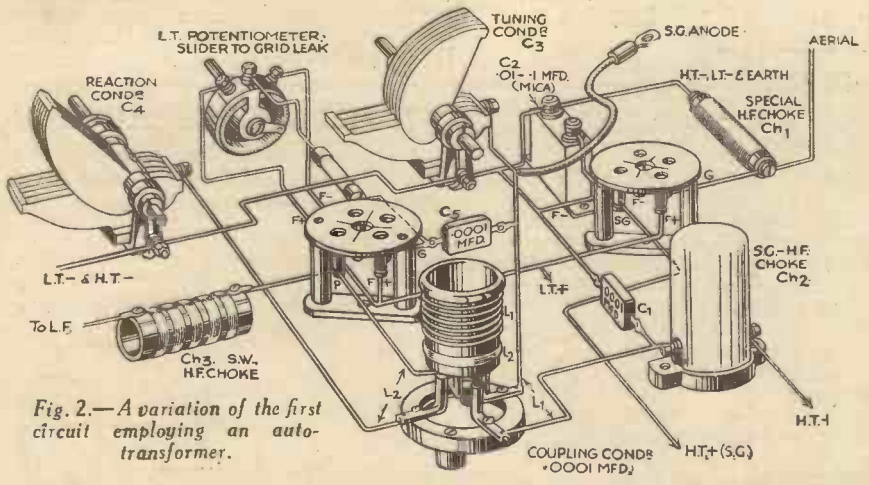

Fig. 2.—A variation of the first circuit employing an auto-transformer.

ebonite tube. A larger choke than this results in bad interference, of the kind called cross-modulation, from the nearest medium-wave broadcasting station, which makes itself heard all over the dial of the short-waver, at any rate in the vicinity of 40 to 50 metres. If the receiver is used so close to a medium-wave station that interference cannot be removed even by cutting the choke down to 50 turns, the insertion of a this may be satisfactory in some cases, but since it generally accentuates any interference from mains hum, "man-made static," or neighbouring broadcasting stations, while offering no advantages over the choke in other directions, it is better avoided. Ch_2 should be a high impedance screen-grid choke of the universal wavelength type; an ordinary broadcast choke has been found fairly satisfactory as a matter of fact, but a short-wave choke gave rise to dead spots in the tuning range and so defeated the whole object of the extra valve. The third choke Ch_3 is the ordinary short-wave reaction choke.

The capacity of the coupling condenser C_1 is not critical but should not be too large; .0001 mfd. is a very good value, and it should certainly not exceed .0003 mfd. The condenser C_2, the screen-grid by-pass condenser, must be a mica component, or at least non-inductive, of from .01 to .1 mfd. capacity. The condenser C_3 and coil L_1 are the usual detector tuned grid circuit and standard values will suit this position. Incidentally, another of the advantages of the screen-grid valve is that the tuning of the detector circuit is not affected by the aerial at all, and consequently it is possible to note the dial reading of any station and be confident of always finding it at that setting and not five degrees away, because the aerial has sagged on to the apple trees or something, as often happens with simple direct coupled detector circuits.

Using an Auto Transformer

A variation of the circuit that is popular in America is shown in Fig. 2. In this arrangement the choke coupling is discarded for an arrangement that is best described as an auto-transformer, the tuned grid coil L_1 being included in the plate circuit of the screen-grid valve in such a way that it forms both the primary and, regarded as the detector grid coil, the secondary of an H.F. transformer with a turns ratio of 1 : 1. There is no coupling condenser in this arrangement, the plate of the screen-grid valve going straight to the grid end of the detector coil. The H.T. positive is connected to the other end of L_1 *via* a H.F. choke Ch_2, and in order to bring this end of the coil to earth potential as far as high-frequency currents go, it is connected to the earthed plates of C_3 through a large fixed condenser C_1. Since C_1 is in the tuned circuit L_1—C_3, any losses in it will reduce the efficiency of the circuit; it must therefore be a really good quality mica component, between .004 and .01 mfd. The grid condenser C_5 must also be a good quality instrument because it has to stand the full H.T. voltage to the screen-grid valve; the usual capacity is suitable. In this circuit the H.F. choke Ch_2 does not play such an important part as in Fig. 1, and may be an ordinary short-wave reaction choke such as Ch_3. The unimportance of Ch_1 is really the only advantage of this circuit over Fig. 1, and in spite of the possibility of trouble with this component in the first circuit, it is none

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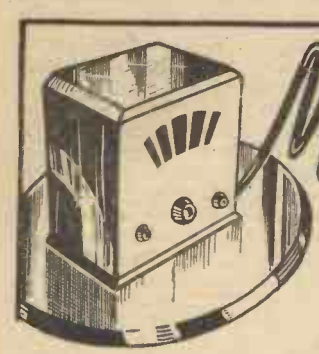

Mains Aerials

An Efficient Alternative to the Frame.

By ERIC JOHNSON

DURING the last two years, the progress made in receiver design has been so rapid that an outside aerial is by no means so essential to good reception as was thought formerly; coupled with this fact, we must remember the general increase in power of the principal broadcast stations has done much to make the set independent of the large and unsightly aerial. In spite of this, few receivers are sensitive enough to dispense with this entirely by relying on the relatively small pick-up of the frame. Apart from this, the only alternative is an indoor aerial system. Whilst such an arrangement can be extremely satisfactory from a sensitivity point of view, it rarely happens that the necessary wires can be erected without causing some inconvenience to the rest of the household. Few listeners realize, however, that where electric lighting is installed they have ready to hand an aerial system which, used in the proper manner, can yield very fine results. Not only may the wiring system serve its primary object of providing the ordinary household current, but it will also serve as an excellent aerial providing certain precautions be taken.

Using the House-wiring System

Obviously no direct metallic connection may be made between the mains and the grid coil on account of the probability of short circuit, which will not only blow the house fuses, but also burn out your tuning coil. In order to guard against this a condenser may be joined in the lead from the mains; this will offer no barrier to the H.F. currents, but will act as an effective stop to the mains current, providing, of course, in the case of A.C. that its value is not too high. The circuit in its simplest form is shown in Fig. 1. There are, however, several serious drawbacks. If the coupling condenser is at all large, the mains ripple will be passed on to the detector and subsequently amplified; even a quite small condenser can cause this trouble if the voltage ripple is of the high-frequency commutator type; admittedly the reactance of a capacity of the order of .0001 mfd. is very high to audio-frequencies, but it must be remembered that a powerful mains receiver will give a good account of a tiny input to the detector. Bearing this in mind it will be appreciated that we are compelled to use a condenser which is of such a value to seriously limit the effectiveness of our aerial; the coupling is far too weak to be efficient. There is another aspect of the matter.

A long and low aerial, of which the mains type is a good example, has a high capacity to earth and a consequent low resistance. On the other hand, a small series condenser has a very high effective resistance. This would be unimportant if our aerial were of the small high resistance type—a little extra resistance would be but a small part of the whole. We cannot increase the size of this capacity without introducing mains hum; furthermore, it will be found that damping on the grid-coil is severe, and it is very doubtful whether good oscillation can be maintained over the tuning range with the aerial connection to the "top-end" of the grid-coil as shown. Fortunately, we have a way out of our difficulties. By arranging for a tap on our grid-coil we immediately reduce aerial damping. The arrangement (shown in Fig. 2), may be considered as an auto-transformer where the aerial tap to earth is the primary, and the secondary the whole of the tuning coil. We have very considerably increased the efficiency of the system by "matching" the low-resistance aerial to the low-resistance primary. Providing the aerial tap is well down the grid-coil (not more than a quarter up), we may increase the value of the coupling condenser to a value where its equivalent resistance no longer swamps the total circuit resistance; at the same time we need have no fear that mains hum will be apparent with the tapping point well down to the low potential end. In these circumstances it may be found that the series condenser may be increased to about .01 mfd. with advantage. There is no point in increasing it beyond this value, as the reactance to broadcast frequencies is but 15 ohms or so. It must be emphasized that it is quite useless to take all these precautions to keep the circuit resistance low if we neglect our earth connection; so be sure to see that this is above reproach.

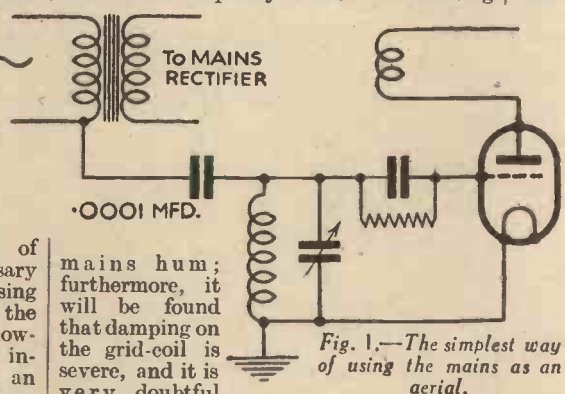

Fig. 1.—The simplest way of using the mains as an aerial.

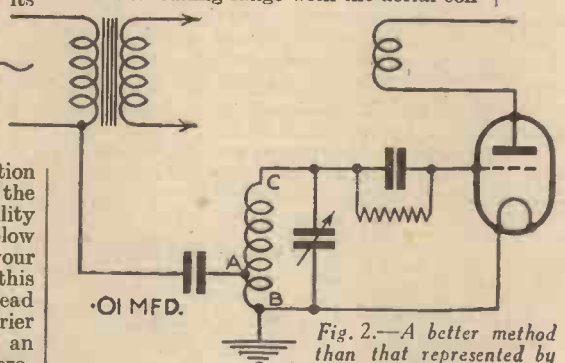

Fig. 2.—A better method than that represented by Fig. 1.

An Alternative Arrangement

Perhaps a better system than that described above is drawn in Fig. 3. Here we have a coupling coil in series with the mains lead. This may be of the so-called aperiodic type or tuned. As a general rule, no trouble will be experienced with hum—the effective coupling for audio-frequencies is far too weak. Should it be desired to tune the coil, it will be found advisable to "tie" down one end to earth potential, otherwise hand-capacity effects will prove troublesome; a condenser for this purpose is shown in broken lines.

A mains aerial constructed on the several lines suggested above should be every bit as effective as the more conventional indoor variety, and should, in fact, bear comparison with a small outside one. It is definitely not recommended for short-wave work, however. The high capacity to earth makes it totally unsuitable for the job; even if the pick-up were good we should find that the inter-winding capacity of the mains transformer would make a very effective short to earth. As a point of fact, the greatest efficiency will generally be obtained on the medium-wave band. On the long waves it is always found that stronger aerial coupling is necessary. For reasons outlined above, this may bring in its train heavy damping and mains ripple. The small loss in efficiency is hardly likely to be very noticeable on these frequencies, however, and certainly should not act as a deterrent to an effective solution to the aerial problem.

THE GOOD COMPANIONS!

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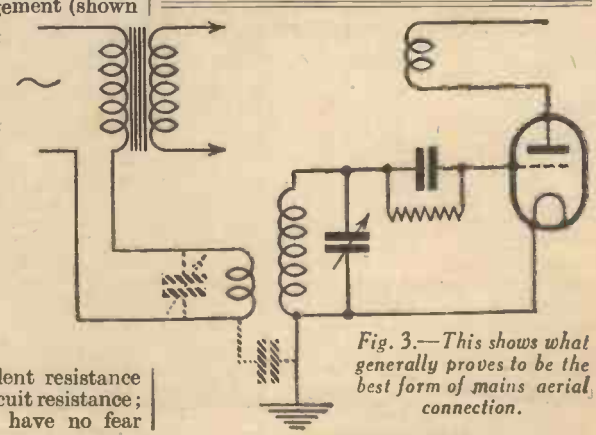

Fig. 3.—This shows what generally proves to be the best form of mains aerial connection.

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keep off!

If you could watch Cossor Valves being made you would be surprised to see every one of the hundreds of girls engaged in assembly wearing thumb- and finger-stalls.

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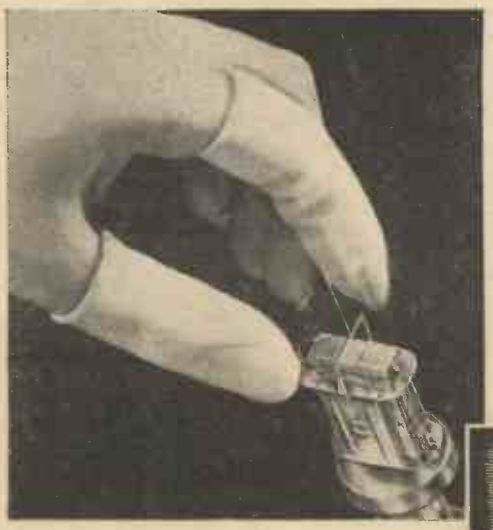

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Please send me free of charge, a copy of the Cossor Valve Catalogue, B 14.

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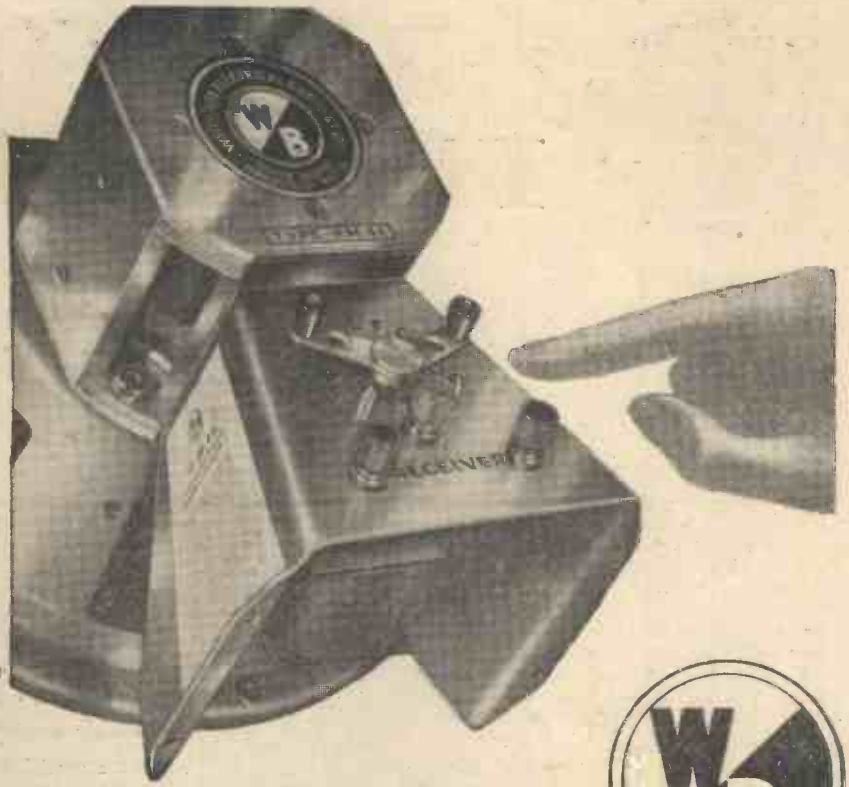

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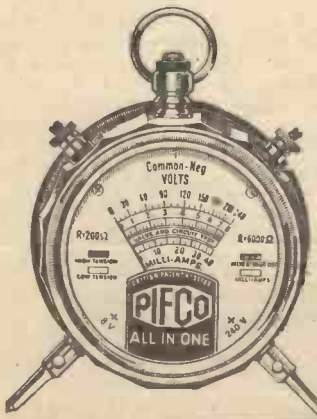

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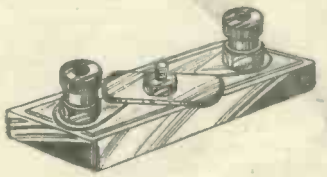
PR3.

READERS' WRINKLES

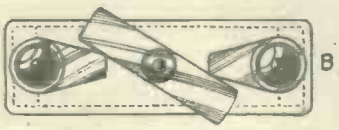
THE HALF-GUINEA PAGE

A Small Capacity Condenser

IT frequently happens in the wireless den that the need arises for a condenser of extremely small capacity, that can be varied for experimental purposes. For capacity coupling, or for balancing purposes, a capacity far below the usual .0001 is



A small capacity condenser.



required. For this, I take advantage of the fact that condensers in series act as the reciprocal of their sum and hence two small condensers in series have a very small capacity indeed. To make the condenser I suggest requires 3 4-6 B.A. screws, 3 nuts and 2 screw terminals to fit, ebonite 1¾in. x 1in. and a piece of mica same size. The ebonite is drilled and countersunk for the three screws as shown in sketch A. Two pieces of thin brass with holes in the ends, as shown in sketch B, are clamped close to the ebonite and a piece of thin mica, cut with scissors to the shape indicated by the dotted line in sketch B, is placed over them and over the central screw. The button, a piece of brass 1in. x ¼in., is drilled in the middle to clear the central screw, and a nut screwed down on it friction tight. On connecting wires to terminals D and E the capacity can be varied from maximum to practically zero by turning the button. The required small capacity having been found the central nut can be made firm and the capacity will then remain invariable.—C. E. HEATH (Brixton).

Fig. 1.—A novel method of making a coil former.

Two Useful Ideas

WHEN winding a long-wave coil in sections on a plain cardboard tube, suitable spacers can be made by cutting strips from corrugated cardboard. These can be glued to the tube in the positions shown in Fig. 1.

For converting components, such as condensers, which are fitted with soldering lugs only, to the terminal type, ordinary wander plugs can be fitted, as shown in Fig. 2. For permanent connections they can be soldered on, but for temporary connections it is sufficient if the wander plugs are just pushed on to the lugs.—C. MOORE (Wolverhampton).

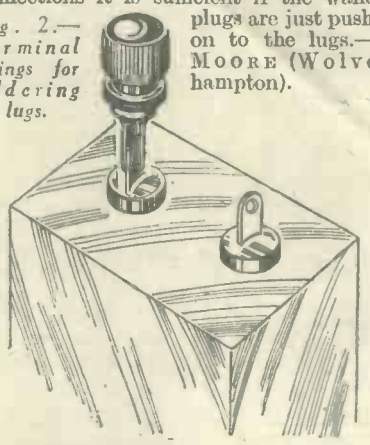


Fig. 2.—Terminal fittings for soldering lugs.

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.

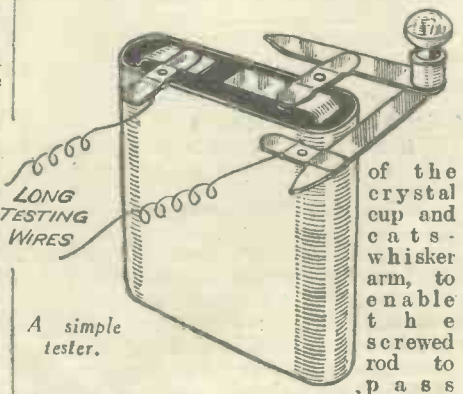
A Convenient Tester

A SIMPLE tester, consisting of a flash-lamp battery and a bulb, was recently recommended in PRACTICAL WIRELESS, for testing the wiring of sets. The illustration herewith shows how the battery and the bulb may be connected so as to leave the experimenter's hand free for testing. A compass type battery-tester is used to hold the bulb, and attached to the flash-lamp battery by one or two of the little brass connecters sold for building up H.T. batteries out of flash-lamp batteries. The testing wires should be quite flexible, and long enough to reach any part of the set to be tested without danger of pulling over the tester; and they should be cotton-covered, except at their ends.—W. W. PADFIELD (Bath).

TRANSFER-PRINT WIRING
THE NEW SCHEME FOR HOME CONSTRUCTORS
SEE PAGE 249
(Prov. Pat. No. 24584/33)

A Novel Lightning Arrester

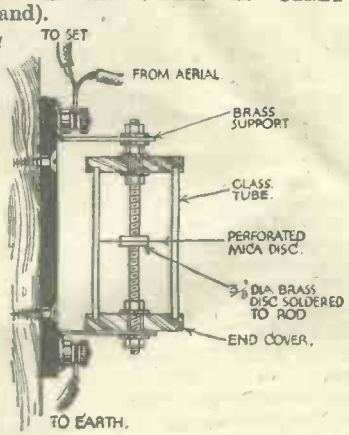
AN efficient lightning arrester may be constructed from an old crystal detector mounting, some 4 B.A. screwed rod, a few nuts and washers, two brass or copper discs about ⅝in. diameter, and 1/16in. thick, and a piece of sheet mica of the same diameter as the inside of the crystal detector tube. A piece of mica removed from an old fixed condenser is suitable if cut to size. The first operation is to enlarge the holes in the end covers and supports of the detector, after removal



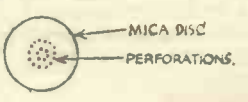
A simple tester.

of the crystal cup and cat's-whisker arm, to enable the screwed rod to pass through. The rod is cut into suitable lengths, which of course vary with the length of the mounting, but an idea of approximate lengths will be seen from the sketch. The brass or copper discs are now soldered respectively to one end of each rod, and the mica disc cut to size and perforated with small holes through the centre part to be covered by the metal discs. The mica disc is then passed into the centre of the glass tube. The screwed rods are passed respectively through the end covers, and adjustment of the inside nuts made so that the metal discs just touch the mica disc. The whole assembly is placed in position and clamped between brackets, respective connections being taken from the terminals, as shown in the sketch.—A. CANEY (Sunderland).

(*Continued overleaf*)

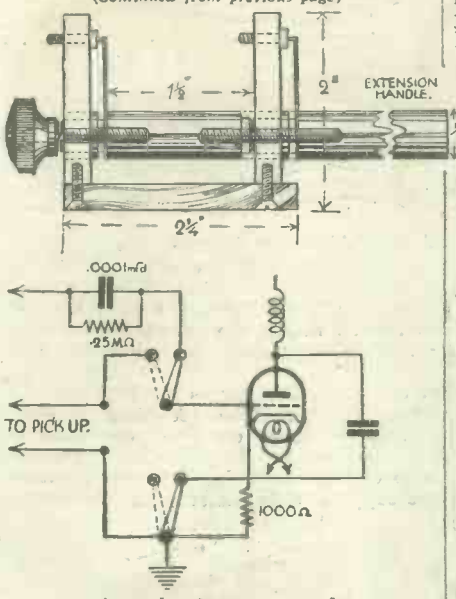


A novel lightning arrester.



RADIO WRINKLES

(Continued from previous page)



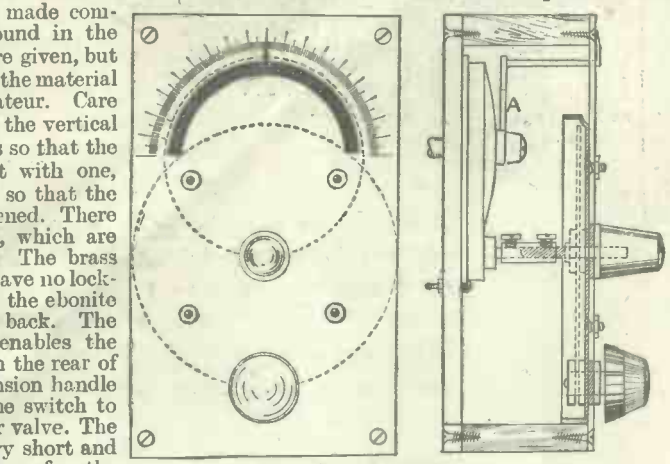
A novel radio-gram switch.

A Novel Radio-Gram Switch

WHEN using a power grid detector with the leak shunting the condenser, it is necessary to short the bias resistance in the cathode lead when using radio. The switch described was made complete out of materials found in the junk box. A few details are given, but these will vary according to the material at the disposal of the amateur. Care must be taken in drilling the vertical pieces. Arrange the studs so that the switch arm makes contact with one, before leaving the other, so that the grid circuit will not be opened. There are no nuts on the studs, which are screwed into the ebonite. The brass bushes for the 2 B.A. rod have no lock-nuts on; they fit tightly in the ebonite and are filed flush at the back. The small knob at the back enables the switch to be operated from the rear of set if required. The extension handle is made long enough for the switch to stand alongside the detector valve. The wiring is consequently very short and neat. There are no stops for the switch arms, the studs being filed a little to leave a small flange on the edge—. W. F. FEARNLEY (Sheffield).

A Slow-Motion Dial

A SLOW-MOTION dial with a ratio of 100 to 1 can easily be made from two slow-motion dials of a 10 to 1 ratio. Any dial will do for the rear dial, but the front one must be able to be completely turned round. In the dial I used, a large disc of celluloid was employed for the larger wheel and this had a stop on it to arrest the scale at 180 deg. This had to be removed. The front dial is bolted to the front panel in which two holes have been drilled to accommodate the knob and the centre spindle. The two dials are connected by a short coupling sleeve and an old valve-pin socket, the large part of which is just the size of the spindle hole in the front dial. A piece of wire is soldered to the moving arm, A, of the rear dial, and is bent to the shape shown. The end of the wire can be hammered flat and then cut to a point with scissors. A semi-circular hole has to be cut in the front panel for the pointer, which rides over a paper scale stuck on to the panel. The two panels are joined by strips of wood, as indicated. —J. W. GRIMES (Richmond).



An easily made slow-motion control.

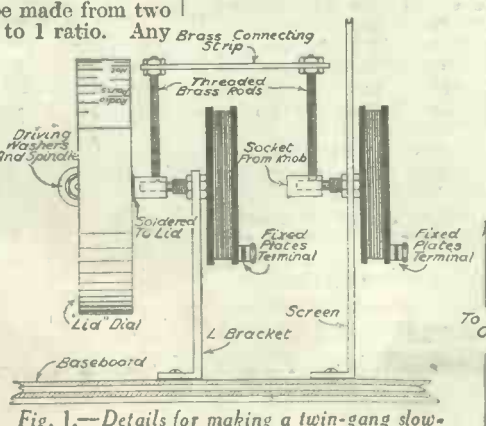


Fig. 1.—Details for making a twin-gang slow-motion condenser.

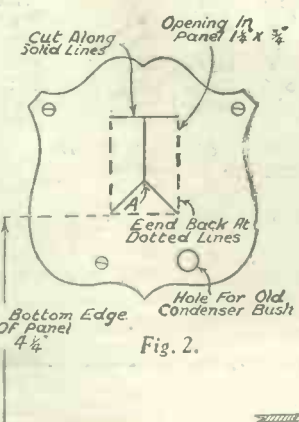


Fig. 2.

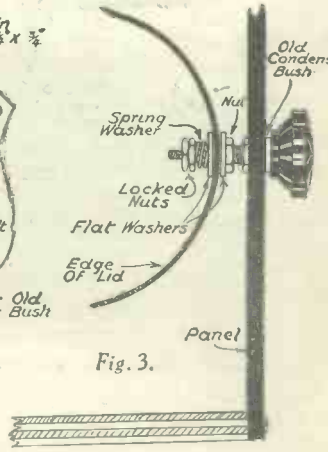


Fig. 3.

Repairing damaged spaghetti resistances.

Using Damaged Spaghetti Resistances

REMOVE the tags and systoflex tubing from the resistance. Trace the break with the aid of a pair of 'phones and a battery, and cut at this point. If desired, the resistance may now be cut down to any standard value if an ohm-meter is available. Allow an extra ½in. for making the connections. Slip a piece of braided covering, obtained from electric light flex, leaving about ¼in. of the resistance exposed at each end. Bind the end of the resistance and the sleeving with thin *tinned* copper wire, leaving about 2in. over for connecting purposes. Run a blob of solder over the bound ends so as to prevent them unwinding. Do not use flux when soldering, as it will soak through to the resistance wire, and cause a bad contact. It is almost impossible to solder direct to the resistance wire as it is an alloy metal, and in any case the wire is too fine and would break easily.—W. L. PATTULLO (Golders Green).

Simple Two-gang Condenser

THE accompanying sketches show how I built a slow-motion twin-gang condenser unit at little cost.

I purchased two solid-dielectric .0005 log-law variable condensers, costing 3s. 6d. each, taking care to see that the knobs supplied with them had brass spindle sockets, and were fixed with grub-screws. This applies to most makes. The circuit I had in mind was a 3-valver, S.G., det. and power. A hole was drilled in the screen, 3in. from the bottom and 2¼ins. from the front edge (or panel), and one of the condensers was mounted on the H.F. side with the spindle projecting through to the det. side. The other condenser was mounted on an L-bracket, screwed to the baseboard 2¼in. from the screen, the two condenser spindles in line, and both pointing in the same direction. To the middle of a tin lid (4in. diameter), on the outside, I soldered one of the spindle-sockets, having broken up the two knobs and extracted the sockets from them. A strip of thick, white paper was gummed round the flange of the lid, to calibrate the stations on as they were tuned in. The two sockets were now slipped on to the condenser spindle, and the socket and lid on to the bracket condenser. In place of the original grub-screws, I fixed them with two 2in. lengths of similarly threaded rod. With both sets of moving vanes "all-out," the two sockets were turned until the two threaded rods were at exactly the same angle, pointed to the top edge of the panel. They were then tightened. A 3in. strip of fairly stout brass was drilled ¼in. from each end, and fastened to the ends of the rods by means of four nuts, as shown. Fig. 2 shows details of the control knob and spindle. The opening for the escutcheon window, measuring 1¼in. by ⅜in. is cut in the panel, and holes drilled to take the three panel screws, and the old condenser bush for the control-spindle. The point A, when bent back, will serve as an indicator (Fig. 3).—E. H. OLIVER (Oxford).

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Dear Sirs,
You will be interested to learn that I shall shortly be discarding one of your H.T. batteries. The H.T. Battery in question is a "Siemens Power" 100 volt and was purchased by me in November 1931, and has been in use in conjunction with a 3 valve set since that date—a matter of 17 months.

I am,
Yours faithfully,
(Signed) C.H.

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SPECIFICATION

Circuit—*Bandpass aerial circuit, screen-grid high-frequency amplifier, followed by tuned-grid power-grid detector. Parallel-fed low-frequency transformer coupling to pentode output.* **Speaker**—*Energised moving coil. Provision for additional speaker of high or low resistance.* **Controls**—*Gramophone LW, MW, 'Off'. Switch, single knob tuning for three-gang condenser. Volume control which also operates on pick-up.* **Motor**—*Induction type (A.C. model).* **Cabinet**—*Walnut.* **Valves**—*A.C. model: MS4B, MH4, MPT4, U12.* **Output**—*1¼ watts.* **Current Consumption**—*65 watts on radio, 95 watts on gramophone.* **Wave-lengths Range**—*200-550 medium-wave metres; 1,000-2,000 long-wave metres.* **Voltage Range**—*200/250 volts, 50/60 cycles.* **Size**—*34 ins. high, 23¼ ins. wide, 16½ ins. deep.* **Price**—*23 guineas.* **Hire-Purchase Terms**—*Deposit £2.8.6 and 12 monthly payments of £1.19.0.*

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Read About Our New Transfer Print System

(Prov. Pat. No. 24584/33)

OUR LATEST GUARANTEED RECEIVER PRODUCED IN OUR NEW LABORATORY

THE longer nights are drawing near and every wireless amateur is giving serious thought to the question of building a new receiver that will provide the family's entertainment throughout the winter months. Mr. F. J. Camm Editor of PRACTICAL WIRELESS has realized for some months past that he would naturally be expected by the many thousands of people who are our readers to give them an entirely new design for their 1934 receivers. For the past few months, therefore, he has been at work producing a design that would appeal to the majority. This has been no light task, since we are fully aware of the difficulty in pleasing everybody, BUT SUCCESS HAS COME OUR WAY ONCE AGAIN AND WE HAVE PRODUCED A RECEIVER THAT WE *KNOW* WILL BE MADE UP IN ITS THOUSANDS. The set is so simple, compact, inexpensive and gives such excellent quality, combined with selectivity and long range that the discerning constructor will be unable to resist it. Needless to say, this very latest receiver is, like every other PRACTICAL WIRELESS design, covered by our very comprehensive *guarantee*.

The "Practical Wireless" Guarantee

We have just said that the guarantee is comprehensive, but perhaps that statement ought to be enlarged upon. Our sets are not merely *called* guaranteed receivers as some others are, but we definitely guarantee that every set made up in exact accordance with the instructions given will yield results equal to those which we claim. If it does not we undertake to give free technical advice until the instrument is as good as our own models. It might seem that the guarantee is unnecessary with some simple, but well designed receivers, but we have found that little difficulties do sometimes crop up, either due to the inexperience of the constructor or to a minor defect in a component. These troubles are admittedly rare, but we know that readers do value the assurance that we give, AND NO MATTER HOW INEXPERIENCED THEY ARE THEY CAN MAKE A "PRACTICAL WIRELESS" RECEIVER WITH AS MUCH CONFIDENCE AS THEY WOULD BUY A READY-MADE ONE FROM THE MOST REPUTABLE FIRM OF MANUFACTURERS. INCIDENTALLY, IT SHOULD BE ADDED THAT "PRACTICAL WIRELESS" IS THE ONLY HOME-CONSTRUCTOR'S PAPER WHICH OFFERS TO ITS READERS ENTIRELY FREE OF ALL CHARGE A GENUINE AND GENEROUSLY - INTERPRETED GUARANTEE.

Designed by Mr. F. J. Camm

Mr. Camm's careful efforts in designing this latest receiver have been considerably simplified, and our facilities for making accurate tests and measurements greatly extended, because of the recently built new laboratory which we have taken over. This is an entirely new laboratory, additional to our previous ones, which has been built on modern lines AND EQUIPPED WITH ALL THE MOST UP-TO-DATE MEASURING AND CHECKING INSTRUMENTS. It is undoubtedly one of the finest of its kind in the country, and its purpose is solely to enable PRACTICAL WIRELESS to give *absolutely unrivalled service* to its readers.

Absolute Accuracy

In addition to the laboratory, our workshop also has been newly equipped with new tools of every kind. This enables us, if and when necessary, to design new components and accessories which could be made up by the various manufacturers for supplying to readers. All our equipment is British Made and is accurate to the n'th degree; because of this, our receivers are accurate, as we could never hope they would be if we employed cheap foreign tools.

A Brief Preliminary Description of the Latest Set

No doubt our readers are by now wondering just what kind of instrument this latest receiver is. Briefly, it is distinctly modern, and although having but three valves, IT GIVES AT LEAST "FOUR-VALVE" RESULTS. It is intended for battery operation because we know perfectly well that the majority of our constructor readers prefer a battery set. At the same time, however, the set is eminently suitable for use with an eliminator of practically any pattern, so mains working can easily be provided if desired.

Low cost, compatible with unimpeachable performance has also been secured.

Every PRACTICAL WIRELESS Receiver is guaranteed to perform in the manner claimed.

We undertake to advise every reader free of charge should any difficulty be encountered in the construction or operation of any of our receivers provided that the parts we specify are used.

We specify only the parts used by our designers. We are thus enabled to guarantee our receivers to perform in the manner claimed. There cannot be a standard of performance unless the reader uses the parts specified by the designer.

PRACTICAL WIRELESS exists to serve its readers!

A WONDERFUL INSTRUMENT WITH AUTOMATIC FADING COMPENSATION

Selectivity and Anti-Fading

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A high-amplification pentode valve is used in the output stage and this enables an ample output of excellent quality reproduction to be obtained from a really great number of stations. Following our usual practice we do not wish to boast of the great number of stations we have received, or how many you can receive; we know, as you do, that such figures mean little and depend almost entirely upon the location of the set, the aerial-earth system employed and innumerable other varying factors. We will merely say then, that you can depend upon results of a kind you have never before dreamed of in connection with a receiver having but three valves and costing so little.

Entirely New Form of Construction

But that is not all, the method of construction is quite different to that ever employed before for a home-constructor's set—not only is it different, but it is *better*. All the components are mounted on the underside of a metallised wooden chassis, so that no wiring is visible on top. This arrangement has made it possible considerably to simplify the constructional work, and at the very same time to attain higher efficiency combined with a particularly "clean" and "professional" appearance. Another advantage which accrues from this method of construction is that it enables the loud-speaker to be mounted in its rightful place—on the chassis with the rest of the components. Thus, the complete receiver can be removed from, or replaced into, its cabinet in a matter of seconds, and it can be tested with ease before it is fitted into the cabinet and whilst it is perfectly accessible.

Simple Controls—Handsome Appearance

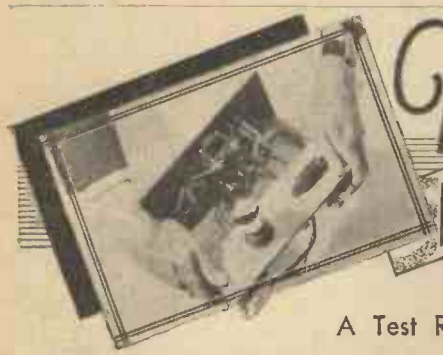
The number of controls has been reduced to the minimum without making any sacrifice of efficiency, and they consist of a single tuning knob which drives a slow-motion condenser dial, a wavechange switch and a reaction control. There is also an on-off switch, but this is so positioned that the symmetrical arrangement of the main controls is not interfered with.

When fitted into its cabinet the receiver is sufficiently handsome to grace any room. Its clean and well-proportioned lines are sure to be appreciated.

A Revolutionary Development—The Transfer Print

After reading of all the revolutionary features referred to above you might think

(*Continued on page* 284)



The ALL-WAVE Unipen

A Test Report and Some Additional Operating Notes

YOU have probably finished making your "Unipen" by now, and I have no doubt that you will have found it a most fascinating little instrument. So that you can compare your results with those that I have obtained from the original set, I propose to give you a brief test report and to tell you at what settings of the tuning dial various stations can be found.

Loud-speaker Reception Under Poor Conditions

I first tried the set in the new PRACTICAL WIRELESS laboratory which is situated on the second floor of the Newnes buildings in the heart of the West End of London. It need not be added that reception conditions in such a locality are just about as bad as they can be. But, in spite of this, and although the aerial consisted of only a thirty-foot length of wire taken along two sides of the wall, and the earth of a long lead to a water pipe, both of the Brookmans Park transmitters could be received on the loud-speaker. Admittedly, there was not a tremendous amount of volume, but speech could be heard all over the room. Daventry National was rather too weak to be called a loud-speaker signal, but its programme could be heard a few feet away from the loud-speaker.

In these preliminary tests the lower pointer on the tuner (selectivity adjuster) was set to the "AG" position, where the minimum amount of selectivity was provided. By moving this over to the "M" and "L" positions for medium and long-wave reception respectively, signal strength was slightly reduced, although the two local transmitters could still be heard on the speaker at rather poor strength.

Headphones were then attached in place of the speaker when the Midland Regional could be clearly received, and by using the appropriate selectivity tapping the London stations were easily eliminated. As a matter of fact, none of the three stations was found to occupy more than about nine degrees on the condenser scale. By reducing the capacity of the pre-set condenser, unscrewing the adjusting knob about two turns, any of the stations could be entirely cut out in something less than five degrees. When the set was operated rather more carefully, making full and careful use of reaction, two or three other stations could be brought in at good 'phone strength. Of these, Fécamp, Bordeaux-Lafayette, North Regional, Radio-Paris, and Hilversum provided good signals. The positions on the condenser scale for the stations mentioned above were as follows: Fécamp, 2 degrees; London National, 21 degrees; North National, 30 degrees; Bordeaux, 31 degrees; London Regional, 43 degrees; North Regional, 120 degrees; Daventry National, 130 degrees; Radio-Paris, 143 degrees, and Hilversum, 157 degrees. These figures may not apply exactly in your case, but they will help you in locating the different stations.

On the Short Waves

Later on, a change over to the short-wave bands was made, and on the lower one (14.4 to 40 metres) a number of continuous wave morse signals were picked up at once. The only telephony station that could be well received was Zeesen, on 19.73 metres, and this was found at a condenser setting of approximately 34 degrees. On changing to the 32 to 90 metre band, Rome (48.2 metres) was received at 12 degrees, and Zeesen (49.83 metres) at just over 14 degrees.

Since this first test was carried out under such adverse conditions and during daylight hours, it gives some idea of what may be expected from the set in the worst localities for reception in the country. In fairness to the set, however, it was felt that it ought to be tested under more average conditions, so I took it out to my own private laboratory, which is situated some twelve miles north-west of London and a similar distance from Brookmans Park. In this case the tests were carried out after dark on an outside aerial 25ft. high and situated fairly well out in the open. As was expected, results were considerably better, and both the London stations and Daventry were received at moderate speaker strength even when using the selectivity tappings. It was a little more difficult to separate the local stations, due to the better aerial "pick up," but even so there was a sufficient reserve of selectivity to make this quite possible.

In order to get the absolutely maximum volume from the nearer stations, I tried connecting the aerial lead-in to that terminal on the pre-set condenser which is joined to the tuner, and turned the selectivity switch to the "AG" position. There was then available sufficient volume to make loud-speaker listening in a small room quite comfortable and pleasant. Of course, tuning was unduly "flat," and the London Regional could only just be eliminated when listening to the National. On the long waves Daventry was very good, but when the set was mistuned a certain amount of medium-wave break-through was experienced; this could easily be prevented by turning the selectivity switch to "L."

A still further effort was made to increase the volume by using a higher H.T. voltage. When the voltage to each tapping was doubled there was undoubtedly a slight improvement, but this was not considered to be sufficient to justify the expense of a larger battery, especially since the current consumption was increased to about eight milliamperes from a little over one-third of this figure.

After I had given the set a thorough test on the broadcast wavebands, I turned my attention to the short waves. Incidentally, this was about 11 p.m., and it did not take more than a few seconds to bring in quite a number of amateur transmitters on the 40-metre band; these were best received between about 5 and 12 degrees on the condenser, with the wavechange switch in the "S2" position. Tuning was extremely sharp, so that it was found to be perfectly essential to turn the condenser as slowly as ever possible by means of the smaller knob. Care had also to be taken in maintaining the valve in the "just oscillating" condition which I mentioned last week. It was very interesting to follow these amateur stations, and I was amazed to find that they could be received almost as well with the "Unipen" as with a very "hot-stuff" single-wave short-waver.

There were not very many short-wave broadcasting stations to be found on the 32-90-metre band at the time of these tests, but Radio Nations (Switzerland), working on 40.3 metres, provided a steady signal at slightly over 10 degrees.

Upon turning to the lowest waveband,

(Continued on page 272)

TABLOID TECHNICALITIES

Low Frequency Feed-back

ONE of the greatest difficulties with a battery set, especially when it affords a large amount of low-frequency amplification, is that of feed-back, low-frequency oscillation, and so-called motor-boating. Actually, all these forms of trouble are due to the same cause, and may appear singly or collectively. They are due to the fact that the anodes of the detector and L.F. valves are virtually joined together through the medium of the necessary coupling components. The trouble is most pronounced when the high-tension battery is running down (or in other words, when its internal resistance attains a fairly high figure) since then the audio-frequency currents appearing in the anode circuit of the detector are unable to leak away to earth so easily as when the battery resistance is low. Because of this they find an easier leakage path by way of the amplifying valves and so give rise to one of the troubles mentioned above.

In the same way, the L.F. currents in the amplifying stages are unable to find an easy leakage path to earth and so pass back to a preceding stage—this state of affairs is precisely what is meant by feed-back.

In practically every case of feed-back or L.F. oscillation a cure can be effected by "de-coupling" the valve, by inserting a resistance in the anode circuit. This offers a high impedance to the audio currents, and the provision of a high capacity (generally between 1 and 2 mfd.) condenser between the "anode" end of the resistance and earth allows the currents to leak away quite easily, since its impedance to them is comparatively low. As a matter of fact, the impedance of a 1 mfd. condenser at 100 cycles is only about 1,500 ohms; thus, if the resistance is of, say, 15,000 ohms (an average value) its impedance is ten times as great.

Because results have proved them the most reliable valves in the world; because performance has proved them the finest design in the world; because public choice has proved them the most popular valve in the radio industry, three million aerials today lead down to Mullard Master Valves. **And three million aerials can't be wrong.**

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The Ever Ready Co. (Gt. Britain) Ltd., Hercules Place, Holloway, London, N.7.

In this Article a Clear Explanation is Given of the Characteristics of the Modern Valve, and how those Characteristics affect the Design and Performance of a Modern Receiver.

By PERCY RAY.

IT is very definitely time that the constructor ceased to regard the valve as a mysterious something hidden away in a silver bulb, and really became familiar with it, because a familiarity with valves means a fairly complete understanding of radio in general, while without such an understanding wireless must necessarily be a rather confusing tangle with no ends.

Further, our old friends, impedance, amplification factor, and slope are really quite simple to understand to those who take the trouble to study their relationship to the valve's performance, and who are willing to permit the writer to introduce them to the internal arrangements of the valve, and to explain the reasons underlying the various sizes, meshes, and spacing used for valve electrodes.

Valves may be divided up into four main classes: screened grids, triodes, i.e., all those having three electrodes; pentodes, diodes, and rectifiers. There are valves that would not seem to fall into any of these categories, such as Class B, but this valve can be regarded as two triodes; and the special automatic-volume-control valves, which can be split up into their various separate valves. Each class will include battery or directly heated valves and indirectly heated mains valves. The latter have a heater in addition to the other component parts, so it will be as well to point out that this item is not referred to as an electrode as it is entirely separate from the functioning of the valve and is there to heat the cathode, which takes the place of the filament. The heater and cathode are shown at Fig. 1.

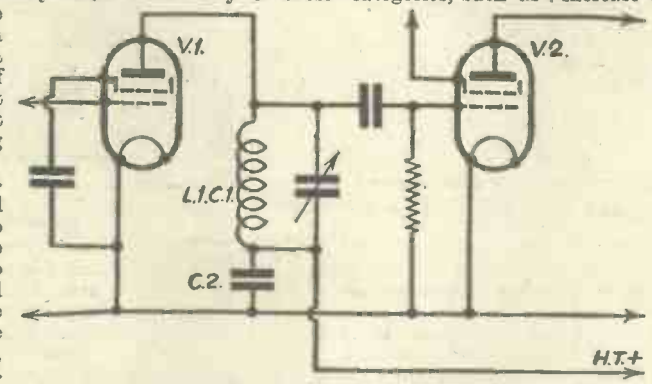

Fig. 2.—A conventional tuned anode circuit, drawn as above, readily shows that the valve V1, the tuned circuit L.C. and the grid-filament of valve V.2. are all in parallel. The condenser C.2. is the normal H.T. by-pass which would normally be shown on the extreme right-hand side of the circuit.

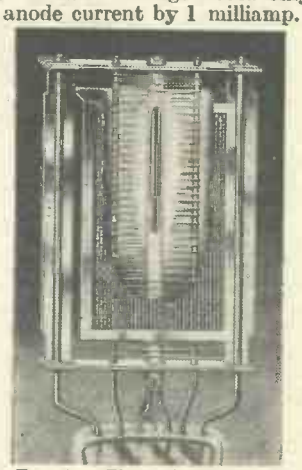

Fig. 1.—Electrode system of Cossor 41MH, cut away to show heater.

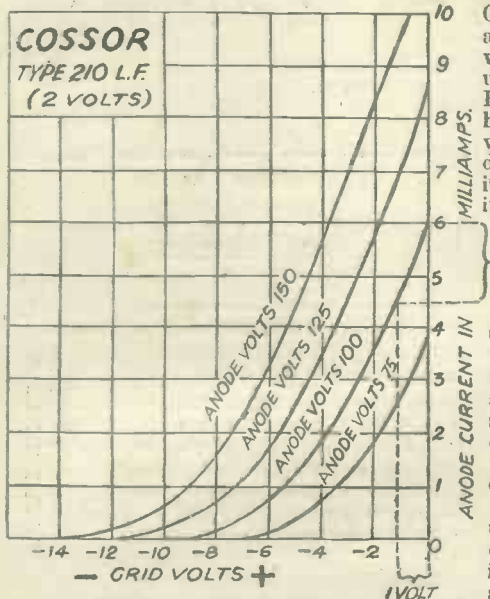

Fig. 3.—The slope can be found by applying one grid volt and noticing the change in milliamps. The slope of the accompanying valve curve shows that one volt (grid) brings about a change in anode current of 1.4 m/A. Hence the slope of this valve is 1.4 m.a./V.

With the exception of the rectifiers, which are not exactly receiving valves, all valves have three main characteristics in common. (In addition, each individual class will have other characteristics common to itself): these are slope, impedance, and amplification factor.

Impedance, usually written R_0 is used to indicate the control over high-tension current possessed by the anode. A high impedance valve has little anode control and a low impedance valve great control.

In other words, if the anode voltage applied to a valve is increased from 100 to 120, the increase in anode current would be 4 milliamps if the valve had an impedance of 5,000 ohms, but if the valve had an impedance of 20,000 ohms the same increase in anode voltage would only increase the anode current by 1 milliamp.

Amplification factor, usually written μ (pronounced Mu) is used to indicate the control of the grid over the anode; the greater the figure shown, the greater the influence of the grid, and the greater will be the amplification of the valve under working conditions.

The 5,000 ohm valve referred to above required the anode to be raised by 20 volts to vary the anode current 4 milliamps. If this valve had an amplification factor of ten the same change in anode current could be brought about by changing the grid bias by only 2 volts. This shows quite clearly that 2 volts on the grid are worth 20 on the anode (the actual factor is given by dividing one into the other). As the incoming signal is applied to the grid and the output is taken from the anode, it will be apparent how the valve acts as an amplifier.

In actual practice the amplification factor is never reached under working conditions, because of the influence of the anode load which, contrary to general belief, is in parallel with the valve and not in series as it appears to be. Fig. 2 shows in a clear manner that this is so; the circuit shown is a typical tuned anode, but the actual drawing is arranged to emphasize the point.

Slope, written "g" (otherwise called mutual conductance), shows the general

(Continued overleaf)

THE VALVE IS NO LONGER A MYSTERY

(Continued from page 253)

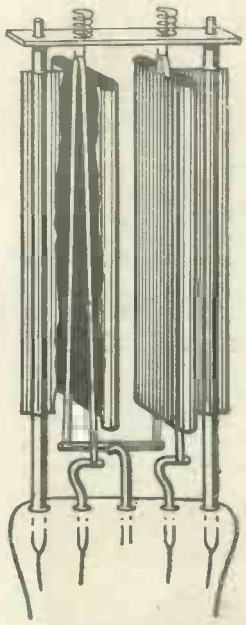

Fig. 4.—The internal construction of the 442BU rectifier showing the tape filament.

efficiency of the valve as it combines amplification factor and impedance, and is arrived at by dividing the impedance by 1,000 and dividing the result into the amplification factor; thus the example valve already used is 5,000 ohms and 10, so the slope must be 2. It is expressed as 2 m.a./v (m.a. per volt), because it also shows the change in anode current brought about by placing one volt grid-bias on the grid.

Fig. 3 shows how slope can be seen by reference to the valve curve.

A brief survey of any valve-maker's catalogue will show that the range offered varies very widely regarding impedance, and that for any class of valve the slope falls off as the impedance quoted increases.

With a two-electrode valve the controlling factors are very limited, and comprise the emission of the filament, the space between it and the anode and the area of the latter; the last being of little significance if it "encloses" the anode, inasmuch as a further increase in size will make no appreciable difference, and a rectifier valve where the anode does not enclose the filament is very rare.

Thus with a filament of known efficiency the impedance of a rectifier valve (seldom quoted) will increase as the distance between filament and anode increases. In the interests of strict accuracy it must be pointed out that this increase in impedance is not proportional to the distance.

The case of a rectifier is very simple, but serves as an introduction to an inner grasp of the function of the valve. Passing on to the three electrode, the presence of the grid throws considerable complication into the picture.

The reader will be aware that the grid is interposed between the filament and anode, and controls the flow of electrons from the former to the latter, and that it must, obviously, exercise control over all the working characteristics of the valve.

Assuming that the distance between grid and anode is kept constant, and that a grid is interposed exactly between them, the characteristics could be varied in four ways: (*a*) by taking the grid nearer the anode; (*b*) by taking the grid nearer to the filament; (*c*) by making the mesh of the grid bigger; (*d*) by making the mesh smaller. This makes the job of the valve designer difficult enough, but when the possibilities of moving the anode are considered in addition to the above it is infinitely worse.

Fig. 5.—How the Cossor Factory overcome grid welding and its attendant disadvantages.

In passing, it may be mentioned as a matter of interest that it is possible to calculate the characteristics of a valve from the measurement of the electrodes if the filament efficiency is known; it is not often done as the modern square anode, oval grid, and V-shape filament make it so involved that it is quicker to make up innumerable samples and test them than to work it out on paper.

Returning to the three-electrode valve, it has already been mentioned how the grid can influence the valve. The nearer the grid to the filament (or cathode) the greater will be the control it will exercise, and consequently the higher will be the amplification factor and the higher will be the impedance, while the resulting slope will be very good; but there will be great danger of grid emission if the grid is so close to the filament, and enclosed by the anode, that it gets hot.

When a low impedance valve is required it will not do to bring the anode in without due care, as the slope will fall off, so all the factors have to be juggled with, also taking into account the straightness of the curve, as such a valve will be required to act as an output valve and the undistorted output will be of paramount importance.

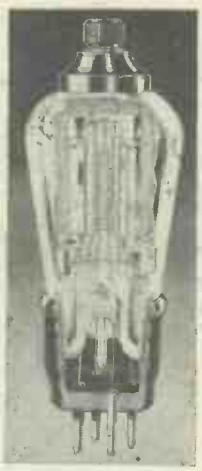

Fig. 7.—Showing the internal construction of an efficient screened grid valve, the Cossor 215S.G.

In drawing the subject of actual valve design to a close, the writer ventures to remark that a number of valves are on the market to-day, and great tribute is due to their designers as "valves"; but many possess various defects that make them less useful as a part of a wireless set than their characteristics would lead one to suppose.

The question of valve design is only brought to the notice of the reader in order that he may more readily appreciate the chief object of this article, which is to enable the best to be obtained from *every* stage.

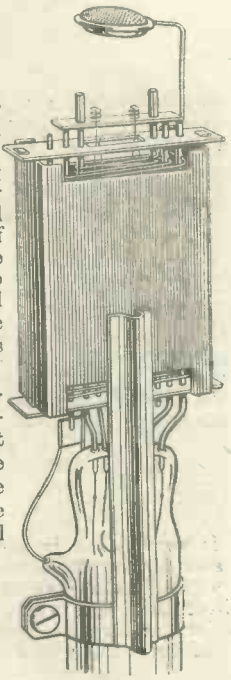

Fig. 6.—The massive construction of the Cossor P.T. 41B—a directly-heated power pentode capable of big output.

NEWNES' NEW MONTHLY
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AN UNTUNED H.F. STAGE

(Continued from page 241)

the less to be preferred, in the author's opinion, to that of Fig. 2. The Fig. 2 circuit is also more prone to unwanted feed-back and therefore some care must be taken over the decoupling arrangements; if a howl does occur a 10,000 ohm resistance in the H.T. lead to the screen-grid valve and a 1 mfd. decoupling condenser will probably cure it.

Battery Voltages

In either circuit the battery voltages to the screen-grid valve are normal for the valve used, *i.e.*, in general, 120 volts H.T. and 60 to 80 volts on the screen. Any sort of screen-grid valve is suitable, although there is no particular advantage to be gained by using one of the variable-mu types; it is unlikely that an untuned stage will give such great amplification that an H.F. volume control will be needed! If cross-modulation interference from a local station is exceptionally severe, a variable-mu valve might help to remove it, but it is improbable that this would be necessary. One of the new H.F. pentodes should also suit this circuit admirably.

An attempt was made to use an ordinary triode for an untuned H.F. amplifier, but this was not very successful because the very low impedance of a triode compared with a screen-grid valve imposes a large damping load on the detector and makes it difficult to obtain oscillation without a considerable increase in the size of the reaction coil. Also because of the lack of internal screening in the triode the removal of dead spots, etc., was very far from complete. With the screen-grid valve it is possible to touch the aerial terminal with the finger without upsetting the tuning, but when this was tried with a triode H.F. valve the receiver stopped oscillating. For those who like to try it, however, the circuit is the same as either of the foregoing with a triode substituted for the tetrode and, of course, the screening grid potential and by-pass condenser removed. The triode should have as high an impedance as possible, the resistance capacity coupling type being the best.

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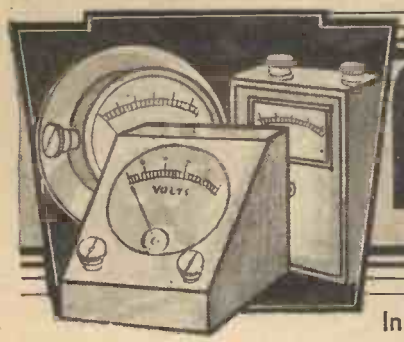

ABOUT METERS

In this Article the Author Describes the Principle of Working of the Various Types of Meters used in Radio Work. By H. BEAT HEAVYCHURCH

ENGINEERS recognize two methods of testing, namely qualitative and quantitative. The two terms are almost self-explanatory, but a simple example will serve to show the real difference between the two. Suppose that you find that your radio receiver is not giving the volume to which you are accustomed; for some reason or another you suspect that all is not well with the output stage. You remove the output valve from its holder and replace it temporarily with one borrowed from a confiding friend. It operates perfectly; volume is restored; you had hit upon the faulty spot first time.

Apt To Be Slow

But it does not always work out thus. Suppose that when you fitted the substitute valve things were no better than before. Then you would have to suspect some other part of the equipment and examine or replace each in turn until at last you found the seat of the trouble. Or, worse still, what if the original trouble was that your valve had been ruined by some wrong connection or short circuit within the set, and that when you experimented with your friend's valve you ruined that too? No, except for a few simple and obvious faults, qualitative testing is too slow, too uncertain, and sometimes too dangerous.

On the other hand, imagine that you possess some simple and cheap measuring instruments—a milliammeter, say, and a voltmeter. When your set showed symptoms of trouble you could have measured the anode current of the output valve. If you found the reading was below normal, you would know at once that one of a certain number of things had occurred. Either the valve had lost a part of its emission, or the high-tension voltage had fallen considerably, or the grid-bias voltage was too high, and so on. Then you could make further tests in order to discover the exact cause of the poor performance. Quantitative testing is quick, simple, and final.

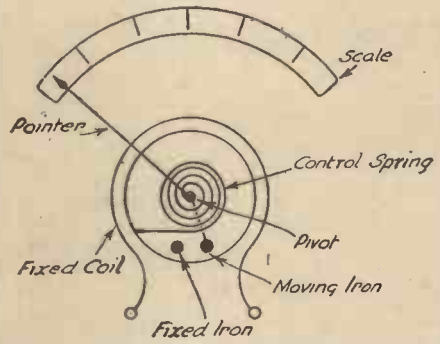

Fig. 1.—Simple diagram explaining the principle of a moving iron instrument. This illustration does not show the actual form of movement.

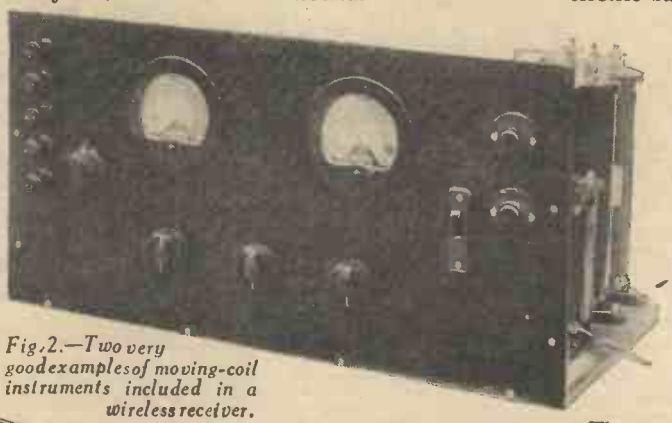

Fig. 2.—Two very good examples of moving-coil instruments included in a wireless receiver.

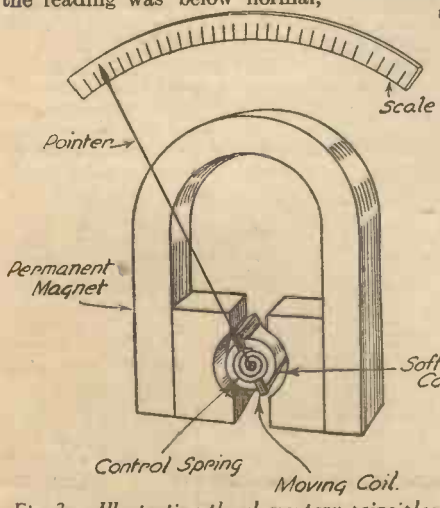

Fig. 3.—Illustrating the elementary principles of a moving-coil instrument.

In the early days of radio, when sets and circuits were comparatively simple and the average standard of performance low, qualitative testing was sufficiently speedy and accurate for most amateur needs. To-day, however, circuits are relatively complicated, and components have a high order of efficiency. Mathematically accurate adjustment is the order of the day, and very small errors in adjustment bring serious consequences in loss of selectivity, sensitivity, stability, and quality.

A Mistaken Impression

It is often thought that testing instruments are an expensive luxury, and this accounts for the fact that only a very small proportion of even those who call themselves serious radio amateurs possess even the simplest gear for carrying out accurate tests. This is, however, quite a mistaken notion, for quite valuable results can be obtained by means of most inexpensive and simple equipment.

Before describing the various types of instruments available and the quickest methods of conducting tests with their aid, it may be of assistance to outline briefly what quantities are most suitable for measurement, and the principles involved in the process.

In the first place it is necessary to realize that all the happenings in a radio set are, in effect, the passage of electric currents of different kinds, some constant in value, and some of varying strength. It is upon the correct values and behaviour of these currents that the set operates.

Like all electric currents, those occurring in a radio receiver are primarily due to the existence of electric pressure—voltage—applied by some apparatus capable of developing that pressure. This may be an electric battery, as in the case of an accumulator for low-tension supply, or a dry high-tension battery; or again, it may be the electric light mains, the pressure of which is generated by a dynamo at the power station. In any case, there must be a voltage before an electric current can pass.

Two Factors

Further, however great the voltage, no current can exist unless there is a complete circuit along which it can pass. The breakage of a wire, the disconnection of some component, or the fracture of a soldered joint will interrupt the path along which a current should travel, and the current will no longer exist.

The strength of the current depends upon two factors, first the amount of the voltage and second the extent to which the circuit offers opposition to the passing of the current. This opposition is termed resistance,

(*Continued on page 269*)

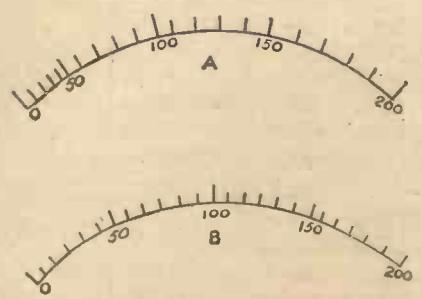

Fig. 4.—Comparison between scale of moving-iron and moving-coil instruments. A. Moving iron (crowded at bottom). B. Moving coil (equally divided).

RADIO EFFICIENCY & CONVENIENCE

To Listen Efficiently Should be the Aim of Everyone Using Radio in their Home. Study this Article to Find the Best Way of Bringing this to a Successful Fruition.

RADIO is not only an absorbing hobby, but also an essential domestic service, ranking in importance, as near as I can judge it, immediately after main drainage, water supply, the gas service, and electric lighting. We install a receiver in our house to enjoy the programmes—but enjoyment cannot be complete unless the apparatus, when installed, operates efficiently, and our arrangements are such that we can listen at our ease and in comfort.

These statements may appear to be trite, but the fact remains that whereas we pay careful attention to the efficiency of our gas cooker, and see to it that the lights in the various rooms are fitted in the most suitable positions and that the switches are conveniently located, there are large numbers of listeners who plank down their receivers and loud-speakers just anywhere, rig up a jimcrack aerial, and expect to enjoy radio. Yet one tenth of the thought usually bestowed upon the position of the hall-stand or upon the efficiency of the kitchen boiler would ensure the highest possible standard of radio and radio enjoyment.

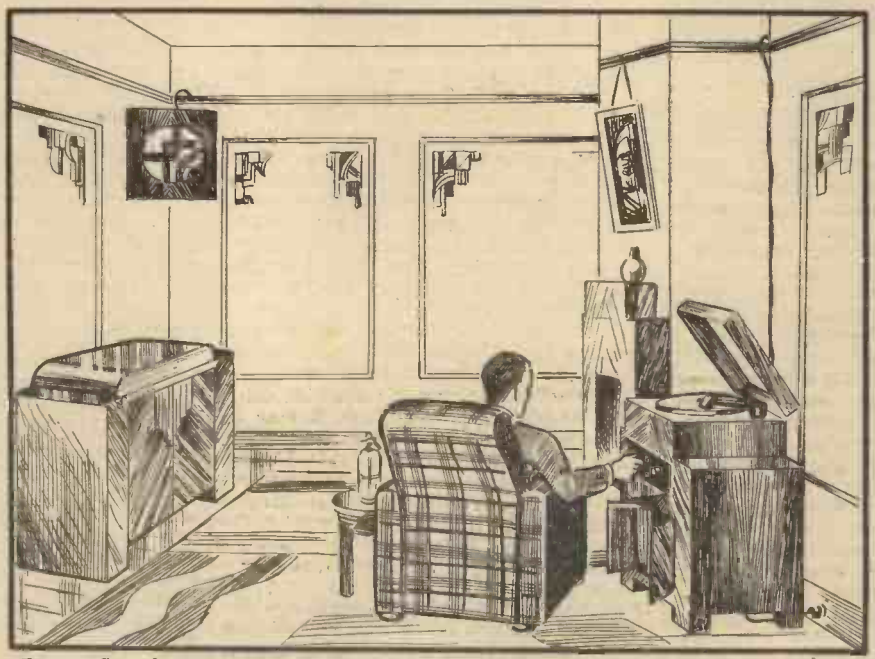

Fig. 1.—Seated in an arm-chair with turn-table and pick-up within easy reach, and the set situated in another part of the room for best acoustical effects.

An Ideal Method

Undoubtedly the ideal method of planning a radio installation is to do it while your house is being built, or at all events before you take over your house. As, however, the big majority of readers are not at the present moment enjoying the "delightful" task of selecting a new home, this article must deal with what can be done by the average householder towards locating and installing a receiver for maximum efficiency and convenience.

At the same time, it is always as well to have the ideal before one all the time, so I propose to tackle the problem from the point of view of how I should proceed to plan my radio installation if I were about to move into a new house. Before proceeding any farther, however, please note that I shall not talk about circuit design or receiver efficiency—overall installation efficiency and radio comfort are my theme this week.

Deciding the Position

To begin with, then, I should first decide upon the position of the receiver itself. It would, of course, be placed in the room in which the family would normally require to listen—usually the lounge or living-room, depending upon the habits of the family. The actual position would be selected as the result of considering four points: (1) the position of the loud-speaker relative to the normal family circle, (2) ease of manipulation of controls from my armchair, (3) possibilities of good aerial and earth connection, and (4) appearance.

These four points are, of course, not of equal importance, nor does it follow that their relative importance is the same in every case. For example, a set having a self-contained speaker must be located having greater regard to (1) than (2), whereas, if a separate speaker is used, this instrument can be located where it will give the best acoustic effect, the receiver proper being positioned where it is most convenient from the control point of view.

Again, although, in general, arrangements for a good aerial and earth are very important, sets of the transportable and portable types are practically independent of these conditions, and even with a set designed for external aerial and earth, provided it possesses at least one high-frequency stage and the listener is not too exacting in his requirements by way of distant reception, aerial efficiency is not a matter of very vital importance.

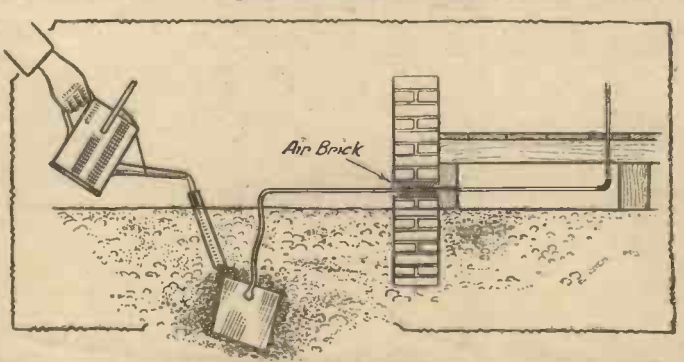

Fig. 2.—Earth plate (or bowl) with tube for watering, and lead from earth taken through air-brick of house and then through hole in floor-board to set.

A Conviction

I know I shall be criticised for this statement, but it is my firm conviction that, for the majority of listeners, a radio set should be a reliable source of entertainment rather than a highly efficient scientific instrument. Efficiency is, of course, highly desirable, but it should take second place to comfort and convenience. Therefore, I say, for the average listener, place your set where it sounds best, is most convenient to operate, and looks best—provided you can, at the same time, obtain the programme service you desire. If, on the other hand, you want to get every ounce out of your set, you may have to sacrifice something in

(*Continued overleaf*)

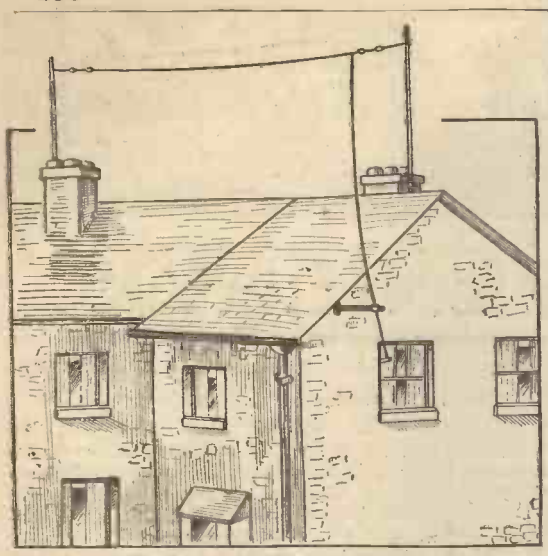

Fig. 3.—High aerial masts between two chimney stacks, with down lead held well away from the walls.

(*Continued from previous page*)

comfort and appearance in order to locate the set in the most favourable position for a good aerial and a good earth.

A word or two may be said about the selection of apparatus if a new set is to be bought or made for the new home. If you are definitely planning for *listening*—and not for experimental work—several alternatives suggest themselves. There is, of course, the ordinary receiver with a built-in loud-speaker. Its position will be decided upon the lines already laid down. Next, and possibly an improvement from the convenience and acoustic point of view, is the receiver with separate speaker.

Most listeners also require a gramophone operation, and the choice then lies between a pick-up on a separate gramophone turntable and a complete radiogram. In the latter case, the position will probably be fixed once and for all from æsthetic considerations—there are usually only one or two positions in an average room where a large radiogram can go comfortably, and it is usually a spot which necessitates long journeys back and forth from your chair for record changing.

Now let us consider the question of aerial and earth. Even if a high-efficiency aerial is not considered essential, a perfect earth is very desirable, and not difficult to achieve. Especially is this the case if you have access to a new house in the process of building, and before the floorboards are laid. Knowing roughly where your set is to be, you can sink a good earth plate, tube or bowl in your garden, as near to the set as possible, but some three or four feet from the wall of the house, bringing the earth wire through the nearest underfloor ventilator or "air-brick." Get the builder to drill a hole in the floorboard close to where your set will stand, and bring your earth wire up through this hole. By the way, when sinking your earth plate, it is not a bad idea to drive in a piece of metal tube—old gas pipe will do admirably—through which water may be poured occasionally to keep the earth connection moist and of high conductivity.

Alternatives

Regarding the aerial, much depends, as I have already pointed out, upon whether you want maximum efficiency or maximum comfort and good appearance. If the former, you will have chosen a spot close to a window as the location of your set, and will proceed to erect a good outside aerial. Note that the effective height is of greater importance than horizontal span, and an aerial stretched between short masts clamped to the chimney stacks is usually quite good, if not better, than a long aerial running the length of the garden. With a set of fair sensitivity, a loft aerial is very little inferior to an outdoor aerial—provided the down wire is spaced out from the wall. But so much has been written already about these two conventional forms of aerial that I do not propose to add to it.

From the æsthetic point of view, any aerial running outside the house has objections, and if you have decided to sacrifice a little in aerial efficiency in order to place your set in the most convenient position, there are several alternatives from which you may choose. A very sensitive set, such as a superhet or a modern receiver employing two high-frequency stages, will give quite a good account of itself with an aerial consisting of a plate fitted inside the lid of the set, or a few feet of wire running up to the picture-rail would be even better. For a less sensitive set, say, a circuit including only one high-frequency stage, it may be necessary to run a wire round the walls of the room, on the picture rail. It is, I know, a counsel of perfection to space such an aerial several inches from the wall—but this is unsightly and very unpopular with the ladies. I have had excellent results from cab-tyre flex clipped in the grooves on the top of the picture rail or plate shelf. In one home I recently visited, this device was used, and the lead down wire was hidden behind the curtains, the set being located close to a convenient window.

Another alternative is to run the aerial in the space between the ceiling and the floorboards of the room above.

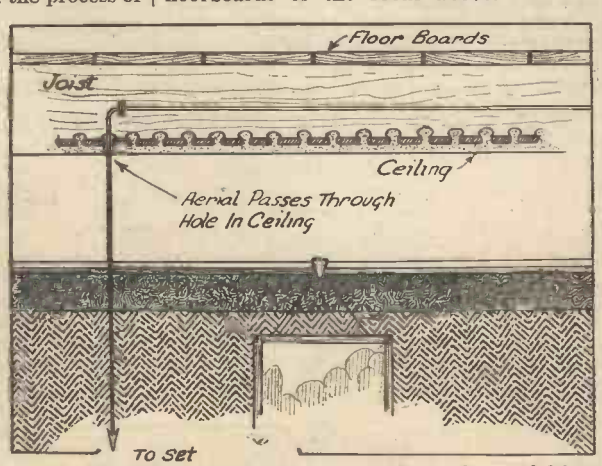

Fig. 4.—Aerial running between ground floor ceiling and floorboards of room above.

STEREOPHONIC REPRODUCTION

IN order to reproduce an exact impression of the original transmission, a loud-speaker has to fulfil three requirements; the most obvious is that the frequency of the original note must in no way be altered, and, furthermore, the over-tones or harmonics must be present in their true proportions. This implies immediately that the *relative* strengths of fundamental and harmonics must remain the same. Within certain limits reception may be just as good at quiet drawing-room strength as when run all out in a small hall, the point to be emphasized is the necessity for maintaining correct proportion over the frequency spectrum. The third requirement of the loud-speaker is the ability to deal faithfully with transients.

We will assume, therefore, that our receiver is above reproach from the quality standpoint, and that our loud-speaker is as near perfect as can be at the present stage. In spite of all this there is an uncomfortable feeling that reproduction is unnatural, notwithstanding that both amplifier and speaker give a straight-line response. We may be listening to a concert from the Queen's Hall, but by no stretch of the imagination (if we are honest) can we believe that we are actually there. This lack of realism is caused almost entirely by the fact that the music comes from a point source. We cannot hope to achieve realism in radio without stereophonic reproduction.

Using Two Loud-speakers

The secret is the possession of two loud-speakers. We will assume that one is incorporated in the receiver as usual, and the other is installed in a remote part of the house. The distant speaker should be run at full volume; as a general rule the best effect will be obtained with our set speaker running at quite moderate strength. Each speaker should be equipped with an independent volume-control. A balance can now be made between the two which will give the impression of an orchestra playing in a large hall. The stereophonic illusion is, of course, achieved by the slight echo effect caused by the sound waves from the distant speaker lagging behind the other. This echo effect may not be acceptable on speech; it is quite simple therefore to cut the distant speaker out altogether by use of the volume-control.

It must be realized that the above is an illusion pure and simple, and is not true stereophonic reproduction, although the latter could be easily realized with the co-operation of the B.B.C. To illustrate the method let us imagine that a play is in progress with a microphone on one side of the stage and another on the opposite side. One is connected to the London National transmitter, and the other to the Daventry National. At the receiving end we must, of course, have two receivers, one tuned to each station with its own loud-speaker. As before, one speaker is built in the set, and the other installed in a distant part of the house. It can be easily seen that the effect of an artist moving from one side of the stage to the other would be reproduced in all its original realism with the transference of the sound from one speaker to the other.

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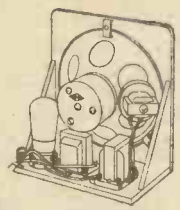

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THE BEGINNER'S SUPPLEMENT

WIRELESS THEORY SIMPLIFIED

An Introductory Article for the Very Beginner. By W. B. RICHARDSON

I SHALL endeavour to give a brief explanation here of the whole process of wireless reception from the time the sound leaves the studio to its reproduction by the loud-speaker.

The first link in the whole chain is the air in the studio itself. It is because this air is set in vibration by the musical instruments or the vocal chords of the artists that sounds are emitted. When, for instance, the string of a piano is struck by the hammer it vibrates from side to side as in Fig. 1. When it moves to one side it compresses the air on that side so that the particles of air bounce outward and then return as the string moves back. This keeps on all the time the string is vibrating, the air immediately surrounding the string pulsating backwards and forwards. However, the movement is not restricted to this part of the air only. It extends outward in the form of waves until they fill the whole room. Naturally the farther they go the weaker they get, so that the sound in the distant parts of the room is not so loud as that near the piano itself.

Fig. 1.—How a piano wire vibrates on being struck by the hammer and so produces sound.

Sound Waves and the Microphone

Somewhere in the room is placed the *microphone*, the instrument which converts sound waves into electrical impulses, and of course the sound waves in their outward journey strike against this instrument.

Now I want you clearly to understand the nature of these sound waves. They do not squirt out in all directions like spraying water from a watering can or like the traditional representation of the sun's rays as in Fig. 2. They radiate in the form of layers of alternately compressed and expanded air as in Fig. 3. Consider, for instance, the air at A. It is vibrating from left to right. As it moves to the right it pushes against the air at B. It then returns to the left again. However, B, which has been pushed to the right, now bumps into C and returns to its place beside A. C continues the game by passing the "shove" it got from B on to D, and so it goes on. Thus the air at E immediately in front of the microphone is beating backwards and forwards in the same manner, although not so vigorously, as that at A.

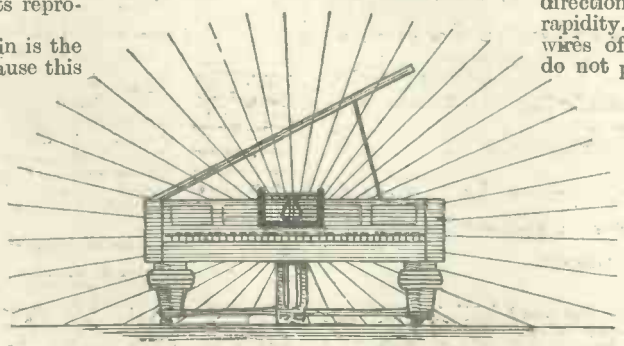

Fig. 2.—Sound does not radiate from the source in rays as above—it travels outward in waves as in Fig. 3.

You must understand that there is no question of the air itself travelling from the piano to the walls of the room. There would be a terrible draught if it did! It is the *waves* induced in the air by the vibrating piano wire which spread outward to all parts of the room, including where the microphone is placed.

The vibrations vary in speed, or *frequency*, to use the proper term, according to the note being struck. Thus middle C on the piano causes 256 vibrations per second, while a higher note causes more and a lower note less. Complicated sounds like those produced by the human voice or several instruments playing together produce a mixture of vibrations at different frequencies.

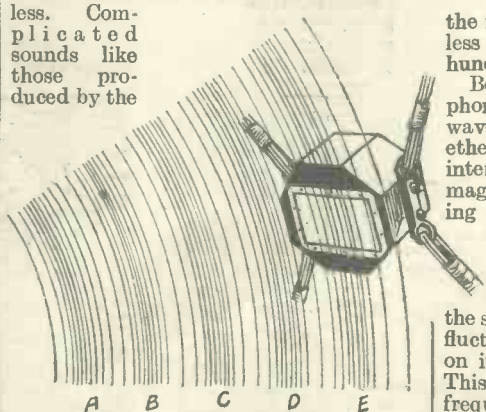

Fig. 3—Diagram showing the arrival of sound waves at the microphone.

The microphone may be compared with a short length of rubber tubing joining two sections of a pipe carrying a steady flow of water as in Fig. 4 (*a*). By giving a succession of rapid pinches to the rubber section as in Fig. 4 (*b*) the flow of water will fluctuate. In the same way the beating of the sound waves against the microphone causes corresponding fluctuations in the electric current which flows through it. This fluctuating current is amplified and sent along wires to the transmitting apparatus. Here we have huge generators and valves which produce what are called *high-frequency currents*. These are electric currents which move first in one direction along the wires which carry them and then in the opposite direction. This they do with amazing rapidity. Such currents flow along the wires of the transmitting aerial. They do not produce any sound waves in the air like a musical instrument, but they cause waves in the *ether*, that evanescent "something" which exists everywhere in space. These waves radiate in all directions.

From Transmitter to Receiver

Now these wireless waves travel outward in much the same way as sound waves, but at an infinitely greater speed. In fact, they travel at the same speed as light, namely, 186,500 *miles* per second! Sound waves only cover about 1,100 *feet* per second. Actually it takes longer for the sound to travel across the studio to the microphone than it does for the wireless waves to reach a receiving station hundreds of miles away!

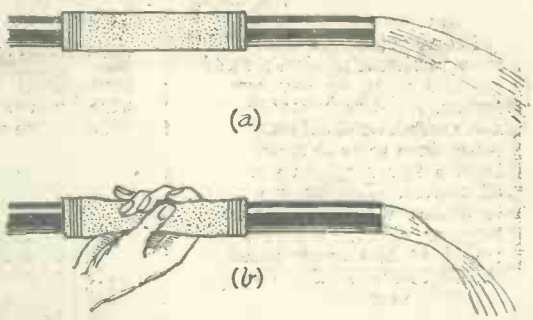

Fig. 4.—The water pipe analogy. (See text.)

Before anyone speaks into the microphone or any music is played the wireless waves are being radiated steadily into the ether. They follow one another at regular intervals and are all of the same size or magnitude. However, the current passing through the microphone is being fed to the transmitting gear, as we have already seen, and is used to control the high-frequency currents in the aerial. Now, so long as there is no sound in the studio the microphone current will not fluctuate, but as soon as sound waves fall on it the current fluctuates accordingly. This current in turn makes the high-frequency currents fluctuate as well, and in this way the waves given out also

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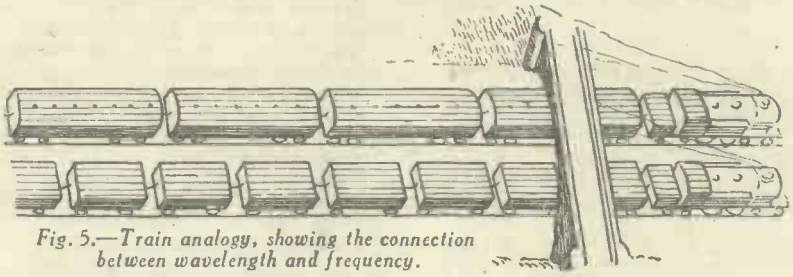

Fig. 5.—Train analogy, showing the connection between wavelength and frequency.

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fluctuate. From this you will see that the waves radiated by the transmitting aerial bear a definite relationship to the sound waves from the studio. They fluctuate in strength according to the pitch and volume of the sound waves.

Tuning

Now let us see what happens at the receiving end. Here we have to convert back into sound the wireless waves which strike the aerial of our set—exactly the reverse of the process of transmission.

First of all the waves striking our receiving aerial are very feeble indeed, as they contain only the tiniest fraction of the total power radiated. Indeed most of the power is wasted through being distributed in all directions and through being absorbed by buildings, trees, etc. However, what little impulses *do* reach our aerial set up high-frequency currents in it similar to those in the aerial of the transmitter.

Before going into details of the reconversion of wireless waves into sound I want to say something about *tuning*. Wireless waves always travel at the same speed, but their length, that is the distance from crest to crest, can be anything from a few metres to several thousands of metres. Let us see what difference it makes whether the waves used are long or short. Wireless waves always travel at the same speed, therefore it stands to reason that the greater is their length the smaller will be the number that pass a given point per second. This will be understood if we think of a train of long coaches travelling at a given speed as in Fig. 5. Close beside the first train is another composed of short trucks and moving at the same speed. Now if we station ourselves at some point, such as a bridge, and watch the vehicles go past we shall see that far more trucks pass in a given time than do coaches, although the speed of the trains is the same in each case. This explains the connection between *wavelength* and *frequency*. The shorter the vehicles, the greater is the frequency with which they pass. It is the same with the wireless waves—the shorter they are, the greater is their frequency and *vice versa*.

In order to avoid interference different wireless stations use different wavelengths. It is always arranged so that whenever possible no two stations use the same wavelength. This means that when we want to receive a certain station we must make our receiver responsive to waves of the particular length being emitted. This is done by means of the aerial circuit of our receiver. This consists of a tuning coil and a tuning condenser, connected to the aerial and the earth. When this circuit is suitably adjusted (by turning the tuning dial or pointer attached to the tuning condenser to the right position), then the waves striking the aerial will set up electric currents in the aerial circuit. These currents will vibrate or oscillate backwards and forwards in sympathy with the incoming waves. This is the first step in reception, for now we have converted the waves sent out by the transmitter back into high-frequency electric currents.

Of course only the waves from the one desired station are converted. Those coming from other stations using different wavelengths will have no effect because the waves arriving will be either too many per second or too few. The aerial circuit is like a pendulum. It only requires a slight tap at the end of each swing to keep it in motion (See Fig. 6 (*a*), but if the tapping is done too rapidly or too slowly, it will get out of step, as it were, and stop.

If it is desired to make the receiver respond to another station of a different wavelength, then it must be re-tuned. For instance, if this other station produces waves of a *higher* frequency, then the tuning circuit must be adjusted to vibrate at a faster rate by altering the setting of the tuning dial or pointer. This is equivalent to shortening the pendulum, for as you know a short pendulum swings faster than a long one. Fig. 6 shows what I mean. The pendulum corresponds to the aerial circuit, while the beats of the mallet represent the impulses of the incoming wave. At (*a*) the blows are arriving at fifty per minute, while the pendulum swings naturally, or has a *natural frequency*, as we call it, of the same number. It is "in tune" with the mallet. At (*b*) the mallet is moving faster, thus corresponding to a station broadcasting on a higher frequency. The pendulum now ceases to respond. On shortening it, however, as in (*c*) its natural frequency is increased so that it corresponds with the speed of the mallet blows and once more swings in unison with it.

The currents moving to and fro in the aerial circuit of our receiver are, as we have

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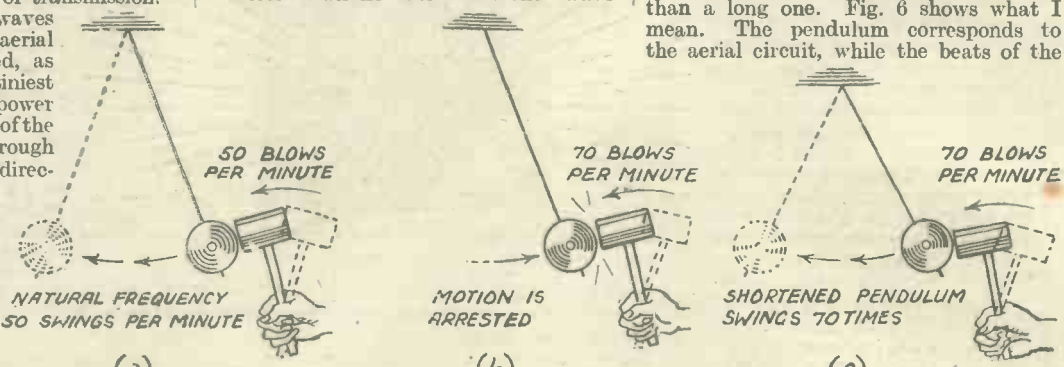

Fig. 6.—Tuning explained by the action of a pendulum and mallet.

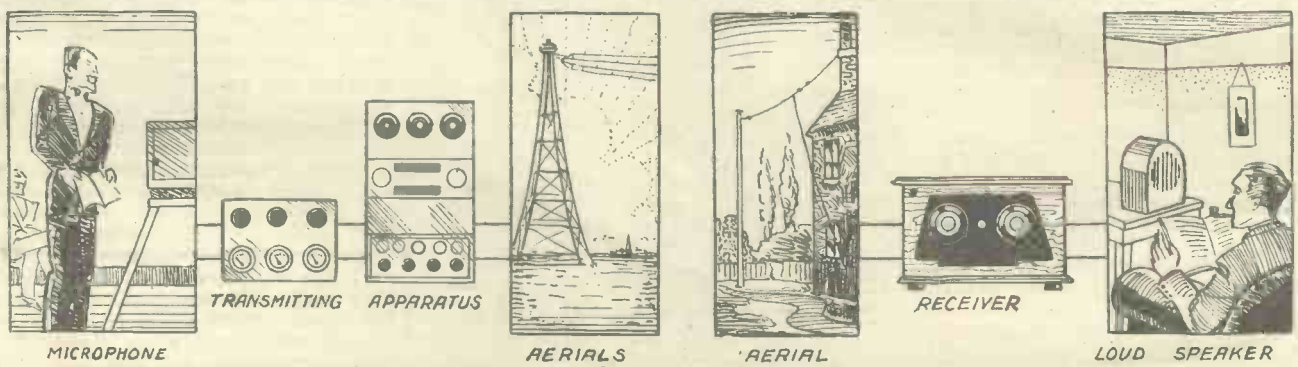

Fig. 7.—The process of broadcasting from studio to speaker is dealt with in simple language in this article.

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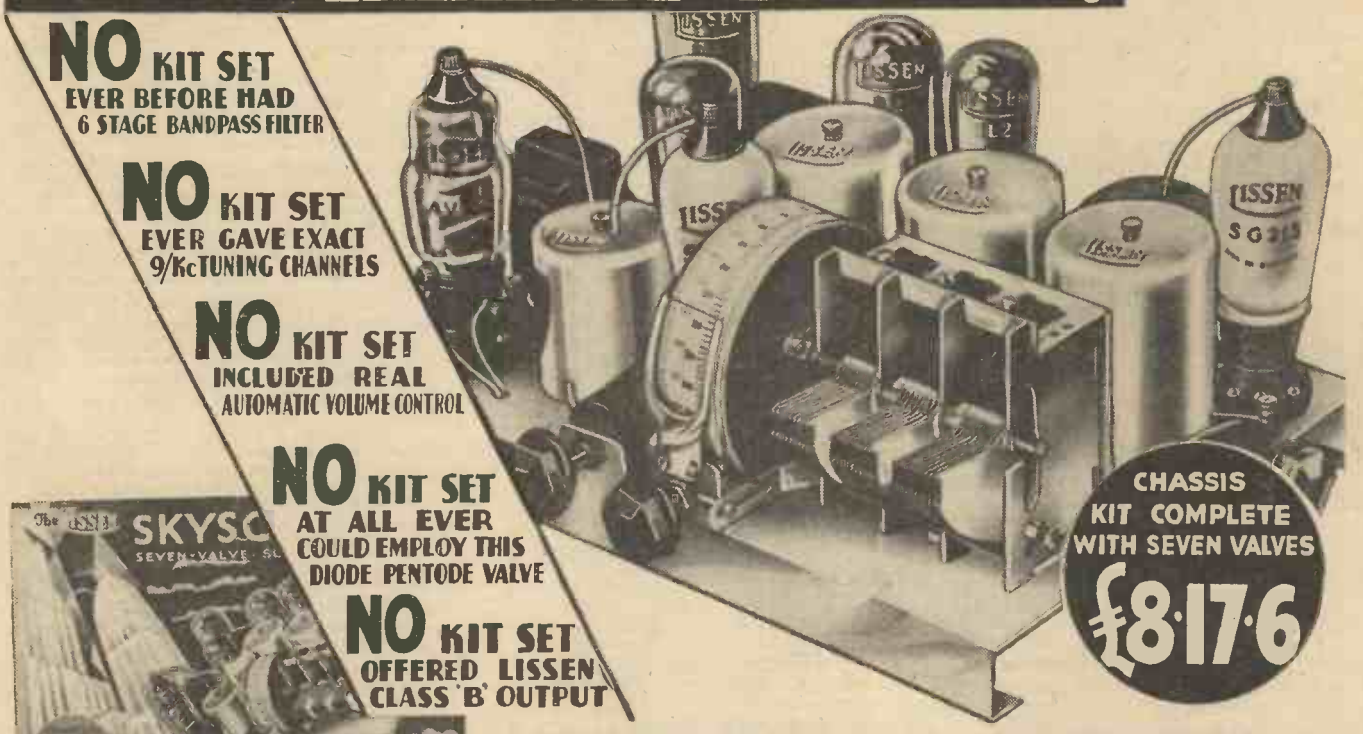

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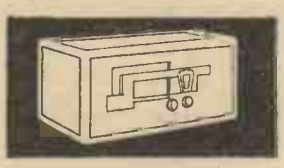

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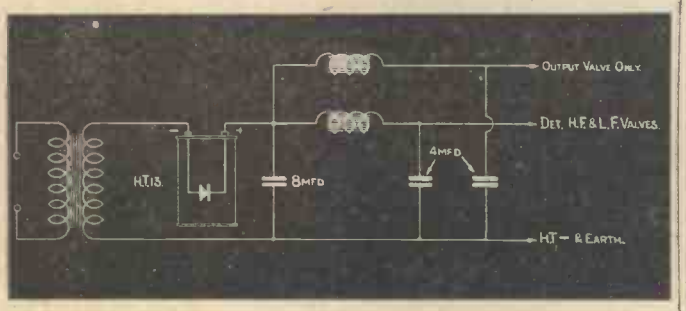

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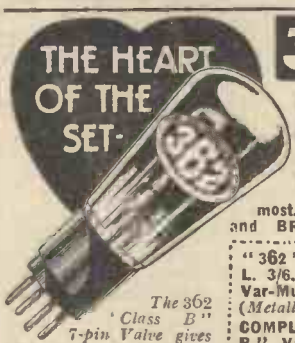

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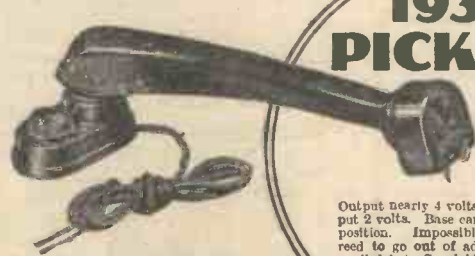

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Electrolytic Condensers

and How They Work.

A Practical Article Dealing With Their Working Principles and Advantages

ONE of the most noticeable features of the progress of radio is the improvement which has been made in the design and construction of components. In fact, the high standard of performance of modern receivers is probably due more to the perfection of the individual components than to any other cause.

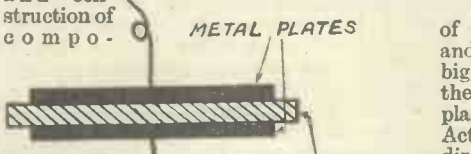

Fig. 1.—The elements of a simple condenser.

A good example of the advance made in the design of components is to be found in the case of fixed condensers. For instance, a year or two ago a new type was introduced known as an *electrolytic condenser*. This type, which has been used to an increasing extent, is remarkable for the relatively large capacity obtainable for small physical dimensions.

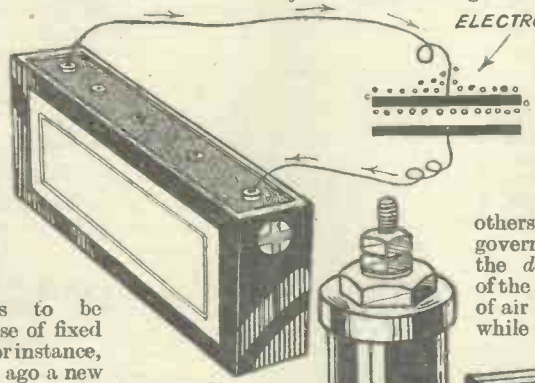

Fig. 2.—Charging a condenser from a battery. Arrows show the path of the electrons.

Electrolytic condensers differ radically from the types previously available, but before describing how they work and the method of their construction we will give just a brief explanation of the fundamental principles underlying the action of condensers generally.

An Electron Reservoir

A condenser is a device for storing electrical energy. In its simplest form it consists of two metal plates separated by a layer of insulating material such as ebonite, glass, mica, waxed paper, or just air. Fig. 1 shows the two plates and the intervening "dielectric" as it is called.

As you know, an electric current is the movement of small "particles," called electrons, from one point in a conductor to another. A condenser acts as a sort of electron reservoir. Thus, if we apply the poles of a battery—which is, in fact, a kind of electron pump delivering electrons at its negative pole and taking them in at its positive pole—to the plates of a condenser, then one plate will acquire an excess of electrons and the other a deficit. This is shown in Fig. 2. The amount of electrons which can thus be poured into the one plate (or drained from the other) constitutes the "charge." The amount of the charge produced by unit pressure (1 volt) is a measure of the *capacity* of the condenser.

The capacity of a condenser is usually measured in *micro-farads*. It is controlled by three things. (1) The effective area of the plates; (2) their distance apart, and (3) the nature of the dielectric. The bigger the plates are, the larger will be the capacity, also the nearer they are placed together the more it will increase. Actually the capacity does not vary directly with the distance between the plates, but is inversely proportional to the square of the distance. Thus, if the distance is halved, the capacity becomes *four times* as great. Regarding the substance of the dielectric, it is found that some materials give a larger capacity for a given size and distance apart of the plates than do others. The factor governing this is called the *dielectric constant* of the substance. That of air is taken as unity, while most other substances show higher figures. For instance, if you had two plates fixed a certain distance apart in air so that they had a capacity of, say, 1 mfd., and then you slid a sheet of ebonite between the plates without moving them, you would find that, although the plates were still the same size and the same distance apart their capacity had increased two or three times. As a further example, if you used a good grade of mica instead of the ebonite the increase would be as much as eight times. In other words, the dielectric constant of mica is eight.

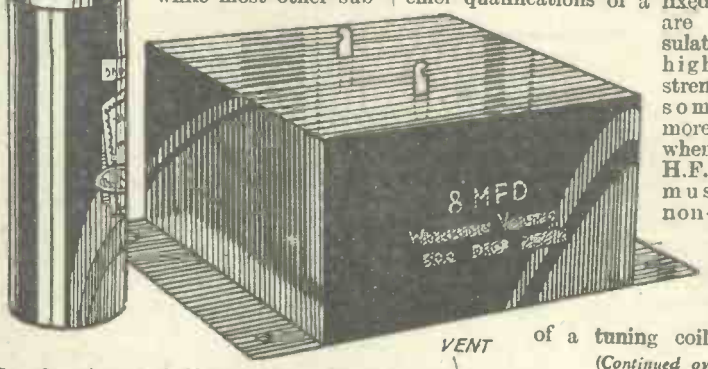

Fig. 3.—A remarkable comparison in size. An electrolyte condenser and a paper condenser of identical rating and capacity.

Dielectric Strength

There is one point we must mention before passing on to the subject of electrolytic condensers and that is the question of efficiency. This is chiefly dependent on the insulating properties of the dielectric. If the dielectric is a poor insulator then the electrons collected on the one plate of the condenser will slowly leak through to the other plate and so the condenser will become discharged. A good condenser will hold its charge for some considerable time. For instance, if a 1 or 2 mfd. condenser is momentarily connected across the mains or an H.T. battery and then removed it should be possible on joining the two terminals of the condenser together after several hours to get quite a fat, crisp spark.

Apart from a condenser's ability to retain its charge, or in other words, to give back as much energy as is put into it (which is the ideal to be aimed at) there is the question of the *dielectric strength*. If the plates are very close together, and the voltage (pressure) of the charging current is very high, it is possible for the insulation between the plates to break down altogether. A spark jumps between the plates, cutting its way through the dielectric, and so the condenser is completely discharged. Naturally, the question of dielectric strength is of great importance, especially in the power circuits of mains sets. As regards the various substances used as dielectrics, mica has about the greatest dielectric strength, paper comes next, and air last of all.

To summarize, you will see that the chief qualifications of a fixed condenser are good insulation and high dielectric strength. In some cases, more especially when used in H.F. circuits, it must also be non-inductive. This means that it must in no way exhibit the properties of a tuning coil as well as

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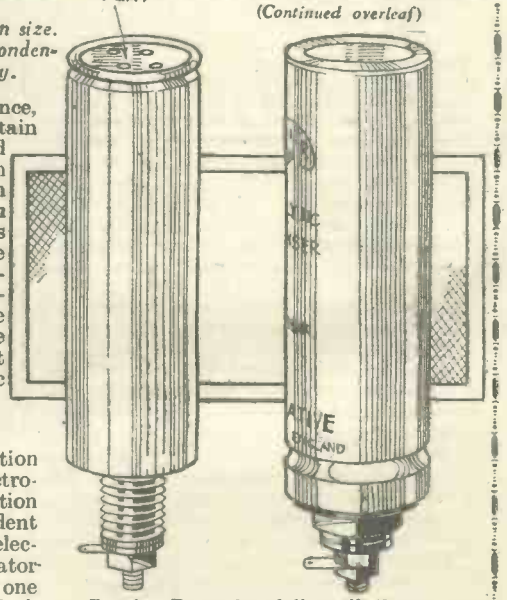

Fig. 4.—Examples of "wet" (left) and "dry" (right) electrolytic condensers.

ELECTROLYTIC CONDENSERS

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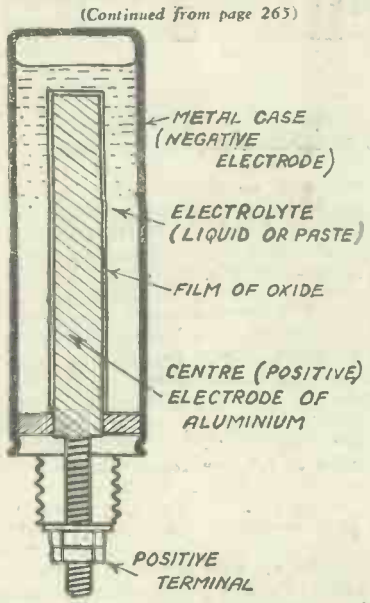

Fig. 5.—Diagrammatic representative of the inside of the electrolytic condenser.

those of a condenser. It must have no *inductance*. How it is possible for a condenser to act like a tuning inductance may not at first be very clear, but if you consider the ordinary paper condenser you will see the reason. This type consists of two long strips of tinfoil separated by layers of paper. The two strips form the plates, and the paper the dielectric. In order to make the condenser compact, the whole thing is rolled up into a little bundle with the paper between the foil. Obviously the strips now form small coils, and if the connection to each strip is taken from one end only, they will act as miniature tuning coils. The remedy for this consists in making contact with each turn of the foil. This is done by arranging for the foil strips to protrude slightly from the sides of the bundle—one strip to one side and one to the other. These are pressed over and coated with solder so that all the turns of each strip are connected together.

Large Capacity, Small Bulk

Now condensers of this type are very efficient and quite compact in sizes up to 1 or 2 mfds., but above this capacity they become rather bulky. Clearly there is a practical limit to the thinness of the foil employed, and also the paper dielectric cannot be reduced in thickness beyond a certain limit, otherwise it will be liable to puncture.

This is where the electrolytic condenser steps in. If you compare the size of that shown in Fig. 3 with the equivalent paper condenser, you will see the considerable saving in space effected by the electrolytic type. There are also other advantages, such as its self-healing properties, but we will deal with those while describing the principle and construction of the condenser.

Electrolytic condensers are of two types —"wet" and "dry." They are both much the same in appearance, as will be seen from the two typical examples illustrated in Fig. 4, but whereas the former contains a liquid as the electrolyte the latter employs a paste, jelly, or some absorbent material soaked in a solution.

The construction of an electrolytic condenser is somewhat similar to that of a dry cell. Fig. 5 represents it diagrammatically. It consists of a centre electrode of aluminium surrounded by the electrolyte (liquid or paste) and an outer metal case. The centre electrode forms one "plate" of the condenser, and the liquid (or paste) the other. How a liquid can take the place of a plate is more easily understood if you remember that the liquid employed is a conductor of electricity—it is not an insulator like oil. Now, if the aluminium rod in the centre is one plate and the liquid surrounding it is the other, where does the dielectic come in? Well, actually when the unit is first assembled there is no dielectric. This has to be "formed." This is done by connecting the centre electrode to the positive pole of a battery or other source of current and the outer case to the negative pole. The current from the battery flows from one electrode to the other through the electrolyte, and in doing so gradually deposits a very thin film of aluminium oxide on the centre electrode. This film has a very high resistance, and the thicker it gets the more the current is reduced until a point is reached when only the smallest current passes—in other words, the film is to all intents and purposes an insulator. The condenser is now "formed," and consists of two plates (the centre aluminium rod and the electrolyte) separated by a dielectric consisting of the newly-formed film of oxide.

Design of the Anode

In practice the centre electrode is not a simple aluminium rod, but assumes more complex shapes. This is in order to increase its effective area. Two typical anodes are shown in Fig. 6. In each case a sheet of aluminium foil supported by an aluminium rod is used.

You notice that we mentioned the *centre* electrode as being connected to the positive pole when the condenser is formed. This polarity must also be observed when it is connected in circuit. If it is connected the wrong way round so that the centre electrode becomes negative and the container positive, then the film will pass into solution and the condenser will cease to function. Of course, this fact limits the use of the condenser to direct current circuits. It cannot be used in alternating or high-frequency circuits, for in such cases each electrode becomes alternatively positive and negative. Of course, any degree of ripple can be imposed on the D.C., providing it is not great enough to cause a reversal of polarity, that is to say, that so long as there is a polarizing D.C. voltage it does not matter what form the current takes.

For Mains Smoothing

In mains receivers where condensers are used for smoothing, filter, and decoupling circuits the electrolytic condenser is ideal. It is easy to arrange for the anode to be connected to the positive line. In fact, with the ordinary type of electrolytic condenser the container is fitted with a locking nut for securing the condenser to the chassis by the one-hole-fixing method, and so if a metal chassis is used, connection is automatically made between the negative electrode and the earthed chassis. The positive connection is then taken to the centre terminal, which is screwed on the end of the anode and is, of course, below the baseboard.

With electrolytic condensers the insulation properties are not quite so good as with the ordinary type, as there is always a very slight leakage of current owing to the film of oxide not being such a good insulator as some substances. In the circuits mentioned above, however, this is of small consequence.

One great advantage of the electrolytic condenser is that it is "self healing." Should the film puncture owing to a sudden increase in voltage the condenser will not be rendered useless. When the voltage drops again the puncture will seal up. This property is, naturally, of great importance in mains sets where the breakdown of a smoothing or filter condenser would put the whole set out of commission. (A punctured dielectric with an ordinary condenser means the destruction of the condenser).

Modern "Dry" Types

The last few months have seen many improvements in electrolytic condensers. As an example, the production of really efficient "dry" and "semi-dry" types is very noticeable. With these types much ingenuity has been shown in the matter of the electrolyte and the design of the electrodes. Of course, the advantages of the dry type over the aqueous are obvious when it is remembered that with all types a small vent hole is necessary. However carefully this is designed, there is always the possibility of some of the electrolyte being spilt if it is of a liquid nature. The advantages of the latest electrolytic condensers are: small leakage current (a fraction of a milliampere in many cases), quick recovery after a period of rest (when first used after standing idle for some time all electrolytic condensers take a larger current than normal for some seconds), and low internal resistance. This means a low power factor. The power factor is really a measure of the efficiency of a condenser. An ideal condenser would have a power factor of zero. Modern electrolytic condensers can be brought down to about 5 or 6 per cent.

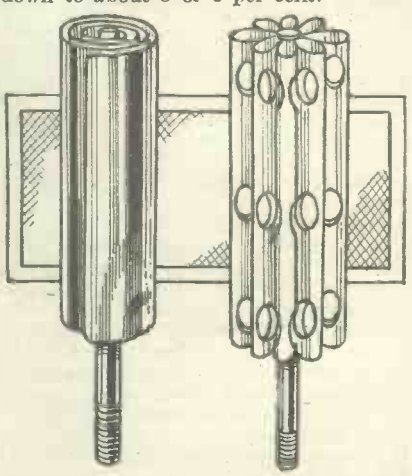

Fig. 6.—Two different types of anode used in electrolytic condensers.

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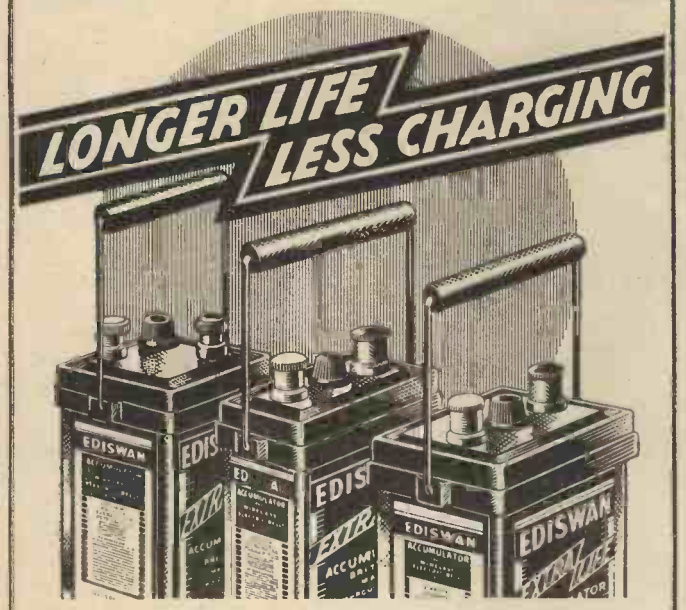

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ABOUT METERS

(*Continued from page 256*)

which is a property possessed by all materials to a greater or less degree. It is clear, therefore, that for a large current to pass through a circuit of a given resistance a bigger voltage will be required than for a small current; and similarly for a current of given value to pass through a high resistance a larger voltage will be required than will be necessary to drive the same amount of current through a smaller resistance.

Thus it will be seen that, in the great majority of instances, tests upon the condition of a receiver will consist of ascertaining whether currents of the correct strength are passing in the different circuits forming the set; so that it is desirable to have at hand apparatus for measuring fairly accurately the strength of electric currents.

Then, if our current tests show that the current values are not correct, we shall know for certain that one or other of the factors which govern the correct strength is at fault.

In order to measure anything, be it length, weight, or electrical quantities, it is necessary to have a standard or unit of comparison. Thus lengths are measured in feet or yards; weights in pounds or tons; and electrical quantities have a special set of units of their own.

Electric current strength is, as most listeners know, expressed in amperes. Very few currents in a receiver amount to more than a fraction of an ampere—the exception is the low-tension current of an A.C. mains set which amounts to about one ampere per valve. So quantities less than a tenth of an ampere are usually measured in milliamperes, one milliamp. being one thousandth part of an ampere.

Electric pressure is measured in volts. Very small voltages may be expressed in millivolts (thousandths of a volt) or even micro-volts (millionths of a volt) but such delicate measurements need very expensive instruments usually beyond the reach of amateur listeners.

Finally, resistance is measured in ohms, very high resistances being sometimes expressed in megohms. A megohm is, of course, one million ohms.

Following a Law

Next, it is important to remember that there is an exact and never varying relation between the direct current flowing in a circuit, the voltage producing it, and the resistance which limits its value. This relation is contained in a formula, commonly known as Ohm's law, which states that the current in amperes is equal to the pressure in volts, divided by the resistance in ohms.

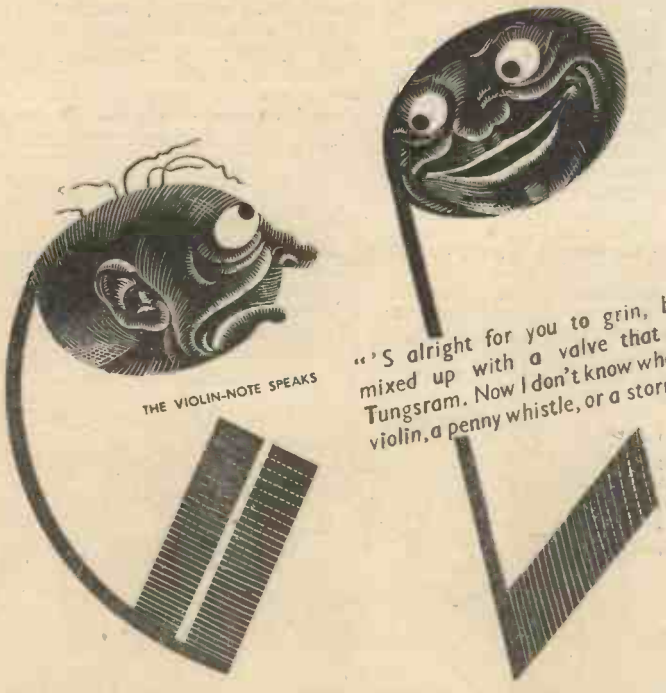
The simplest form of measuring instrument, and that upon which all other indicating meters are based is the ammeter or milliammeter (the name depends upon whether it will measure currents of large or small intensity). Of the many types of these instruments, only two are likely to be handled by the amateur, namely, moving-iron instruments and moving-coil instruments.

In the moving-iron instrument the current to be measured is passed through a fixed coil of wire within which are two pieces of iron, one fixed in position and the other capable of moving about a central pivot, see Fig. 1. When the current to be measured passes through the coil it produces a magnetic field, and both pieces of iron are magnetized in the same direction. They consequently repel each other, with the result that the piece which is pivoted moves away from the fixed piece. The movement of this piece is opposed by a spiral spring, and the amount of movement depends upon the magnetizing force which, in its turn, depends upon the strength of the current. A pointer attached to the pivot moves over a scale, thus indicating the amount of deflection of the iron and hence the strength of the current.

The second type of instrument is known as the moving-coil instrument, two good examples of which are shown in Fig. 2. It consists of a permanent magnet, usually of the horse-shoe type, between the poles of which is pivoted a coil of wire as indicated in Fig. 3. The current to be measured passes through the coil of wire which is, of course, magnetized. Mutual attraction and repulsion between the poles of the magnet and the poles of the coil takes place, and the coil, being free to move against the pressure of a spiral spring, is deflected to an extent depending upon the current strength, its deflection being indicated by a pointer which passes over a graduated scale.

In practice the moving-coil instrument is preferred to the moving iron, chiefly because it is more accurate, and because the scale is more "open," that is to say, the divisions are equally spaced. With a moving-iron instrument, the scale divisions are cramped at the lower end and spread out at the top, making readings of small values very difficult and inaccurate, the comparison between the scales of the two instruments being shown in Fig. 4.

It must be remembered, however, that moving-coil instruments are only serviceable for direct current measurements, while moving-iron instruments may be used for either direct or alternating currents.



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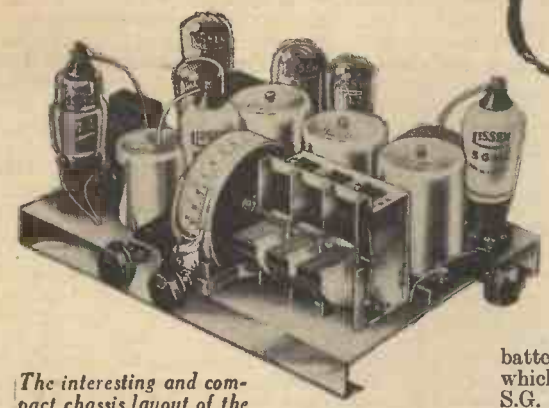
OUR VIEWS ON RECEIVERS

The Lissen "Skyscraper Superhet Seven."



The interesting and compact chassis layout of the Lissen "Skyscraper Superhet Seven" reviewed on this page.

THE Lissen "Skyscraper Superhet Seven" is probably the most ambitious kit set ever offered to the home-constructor, but despite this it has been so well designed that the veriest beginner in wireless construction can find no difficulty in building it up in a very short space of time. As the name implies, this receiver has seven valves, which are arranged to form a particularly efficient battery-operated superheterodyne. The mere name "superheterodyne" often conjures up to the mind of the beginner visions of complications and wonderful circuits well beyond his ken. He pictures involved wiring, tricky adjustments, and difficult operation, but none of these are to be found in the set under review. In fact, extreme simplicity is the keynote and is one of the salient features throughout.

Very Modern Refinements

That the "Skyscraper Seven" is really up to the minute can be seen at once when but a few of the refinements are mentioned. For example, the tuning scales for both long and medium waves are marked off in metres; efficient automatic volume control is provided by means of the very latest valve development—the Lissen type AVC2 battery-operated diode-pentode; a three-way loud-speaker tone control is provided; the output stage employs two special Lissen valves arranged as an excellent Class B amplifier.

An Easily-assembled Kit

But let us start at the beginning, by dealing with the kit of parts which are supplied in a strong partitioned box with every one marked for easy identification. There is a strong aluminium chassis, completely drilled to receive every component and connecting wire, and all the parts are supplied with screws so that they can be mounted in a minimum of time. There is also an ample length of wire and a supply of insulating sleeving, not to mention a very well-prepared chart showing the entire construction in easy stages. This latter is truly a wonderful piece of work, and its compilers are to be congratulated on supplying such a wealth of detail in so concise a form.

When the constructional work is commenced one quickly appreciates the full-scale drawings and the clarity with which the wiring procedure is explained. Every wire shown on the plans is numbered, and a key index gives the exact length of each wire, tells which terminals it is to be connected to, and the number of the hole (when the wire goes through the chassis) through which it must be passed. The battery leads and also the flexibles which connect up the anodes of the S.G. valves are colour coded so that they can be identified at once.

Neat and Compact Cabinet

The walnut cabinet, whether of the consolette or table model type, is supplied in sections which can be assembled in next to no time without the use of glue. Both types are, of course, polished and have a distinctly handsome appearance, which is much better than that of many factory-made ones that are used to house commercial sets. They are extremely compact, and the consolette one, which is large enough to accommodate all the batteries, measures only 20ins. long by 11ins. high and 11ins. wide. This is supplied with a Lissen permanent magnet moving-coil speaker which really does justice to the set.

There is a considerable amount of fascination to be had from building the receiver, but to handle the finished instrument is no less interesting. The first thing is to adjust the trimmers on the three-gang condenser and to find the optimum setting for a long-wave padding pre-set. This operation is delightfully simple, thanks to the detailed instructions which are given, and we found that it could be carried out entirely in about ten minutes. Once it has been done the trimmers never need any further alteration and their settings "hold" accurately over both wavebands.

Simple Controls—and a Criticism

There are only three controls on the whole instrument; two of these are on the front of the cabinet, and the third is at the side. Of those on the front, one is for tuning and drives the condenser through a delightfully smooth slow-motion mechanism, and the other is a volume control. The side knob acts as a combined wave-change and on-off switch. It has a rotary movement, and when in its central position the set is "off"; rotating it to the left or right connects the batteries and gives medium or long-wave reception respectively. If we may be allowed to make one small criticism, it is that this switch is not quite so "positive" in action as we should like. As a result, it is sometimes a little difficult to know whether the set is "on" or "off." This is, of course, a very small point, and were it not for the excellence of the set in every other direction it would scarcely have called for any mention. We have no doubt that the makers could overcome this little difficulty quite easily by fitting slightly stronger contact springs.

We gave the "Skyscraper Seven" a prolonged test on a short aerial of less than average efficiency and have nothing but praise for the performance it gave. The wavelength-calibrated dial was found to be very accurately made, so that we had no trouble in finding any desired transmission whose wavelength was known. It would be impossible to mention by name even half the number of stations that were well received, for they simply tumbled in all round the dial. Not only were they brought in at good strength, but the quality was in all cases distinctly above the average for a battery receiver. By making use of the loud-speaker tone control reproduction could be varied from very "brilliant" to "deep mellow." The advantage of automatic volume control was very evident, for stations which normally fade badly could be held at practically constant strength for hours on end. Additionally, the blasting which one usually gets when tuning to the local station was entirely absent and it was found impossible to overload the detector even when listening to Brookmans Park, less than twelve miles from the receiving aerial.

Real Selectivity—Silent Background

Selectivity was all that could be desired, but at the same time there were no signs of "sideband cutting" provided that tuning was accurately carried out. What rather surprised us was the entire absence of those background noises which one is liable to

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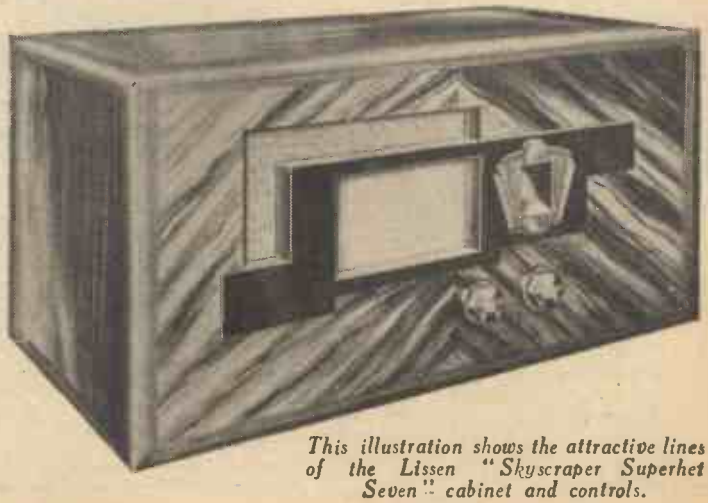

This illustration shows the attractive lines of the Lissen "Skyscraper Superhet Seven" cabinet and controls.

OUR VIEWS ON RECEIVERS

(*Continued from previous page*)

associate with super-heterodynes. Second channel interference was, so far as we could judge, entirely absent; if there was any it was too slight to be noticed. It would rather seem that these excellent results are due in no small measure to the use of the 126 k/c intermediate frequency which Messrs. Lissen have standardized in their superhet equipment, as well as to the use of three complete band-pass filter circuits.

Novel Circuit Arrangement

The novel circuit arrangement of this receiver will be of interest to the more technically minded reader in view of the many outstanding features incorporated. A capacity-coupled band-pass aerial tuning circuit precedes the first detector and the aerial coil has a loose coupled winding which is connected to a tapping on the long-wave portion; this effectively prevents medium-wave "breakthrough" and removes aerial damping from the first tuned coil. A Lissen S.G.215 variable-mu valve acts as first detector, operating on the anode bend principle. Its bias voltage is varied by the A.V.C. valve acting as second detector, and thus overloading is prevented. A separate oscillator (a Lissen H.L.2) is used and is tuned by a shaped oscillator section on the gang condenser. Next comes another variable-mu valve acting as I.F. amplifier and having its bias voltage controlled by the second detector. The latter valve, as mentioned before, is a production of Messrs. Lissen and is not as yet made by any other firm. It is a six electrode valve, having the filament, three grids, and anode of an ordinary high-frequency pentode, plus an auxiliary anode which functions in conjunction with the filament as a diode rectifier. It is coupled to the Lissen L.2 driver valve through a resistance-fed transformer, a volume control resistance being included between the main anode of the diode-pentode and the transformer primary. The driver feeds a pair of Lissen B.2 valves which together form an efficient Class B amplifier. To prevent any L.F. instability a .003 mfd. fixed condenser is connected between the anode of each valve and earth. No output transformer is fitted to the set itself since this is provided on the Class B speaker supplied. The tone control takes the form of a small bakelite cased unit containing a fixed condenser and having two connecting tags which may be attached to alternative terminals on the loud-speaker to adjust the tone to the pitch required for individual tastes.

We were rather surprised to find that no provision had been made for connecting a gramophone pick-up and, although the average constructor would find no difficulty in adding a switch and terminals for this purpose, we think that this addition to the original set would probably have been appreciated by many of those who will build it.

Value for Money

The price of the "Skyscraper Seven" kit, including valves, is £8 17s. 6d.; with valves and table model cabinet it is £9 15s.; complete with valves, consolette cabinet and moving-coil speaker it costs only £11 10s. It will be seen from these figures that this very wonderful receiver represents particularly good value for money, and we can do no more than to recommend it very strongly to all our readers who require a powerful, selective, and entirely modern instrument. Both electrically and mechanically it is a very fine job.

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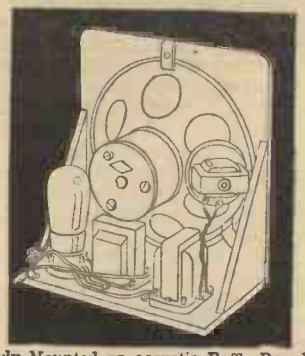

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COMPLETING THE LUXUS A.C. SUPERHET

Details Regarding the Construction of the Mains Unit, and Operation of Our Latest Luxury Super-heterodyne Receiver

By W. J. DELANEY

THOSE readers who endeavoured to complete the construction of this receiver from the theoretical circuit will no doubt have met a rather difficult point. This concerns the method of mounting the two electrolytic condensers. It will be seen from the theoretical circuit that the field winding is joined between the *negative* poles of these condensers, and not, as is customary, between the *positive* poles. This has certain advantages in this particular circuit, but renders it necessary to carry out a little unusual method of mounting.

Mounting the Electrolytics

Two brackets will have to be constructed from stout gauge aluminium or brass, and a terminal mounted on the side, as shown in the small sketch, Fig. 1. In addition, two squares of stout cardboard should be cut, slightly larger than the foot of the brackets. As a further safeguard—in view of the fact that it may be possible to develop a short circuit across the high-voltage section of the mains unit—when the positions of the two brackets have been marked on the chassis from the illustration, Fig. 2, the metal coating should be scraped away with a penknife. All risk of short circuits is then obviated.

Mounting the Speaker

To mount the speaker in position before assembling the two units in the cabinet, a small baffle should be cut from ordinary thin plywood, and this should be screwed to the front of the mains unit chassis, with a hole sufficiently large to clear the diaphragm, but with room enough for holding down bolts or screws.

Mount the valve-holder first, then the two electrolytic condensers. Do not omit the special locking ring which is included on these components, and when the condenser is fitted to the bracket, lock the nut up as tight as possible, when the patent ring will sink slightly into the metal and avoid all risk of the condenser coming loose at a later period. Next, mount the mains transformer, and then commence the wiring of this unit. The .01 condenser should be screwed in the position shown, and a small bracket should be made from strip brass or aluminium to hold the connecting cable. Great care should be exercised, when connecting this cable, in order to get the correct pins wired to provide the proper voltages in the receiver.

Final Details

In other words, do not get mixed between the grid and anode pins of the plug. When the wiring is completed the speaker should be fitted to the baffle and the field winding joined to the two terminals on the electrolytic condenser brackets. It does not matter which way round the field is connected. That is to say, there is no positive and negative end to this winding, and one lead should be joined to one terminal, and the other lead joined to the remaining terminal. One side of the fixed condenser should now be joined to the terminal marked 0 on the transformer on the speaker chassis, whilst the remaining terminal on the condenser is connected to the terminal marked 75, as well as to the positive poles of the two electrolytics. Connection to the speaker is made by means of a flexible lead joined to the anode terminal of the pentode valve, and this should be passed through a hole in the receiver chassis, and cut off just long enough to reach the speaker transformer. When the wiring is quite complete the two chassis should be stood side by side and the set tested before putting it into the cabinet. Connect a length of flex to the Bulgin mains plug and plug this into the nearest mains socket. Plug in the special 5-pin plug to the valve-holder on the rear of the receiver chassis, and insert the valves in the respective sockets. These are marked on the wiring diagram given last week.

There should not be the slightest hum or trace of instability when the receiver is switched on, and the local stations should be heard at quite good strength without any adjustment of the I.F. transformers or the trimmers. In order to carry out the necessary trimming adjustments a weak station at the bottom of the tuning dial should be selected, and the volume control turned until the station is practically inaudible.

If the station is known the wavelength should be checked with the markings on the tuning scale, and the trimmer nearest the panel adjusted to bring the tuning point to the correct dial reading. When this has been done the remaining trimmers should be adjusted for maximum response, any improvement in signal strength being compensated for by reducing the volume control. It should not be difficult to find the best settings, the correct position, of course, being that where a reduction in strength results when the trimmers are turned in either direction.

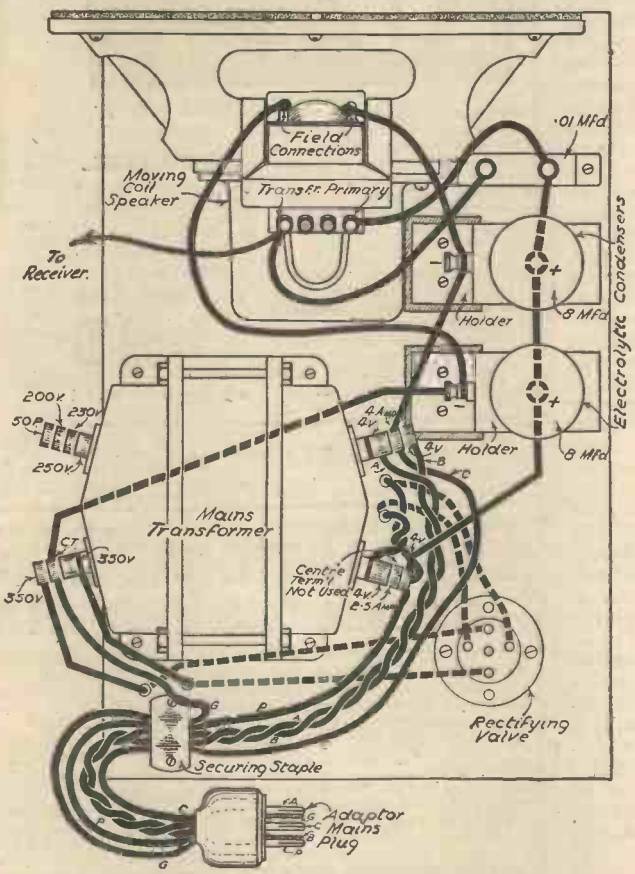

Fig. 2—Wiring diagram of the Mains Unit.

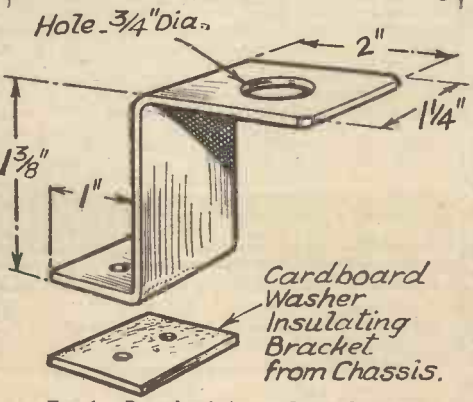

Fig. 1—Details of the condenser brackets.

THE ALL-WAVE UNIPEN

(Continued from page 250)

however, things were quite different, and a really good "bag" of stations was soon obtained. Brook Bound (call sign announced W3XAL) came in well at 11 degrees and gave a nice steady signal with practically no signs of fading. Another American, Schenectady (W3XAD), was also quite good at a condenser setting slightly above that of Brook Bound; Pittsburgh (W8XK) was another good station, coming in at 104 degrees. Zeesen, Rome, and other Continental stations could be received without the slightest difficulty, and were often as loud as Midland Regional. Practically all the stations that were received on 'phones could be brought up to full loud-speaker strength by using the set as an adaptor in conjunction with a standard Det.-2 L.F. receiver.

Reducing H.T. Battery Current Consumption

In this Article the Author Explains how the H.T. Current Consumption of an Ordinary Receiver can be Reduced without any Losses in Amplification or Quality.

ONE of the most important features of Class B and Q.P.-P. amplification is that the amount of current drawn from the high-tension battery is directly proportional to the strength of the signals given out by the loud-speaker. Thus, if volume is reduced, the current consumption is similarly made less. This is extremely important because, even when a station is tuned in at its maximum volume, the actual sound intensity is constantly varying, and the average intensity is much less than that of the loudest passages.

With the ordinary type of receiver, using a power or pentode output valve, the drain on the high-tension battery is just the same, whether one is listening to the local station at full volume or to a more distant transmission which is perhaps only just audible. In the same way the drain remains constant irrespective of the loudness of the sound being reproduced. This is obviously wasteful, so that the set user is really made to pay for a considerable amount of current which is not put to any good use.

The Modification is Quite Simple

This state of affairs can, of course, be overcome by changing over to one of the newer methods of amplification referred to in my opening paragraph, but very often there are objections to this course. In the first place a fair amount of expense is involved, and in the second, there are very many listeners who have no use for the additional volume that Class B and Q.P.-P. make possible. A newer and less expensive arrangement is, therefore, of especial interest, particularly because it can be applied to any receiver in which a power or pentode valve is used in the output stage. The arrangement is perfectly simple, and can be added at little expense in the manner shown in Fig. 1; Fig. 2 is a diagrammatic illustration of the same circuit, and will be helpful to those who wish to consider the "whys and wherefores" of the scheme.

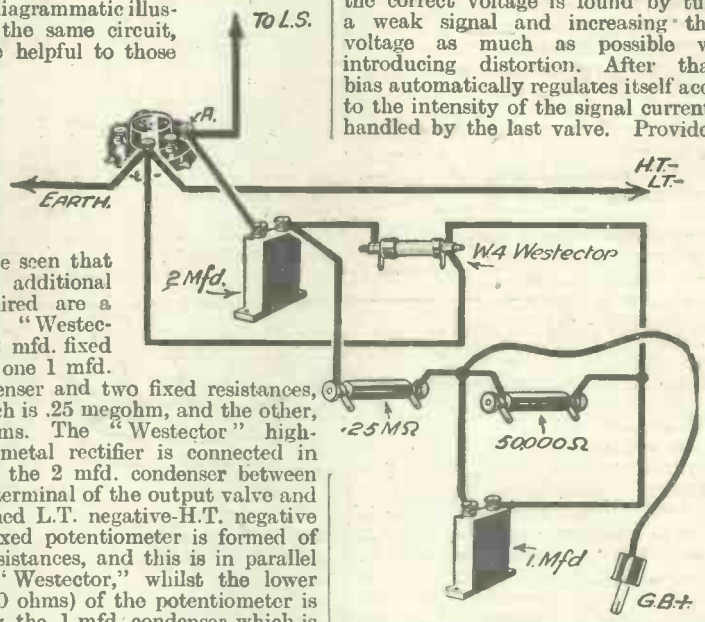

Fig. 1.—This sketch shows how the new components are connected to the output valve-holder.

It will be seen that the only additional parts required are a half-wave "Westector," one 2 mfd. fixed condenser, one 1 mfd. fixed condenser and two fixed resistances, one of which is .25 megohm, and the other, 50,000 ohms. The "Westector" high-frequency metal rectifier is connected in series with the 2 mfd. condenser between the anode terminal of the output valve and the combined L.T. negative-H.T. negative lead. A fixed potentiometer is formed of the two resistances, and this is in parallel with the "Westector," whilst the lower arm (50,000 ohms) of the potentiometer is shunted by the 1 mfd. condenser which is for decoupling purposes. Normally, of course, the positive grid-bias lead is joined to high-tension negative, but in this case it is transferred to the junction between the two resistances, as shown.

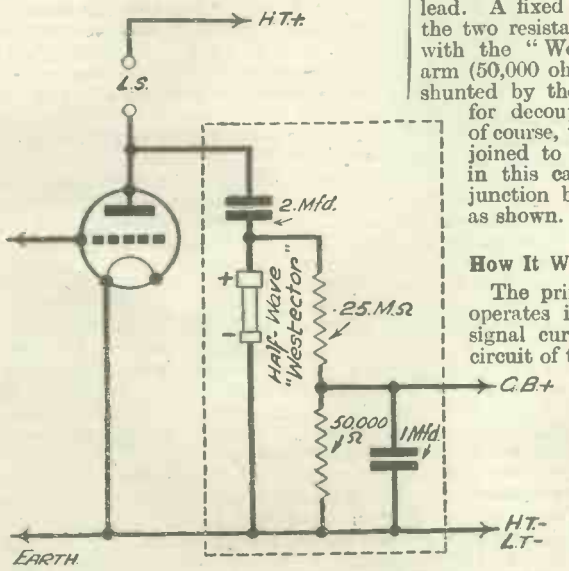

Fig. 2.—Circuit arrangement of the rectifier and resistance-condenser network used for reducing the H.T. current consumption of a power valve.

How It Works

The principle upon which the idea operates is that a small part of the signal current appearing in the anode circuit of the output valve is deflected from the loud-speaker and passes through the 2 mfd. condenser to the metal rectifier. Here the alternating current is rectified, and it produces a voltage which makes the valve filament (through the medium of the H.T. and L.T. negative lead) more negative in respect to the grid. This is, in effect, the same as making the grid *less* negative, and it can therefore be said that the voltage produced acts in opposition to the normal grid-bias voltage. It is obvious that the amount of current that can pass through the rectifier is proportional to the signal current in the anode circuit of the valve; that is, the more powerful the signal is, the greater does the "opposition" bias voltage become. In order to set the scheme in operation, therefore, the grid-bias voltage supplied by the battery is increased to a figure of about twice that nominally required by the valve. Actually, the correct voltage is found by tuning in a weak signal and increasing the bias voltage as much as possible without introducing distortion. After that the bias automatically regulates itself according to the intensity of the signal current being handled by the last valve. Provided that the values of the two resistances are suitably chosen there is no chance of distortion being introduced, since it is perfectly correct to over-bias any valve when it is handling a small input signal voltage. There is, of course, a limit to the bias increase that can be made before introducing distortion, but that can easily be found by adopting the method previously described.

Alternative Resistance Values

The resistance values shown in the sketch are correct for nearly all average small power and pentode valves, but they will not always prove just right for more or less special valves of the high amplification type. When using the latter kind of output valve it is therefore wise to spend a little time in determining the optimum resistance ratings; this can be done, either by trying

(Continued in col. 3, overleaf.)

SOUND ENERGY

The Application of its Fundamental Principles to the Gramophone and Loud-speaker.

By F. W. LANCHESTER

IN the present article the demonstration is given of a simple method of determining the fundamental relationships which are of immediate importance in the reproduction of sound. Also, by way of example, the application of the principles concerned to the mechanical gramophone and to the loud-speaker.

When we produce sound, either mechanically as in the gramophone, or electrically, as in the speaker, we want data or equations of some kind to express the relations between the force and amplitude of motion of the diaphragm and the energy input and output. The first problem we have to face is that of expressing acoustical energy in terms of the amplitude and frequency, and we shall take it that we are dealing with a pure tone, i.e., a simple harmonic form of wave, and that we wish to know, for given amplitude and frequency, how many foot pounds a second or alternatively (if we use electrical units) how many watts are required to maintain a given rate of emission over a unit area, say, one square foot; thus, we may imagine a beam of sound coming through a window one foot square and we require to know how many watts it represents. The answer to this question may be reached by a formal mathematical analysis, and cognizance taken of any possible superposition of waves of different frequency, but this is both complicated and unnecessary; it is perfectly well understood that what may be proved for any single frequency applies equally when a number of waves of different frequency are superposed.

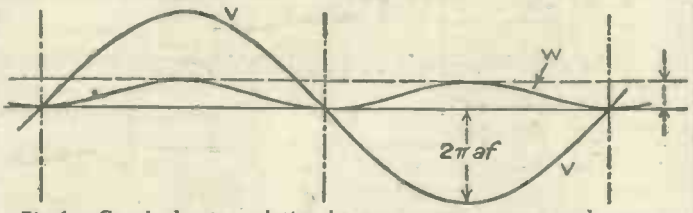

Fig. 1.—Graph showing relation between pressure energy and pressure distribution.

In any actual sound wave the energy is partly kinetic and partly potential, that is to say, a part is in the form of motion, and a part is in the form of compression and rarefaction, i.e., plus or minus pressure, taking atmosphere as datum. When two equal and oppositely moving sound waves are superposed, as in the case of a wave reflected from a plane boundary wall, the energy of the superposed system is alternately wholly kinetic and wholly potential. The amplitude is twice that of one of the component waves, and the maximum pressure (above or below atmosphere) is twice that of one of the component waves alone. Also, the energy in the superposed system is twice that of one of the component waves alone.

Thus, in the superposed system, the whole energy may be calculated as kinetic, or the whole energy (the same energy), may be calculated as potential (pressure) and the two measures (since they relate to the same energy) must be equal.

The Energy in the Kinetic State

If a be the amplitude or the single wave, then $2a$ will be the amplitude of the superposed system. And if the frequency be f the maximum velocity is $2\pi af$ inches per second. Confining ourselves to a small unit volume having this velocity the energy per cu. ft. (whose mass is .075lbs.) will be :—

$$=\frac{4\pi^2(af)^2\times .075}{2g\times 144}\text{ ft. lbs.} \qquad (1)$$

Now throughout the system at the instant when the whole energy is kinetic, the velocity is distributed harmonically; let this be represented as in Fig. 1, as a sine curve V, the loops being alternately positive and negative. Then velocity^2 is represented by another sine curve of twice the frequency W, which is wholly positive, clearly the mean height of this is half the maximum, so that the actual energy (per cu. ft.) will be half that given by expression (1) :—

$$=\frac{2\pi^2(af)^2\times .075}{2g.\times 144}=.00016\,(af)^2\text{ ft. lbs.} \qquad (2)$$

This is the energy per cu. ft. in the region occupied by one or more complete waves in the superposed system, for a single wave train we must halve this again :—

$$\text{Energy per cu. ft.}=\frac{\pi^2(af)^2\times .075}{2g\times 144}=.00008\,(af)^2. \qquad (3)$$

Now this is the energy in one cu. ft. of air transmitting sound waves of amplitude $= a$ and frequency $= f$, and requires to be multiplied by the velocity of sound V, in order to give the amount of energy passing per second through a one-foot square window.

Taking $V = 1140$.

$(af)^2\times .00008\times 1140=.091\,(af)^2$ ft. lbs./sec.

or, in electrical units, $= .125\,(af)^2$ watts per sq. ft. wave front.

Or, *watts per sq. ft. wave front* $=\frac{(af)^2}{8}$.

It will be observed that the potential energy (compression and rarefaction of the air) has not come into the calculation. This need cause no surprise, since, by the method of superposing two equal waves, the energy is *alternately wholly* kinetic and wholly potential, and not, as in a single wave, partly in one state and partly in the other.

The Condition When the Whole Energy is Potential

The pressure distribution is harmonic, and the pressure energy is proportional to the square of the pressure. Thus we may read the graph V, Fig. 1, as showing pressure, of which the loops are alternately positive and negative according as the pressure is above or below atmosphere. The energy is proportional to the graph W, the mean ordinate of which is half the maximum. As representing pressure the maximum (of the superposed system) is denoted by $2p$ when p is the maximum pressure of the single component wave. We take 1 cu. ft. of air as before. The compression (or rarefaction) is adiabetic and the volumetric compression will be :

$$=\frac{2p}{14.7\times 1.400}\text{ cu. ft.,}$$

where 1.400 is the thermodynamic constant (that is, the specific heat of air at constant pressure divided by the specific heat at constant volume). Hence the energy in 1 cu. ft. air compressed to $2p$ pounds per square inch is :—

$$\frac{2p}{14.7\times 1.4}\times\frac{144\times 2p}{2}=14\,p^2\text{ ft. lbs. (per cu. ft.).} \qquad (4)$$

And this we divide by 2 to give the actual energy per cu. ft. in the superposed system : $= 7\,p^2$.

And this is the same energy as given by expression (2). Hence :—$7\,p^2=.00016\times(af)^2$

$p = .0048\,af = \frac{af}{210}$ (pounds per sq. in.).

Note: $\frac{1}{210}$ includes dimension $\frac{m}{ft^2}$.

Summary :—

Watts per sq. ft. wave front $=.125\,(af)^2=\frac{(af)^2}{8}$.

Pressure (pounds/sq. in.) at maximum of wave $= .0048\,af = af/210$.

REDUCING H.T. BATTERY CURRENT CONSUMPTION

(Continued from page 273)

different fixed resistances, or by using a potentiometer in place of the two fixed components. The potentiometer should have a maximum resistance of about 250,000 ohms, and the positive grid-bias lead will be joined to the centre terminal.

It has been stated that the method described is perfectly simple to adopt, but perhaps one or two more practical notes will be of assistance. The metal rectifier is clearly the most important component, and this should be of the half-wave type, the Westinghouse Style W.4 being the one required. Care should be taken that this is connected the right way round, since it cannot otherwise operate correctly. The positive end, which is coloured red, goes to the anode of the valve, and the negative end is joined to high and low-tension negative.

The necessary components can nearly always be accommodated on the receiver chassis near to the last valve-holder, but they may be fixed somewhere outside the cabinet, if desired.

Perhaps it ought to be mentioned here that the idea of reducing H.T. battery consumption by means of a rectifier is not entirely new, since one firm of manufacturers have successfully incorporated it in their battery receivers for some time. In their case, however, a valve rectifier is employed, and although it functions as well as the "Westector" it requires a certain amount of low-tension current and occasionally needs to be replaced. The system described in this article has no such disadvantages, costs very little to apply, and absolutely nothing to operate. It is, in fact, so simple that you might scarcely believe that it can effect a saving of quite a few milliamperes. If you have any doubts, you can take comparative measurements yourself by inserting a milliammeter in the negative high-tension lead, first with the rectifier components out of circuit, and then with them in. You will soon see the difference.

THE PROGRESSIVE EXPERIMENTER

(Continued from page 239)

stouter wire by winding it once round. Now proceed to put on the next twenty turns, make a second tapping, wind another twenty turns, make a third tapping, and then complete the last ten turns. The end of the wire should be anchored just as the beginning was, again leaving 8ins. or so for connecting purposes. In order to keep the winding more even it is best to arrange the tapping points on different ribs, as in the original coil which you can see in one of the photographs.

The coil is attached to the top surface of the chassis in a very simple manner by screwing down a short length of wooden rod or a cork over which the hollow ebonite former will fit tightly. Connect the top end of the winding to the terminal on the tuning condenser which is in contact with the fixed vanes, and join the lower end to the other condenser terminal. The crocodile clip on the flexible lead from the pre-set condenser will be attached to the different tappings of the coil.

You are now quite ready for giving the set a preliminary trial and to commence your experiments. Fit the nine-volt grid-bias battery in the clips attached to the chassis and put plug "G.B.+" into the positive socket and plug "G.B.—" into the "4½ volt" one. Join up the two-volt accumulator, and then connect the high-tension battery. The "H.T.—" plug should be put into the negative socket; then plugs "H.T.+1" and "H.T.+2" should be fitted into the "120-volt" and "60-volt" sockets respectively.

Connect up the loud-speaker (using the two black terminals only) and set the contact arms to positions "A" and "E" respectively, in order to obtain the correct ratio for the power valve specified.

Attach the "E" wander plug to the earth lead and that marked "A" to the aerial lead-in, and insert these in the terminal sockets marked "E" and "A1."

The First Experiment—Selectivity

The first experiment can now be tackled. Fit the crocodile clip on to the first tapping (thirty turns) on the tuning coil and rotate the condenser dial until a station is received. You will find that the station can be heard over a fairly wide "band" on the condenser, indicating that selectivity is not good. If you clip the crocodile on the lead from the top of the coil selectivity will be still worse, but by transferring it to the lower tappings a proportionate sharpening of tuning will be observed. At the same time that selectivity is improved there will be a corresponding reduction in signal strength. By trial, however, you will be able to find a setting which gives a good balance between volume and selectivity.

The next experiment consists of transferring the aerial lead from socket "A1" to "A2," so bringing into circuit the pre-set aerial condenser. First connect the crocodile clip to the highest tapping, and then try the effect of varying the capacity of the pre-set condenser by screwing the knob up and down. It will be found that this has a similar effect to altering the position of the tapping, but in some cases it will give the necessary increase in selectivity without quite so much loss in other directions.

You will find plenty to interest and instruct you until next week, when I shall describe how signal strength can be increased by the application of reaction, and give constructional details for a complete tuner.

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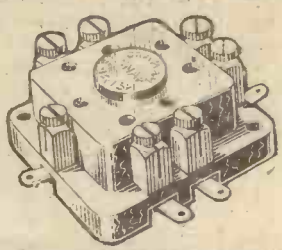

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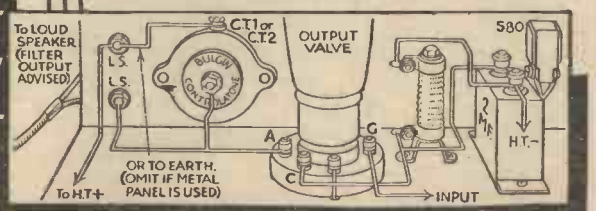

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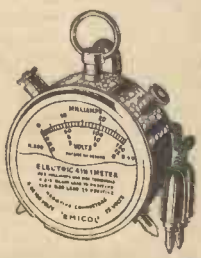

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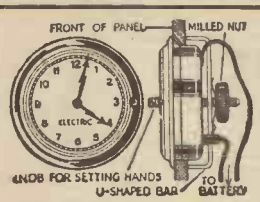

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½ amp., 2-6 volts, in ventilated metal case, with mains flex (Westinghouse Rectifiers), 1 amp., 21/-. Carriage 6d. extra. 7 days' trial. Guaranteed one year.
P. ARDEN AGENCY, WOLLASTON, WELLINGBOROUGH.

BEGINNER'S SUPPLEMENT

(*Continued from page 262*)

seen, very feeble and are therefore very often amplified by one or more valves before being *rectified*. These first valves are called high-frequency (H.F.) valves, and their business is to produce currents similar in every respect to those in the aerial circuit, but much stronger; the extra energy comes from the batteries or the mains which supply them with current. The next process, namely *rectification*, is carried out by the *detector* valve. This valve also amplifies to some extent, but its chief function is to convert the high-frequency currents, which, as we have seen, are currents which move quickly in first one direction and then the other, into a current which moves only in one direction, but at the same time preserving the variations in strength which are due to the speech or music "carried" by the waves. This is admittedly a little difficult to grasp, but you should remember that the waves given out by the transmitter fluctuate in strength according to every fluctuation in the current from the microphone. Accordingly when these waves strike our aerial and set up high-frequency currents in the aerial circuit, these currents, besides moving rapidly to and fro, due to each rise and fall of the waves, also vary in intensity in the same way as the waves themselves vary in intensity due to the fluctuating microphone current at the other end. It is these variations due to the speech, etc., which we wish to retain in the current to be passed to the loud-speaker.

It is no use passing high-frequency currents directly through the loud-speaker, because they move too quickly.

What the detector valve does is to cut out the current in one direction. The remaining impulses in the opposite direction still vary in intensity according to the speech and are then amplified by another valve or two and fed to the speaker. This latter does exactly the opposite thing to the microphone. It converts electrical impulses back into sound waves. The cone of the speaker vibrates in and out and so sets the air vibrating as well.

THE SUPERHET

(*Continued from page 240*)

tracking of the section of the variable condenser which tunes the oscillator coil. It may not be apparent at first sight, but a little thought will reveal the fact that this tuned circuit will not have the same variation (when tuning through the broadcast band) as the aerial circuit, or the first detector input circuit. For instance, the normal or medium broadcast band is from 1,500 to 500 kc/s (200 to 600 metres). Our oscillator circuit will have to cover, therefore, from 1,610 to 610 kc/s. The ratio of our signal-tuning circuit is 3 to 1 (1,500 over 500), whilst the oscillator ratio is 2.65 to 1 (1,610 over 610). In order, therefore, that a ganged condenser may be used to tune both oscillator and input circuits it is necessary to "pad" the oscillator circuit in order to bring it up to the same ratio as the other circuits. Hence, a small condenser will be used to artificially load the oscillator inductance, and as this pads the circuit it is known as a padding condenser. Alternatively, instead of employing this arrangement we may cut the vanes of the oscillator tuning condenser so that they give the same effect, and this is the method used in the Premier Superhet described in PRACTICAL WIRELESS No. 52.

RESISTANCE MEASUREMENT

An Article Dealing with the Method Used, and the Construction of a Simple Bridge.

By G. L. GRISDALE

RESISTANCES are used in any radio set, and are not infrequently the cause of breakdowns. Yet how many people would be able to test a resistance in the case of a breakdown? The first test to be applied would probably be with a pair of 'phones and small battery, which shows if there is a definite disconnection inside the component concerned. But the simple test with the 'phones will not show if a resistance has changed from 10 to

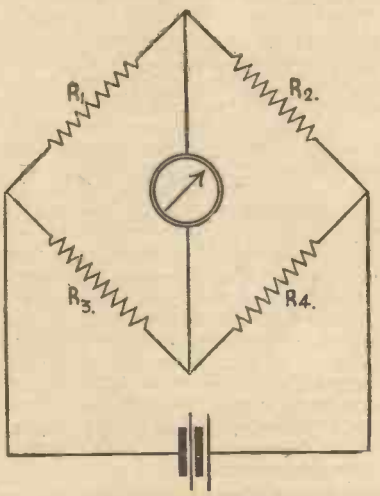


Fig. 1.—The circuit arrangement of a standard bridge.

1,000 ohms or from 1,000 to 10 ohms. Such a change might easily take place, due to a break in the winding and then partial conduction across a poorly-insulated part of the winding, or due to the insulation of the winding breaking down. A breakdown in such a position as the bias resistance in a mains set might lead to a ruined valve and distorted output. We must have, therefore, a more accurate method of finding the value of a resistance.

The next alternative to the continuity test seems to be the use of a battery and ammeter, with an application of Ohm's law. Most readers will know that this law gives the relation between the current, voltage, and resistance in a circuit as

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}.$$

It must be remembered that the values of current, voltage, and resistance are given in amperes, volts, and ohms, and all the quantities must be reduced to these units. This will be quite simple if it is remembered that milli stands for one thousandth, micro for one millionth, and mega for one million. One milliamp is one thousandth of an amp, one megohm is one million ohms, and so on.

Suppose that a 50-m.a. meter is available, and it is required to test a 10,000 ohm resistance which is suspected of being faulty. The current will be most convenient if it is about 20 milliamps, in order to bring it to the middle of the meter scale. Reducing this to amperes by dividing by 1,000, we find it to be 0.02 ampere. The voltage can now be found by applying Ohm's law, voltage being equal to current times resistance, or 0.02 × 10,000 volts—200 volts. So that in order to test the resistance with the apparatus at our disposal, a 200-volt battery is also necessary. This is an article rarely to be found in an amateur's junk box, so that the method of using the milliammeter for finding the resistance becomes very inconvenient. There is also the danger that should the resistance be lower than was at first supposed, the current will be large and will do considerable damage to the meter.

The Bridge Method

There is, fortunately, a very good method of comparing resistances by the bridge method, which is used in most laboratories and is very accurate. The circuit of the bridge is shown in Fig. 1. If the values of the four resistances in the circuit are in a certain ratio, there will be no difference of voltage between the ends of the galvanometer. When this is so the bridge is said to be balanced and it is easy to deduce, simply using Ohm's law, that balance is obtained when

$$\frac{R1}{R2} = \frac{R3}{R4}$$

From this, if we know three resistances, we can calculate the fourth. It may at first be thought that the bridge would have no application for the radio man since three resistances must be used, of which the values must accurately be known, and one of these must be variable, in order to obtain balance. Fortunately, however, there is quite a simple way out of the difficulty in which only one known resistance is necessary. This is how it is done.

The resistances R3 and R4 are replaced by a wire AB (Fig. 2) which has a sliding contact running over it at C. The wire AB is of as high a resistance as is consistent with good mechanical strength and is usually of 22 or 24 gauge manganine wire which may be obtained from any scientific instrument makers. The wire is stretched over a scale which is divided into 100 divisions and 1,000 sub-divisions, a metre rule of the usual wooden type being suitable. Now the values of the resistances R3 and R4 are proportional to the lengths of wire AC and BC in each case. So that the ratio R3/R4 is equal to the ratio of the lengths AC/BC. The lengths are easily measured on the rule. But according to the law for balance, R1/R2 is equal to R3/R4, which in turn is equal to the ratio of the lengths. So if R1 is known the value of the unknown resistance is easily found.

Constructing a Simple Bridge

So much for the theory. Now let us consider the construction and range of a

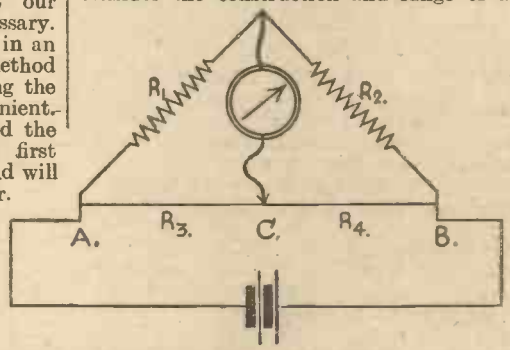


Fig. 2.—The two arms, R3 and R4, of Fig. 1 replaced by a fixed wire and adjustable contact point.

simple bridge. The main detail is the slide wire which comprises the two lower resistance arms of the bridge. It must be absolutely uniform, otherwise the resistance will not be proportional to the length in the circuit. Furthermore, it must be exactly the correct length. Fig. 3 shows the simple construction employed, the whole apparatus being mounted on a piece of wood about 3ft. 9in. long and 6in. wide. The metre rule is screwed down on to the wood, and at each end of the rule, and touching it, is a flat strip of copper, which is screwed down to the baseboard. Two terminals are fitted to the copper strip as shown, and another similar strip on which there are three terminals is mounted at the back of the baseboard. The important point in the whole construction is the fixing of the slide wire, which must be so soldered that it is exactly the metre in length to the point where the solder commences. This is because the resistance of the solder and the copper strip is negligible compared to that of even a small portion of the slide wire. So a good blob of solder should be put on at the edge of the end of the rule. The sliding contact is a small piece of copper strip, screwed to a piece of wood as a handle. It must be pressed firmly on the slide wire. The battery is connected to the terminals B, the resistances R1 and R2 to the terminals so marked, and the galvanometer between G and the sliding contact.

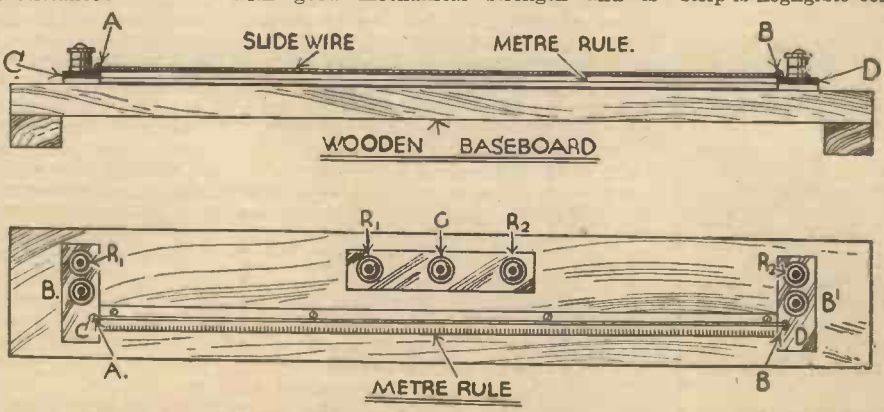
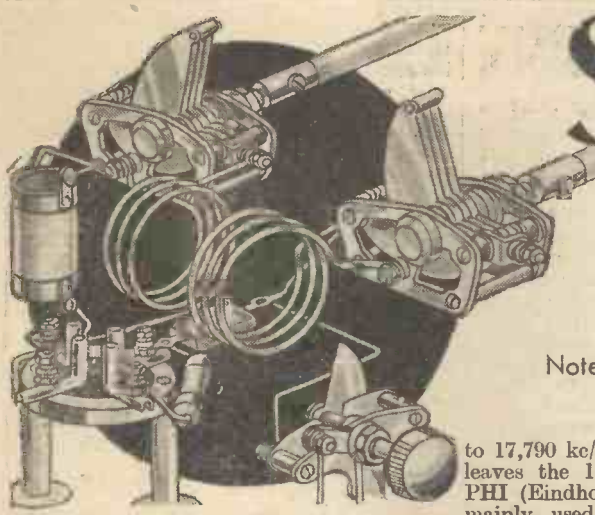


Fig. 3.—The lay-out of the adjustable arm, shown in plan and elevation. The rule by which values are computed may be seen.



Short Wave Section

Notes on the Most Important Broadcasts Below 50 metres

By E. THURWAY

DURING the past few weeks conditions of the ether have so improved that it has again been a pleasure to bring the short-wave receiver into operation. As most nations are now realizing the value of channels below 50 m., much development has taken place on these lines, and almost every week new transmitters are launched on the ether. The logging of broadcasts from distant stations on these lower wavelengths is by no means a matter of much difficulty; not only have circuits been improved, but—a more helpful factor—the stations themselves are working at higher power, and in many instances with a very modest receiver signals can be heard at good loud-speaker volume. (As a general policy, however, the actual *search* is better made on headphones.)

With the return of winter time many stations are establishing new schedules of transmissions; in addition, the policy of using two or three alternate channels, according to the time of day or night, is also retained. It is *essential*, therefore, that the short-wave fan should make a note of the alterations in times—and in many cases, wavelengths—otherwise disappointment will inevitably arise.

The European Zone

Starting with Europe, it is useless at present to search for Vienna (UOR2), as this station is temporarily closed with a view to a complete overhaul; much the same may be said of Poznan (SR1) which, however, may start again during the next fortnight or so.

On the other hand, we may add to our log of European short-wave transmitters a new station—probably at Jelöy—which now re-broadcasts the Oslo (Norway) programmes nightly. Its wavelength has not yet been definitely fixed as the most favourable channel is being sought, but tests are now carried out on and around 42.6 m. The station will eventually be used for the relay of the Oslo wireless entertainments to the Vadsö 10kW. broadcaster, at present under construction, and for any other northerly transmitter in Norway which cannot receive the programmes by the existing landlines.

OXY, Skamlebaek (Denmark) which has been trying out more comfortable positions in the ether than its old wavelength, is now well heard on 49.26 m. (6,090 kc/s); it acts as the short-wave relay of Copenhagen. Also note that GSG, Daventry Empire, having suffered from interference, has altered its frequency to 17,790 kc/s (16.86 m.), and in this way leaves the 16.88 m. wavelength free for PHI (Eindhoven), the new Dutch station mainly used for the broadcast to the Netherlands East Indies. (This station, however, will also use 25.57 m. for its transmissions at a later date.) The times of transmission are from G.M.T. 13.00—15.00 (Mondays, Tuesdays, and Fridays) with an extension until 15.30 on Saturday and Sunday. The announcements are made in six different languages.

Transatlantic Broadcasts

Of the transatlantic broadcasts, one of the most frequently reported has been YV1BC, Caracas, which on 49.08 m. (6,112 kc/s) has been working on weekdays between G.M.T. 16.00—18.30, 22.45—03.30, and on Sundays between 19.30—03.30. The interval signal is easily recognized; it consists of four chimes on a gong every fifteen minutes, and usually precedes the call. If you can prove reception of a broadcast by giving details of some items heard, and write to YV1BC, Radio Broadcasting, Caracas, Venezuela, you may be rewarded, as confirmation, with a booklet in Spanish and English, illustrated with maps and photographs.

Another station for which it is well worth trying is XETE, Mexico City, on 31.25 m. (9,600 kc/s). Between midnight and 5 a.m., G.M.T., would be the best period to institute a search. Some of the North American transmitters have altered their schedules; the latest information received is given hereunder.

VE9GW, Bowmanville (Ontario), relaying CKCW, Toronto, on 49.22 m. (609 kc/s), works between G.M.T. 13.00—17.00 (Mondays and Tuesdays); 21.00—01.00 (Thursdays and Fridays); 21.00—05.00 (Saturdays) and 16.00—02.00 (Sundays). According to an official report broadcasts hitherto carried out on 25.42 m. have been discontinued. VE9HX, of the Maritime Broadcasting Company, Halifax (Nova Scotia), which takes the CHNS programmes from that centre on 49.10 m. (6,110 kc/s), may often be picked up between G.M.T. 22.00—03.00. Here again, a gong signal is used; there are four notes every half-hour, preceding the call and announcements. VE9JR, Winnipeg (Canada) on 25.6 m. (11,715 kc/s) appears to work in spasms between G.M.T. 14.30 and 03.00 daily. Strokes on a gong are also used as an interval signal, and the station opens its broadcasts by playing a gramophone record, *O Canada*.

In respect to stations in the United States, the following changes should be noted: W9XF, Chicago, short-wave relay of WENR, of the N.B.C. network on 49.18 m. (6,100 kc/s) does not broadcast on Saturdays. On Sundays it operates from G.M.T. 20.30—23.00 and from 01.00—05.00; on other weekdays from G.M.T. 01.30—05.00.

W1XAL, Boston, as a relay of WEEI of that city, is now on the air on 25.45 m. (11,790 kc/s), on weekdays between G.M.T. 02.00—03.00; from 23.00 to midnight (Saturdays) and on Sundays from G.M.T. 17.30—19.30, and again between 00.30—02.30.

Finally, returning homewards, it is well to bear in mind that at present the Moscow broadcasts are carried out by two separate stations on the lower channels, namely, on 50 m., for programmes transmitted by the new 500 kW. Moscow (RCZ) giant, and on 45.38 m. as relay of the Trades Unions' studio (RCY) working on 1,304 m., or, alternatively, ROZ, 1,000 m. and 424.3 m. On most evenings they are two distinct programmes.

PRACTICAL SHORT-WAVE NOTES

SOMETIMES when a new short-wave receiver is put on test for the first time it is found that the receiver does not possess the prescribed wave-range, zero on the dial tuning the receiver to a wavelength far above that of the intended minimum. A receiver may behave itself in this manner according to either one of two defects—in the first, the minimum wavelength is not low enough, but the maximum is correct, and the second in which the whole wave-range from zero to 180 degrees on the dial is either lower or higher than the intended original. Unfortunately, there are no coil standards in common use for short-wave tuning, and beyond the figures published by manufacturers for use with their own coils and a given capacity, we are more or less in the dark when it comes to a question of estimating the wave-range of a short-wave coil. However, by the use of a test oscillator of the type described in the first of these notes, the amateur will have a home-made standard by which to judge other coils.

The performance of a receiver can be vastly affected by the use of metal shielding, and can be completely marred by the misuse of it. If a metal chassis construction is used, special steps must be taken to ensure that the tuning coils themselves do not come too near the panel. If plug-in coils are used, some provision must be made to mount the coils at a distance

(Continued on opposite page)

SHORT WAVE SECTION

(Continued from previous page)

from the chassis. To achieve this, the best plan is to use a piece of inch-thick wood, measuring about 2ins. by 2ins., mounting this on top of the chassis plate, and on top of the wood mounting an ordinary baseboard valve socket, if coils requiring this type of socket are used, or, of course, using a larger piece of wood and coil socket if other types of coils are employed. The bottom end of the tuning inductance will now be some small distance away from the metal, and there will be practically no ill-effects, whereas if the coil was mounted on a socket mounted directly to the metal, the tuning range would be affected, together probably with a loss of oscillation.

If the tuning range is found to be too high—that is, if both ends of the dial tune to too high a wavelength, the best method of reducing the wavelength is, of course, to remove possibly one whole turn from the tuning coil, which may also require a little attention being given to the reaction coil as well. If the tuning range is found to be limited, that is, a correct maximum figure but too high a minimum, steps will have to be taken to reduce capacity in some other part of the circuit. Some variable condensers do not, unfortunately, have a low enough minimum, so that if a receiver is being built to a specification it is very important to see that the correct tuning condensers are employed, otherwise the effect described above may be experienced.

Also, do not make the mistake of running any of the wiring in the tuning circuits too near the metal chassis merely in order to secure neatness. Extra capacities can be formed in this manner in a number of places which have a rather disastrous effect on the efficiency of a short-wave set.

Actually, the chassis system of construction, if employed sensibly, is very excellent for short-wave receivers. We can, for instance, make use of chassis-type valve-sockets which have considerably lower losses than some examples of other types, and the wiring can be kept very short, with a minimum of actual connecting wires. Those amateurs who do not object to the use of solder can take advantage of some of the very small fixed condensers and resistances now available with wire ends, and wire these directly into the circuit. These will be found particularly advantageous for the grid circuits as the condenser and leak in the detector circuit can be practically wired on to the detector valve socket itself, thus reducing considerably the length of wire in use.

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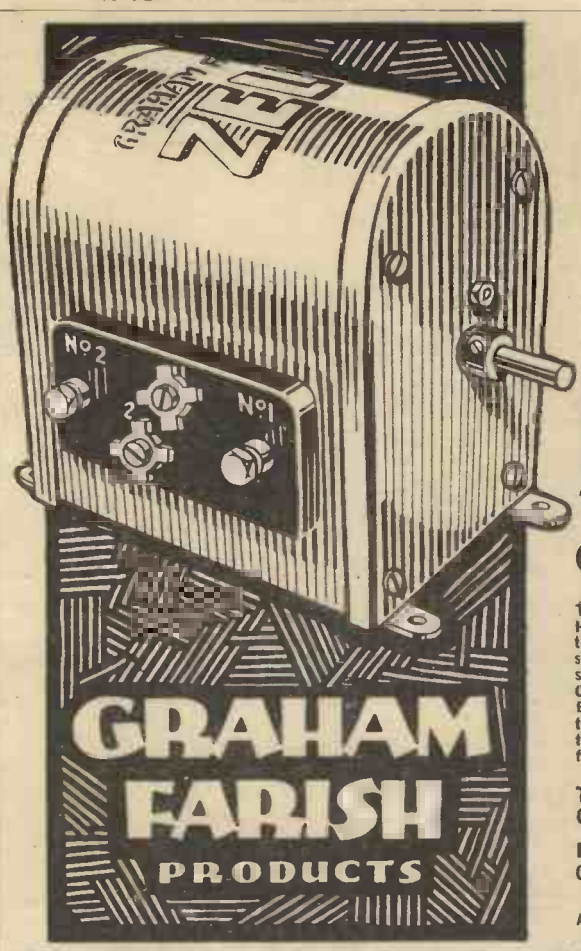

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188	1933 Ekco 2-v. D.C. ..	9 10 0	4 4 0
0180	1931 Ekco E.S.2 3-v. ..	15 15 0	7 7 0
A6	1931 Ferranti A.C.	15 15 0	7 7 0
206	1931 Umello 5-v. with Mains Unit A.C.	12 12 0	5 5 0
119	1929 Lincoln 3-v. A.C. ..	10 10 0	4 10 0
182	1933 Pye G 3-v. A.C. ..	12 12 0	8 8 0
95	1933 Lumophone 3-v. A.C.	14 14 0	8 8 0
11	1933 Ultra Lynx 3-v. A.C.	11 11 0	7 7 0
202	1933 K.B. Pup 2-v. A.C.	7 10 0	3 3 0
137/8	1930 Phillips 2-v. A.C. without Speaker	10 10 0	3 0 0
177/41	1931 Ekco 3-v. A.C. with separate Speaker ..	17 17 0	6 6 0
5	1931 Selector 4-v. Transportable A.C.	57 15 0	8 8 0
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13	1933 Alba 3-v. A.C. ..	18 18 0	12 12 0
114	1933 E.R.P. 3-v. A.C. ..	18 18 0	12 12 0
133	1932 H.M.V. 12-v. S/het (Auto record change) ..	73 10 0	35 0 0

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228	1932 Pye T.T. 4-v. ..	14 14 0	8 10 0
194	1932 Cossor Silvertone 2-v.	4 4 0	1 15 0
171	1931 Umello 5-v. Portable	10 10 0	3 3 0
205	1933 Lissen Skyscraper (assembled) with cabinet and speaker	6 5 0	5 10 0
151	1932 Selector 4-v. S.G. Portable	17 17 0	5 0 0
A1	1932 Cossor S.G.3. ..	6 7 6	3 5 0
A2	1933 Portadyne Transportable	14 14 0	8 10 0
A3	1931 Osram Music Magnet 4-v. without speaker ..	10 9 6	4 17 6
A4	1933 Osram "Thirty-three" 3-v.	9 9 0	4 17 6
168	1932 Burgoyne 3-v. ..	4 10 0	2 15 0
145	1930 Kolster-Brandes 3-v. no speaker	5 5 0	1 12 6
18	1930 Red Star 3-v. no speaker	6 6 0	1 12 6
0202	1932 Kolster-Brandes 2-v. built-in speaker ..	4 10 0	2 10 0
229/31	1933 Lissen 3-v. Skyscraper (assembled in cabinet) with Baker P.M. speaker	7 7 0	5 17 6
109	1930 Naydon Scrace 5-v. Transportable, built-in speaker	5 17 6	3 0 0
227	1933 Columbia 3-v. built-in speaker	9 19 6	5 15 0
191	1931 Halcyon Transportable 3-v.	12 12 0	4 4 0
A7	1933 Telsen 3-v. no speaker	3 1 0	1 10 0
235	1931 National 5-v. Transportable	—	2 10 0
225	1932 Radio for the Million 3-v. assembled chassis	5 17 6	2 2 0
232	1930 P.W. Everybody's 3-v. assembled in cabinet no speaker	15 0 0	4 4 0
A5	1933 K.B. Kobra 3-v. ..	9 17 6	4 10 0

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FACTS & FIGURES

BAKER'S CLASS B CONVERTER

THE illustration below shows the latest type of Class B unit which is manufactured by Baker's Selhurst Radio. This consists of a heavy metal case finished in a very neat black grained effect, with the name Baker clearly embossed on the upper surface. At one side is fitted a seven-pin valve-holder, whilst at the opposite side is a tone control knob of the two-position type. The case contains two transformers, the driver and the output transformer, and, in addition, some fixed condensers for tone control purposes. These are connected in the usual way across the grids of the Class B and on the output side of the second transformer. The condenser shunting the two grids is open-circuited by means of the tone-control switch and thus enables two different tones to be obtained, according to the loud-speaker in use or the type of music being received. A multiple cable is wired into the circuit and led out through the top of the case, and is fitted at the end with a five-pin combined plug and socket. This is inserted in place of the output valve of a receiver, and the valve plugged into the top of the adaptor, thus supplying the Class B valve with the various voltages as well as connecting the driver transformer in circuit with the output valve of the receiver. In practice the device works very well indeed, the tone being quite pleasing. The tone control works admirably and enables quite a good high-note cut off to be obtained when required. The volume is fully up to Class B standards, and the coupling of the unit to the receiver is simplicity itself. The price of the unit is 37s. 6d.

Baker's "Selhurst" Class B Converter.

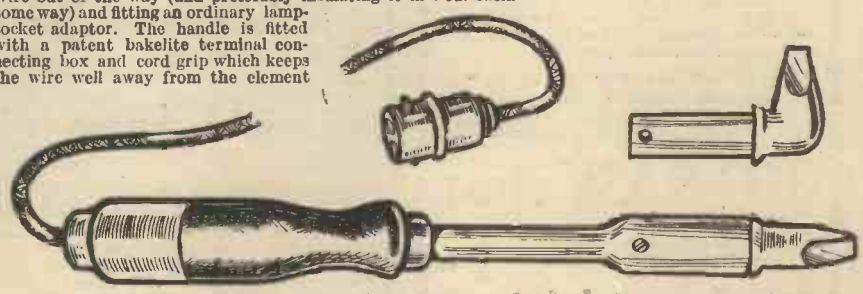
SOLON "EMPIRE" SOLDERING IRON

THE advantages of the electric soldering iron are too well known to need description, but when the iron is fitted with a replaceable copper bit it is still further improved. The iron illustrated is made by W. T. Heuley's Telegraph Works, and costs only 10s. The rating of the iron is 70 watts, which means that it may be used for approximately 15 hours for the cost of one unit of electricity. The copper bit fits inside the tubular portion of the iron in such a way that it is impossible for any excess flux to penetrate to the element and so cause trouble, yet at the same time by merely loosening a screw, the bit may be dropped out and the angle bit which is shown may be inserted for the purpose of getting into awkward places. The iron is supplied with six feet of tough rubber 3-core flex, two of the cores being insulated with rubber and the third (the earth wire) cotton covered. It is thus intended primarily for connection to a three-point power switch, but it may be used on an ordinary lighting circuit by bending back the earth wire out of the way (and preferably insulating it in some way) and fitting an ordinary lamp-socket adaptor. The handle is fitted with a patent bakelite terminal connecting box and cord grip which keeps the wire well away from the element and at the same time ensures that the leads cannot be inadvertently pulled off. The iron takes approximately four minutes to reach the necessary temperature for soldering purposes, and it is thus a very satisfactory accessory for the experimenter or the service man.

BULGIN SPIROHM RESISTANCES

A BATCH of Bulgin Spirohm Resistances have been received for test, and we must say that we are very impressed with this particular component. A neat porcelain former (2in. long by just over ¼in. in diameter) is provided with a spiral thread, and round this is wound a resistance element consisting of a heat-resisting core surrounded by a winding of bare resistance wire. A threaded metal rod passes through the former, and small holding-down brackets are fitted at each end. Connection is made by means of a clip fastened round the ends of the element, and a terminal is mounted on the top of the clips, with the addition of a small hole for soldering where this method of connection is preferred. The great advantage of this type of resistance—apart from the valuable cooling properties which it possesses—is the fact that the resistance may be varied in quite small steps by sliding the clip along. For instance, we took one Spirohm which was rated at 5,000 ohms, and in order to test its adaptability we chose (quite at random) a value of 1,400 ohms. One clip was loosened and passed along the bare wire whilst the instrument was joined to our resistance bridge, and by setting the arms at 1,400 ohms it was found possible to obtain this value exactly on the particular spirohm used. This is, of course, a valuable feature in mains receivers, etc., where an exact value of resistance is not marketed, or where it is desired to make certain adjustments in order to arrive at specific values. The resistance used for our test was then submitted to a very high current, approximately double that for which it was rated, and although it certainly rose to a fairly high temperature, it did not break down, and it was left for some hours, after which it was found that the value was exactly the same as before. The prices of the resistances vary, according to the value, from 300 to 5,000 ohms, costing 3s. 6d. ; from 7,500 to 40,000 ohms, costing 3s. 9d., etc. The dearest, 100,000 ohms, costs only 6s.

Another interesting item which is manufactured by Messrs. Bulgin is the bakelite knob, which is obtainable with various spindle sizes, but all of which are finished with the same colour and pattern. It is thus possible to furnish a home-constructed receiver with control knobs which all match, and so adds to the appearance of the finished receiver. These knobs cost 4½d. and 6d. each.



The Solon "Empire" iron, with one of the spare angle bits.

RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

ANGLO-AMERICAN RADIO AND TELEVISION SOCIETY

This Society has pleasure in announcing the formation of a department to obtain work for its unemployed members. There are no charges for this service, or for admittance to the society. Programmes dedicated to the society will shortly be broadcast regularly from American stations. Christchurch, New Zealand, is organizing a branch of the society.—Hon. President, Leslie W. Orton.

SLADE RADIO (AFFILIATED TO THE R.S.G.B.)

Readers of PRACTICAL WIRELESS are cordially invited to attend a meeting of the above Society on any Thursday, at 8 p.m., at their headquarters: Parochial Hall, Broomfield Road, Erdington. The following is a programme of future events:—

Oct. 26th—"Recent developments in receiver design," by Mr. A. F. Poynton.
Nov. 2nd—"Gas filled relays."
„ 9th—Debate, Superhet *v.* Straight set. Messrs. A. S. Freeman and E. G. Jeynes *v.* G. T. Peck and A. Taylor.
„ 15th—Whist Drive and Dance.
„ 16th—"Modern radio practice," by Mr. P. W. S. Valentine, B.F.H., A.M.I.E.E.
„ 23rd—Lantern lecture: "From Nelson's day to the present," by Lieut. Commander Brewster.
„ 30th—Annual General Meeting.
Dec. 7th—Annual Dinner.
„ 14th—"Rotary transformers for radio including car use," by Mr. R. H. Woodhall.
„ 21st—Members night.
„ 28th—Lecture and demonstration "A.V.C.," by Mr. G. F. Clarke.

Entrance fee, 2s. 6d. Subscription, 8s. per annum. Hon. Sec., 110, Hillaries Road, Gravelly Hill, Birmingham.

THAMES VALLEY AMATEUR SHORT-WAVE AND TELEVISION SOCIETY

The first meeting of this Society was held at Twickenham on Wednesday, October 4th. A large gathering attended including many well-known transmitters, the host being Mr. Crocker, G2NN. The chair was very ably taken by Mr. Buttress, G6MB (Sunbury), and during the evening discussions on the season's programme were given. Mr. R. Sheargold, G6RS (Shepperton), gave an outline of the phases of short-wave work to be followed during the season; also an enthusiastic television group was formed. A very interesting talk, given by Mr. F. J. Wadman, G2GK (Walton-on-Thames), on "Station Arrangement," followed by Station Description No. 1, was well received. Mr. Wilkins, G6WN (District Representative No. 14, R.S.G.B.), spoke on matters concerning all Radio Societies, and aroused much enthusiasm. The meeting closed with inspection of apparatus exhibited. Intending members should write to:—Hon. Secretary, Mr. R. Sheargold (G6RS), "Glenmore," Manygate Lane, Shepperton, Middx.

GOLDERS GREEN AND HENDON RADIO SCIENTIFIC SOCIETY

On Thursday, November 2nd, at 8.15 p.m. in the lecture hall of the Hampstead Public Library (at the corner of Finchley Road and Arkwright Road, N.W.3.), a unique lecture and demonstration is to be given, entitled "Music from the Air," when the new Valve Electronic Musical instrument will be played for the first time in Hampstead by Mr. Martin Taubman, accompanied by Mr. Percy Kahn. Mr. H. J. Barton-Chapple, W.H.Sch., B.Sc., A.M.I.E.E., will introduce the subject of the lecture. As the subject is rather unusual in character and quite new to many, we extend a hearty invitation to readers of PRACTICAL WIRELESS, to whom seats are free. Please let me know, enclosing a stamped and addressed envelope, as soon as possible the number of seats required, as our numbers are limited to 150. Ladies are cordially invited.—H. Ashley Scarlett, Vice-President, 60, Pattison Road, London, N.W.2.

THE CROYDON RADIO SOCIETY

The President, H. R. Rivers-Moore, B.Sc., opened the new season on Tuesday, October 3rd, with a lecture-demonstration, entitled "My Ultra-modern Amplifier, and its five loud-speakers. "The event took place at St. Peter's Hall, Ledbury Road, S. Croydon, with Mr. F. Nightingale presiding. The apparatus had necessitated two large motor-vans for its transport to headquarters, as the amplifier alone was contained in a metal box five feet high and two feet square. The various components were described as assembled, and worthy of note was the power transformer weighing half a hundredweight, and providing a mere 2,000 volts for the output valves. Also noticeable was the huge output transformer for the five "Lion" speakers of a special type. In much detail was it explained how two stages of Paraphase Amplification had been used without transformer coupling.—Hon. Secretary, E. L. Cumbers, Maycourt, 14, Campden Road, S. Croydon.

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PRACTICAL LETTERS FROM READERS

The Editor does not necessarily agree with opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication.)

Accumulator Charging Arrangement

SIR,—About two months ago I pointed out that I had found plug and socket working preferable to switch gear. It is this point that has again aroused my interest. I have taken a part of the diagram by A. Bingham, Liverpool, in No. 53, page 28, to make clear this preference. You will admit, I am sure, it is by a strange coincidence that this is the very circuit I abandoned, and sent in the plug and socket arrangement for preference. A glance at Fig. 1 shows that the accumulator on charge is absolutely separated from the set, but it is a matter of a moment to change over plugs when required. There is no risk of hum as in the arrangement with the D.P. double-throw switch which necessitated one lead from trickle charger going straight to L.T. terminal on the set. Having eight contact points in the case of the two plugs and sockets, against six in the case of the switch, enables one to completely separate the circuits besides being instantly detachable.

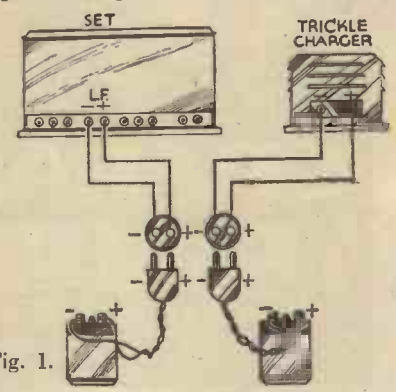

Fig. 1.

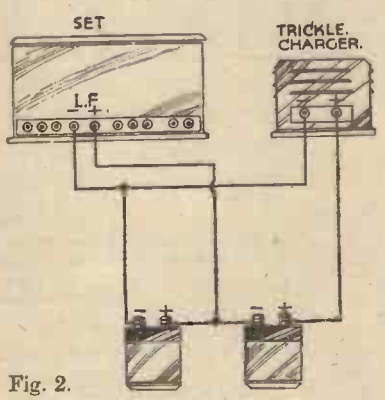

Fig. 2.

Figs. 1. & 2.—Diagrams accompanying Mr. Cole's letter.

The commercial type of spade terminals are dispensed with at the accumulators, and ones made from sheet lead with flex leads attached with a blob of solder are used. These are smeared with vaseline to eliminate corrosion trouble. I have had this arrangement working for months, and have not once run out of L.T. since its installation.

Before the arrangement mentioned was in use we were on one occasion treated to a "silent night," owing to the failure of two accumulators. The hook-up, shown in Fig. 2, saved the situation. The two accumulators were connected in series, and the trickle charger tapping raised to 4 volts and connected across two accumulators. Two volts only were tapped off to the set, and the programme which had begun came in as usual. There was a slight hum between items, and for this reason it was not used as a permanent arrangement. It was, however, continued successfully for the whole evening.—F. C. H. COLE. Harlesden)

Facilities for Binding Vol. II

SIR,—As a reader of your weekly from the time of its inception, may I ask whether the same facilities for binding Vol. II will be offered as were given in the case of Vol. I.

May I take this opportunity of congratulating you upon keeping the standard up to the high level at which it was introduced. It is my high opinion of the value of this periodical which prompts my inquiries as to binding facilities.—H. THOMAS (Stratford).

[*This is being prepared and an announcement will be made in the near future.*—ED.]

CUT THIS OUT EACH WEEK.

DO YOU KNOW?

—THAT the metallized coating of some mains valves is joined to one of the pins and not to the cathode.
—THAT the suppressor grid is connected to one of the pins in some mains pentodes, and is not joined to the cathode.
—THAT the normal tuned-anode arrangement offers greater amplification than any other form of H.F. coupling, but is more difficult to stabilize.
—THAT removal of the earth connection should result in a reduction of signal strength, unless the earth is inefficient.
—THAT signals from a powerful local station may often be obtained by holding the aerial terminal instead of joining up the correct aerial lead.
—THAT an electrolytic condenser must be chosen with care regarding the voltage strain to which it is subjected.
—THAT trimming adjustments in a receiver on the H.F. side should be carried out with a wooden instrument, and not an ordinary long metal screwdriver.
—THAT it is possible to hear the American medium wave stations in England with a single H.F. stage on favourable occasions.

NOTICE.

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

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

Replies to QUERIES and ENQUIRIES

By OUR TECHNICAL STAFF.

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.

INCREASING OUTPUT OF MAINS UNIT

"I have a home-made mains unit which gives me all that I want at the moment in the way of H.T. A full-wave rectifying valve is used with the usual filament and H.T. supplies. I anticipate building a more powerful set in the near future, and I think I could save expense by buying a similar rectifying valve and connecting the two in parallel to double the output. Will you inform me if this method is practicable, and if not why not?"—G. B. M. O. (Belfast).

On no account should you try the expedient you suggest. Very unsatisfactory results would be obtained, and in all probability some part of the apparatus would be damaged. A much better arrangement would be to purchase another similar valve and connect the two as half-wave rectifiers, that is, with the anodes of each valve joined together. We think, however, you will find it much better to make up a complete new mains unit to deliver the required H.T. voltage and current, rather than attempt any arrangements on the lines mentioned, as more reliable working will thereby be obtained.

BIASING AN H.F. VALVE

"I have a well-made set which employs three screen-grid H.F. valves, and since I have been reading your book I have been trying to study the circuit of this set. It seems to me that there is no bias of any kind on the H.F. valves, the only battery in the set applying 9 volts to the output valve. From various valve catalogues, etc., I think the set would be improved by fitting bias to the first valves, and I should like to know whether you agree with this, and if so, how to apply it. I cannot sketch the circuit as it is too complicated, but screened coils are employed throughout."—R. H. (Weymouth).

Whilst it is quite true that most H.F. valves require a small negative bias for best working, this does not apply in every case. In your particular receiver we should imagine that the makers would fully understand the requirements and would have arranged the bias if it were necessary. It may be possible that the bias is obtained automatically by means of a resistance in some part of the circuit and this would, of course, account for the absence of the battery. We would advise you not to tamper with the circuit without first consulting the makers.

BIAS RESISTANCE NOT REQUIRED

"I am sending you herewith the circuit of a set which I have designed, by building together various parts of the receivers which you have published. I have taken the H.F. stage from one set, the detector from another, and the output from yet another, as I think that each part has been designed to work in the most efficient manner. Unfortunately, I do not know a great deal about wireless and am not sure whether I have gone wrong in any particular. Could you please check over the circuit, and let me know whether it is sound."—W. J. (Thames Ditton).

The circuit is of an A.C. three-valver, and is perfectly satisfactory in all but one point. In the cathode lead of the detector valve you have included a resistance shunted by a condenser. In addition, a grid leak and condenser is joined in the ordinary manner in the grid circuit. No provision for pick-up connections are shown. Therefore, either the resistance and condenser must be removed, and the cathode joined direct to earth, or you need to show the pick-up terminals. The best thing, as you have the resistance is to connect the grid leak direct to the cathode, and to arrange pick-up terminals between grid and earth.

DATA SHEET No. 57

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

THE NEW VALVES

Name.	Electrodes.	Use.
Duo-Diode-Pentode	Heater, Cathode, 2 auxiliary anodes, grid, anode, 2 auxiliary grids	Detection, plus automatic volume control, plus L.F. amplification.
Duo-Diode-Triode	Heater, Cathode, 2 auxiliary anodes, grid, anode,	Detection, plus automatic volume control, plus L.F. amplification.
Heptode ..	Heater, Cathode, five grids, anode	Combined oscillator-modulator, or, in other words, combined first detector plus oscillator with the normal variable-mu (or volume control) properties.
Pentagrid..	Alternative term for Heptode.	

MAKING A CALIBRATED SCALE

"I am rebuilding my old set in a modern radio-gram cabinet, and I wish to include one of the new straight-line type of dials. I do not want to buy one, but would like to make one to my own length, and with all the wavelengths marked on it. How can I set out the correct scale so that it will agree with my coils? Is there any formula which will help me in this?"—H. C. W. (Merton, S.W.).

There is no way of carrying out your idea from any table or formula. Various types of tuning condenser will require various degrees of marking out on a scale in order to give a wavelength calibration, and the best way for you to proceed is to cut out your material and mount everything up, without marking the scale in any way. When the receiver is finished, connect it to your aerial and proceed to tune in various B.B.C. stations. You should be able to find sufficient spots on the scale in order to enable you to find accurate positions for the remaining wavelengths. Before making the markings permanent you should endeavour to receive as many stations as possible and check up the positions of your markings. It should not be a difficult task.

HUM TROUBLE

"My receiver is of the A.C. mains operated type and was bought from a shop some time ago. It works perfectly in every respect but one, and although this is not serious it worries me slightly. When I switch on the speaker hums quite loudly for about twenty seconds and then this dies away gradually as the signals build up. When the music or station is on there is no audible hum. Can you suggest a cure for this, or is it a natural function of some circuits?"—G. J. (Rochester).

Probably your receiver utilizes indirectly heated valves for the receiver portion and a directly-heated output valve, or energized speaker. When the receiver is switched on the speaker will be receiving a certain load due to the rectifying valve heating up quicker than the receiver valves, and this is audible as a hum. As the receiver valves get warmed up the load on the speaker is removed and consequently the hum dies away. There is just a possibility that the smoothing condenser on the mains side of the speaker field (or smoothing choke) is developing a fault, but this could be discerned by examining the rectifying valve when first switching on. Any sign of blue-glow will indicate that there is an undue load and this will most likely be caused by a faulty smoothing condenser.

SUPERHET CIRCUIT.

"I should like to make a really good superhet, and I have a number of valves by me. I do not know exactly what type of set to build, and I am not very particular regarding the amount which I spend on it. I should like to make a circuit employing H.F., Det., Osc., I.F., Det. and Pentode, or, using the same valves, Det., Osc., two I.F.'s, Det. and Pentode. Which would you advise me to build?"—Y. B. (Pinner).

As you are situated so near to the Brookmans Park transmitters you will have to take care to avoid very prominent whistles due to these stations. In the case of the first circuit you mention, the number of tuned circuits should be sufficient to give a degree of selectivity good enough to remove second channel interference. The second circuit would require good band-pass coils in the aerial circuit for the same reason, and it would be worth while employing the new iron-core coils in this position. Two I.F. stages may give rise to rather a high background of noise We think, after studying your particular local conditions, that the best arrangement would be the first, with preferably a variable-mu valve for the preliminary H.F. and I.F. stage. It should then be possible to use a cold valve (or alternatively a duo-diode-triode) for the purpose of automatic volume control on these two variable-mu valves.

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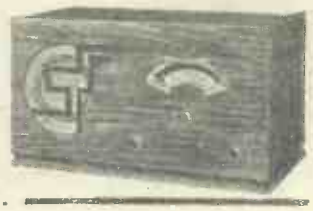

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E.D.C.C. ROTARY CONVERTERS

THE difficulties attending the conversion of direct to alternating current are well known, and to effectively eliminate the effects of radiation of high-frequency disturbances to the aerial, and voltage ripples, a satisfactory rotary converter must be carefully designed, electrically and mechanically, and must be capable of being run for long periods. The well-known E.D.C.C. Converter meets all these conditions and gives "interference free" reception, even when installed quite close to a receiver or radiogram. Full particulars and prices of various models with outputs ranging from 40 to 600 watts, are given in the latest list issued by Electro Dynamic Construction Co., Ltd., Devonshire Grove, London, S.E.15. Also included in the list are Rotary Transformers for public address equipment, an H.T. Anode Converter, and A.C. to D.C. motor geuerators, the latter being primarily designed for supplying direct current to receivers and radiograms installed in districts where a change over from D.C. to A.C. has taken place. Three pages in the list are devoted to useful tables giving prices of complete portable rotary converters suitable for operating popular A.C. instruments from D.C. mains.

PETO-SCOTT RADIO CABINETS

MODERN requirements demand that a cabinet for a receiver or radiogram must be something more than just a box to house the set; it must also be an article of furniture that can take its place with the other furniture in a room. Thanks to Peto-Scott Co., Ltd., and modern production methods, high-class cabinets are now obtainable at competitive prices within the means of all. This firm have specialized in radio cabinets for the last fourteen years, and the fruits of their experience are to be seen in a neat booklet giving full particulars and prices of a useful range of cabinets of modern design suitable for receivers and radiograms. Constructed of either walnut, oak, or mahogany, and French polished, the receiver cabinets range in price from 15s. to 25s. The 1934 Adaptagram is a splendid example of the cabinet-maker's art. The design is carried out in a striking manner, a decorative finish being added by contrasting walnut inlaid veneer panels, and dark-finish legs. This is an ideal cabinet for converting an existing set to a radiogram, and it is available with motor-board ready for the gramo. fittings. The price of the cabinet is only £3 3s. 0d. Something new in radio furniture is the De Luxe Twin Cabinet, which Peto-Scott have designed for separately housing the receiver and loud-speaker. It is actually two cabinets, the loud-speaker portion being placed on top of the portion containing the set, the combination making an attractive table consolette. The price of the pair of cabinets is 45s., or each portion can be obtained separately. Particulars and prices of Metaplex, the new metallized baseboard, are also given in the booklet, which all constructors are advised to get. The address is 77, City Road, London, E.C.1.

CLIX

THE importance of good contact cannot be over estimated, as a large number of reception troubles are directly traceable to faulty connections in the set, battery, or accumulator. Constructors desirous of having perfect contact in the wiring connections of their sets would do well to peruse a copy of a neat folder, entitled "A Matter of Connection," which has just been issued by Lectro Linx Ltd. A useful range of the popular Clix fittings is shown, including plugs and sockets, chassis-mounting strips, and valve-holders for chassis mounting fitted with terminals. Amongst these are the new "Airsprung" and floating models.

Another new Clix fitting is a wall plug which provides a solution to the troublesome problem of faulty plugs. These new plugs are non-collapsible, and will return to their setting after they have been inserted, any number of times, in the smallest possible socket. The wire grip is specially arranged to eliminate all strain at the contact point, and the lead wires are firmly gripped in a vice-like contact, dispensing with the usual screw contact-grip. The range of Clix wall plugs include vertical side entry, and earthing-pin models in all B.E.S.A. amp. ratings. The price of a 5 amp. plug is only 9d., and full particulars are given in a leaflet, a copy of which can be obtained from Lectro Linx, Ltd., 79a, Rochester Row, Westminster, London, S.W.1.

Replies to Broadcast Queries

UNO (W.9): (1) G5CU, J. Cuthbertson, 2, Leamington Grove, Park Estate, Ormesby, Marton-in-Cleveland, Yorkshire; (2) F8XU (C ?) Fantangier, Villa Jean, Avenue des Ormeaux, Cahors (Lot) France; (3) F3DC, Regret, cannot trace; (4) G5ST, Dr. R. T. Morrison, "East Green," Kilmacolm, Renfrewshire; (5) G5BT, C. W. Crook, 67, Tunstall Road, Croydon, Surrey; (6) F8YR, Beaujeu, 85, rue Sadi-Carnot, Armentieres (Nord), France; (7) G5TX, W. G. Sherratt, 11, Bath Road, Cowes, Isle of Wight; (8) Regret, cannot trace. CHICKEN (Gordon): Athlone advertised Accordion and Fiddle solos at that time; duets may have been included. TALER DE DANSKE (Aberdeen): G5GR, L. W. Gardner, 40, Medina Road, Coventry, Warwickshire; G2LU, Alderman's Green, Coventry; G5OD, R. Bates, "Holmside," St. Catherines, Lincoln; G2QH, C. Hewins, "Sunnyside," Fairfield Avenue, Scarthoe, Grimsby, Lincolnshire,; G6AK, T. S. Brister, 22, Sherbairn Street, Cleethorpes, Lincolnshire; G2NU, A. J. Hall, 33, Hazelbrouck Gardens, New North Road, Hainault, Ilford, Essex. Regret, cannot trace G6UA. PAO1V (U ?), J. H. Verhave, Hoofdweg 10, Amsterdam (W.), Holland; PAO5A, call apparently wrong; regret, cannot trace. The Belgian transmitter you heard was apparently ON4CB, A. Depuydt, 10, rue d'Anvers, Ostend, Belgium. The short-wave Norwegian station at Jeloy (near Oslo) works on 42.86 metres (7,000 kc/s.). SOUND SYSTEM (Yorks): Regret, but cannot trace on that wavelength; possibly HVJ, Vatican on 19.84 m. (15,120 kc/s.). MICKY (Llandudno): (*a*) Amateur transmitter, but regret cannot trace call sign, (*b*) Ship-shore telephony, but cannot trace without call sign. NEWONE (Hull): We can trace the following call signs: G5CU, J. Cuthbertson, 2, Leamington Grove, Park Estate, Ormesby, Marton-in-Cleveland, Yorkshire; G5OG, C. I. Orr-Ewing, "Poud Cottage," Weald, Sevenoaks, Kent; G6RL, R. F. Loomes, 14, Nursery Close, Wickham Road, Shirley, Croydon, Surrey; G6MF, M. H. Munroe, 1, Paisley Avenue, Edinburgh, Scotland; G2GF, P. E. A. Griffiths, 12, Glencoe Mansions, Chapel Street, Brixton, London, S.W.9; G2KM, C. Stainton, 37, New Bridge Road, Hull, Yorkshire; G6LI, A. E. Livesey, Stourton Hall, Horncastle, Lincolnshire. TWIDLEKNOB (Letchworth): WEA, 28.27 m. (10,612 kc/s.) and WEM, 40.54 m. (7,400 kc/s.), Radio Corporation of America, Rocky Point, New York, U.S.A.

"Fifty Tested Wireless Circuits," by F. J. Camm, 2/6, or 2/10 by post from Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.

Stop Press News

BELLING-LEE PRICE INCREASES

CERTAIN items of Belling-Lee manufacture have had to be raised in price owing to the increased cost of raw materials. The Type "R" terminals are increased from 2½d. to 3d. each, and the Banana Plug, which used to cost 2d., is now 2½d. The Banana Plug and Socket, which formerly cost 4d., will now be 4½d., whilst one shilling has had to be added to the cost of the Disturbance Suppressor, making this article now 10s. 6d. We trust readers will make a suitable note in their catalogues, etc.

INCREASED OUTPUT OF MULLARD RECTIFIER

THE Mullard Rectifier, type D.W.6, was originally rated to deliver an output of 120 mA. at 1,000 volts. The design of this valve has now undergone a slight modification, with the result that it has been improved. Its output now rates at 150 mA. at the same voltage, whilst the filament rating remains unchanged at 4 volts 4 amps.

WILKINS AND WRIGHT, LONDON ADDRESS

UTILITY products (manufactured by Messrs. Wilkins and Wright) may now be obtained from this firm's London office, 11, Newman Street, Oxford Street, London, W.1. Telephone: Museum 6616. A full display of their numerous electrical, radio and general brassfoundry products may be seen in the showrooms there.

THE ORBIT

(Continued from page 249)

that every single point of interest had been dealt with. But that is not so; this new receiver is meant to be constructed by thousands and thousands of wireless amateurs throughout the country—by engineer and parson; electrician and market gardener; builder and bank clerk; joiner and chemist; butcher and baker—in short, by every person who is interested in the practical side of the world's greatest hobby. Because of this I have devised and patented an idea which supersedes the well-known blue-print. This sounds revolutionary, and it *is*, but it is a most practical and infallible development which removes the last trace of difficulty or ambiguity from the task of building a reliable wireless set. I refer to the PRACTICAL WIRELESS "Transfer Print" (Provisional Patent No. 24584/33), which, as the name implies, is a combination of the ordinary blue-print with a transfer. Every component and every wire and connecting point is clearly marked on the "Transfer Print," so that it is only necessary to place the transfer over the chassis, apply a warm flat iron, when every detail of construction is clearly transferred to the chassis. The immense value of this idea cannot be over-estimated. It reduces the task of mounting the components to one of utter simplicity and perfect accuracy, and since every wire is shown on the chassis the wiring can be carried out in a fraction of the time normally taken, and without any chance of mistake. The whole system is infallible—so much so in fact that you will marvel when you first take the opportunity of trying it for yourself.

These extraordinary "Transfer Prints" are more costly than ordinary blue-prints, but so pleased am I with the idea, and so anxious that every one of my readers should try it, that a FREE print will be presented to every purchaser of PRACTICAL WIRELESS dated November 4th.

You have not yet been told the name of the new set—it is the "ORBIT." You will be given further details next week.

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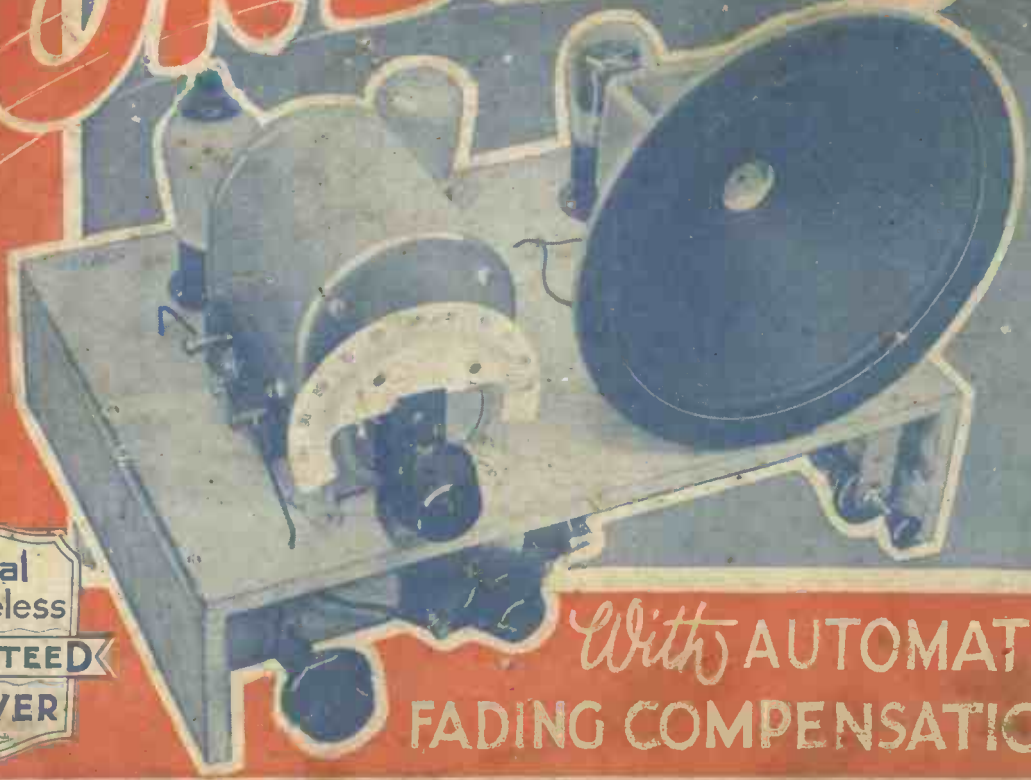

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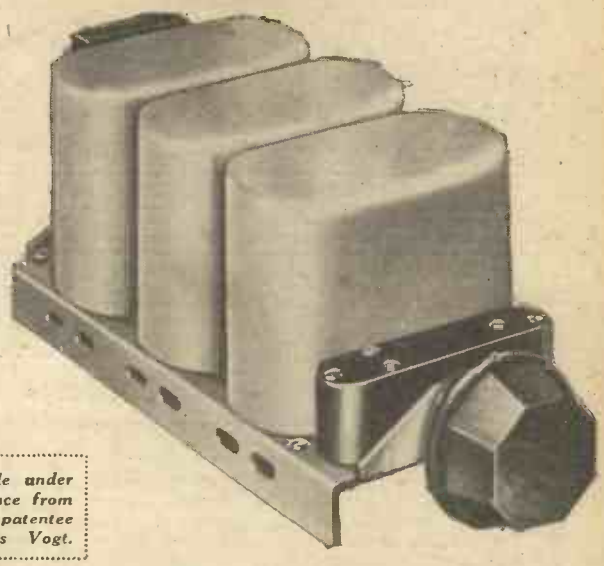

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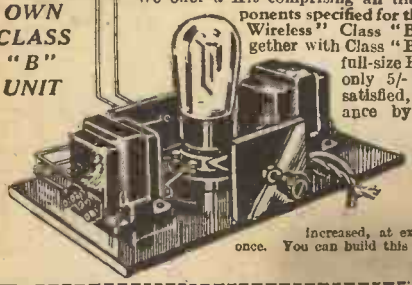

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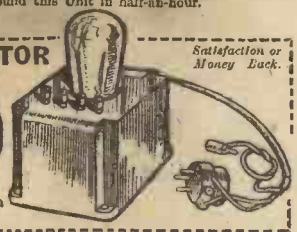

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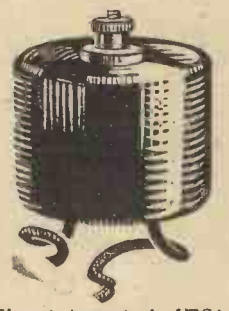

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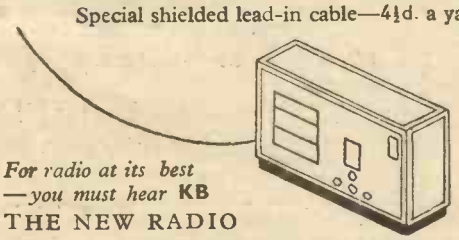

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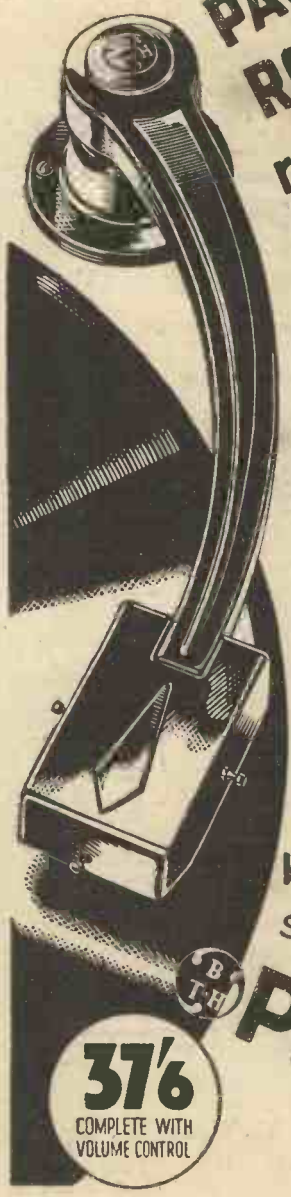

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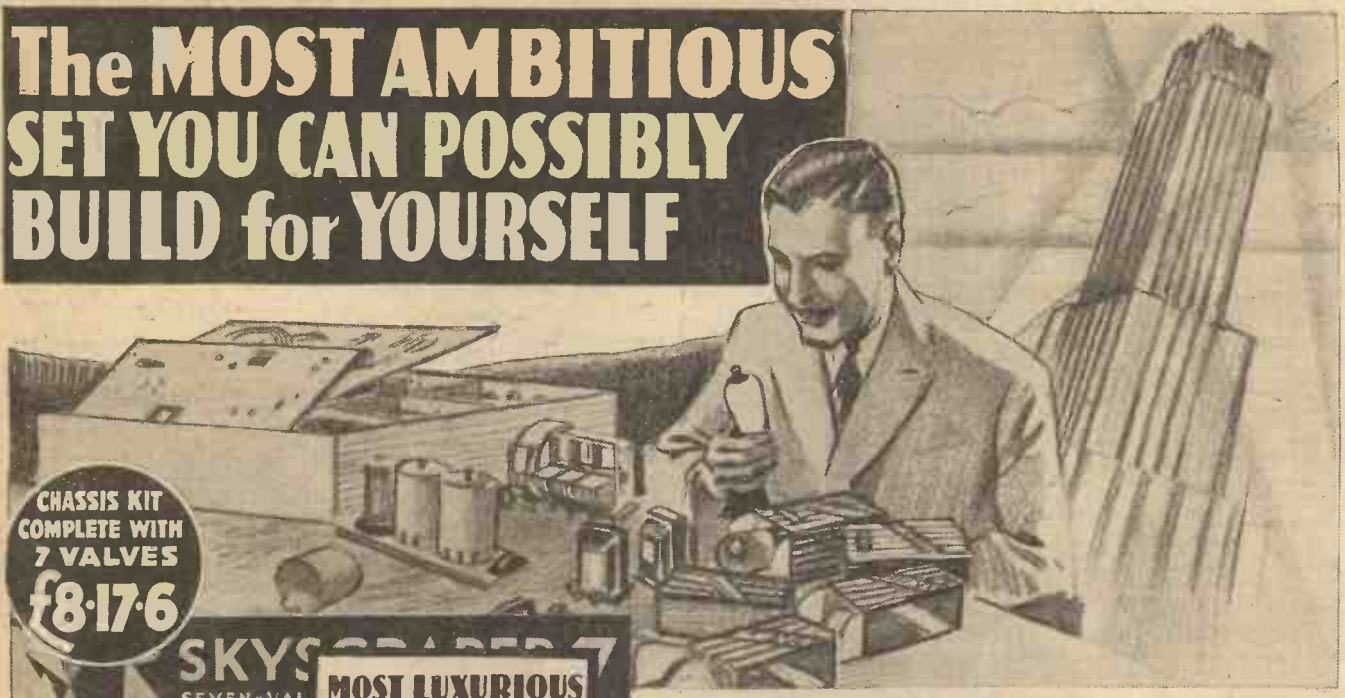

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Never before has there been any receiver for Home Constructors on such an ambitious scale as this new Lissen "Skyscraper" Seven Valve Superhet. It embodies every up-to-the-minute advance and refinement of the most luxurious factory-built superhets—it gives the constructor the opportunity to build a £20 receiver for less than half that price. The circuit of the Lissen "Skyscraper" Seven Valve Superhet incorporates a 6-stage bandpass filter giving exact 9-kilocycle channels and therefore providing a standard of selectivity never before achieved by a home constructor's kit set and very rarely found except in laboratory apparatus. Amplified Automatic Volume Control is provided, a special valve for this purpose having been produced by Lissen for use in this receiver. The use of this Amplified Automatic Volume Control constitutes an entirely new experience in listening ; no "fading," no "blasting"—you will find yourself enjoying every word of every programme, however near or however distant, without the slightest temptation to interfere with the receiver once you have tuned it. This is radio listening as it should be enjoyed ! Lissen Class "B" Output through a new full-power Lissen Moving-Coil Loudspeaker—glorious rich tone and majestic volume, actually more faultless in its reproduction than anything you ever heard from even the most powerful mains receivers yet working economically in this Lissen "Skyscraper" from H.T. batteries.

Lissen have published for this great new "Skyscraper" Seven Valve Superhet a most luxurious Chart which gives more detailed instructions and more lavish illustrations than have ever before been put into a constructional chart. It makes success certain for everybody who decides to build this set ; it shows everybody, even without previous constructional experience, how they can have a luxury receiver and save pounds by building it themselves. A copy of this Chart will be sent FREE in return for coupon on the left, or your radio dealer can supply you. Get your FREE CHART now !

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"SKYSCRAPER" 7
SEVEN VALVE SUPERHET

THE JOURNAL WITH ORIGINAL IDEAS!

ROUND *the* WORLD *of* WIRELESS

The Orbit—Mr. F. J. Camm's Latest Success

LAST week we made a preliminary announcement concerning THE ORBIT, the latest receiver designed by Mr. F. J. Camm. As then explained, this unique receiver, FOR WHICH OUR NEW PATENTED TRANSFER PRINT WIRING DIAGRAM WILL BE GIVEN NEXT WEEK, employs a simple device for AUTOMATIC FADING COMPENSATION. Readers will agree that fading is the bugbear to the reception of distant foreign programmes, and early in the history of this paper our correspondence indicated that this was a problem to which all too little attention had been given in-so-far as the home constructor is concerned. Mr. F. J. Camm therefore decided that this was a problem his readers would expect him to tackle, and for the past months he has been busy designing a set of which the Orbit is the outcome. This receiver, although employing only three valves, gives readers for the first time all of the advantages formerly only associated with the most expensive multi-valve receivers. The transfer print is *another* new PRACTICAL WIRELESS idea which will enable the receiver to be built in a simpler manner than ever before. Order your copy of next week's issue containing the free gift transfer print wiring diagram to-day!

THE ORBIT

F. J. Camm's stunningly successful and latest receiver, employing an ingenious device for

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Some Chance for Lucerne!

WAVE plans, such as those drawn up in the past at Geneva, Prague, Brussels, and more recently at Lucerne, are subject to the sanction of the various European Governments interested in the scheme. They are based on decisions taken at the International Radio Telephony Conventions. That it takes some time before they are officially adopted is proved by the fact that the decree ratifying findings of the 1927 Washington Convention was only passed on August 30th, 1933, a matter of some six years! In the meantime another International Conference took place at Madrid in 1932!

Radio Bari and Albania

AT times when tuning in a broadcast from the station at Bari (Italy) you may be puzzled by the fact that the language heard is different from that picked up from Rome, Naples, or one of the other Italian transmitters. Bari, which lies on the borders of the Adriatic, is the station best heard in the Republic of Albania, and for this reason the station broadcasts every day special programmes destined to that little country. For these the Albanian tongue is used.

High Power for Belgrade

SO far the main station in Jugo-Slavia has been limited in power to 2.5 kilowatts, but a new transmitter is now being built at Makis, in the immediate vicinity of the Capital. As it may eventually work on an exclusive channel—437.3 m. (686 kcs.)—up to 100 kilowatts would be allowed. It is hardly likely that more than half this energy will be found necessary to give good service. Three other relays are also being installed at Skoplje (476.9 metres) for the district of Macedonia, at Subotica or Sombor (230.2 metres) in the Voivodin, and at Serajevo in Bosnia. The Belgrade high-power station will be testing in the early part of 1934.

Gramophone Record Broadcasts

ACCORDING to recent statistics, the Dutch stations include more broadcasts of this nature in their programmes than any other European studios. Belgium follows as second best, and France occupies the third position. In Switzerland, of one hundred hours of transmission carried out by Sottens and Beromünster, only twenty-three were devoted to "canned" music.

Cologne, Frankfurt and Stuttgart on S.B.

IN order to effect drastic economies in both staff and programme material, the Cologne, Frankfurt, and Stuttgart studios have amalgamated to form one group. Wireless entertainments simultaneously broadcast through these three high-power stations will be announced as emanating from the *Sendergruppe West*.

Weather and Wireless Waves

THE reception of distant transmissions appears to vary considerably with the rise and fall of the barometer, although so far it has been difficult to establish any kind of meteorological table which can prove reliable. It is the experience of most listeners, however, that during rainy periods the medium-wave broadcasters are heard at their best and this applies also to most stations working on channels above 1,000 metres. As regards the entire wave-band, atmospherics seem to be most prevalent when the weather is *on the point of changing*. Such disturbances do not necessarily foretell a wet spell, as they will frequently mar the programmes on the eve of fine weather following a showery period. Falls of snow as well as heavy morning and night frosts may also be relied upon to spoil transmissions on all but neighbouring stations.

German Studios as Armed Camps

THROUGHOUT Germany to-day the studios are run on strictly military lines, and the staff is daily compelled to undergo physical training and army drill. Most of the employees of the old régime have been replaced by members of the Nazi party now in complete control of the entire broadcasting system. At most studios and stations the doorkeeper has had to make way for a sentry and an armed guard

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

Listen to the Argentine

IN view of the fact that a number of U.S.A. stations working on the medium waveband can now be heard after midnight with the average three-valve receiver, it is well worth while making a search for some of the Buenos Aires (Argentine Republic) transmitters. Radio Excelsior (LR5) may be found on almost the same setting as Muhlacker (361 metres); the reading for Radio Splendid (LR4) on 303 metres, approximating closely to that of Bordeaux P.T.T. The former may be easily identified by its interval signal of three musical notes. Other stations of which reception has been reported in the British Isles are Radio Fenix (LR9) on 291.3 metres; Radio Nacional (LR3) on 316 metres and LS1, Broadcasting Municipal on 423 metres. In most instances announcements are made in both Spanish and English.

New Spanish Broadcasting Station

A SMALL transmitter has been installed at Palma de Mallorca, the capital of Majorca (Balearic Isles), and a popular port of call with Mediterranean cruises. The station is privately owned and broadcasts daily. The wavelength is a provisional one, as it is feared that reception of the programmes may be marred by harmonics of the Guadaljara wireless telegraphy station. Palma is roughly one hundred and thirty miles south-east of Barcelona.

New Portuguese Station

IT is reported from Spain that the *Diario de Noticias*, a prominent daily newspaper at Lisbon, is financing a scheme for the installation of a small broadcasting station at Oporto. Publicity and sponsored concerts will be a feature of the programmes. It is stated that the step taken will only be a temporary one, and that the transmitter will be transferred to another district when Oporto gets its official station under the new Government scheme.

Spain's New Wavelengths

FROM January 15th, 1934, many alterations will be made in the wavelengths of the broadcasting stations now worked by Union Radio, Madrid EAJ7 will operate on 293.5 metres (1,022 kcs.); Barcelona (EAJ1) on 274 metres (1,095 kcs.); Valencia 352.9 metres (850 kcs.); Seville 410.4 metres (731 kcs.) and San Sebastian (EAJ8) on 238.5 metres (1,258 kcs.). The channel on the longer wave band of 1,639 metres (183 kcs.) is being reserved for the Madrid high-power transmitter which the authorities intend to erect near the Spanish capital. Further stations to be installed are: Coruna (Santiago) on 377.4 metres (795 kcs.) and a few smaller relays which must use 207.3 metres (1,447 kcs.). Barcelona (*Asociacion*) EAJ15, which may be heard nightly on 252 metres, is a privately owned concern, and in consequence will either have to close down or declare itself satisfied with this latter wavelength (207.3 metres) allotted to Spain as an "onde commune" for transmitters not exceeding a power of 5 kilowatts.

INTERESTING and TOPICAL PARAGRAPHS

Changes in German Broadcasting System

MORE relay stations are to be placed on common wavelengths in order to free channels. In January the Stettin and Magdeburg transmitters will be transferred to the Hamburg group to operate on a wavelength common to Hanover and Flensburg. The power of the latter station will be raised to 1½ kilowatts, as will that of Stettin. In view of the better service expected when these alterations are completed, it is proposed to close down the Kiel and Berlin (2) relays.

Another Station for Spain

IT is reported that an old transmitter at Bilbao has been overhauled and that it will be shortly testing on 203 metres.

Japan's Loud-speaker

THE high-power station which the Japanese authorities intend to use for propaganda purposes is in course of construction at Kurume, on the Island of Kyushu. The station will be linked by cable to Nagasaki.

Resumption of Polish S.W. Broadcasts

THE Poznan short-wave station (SR1) which closed down some weeks ago for reconstruction, has now resumed its broadcasts on 31.6 metres. Provisionally tests will be carried out every Tuesday and Thursday at 5.30 p.m. G.M.T., but the time schedule is subject to revision within the next week or so, as the short-wave programmes will be considerably enlarged.

Penny in the Slot Radio

A FIRM has recently launched on the German market an automatic receiver which functions when a ten *pfennige* coin (at par, one penny) has been inserted in a special slot. For this amount the set can be used for one hour, after which it switches itself off. On payment of a small deposit householders may have the receiver installed, and at fixed periods agents collect the money. The sums thus obtained are placed to the credit of the purchaser who by this means is permitted to buy a set on the easy payment system.

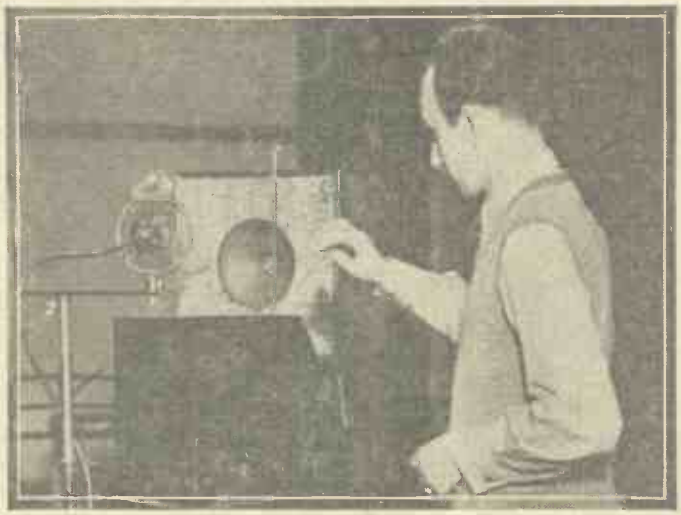
Monthly Instalments Defeat Radio Pirates

IN Germany, Poland, and several other small Continental states, the wireless listener's licence may be paid in monthly instalments, and it is due to this fact that statistics show a monthly increase or fall according to the season of the year. On the other hand, the method has proved an advantage to the authorities, inasmuch as the postmen entrusted with the collection of the fees also act as radio spies, and calling from house to house are thus able to give information in respect to unlicensed wireless pirates.

Crystal Receivers in France.

UNTIL the new law was passed in France, as licences were not compulsory, the authorities could not establish the number of wireless listeners in the country. On August 15th last 1,400,000 owners had declared possession of radio receivers, and much to the astonishment of officials this figure included 300,000 primitive crystal sets. Of the total number of registrations roughly thirty-four per cent. emanated from the Paris district.

MUSIC FROM THE AIR



"His Master's Voice" have just issued the first records made by Martin Taubmann on the new Electronde instrument. He is seen recording four popular numbers at the H.M.V. studios. The musical notes from the Electronde are produced by moving the right hand to and fro from the upright rod. By pressing a switch held in the left hand the tone can be interrupted and the volume varied by pressing a pedal with one foot. The instrument has a nine octave range.

SOLVE THIS!

Problem No. 58.

Whilst passing one of the numerous London wireless stores, Bradbury saw a number of superheterodyne components for sale very cheap, and decided that he would build up one of the modern receivers. He accordingly purchased all the parts which he himself had not got and proceeded to construct a receiver on the lines of the Luxus A.C. Superhet. When finished, results were very disappointing indeed, the volume on the local not being sufficient to operate the speaker. Wiring was checked, and all parts were examined by a radio expert. Not a single component or valve was defective, all wiring was correct, the circuit was accurately copied, and all voltages and currents were measured and found accurate. Why did the receiver fail to function? Three books will be awarded for the first three correct solutions opened. Mark your envelopes Problem No. 58, and address to The Editor, PRACTICAL WIRELESS, Geo. Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2. Post to reach here not later than Nov. 5th.

SOLUTION TO PROBLEM No. 57.

The receiver which Parker purchased was not intended for use with a frame aerial and, therefore, was fitted with a tuning coil in the first grid circuit. When he joined the frame aerial he was connecting this in parallel with the first coil, and this resulted in the flat tuning and the lack of directional properties.

The following three readers gave correct solutions to Problem No. 56, and books have, therefore, been forwarded to them: J. E. Knowles, 112, Newbridge Lane, Stockport; J. L. Hitchman, 16, Prospect Hill, Walthamstow, E.17; G. H. Leighton, 85, Garibaldi Street, Grimsby, Lincs.

MOTOR-BOATING

Its Causes and Cure

A Practical Article Explaining the Remedies and Principles Involved.

By "LAMBDA"

HERE is a little experiment for you to try. If you have a low-frequency transformer in your receiver of the very inexpensive type, take it out and beg or borrow a really first-class low-frequency transformer; one giving straight line amplification down to about 50 cycles, and fit it in place of the transformer removed from your set. If your receiver is not very well decoupled it is quite possible that the set will commence motor boating. Here we have placed a really first-class low-frequency transformer in our set to improve the quality of reception and the net result—motor-boating. Absurd! you say. Not a bit of it! Quite feasible. Read on and you will see the reason.

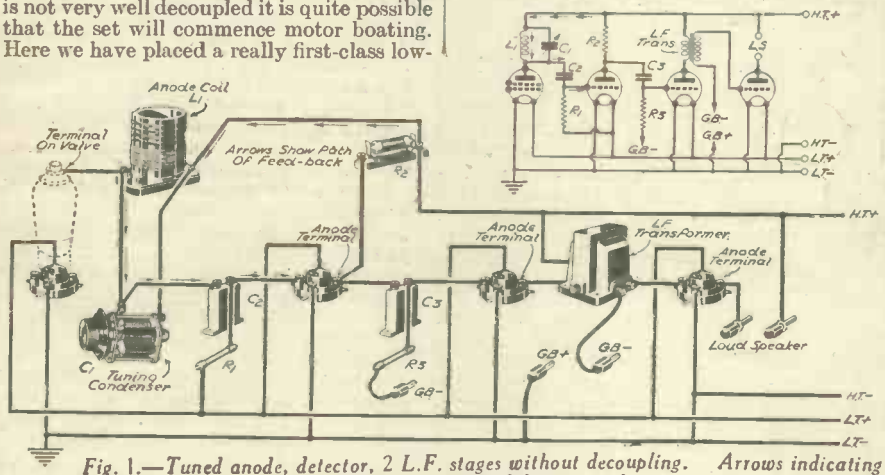


Fig. 1.—Tuned anode, detector, 2 L.F. stages without decoupling. Arrows indicating path of feed-back to grid of detector valve.

Causes of Motor-boating

Before solving this very interesting problem let us get down to the root of things, and see why motor boating occurs. It is not unknown, even in receivers which have been functioning quite satisfactorily for some time. If we can find the reason for this peculiar trouble, it will be easier to find a remedy, and so avoid a similar difficulty in the future. It is, of course, unnecessary to describe what happens when a set commences motor-boating. We are all familiar with it, and recognize quite easily that annoying tut, tut, tut, emitted by the loud-speaker, reminiscent of the noise of the engine in a motor-boat. Motor-boating has a tendency to attack battery receivers in particular, although sets deriving their power from the mains are not immune from it, so take heed. It is rather prevalent in the detector, low-frequency type of receiver, developing in many cases some time after the receiver has been in operation. You know what happens. Your new set functions quite satisfactorily for a month or so, and eventually motor-boating develops. Why?

The majority of battery sets are fed from a common source of high-tension supply. Dry batteries always possess resistance, and after being in use for some time this resistance increases. When new, the internal resistance of a large dry cell H.T. battery may be about 0.2 to 0.3 ohms per cell. As the battery is used, however, this resistance increases until it may reach as much as 5 ohms per cell.

Let us take, as an example, a standard H.T. battery of 120 volts. When new, its internal resistance might be 24 ohms, and after a few months use, although still capable of delivering current, its internal resistance would have risen to perhaps 500 ohms. When high-frequency currents are permitted to reach the high-tension battery, undesirable internal feed-back effects are likely to occur when the battery voltage rises above a certain value. Back coupling will be produced if the source of H.T. supply has a resistance common to the anodes of all the valves. If A.C. potentials are developed across the resistance of the H.T. battery these will be fed back to the grids of the valves, re-amplified, and eventually will cause the set to motor-boat. Sometimes, owing to a reversal of the feed-back, amplification may be reduced and distortion arise, although motor-boating may not be heard. Receivers employing resistance-capacity coupled stages are particularly susceptible to low-frequency instability, and may oscillate before the battery resistance has risen to any great extent.

If fluctuating potentials be set up in the anode circuit of the last valve, and then passed through a resistance a fluctuating potential will be set up across it, the value of the potential developed increasing as the value of the resistance increases. Coupling between the various components in the low-frequency stage of a receiver will sometimes cause motor boating, but this is not so serious as the other cause mentioned. Sometimes when two transformer coupled stages are employed, trouble occurs, particularly if the amplifier is operating very efficiently.

Battery coupling manifests itself by reproduction becoming woolly, the tone being deep and muffled. This effect is due to the impedance of a common H.T. supply which distorts the frequency characteristic to some extent.

Remedies

In considering the remedies to be applied, look at the circuit diagram shown in Fig. 1. Here is a simple tuned anode, screen-grid H.F. stage receiver, with detector and two low-frequency stages, resistance capacity and transformer coupled respectively. This circuit is absolutely devoid of any frills, and all the anodes of the valves are connected to the common H.T. supply. In its present form, this circuit is ideal for producing motor-boating, no effort having been made to divert the fluctuating potentials from developing across the battery resistance.

The Output Stage

We will assume that you have just completed the construction of a receiver based on this circuit diagram. At the present moment the loud-speaker connected to it is emitting a noise like that of a speed-

(Continued overleaf)

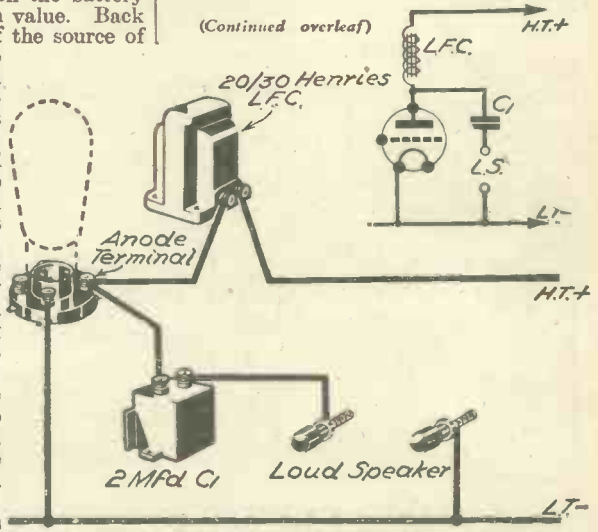


Fig. 2.—Choke filter output circuit.

(Continued from previous page)

boat. How are we going to get rid of this trouble, and where shall we begin? Our job is to prevent the fluctuating currents produced by the signal from passing through the H.T. supply, for then there will be no voltages built up across the supply by the signal. We will commence with the output circuit, because the output valve produces the largest fluctuating signal. In Fig. 2 the output circuit is shown with the remedies applied. First of all, we have fitted a low-frequency choke in the anode circuit of the power valve, then joined the loud-speaker to the anode of this valve, but with a 2 mfd. condenser interposed between them.

Owing to the action of a choke in retarding the flow of alternating current through it, these currents will not pass through the power supply. The impedance of the choke is high in comparison with the impedance of the 2 mfd. condenser, which will, therefore, offer an easy path, *via* the loud-speaker, for the fluctuating currents to earth.

In actual practice it is extremely unlikely that you will ever have to deal with such a bad case as that of the circuit under discussion, but it serves to illustrate the principles involved. In this instance, therefore, it is very doubtful if our output filter will have the desired effect of eliminating the motor-boating to any appreciable extent, so we pass on to the two low-frequency stages.

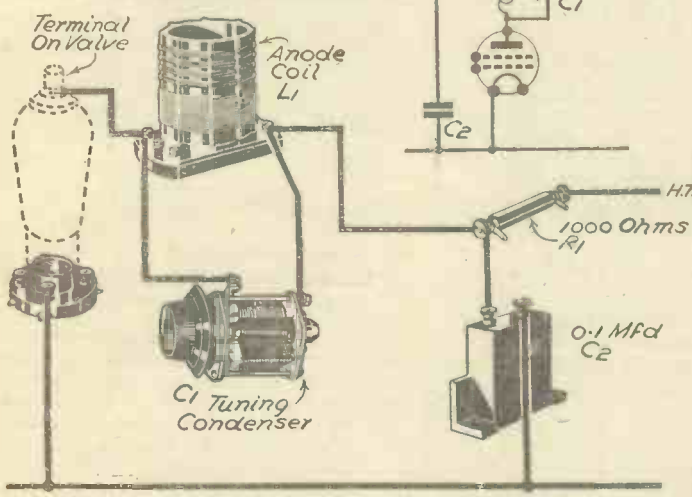


Fig. 4.—Decoupling the tuned-anode circuit.

The low-frequency stages

In Fig. 3 we have reproduced the two low-frequency stages as in the previous instance, with the suggested cures applied. Notice the 20,000 ohm resistance connected in series with the primary of the low-frequency transformer which is then connected to the anode of the L.F. valve, also the 2 mfd. condenser connected to earth. As in the case of the output stage, the condenser offers a relatively low impedance to fluctuating currents, the resistance offering a high impedance, therefore they take the path of least resistance.

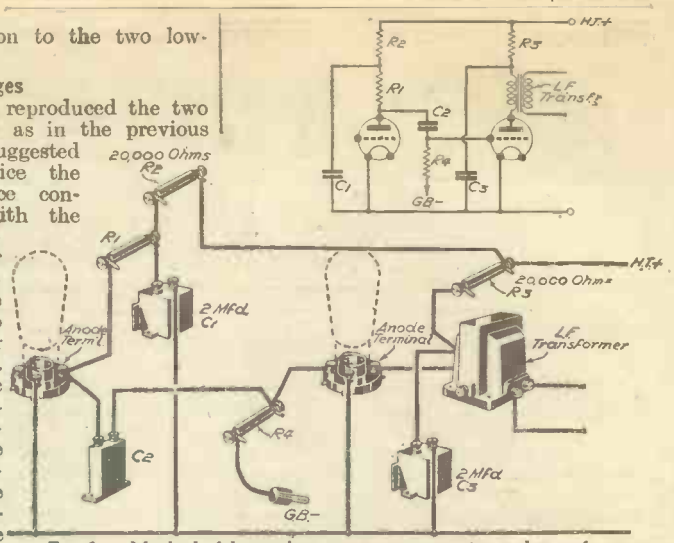


Fig. 3.—Method of decoupling resistance capacity and transformer-coupled low-frequency stages.

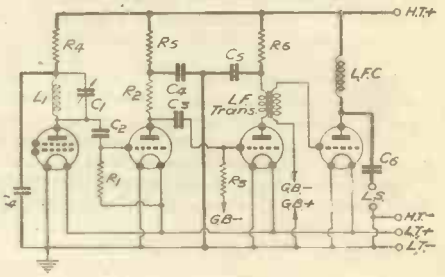
At a frequency of 50 cycles the condenser would have an impedance of only 1,600 ohms, which is very much lower than the 20,000 ohm resistance. For effective decoupling the value of the resistance is the lowest that can be effectively employed. If a lower value of resistance be used it will be necessary to increase the value of the condenser to 4 mfd.

The cost of a larger capacity condenser is considerably more in proportion than that of a resistance of higher ohmic value, therefore the former method is to be preferred. It is not advisable to increase the value of the resistance too much owing to the drop in H.T. voltage across it which will necessitate the employment of higher voltages, if adequate potential is to be applied to the anodes of the valves. The same methods are applicable to the resistance-capacity coupled circuit.

Once again we assume that all the remedies have failed, and as a last resource we tackle the high-frequency stage. Here you will observe tuned-anode coupling is employed. With this method of H.F. coupling trouble is more likely to be encountered than with either high-frequency transformer or tuned grid coupling, the reason being that the voltages developed across the relatively high internal resistance of the battery or H.T. eliminator can be passed back fairly easily by way of the tuned anode coil and grid condenser. The anode circuit should be decoupled, and it is worth while trying a smaller capacity grid condenser, say, 0.0001 mfd.

In this case such high resistance and

(Continued on page 294)



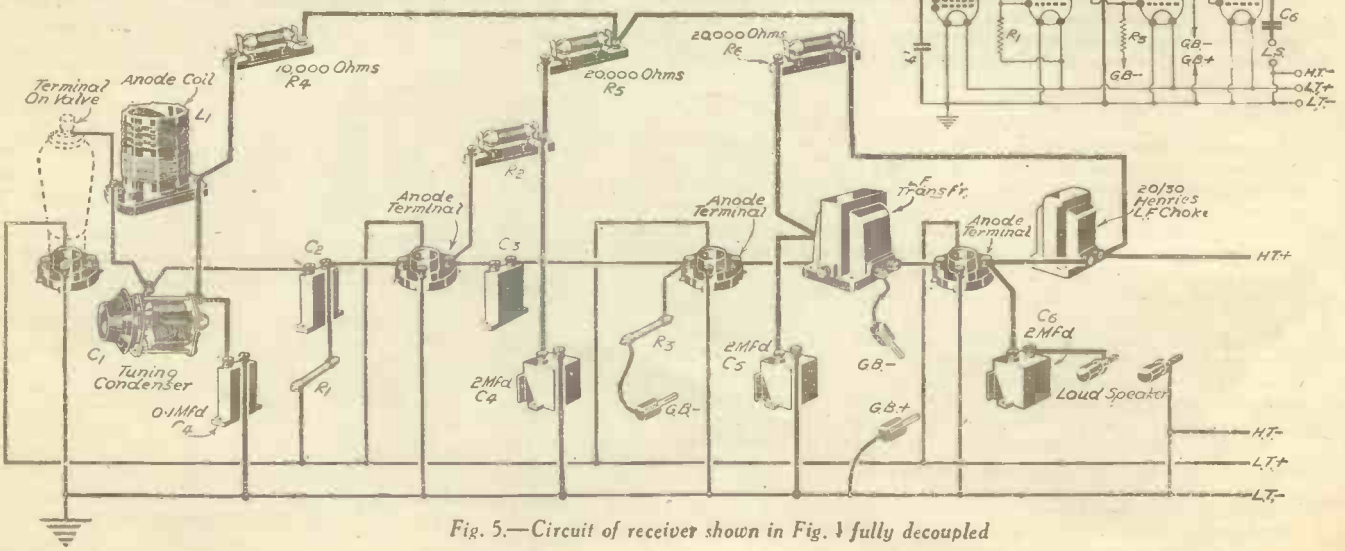


Fig. 5.—Circuit of receiver shown in Fig. 4 fully decoupled

VOLTAGE DROPPING—Simply Explained

Describing the Method of Calculation, and Giving Various Examples

By P. N. BONE

THIS article is written mainly because the writer has come across so many people who seem unable to understand the method of calculating the correct value of a resistance to be used in the plate circuit of a valve in order to provide the correct voltage at the anode or plate.

It may be that they come across a formula involving the use of a little mathematics, however simple, and they immediately turn to the next page and commence reading another article. For this reason no actual mathematics with mathematical signs will be given in this article, but all formulæ will be quoted in factors which should not present any difficulties, even to the veriest amateur.

It has never been the writer's policy, however, merely to quote bare formulæ, rather has he endeavoured to get the reader to *understand the meaning* of the formulæ, and for that reason the first portion of this article will be devoted to a simple explanation of a law without which calculations in practically every section of radio-telegraphy would be much more involved than they actually are.

After certain experiments extending over a considerable period of years, Professor Georg Simon Ohm formulated a law—now commonly known as Ohm's law—which even up to the present day has never been disproved; rather has its accuracy been more assured. This learned gentleman made the statement that if a specified voltage was placed across the ends of a known resistance, then a certain current would flow, according to the value of the resistance and the voltage placed across it (Fig. 1). Trouble is experienced sometimes when symbols are used for this and other formulæ, and therefore, as previously mentioned, symbols will not be used in quoting these formulæ.

Simple Formulæ

Putting Ohm's law into a simple form, we therefore obtain :—

Formula 1. $\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$

As an example, suppose that 4 volts is placed across a resistance of 2 ohms, then the current will be (4 ÷ 2) 2 amperes. The ampere is, of course, the unit of current, and similarly, resistances are usually quoted in ohms.

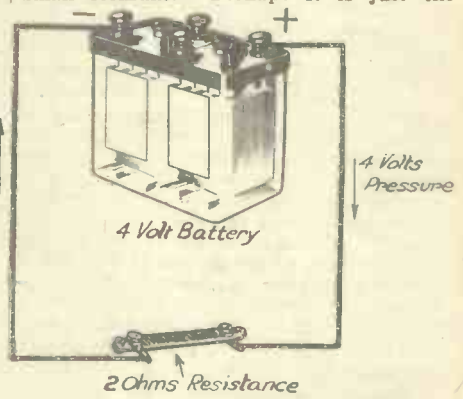


Fig. 1.—This sketch illustrates the principle of Ohm's law.

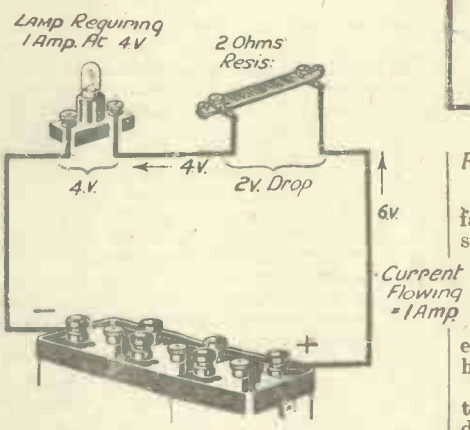


Fig. 2.—Showing how a resistance may be connected to produce a voltage drop.

This formula can now be changed into another form, or, as the mathematicians like to put it, "transposed," and we then obtain :—

Formula 2. $\text{Resistance} = \frac{\text{Voltage}}{\text{Current}}$

Taking the same example as before, suppose we have a voltage of 4 across a circuit in which the current flowing is 2 amperes, then the resistance will be (42) ÷ 2 ohms.

Again transposing, we get :—

Formula 3.

Voltage = Current × Resistance.

Calculating with the same example as before, if we have a current of 2 amperes and a resistance of 2 ohms, then the voltage necessary to provide that current must be (2 × 2) 4 volts. (Fig. 2.).

Simple really, isn't it? And yet so much trouble is encountered over these three small formulæ. Perhaps it is just the fact that they are so often quoted with symbols instead of the more common factors used in this article that causes people to fail to grasp them. They are, of course, the basis of all resistance and current problems, and if only these three equations are understood, this article will have served its purpose.

To proceed with the actual portent of this article—an explanation of voltage dropping—it is necessary to revert to Formula 1, which said that if a certain voltage was present across the ends of a resistor, then a specified current would flow. Putting this conversely then, if a specified current is flowing through a resistor, then a certain voltage must be present across the ends. Going one step farther, if a circuit consumes a less current than the voltage could actually supply then there would still be a voltage across the ends of the resistor—although a smaller voltage than the actual voltage across the whole circuit—*and it is the voltage actually across the ends of the resistor which is dropped.* The surplus voltage, and that which we actually require, is that remaining after a certain amount has been used to provide the necessary current through the circuit. It is quite simple, and yet many people miss the point just by not having a working knowledge of Ohm's law.

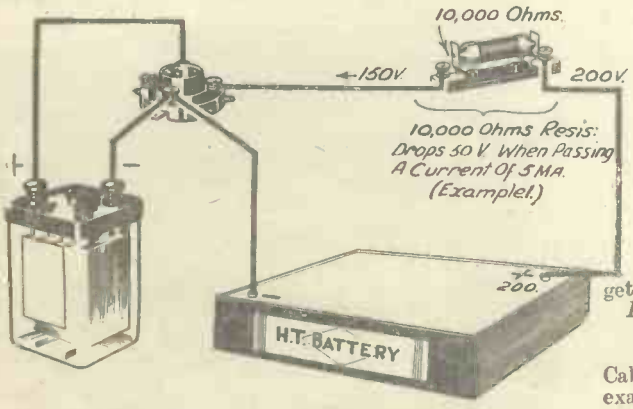


Fig. 3.—Here you see how the anode voltage of a valve may be reduced by inserting a fixed resistance in circuit.

Some Practical Examples

Let us proceed with the calculations and examples. Using Formula 2 we could, theoretically, find any resistance value necessary, but one point must be noted before we do this. Seldom are currents so high as amperes used in radio circuits,

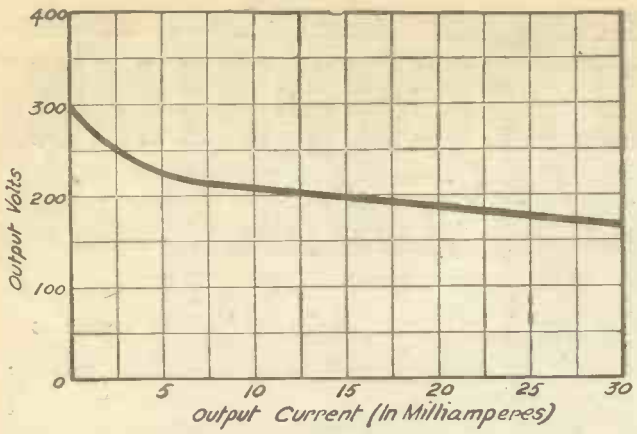


Fig. 4.—The above graph shows how the voltage output from an eliminator varies with the current drawn from it.

except, of course, in filament circuits, with which we are not at the moment concerned, although, of course, the same principles apply. We have, therefore, to make another formula to suit the need.

Currents used in radio are usually of the order of milliamperes. Now one milliampere is one-thousandth of one ampere. We can say, therefore, that 5 milliamperes is .005 of an ampere, or similarly, 50 milliamperes is .05 of an ampere. These fractions of an ampere could be used as the divisor in formula 2. It is much easier, however, to leave the divisor in milliamperes, and multiply the top line by 1,000. *This amounts to exactly the same thing.* We can therefore define:

Formula 4.

Resistance value =
Voltage to be dropped × 1,000
Current flowing in milliamperes.

This is the formula which we shall use throughout all our calculations, and really it is the only one that need actually be memorized, although the previous three will be found very useful in the understanding of the principles.

We can now go ahead with all speed and work some examples. (Fig. 3.)

Example 1.—Let us suppose that 200 volts high tension is available, and that one of the valves we have to supply requires 150 volts at 5 milliamperes. It is therefore obvious that we have to dispose of 50 volts (200—150), and by using Formula 4, we see that Resistance required=

$$\frac{50 \times 1,000}{5} = 10,000 \text{ ohms.}$$

Example 2.—In this case, the same high tension is available, but the valve only requires 150 volts at 2 milliamperes. Employing the same formula it is found that the Resistance required=

$$\frac{50 \times 1,000}{2} = 25,000 \text{ ohms.}$$

and so we can proceed with any type of valve to be used.

Eliminator Output.

One point, however, is worthy of separate note, and that is when an eliminator *current* is higher than the total current required by the set. For instance, suppose that a set consumes 10 milliamperes at 150 volts, and that the eliminator has an output of 200 volts at 20 milliamperes. In this instance it is quite useless to calculate the resistance for a voltage drop of 50, because, as we do not consume *all* the current supplied by the eliminator, the voltage of the eliminator would rise considerably and, therefore, render all our calculations useless.

It is necessary, therefore, to calculate the voltage to which the eliminator would rise, using only 10 milliamperes, and luckily most manufacturers publish curves of the output voltages of their eliminators at various currents, and if the eliminator is a home-made one, this can be ascertained from the components used.

Looking up one of these curves we find that, although the output of the eliminator is 200 volts at 15 milliamperes, the voltage rises to 220 volts at only 10 milliamperes. (Fig. 4.) This is quite a normal rise, and not by any means a special case quoted to suit the occasion.

We see, therefore, that we have to calculate for a voltage rise of 70, instead of the 50 as was at first probably thought. We find therefore that the Resistance required=

$$\frac{70 \times 1,000}{10} = 7,000 \text{ ohms.}$$

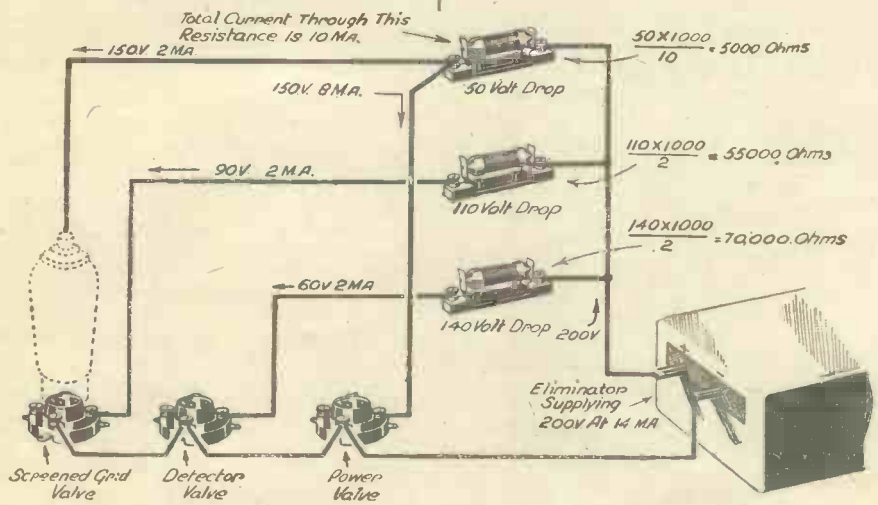


Fig. 5.—This illustrates the method of obtaining alternative anode voltages from an eliminator.

This would be right, of course, if only one resistance were used. Actually in practice it might be necessary to use three or four, in which case each required value would be worked out separately, and the method of doing so is shown in Fig. 5.

The total current taken by the valves is first ascertained and then the voltage given by the eliminator at this current is found from the curve. The values of the voltage dropping resistances are then worked out separately, using the output voltage obtained from the curve as a basis.

No trouble should now be experienced in any calculations of this kind. It is, of course, necessary to ensure that a correct wattage rating resistor is used for the required purpose. The method of ascertaining the correct wattage to be used is also quite simple, but it really requires to be dealt with separately. For that reason no explanation is dealt with here, but the writer hopes to do so in a later issue of this journal.

MOTOR-BOATING

(*Continued from page 292*)

capacity values are not necessary, as we are dealing with higher frequencies. Therefore, fit a 1,000-ohm resistance in series with the anode of the screen-grid valve and a bypass condenser of about 0.1 mfd. The bypass condenser should be of the mica dielectric type.

Now one or more of the remedies just described should be applied in each individual case, depending upon circumstances and the amount of decoupling already employed, and it should not be necessary to adopt them all. There are other remedies which, however, may be tried as a last resource. One is to arrange that any oscillations fed back are out of phase with the normal oscillation, thus producing a form of reverse reaction. This is quite a common remedy, and one which many constructors invariably use. It is carried out by reversing the connections to the primary or secondary of the low-frequency transformer. This remedy is not ideal, however, as it does not get down to the cause of the trouble. In many cases it so modifies the frequency characteristics of the low-frequency transformer that distortion is apparent. In some cases a whistle or howl which was previously audible is now converted into an oscillation above the limits of audibility and this will cause general distortion. In the foregoing remarks the examples have been taken assuming the employment of a dry H.T. battery, but motor-boating may occur when a high tension eliminator is employed, and the same remedies are applicable.

If a really first-class transformer be substituted for an inferior one the efficiency of the low-frequency amplifier will obviously be increased, and the low note response will be improved. Some of these low frequencies will be fed back to the detector stage, with the result that low-frequency oscillation will manifest itself, and the remedies outlined in this article should be applied.

The quality of reproduction of modern loud-speakers is considerably in advance of earlier types of speakers, many giving a much more even response to the range of frequencies transmitted, and they are also capable of increased reproduction of the lower frequencies. The accentuation of any frequency produced by back coupling is therefore much more apparent than previously.

This week you are told how to add reaction to the two-valve experimental receiver, and different methods of doing this are described so *that you can try and compare them yourself.*

By FRANK PRESTON, F.R.A.

IN the first article of this series, which was given last week, I suggested a few simple experiments that you could try in relation to selectivity. No doubt you have gone through all these and learned a good deal about the simplest methods of making a receiver able to reject unwanted transmissions. You will also have found that some methods of sharpening the tuning cause a loss in signal strength, whilst others do not have this effect. It all depends upon the aerial-earth system in use, and quite often it so happens that by making a careful choice of both the coil tapping and the capacity of the pre-set series aerial condenser a combination can be found which gives not only more selectivity, but also louder signals.

The Results of My Selectivity Experiments

Perhaps it will help you if I briefly describe the results that I obtained from the experiments that were described. In the first place, however, I must state that I used a 30ft. indoor aerial situated some eleven miles from Brookmans Park, and a long earth lead taken to a water pipe. This system is, of course, distinctly bad, but served my purpose quite well. When the lead-in was plugged into socket "A.1." and the crocodile clip attached to the highest tapping (thirty turns down the coil), London National was tuned in at about 5 degrees on the condenser dial and London Regional was loudest at about 30 degrees. I say "loudest" because tuning was very "flat," and it was not possible to separate completely the two London transmitters. Both stations provided moderate loud-speaker signals and were extremely loud on the phones.

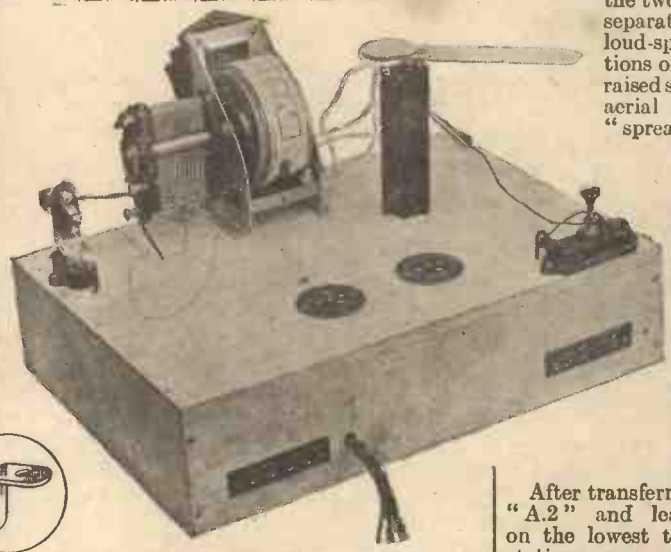


Fig. 1.—The "Progressor," as it appears during the experiments described this week.

Midland Regional could also be heard on phones, but it was impossible entirely to cut out London Regional. One or two other stations were heard at varying strengths, but none could be listened to in comfort due to the interference from the locals.

By changing to the second tapping the two London stations could be separated with ease and gave fair loud-speaker signals. Their positions on the condenser dial were raised slightly due to the "looser" aerial coupling, and the tuning "spread" of each was something like 15 degrees. When the lowest tapping was made use of the signals from both stations were insufficient for operating the speaker, but were comfortable on the phones. Incidentally, they now occupied about 9 degrees each on the condenser scale. Midland Regional could be heard free from interference, but there were no other stations that were productive of good signals.

After transferring the lead-in to terminal "A.2" and leaving the crocodile clip on the lowest tapping, even the London stations were very weak on the phones unless the pre-set condenser knob was screwed right down. But when the clip was moved to the highest tapping perfectly good speaker signals could be obtained from the locals, and with the pre-set adjusted to about half its maximum

(*Continued overleaf*)

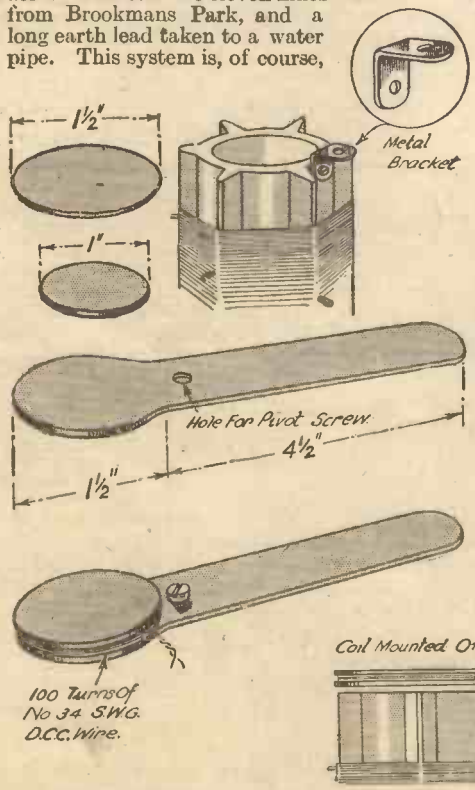


Fig. 2.—All constructional details for the reaction coil and its mounting are given in this sketch.

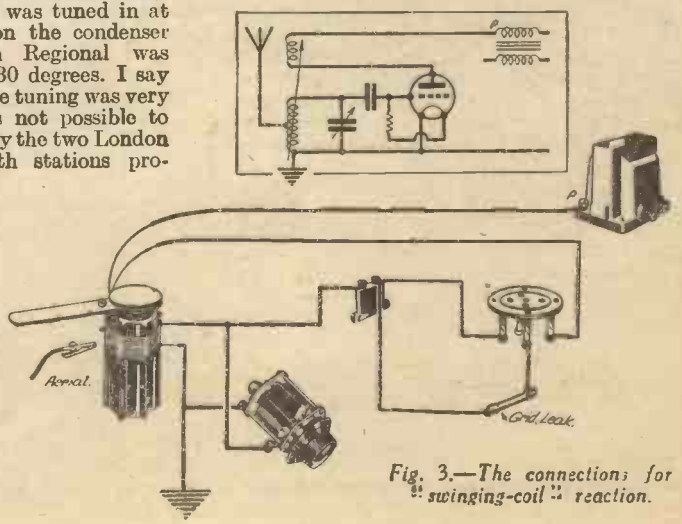


Fig. 3.—The connections for "swinging-coil" reaction.

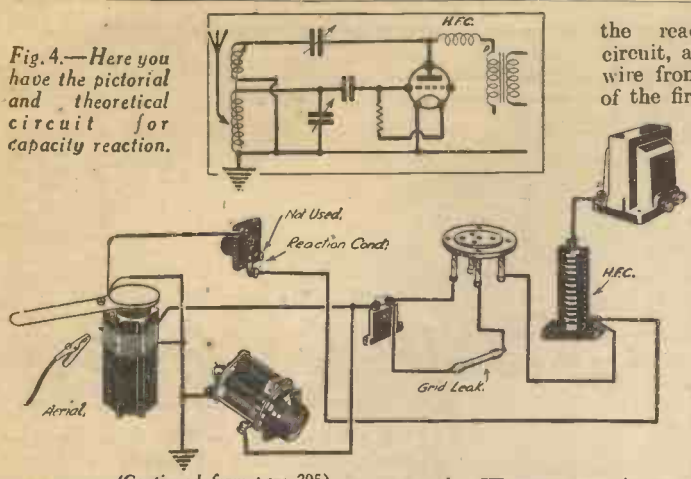


Fig. 4.—Here you have the pictorial and theoretical circuit for capacity reaction.

(*Continued from page 295*)

capacity there was ample selectivity for local station reception. It was concluded that this particular setting was most suitable for use with the aerial-earth system employed.

A Name For the Receiver

Now that we have gained a good deal of useful information regarding the best form of aerial coupling, we are ready to add a few more parts to our receiver. By the way, it has been suggested by several readers that this experimental set should be given some name. I agree with this, and have decided that we will call it the "Progressor"; this name will apply right from the commencement of our simple experiments until the time that the complete four-valve receiver has been finished off.

"Swinging Coil" Reaction

In order that the set may be made considerably more powerful without even spending a single penny on it, we shall next add reaction. The very simple method of doing this is illustrated by a sketch printed on page 295, and you will see that the reaction coil is wound on a narrow bobbin made up from three strips of stiff card. One of these is shaped rather like a tennis racket, one end being circular and of 1¼ins. diameter; the second is a disc 1¼ins. diameter, and the third is another disc, this time 1½ins. diameter. The three pieces of card are glued together to form the bobbin in which about 100 turns of the 34-gauge d.c.c. wire left over from the tuning coil are wound. The beginning and end of the winding is anchored by passing the wire through a pair of small holes made with a pricker or compass point. Leave about 10ins. of wire spare at each end for making connections later on. A small angle bracket must now be attached to the top of the ebonite coil former by means of a short bolt and nut. This bracket can be made from a 1in. by ¼in. strip of brass, or may be an angle bracket from a set of Meccano or Trix.

The reaction coil is next fastened to the bracket with another bolt and nut, and is so arranged that it can be rotated over the end of the tuner. Now we must connect the reaction winding in circuit, and to do this the wire from the plate terminal of the first (detector) valve-holder to the terminal marked "P" on the low-frequency transformer must be removed; the two ends of the reaction coil are then passed through small holes made in the chassis and connected to the terminals from which the wire has just been removed.

Observing the Effects of Reaction

We are now in a position to observe the effect of reaction. Rotate the reaction coil until it is as far away as possible from the tuned winding and then tune in the local station. After that, slowly move the reaction coil over the end of the tuner. Signal strength might increase, or it might decrease, depending upon whether the ends of the reaction coil are connected right or wrong way round. If the signals become gradually louder, all is well; if not, reverse the connections and try again. You will now find that the volume is increased enormously as the reaction coil becomes closer to the tuning coil. At least, volume will increase for a time and then it might fall off as the set starts to oscillate; this will be indicated by the fact that reproduction will become distorted or by a whistle being heard in the speaker. In either of these latter two events, reaction must be slacked off at once or else you will run the risk of causing interference to neighbouring listeners.

There is another point to watch, because tuning will be affected to a certain extent by varying the reaction coupling. For this reason it is best to try altering the position of the tuning dial slightly whilst reaction is being adjusted.

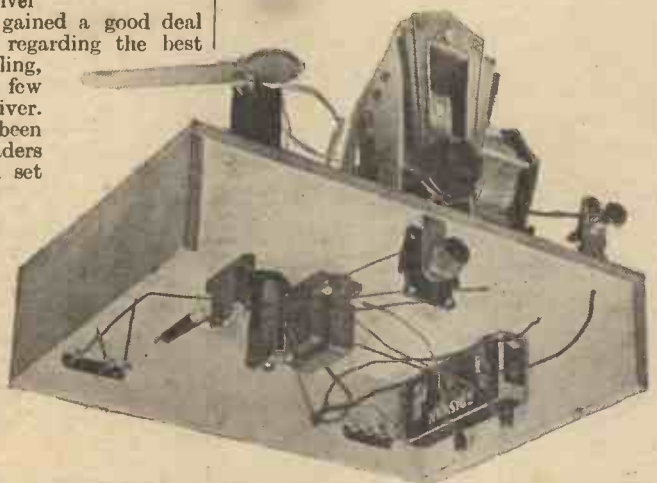


Fig. 6.—A general view showing the under-side of the chassis after the H.F. choke and reaction condenser have been mounted.

Increased Signal Strength and Greater Selectivity

Once the reaction control is functioning properly, you will find that signals are considerably stronger, that tuning is quite sharp, and that the number of stations that can be received is at least ten times as great as before. The only point to watch—and you really must watch it very carefully—is that your set is not allowed to oscillate. This can always be prevented if the proper sequence of operations is followed when tuning in. It is as follows: advance the reaction setting to the point where a faint "breathing" sound is heard in the speaker (the detector is then just off the point of oscillation, and is in its most sensitive condition); rotate the tuning dial slowly, occasionally modifying the reaction setting so as to maintain the detector valve in the "nearly-oscillating" condition. You will find that by following this method a large number of stations can be received with ease.

After you have become quite "at home" with the reaction adjustment, you should repeat the selectivity experiments described last week, because you might find that conditions are now a good deal different. Settings which were previously useless from the point of view of selectivity may now be entirely satisfactory.

Changing Over to Capacity Reaction

The system of reaction control which I have just dealt with is that known as "swinging coil" reaction, and is the kind which was used universally a few years ago. It is not in very great favour at the present time, however, because it cannot be adjusted with quite sufficient delicacy, and it has rather too great an effect upon the tuning. The system which is to-day used in the majority of receivers is known as capacity reaction (due to the fact that it is varied by means of a condenser), or more popularly, Reinartz reaction (because it was invented by a radio experimenter of that name).

In order to experiment with capacity reaction, we shall require a high-frequency choke, a .0003 mfd. reaction condenser, and a small bracket on which to mount the latter component. For ease of reference the exact types and makes of these components are given in tabular form in another place on page 325. The positions in which the parts are to be mounted on

(*Continued on page 325*)

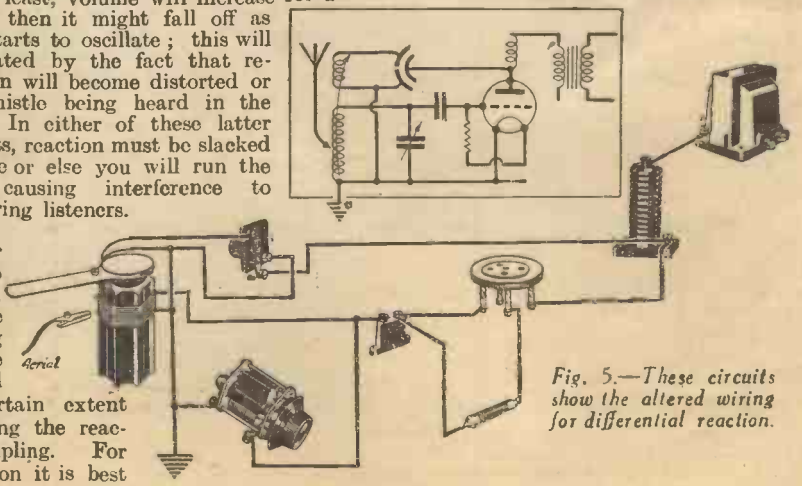


Fig. 5.—These circuits show the altered wiring for differential reaction.

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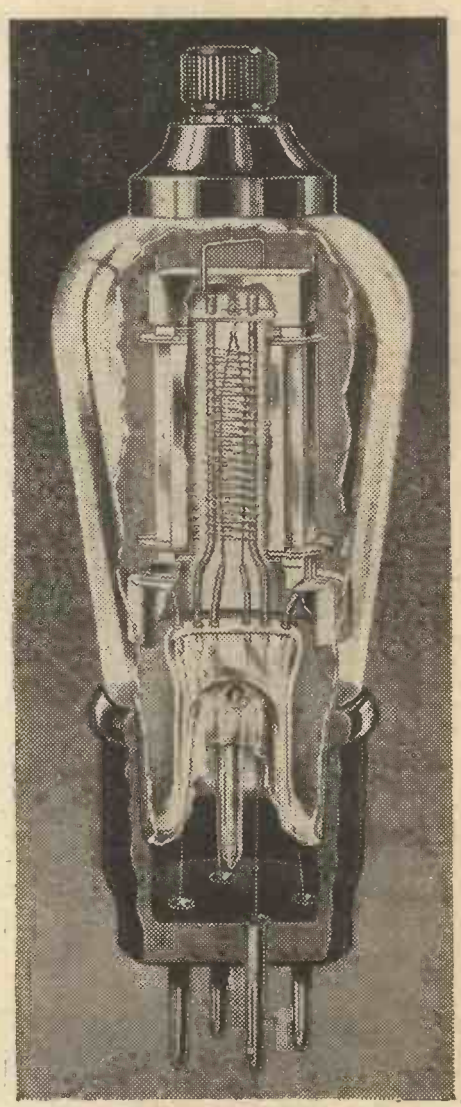

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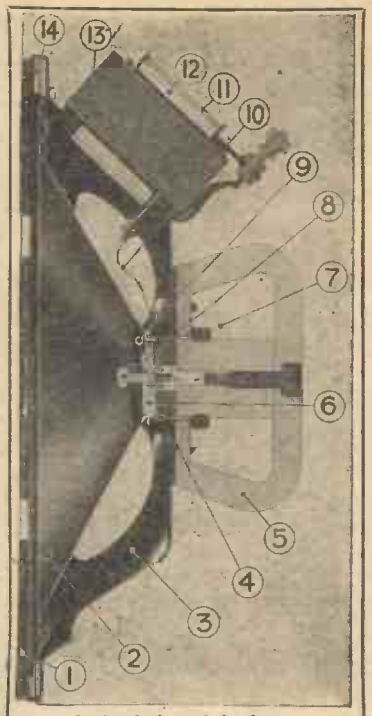

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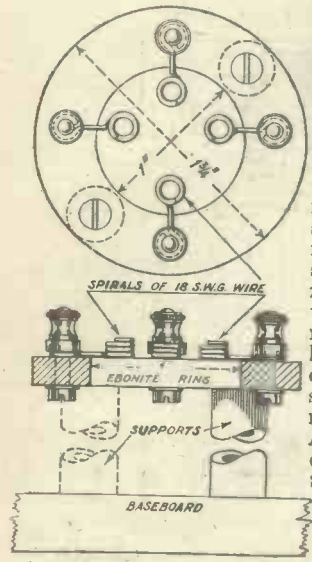
READERS' WRINKLES

THE HALF-GUINEA PAGE

A Low-loss Valve-holder

THE accompanying sketch shows an easily-constructed low-loss valve-holder suitable for short-wave work. First cut out the ebonite ring to the dimensions shown, and drill the two holes for the holding down screws. Next make the contacts, forming the spirals on a nail of the same diameter as a valve leg, and make the loops at the outer ends to suit the terminals used. Arrange the contacts on the legs of an old valve, and then mark off and drill on the ebonite ring the holes for the terminals. The whole can then be assembled as shown.



A novel low-loss valve-holder.

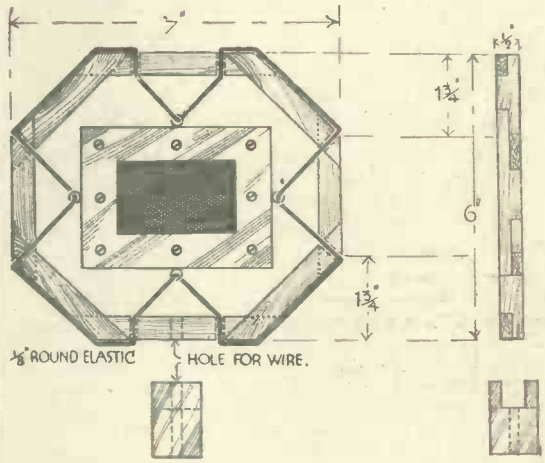
The supports, which may be of ebonite tubing, should be of a length that suits the lay-out of the set and gives the shortest wiring.—H. H. CRAWLEY (Oxford).

A Cheap Screened Aerial Lead-in

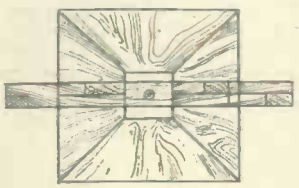
SCREENED aerial lead-in tubes are expensive to buy, but quite a good one can be made from flexible metallic gas tubing, as shown in the accompanying sketch. A number of cork washers should be threaded over the aerial lead-in wire, which should be rubber covered, and spaced about every six inches to prevent the wire moving about inside the tubing. The end of the tubing near the aerial should be sealed up with a tightly-fitting cork, and smeared over with Chatterton's compound or wax. Earth the tubing by binding some bare copper wire tightly round the end and cover with insulating tape.—W. L. PATTULLO (Golders Green).

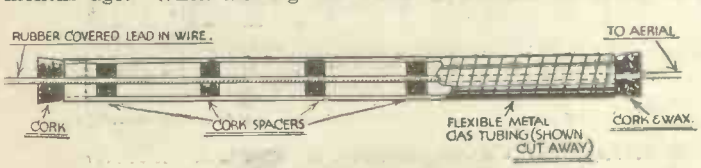
A Simple Microphone Stand

THE accompanying sketches show a microphone stand which I made some time ago. The microphone is one which appeared in PRACTICAL WIRELESS some months ago. When making the frame I drew it full size on a piece of paper, and laid each piece of wood on its proper place for marking before cutting. The sketches clearly show how the parts of the frame are put together. Materials required are 3ft. of ½in. strip wood, ½yd. of ¼in. round black elastic, and some brown enamel. I applied two coats of enamel to the stand which gave it the appearance of bakelite. The microphone was coated with aluminium paint. The microphone works a lot better on this stand, being protected from extraneous noises due to vibration.—JOHN M. CAMPBELL (Glasgow).



Details of a serviceable microphone stand made of wood.





A screened aerial lead-in tube.

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A Cheap H.T. Eliminator

THE following particulars of an H.T. eliminator, made chiefly with scrap materials, may be of interest to other readers. I have had one working satisfactorily for some time supplying a three-valve set (Det., R.C. and Trans.). The materials required are:—One Bell transformer (costing about 4s. 6d.) two Ford coils, one valve (an old 6-volt bright emitter), one valve-holder, one rheostat, two condensers (4 or 6 mfd.). The lay-out of the components is given in Fig. 1, and the circuit diagram in Fig. 2. The output appears to be about 100 volts at 8-10 milliamps, and is therefore quite sufficient to operate my three-valve receiver very satisfactorily.

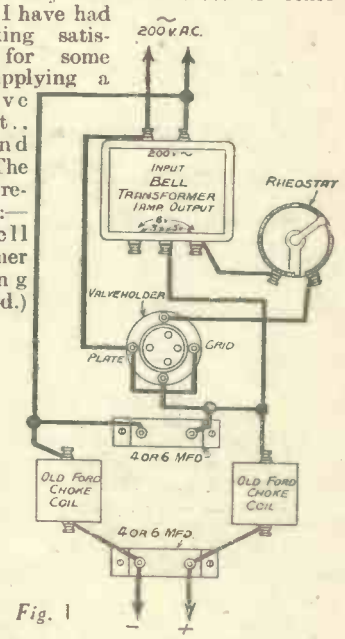


Fig. 1

Wiring diagram for a cheap H.T. eliminator.

Should a second H.T.+ tapping be required, it can be provided easily enough by connecting a resistance and condenser as shown in broken lines in Fig. 2. The resistance should be about 10,000 ohms. (for the detector voltage), and the condenser 2 mfd.

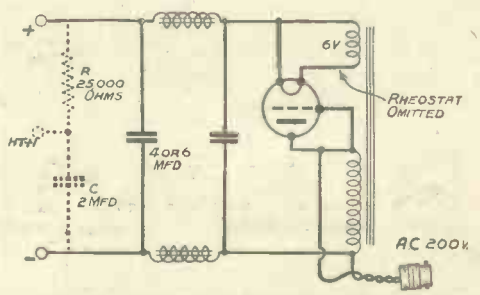


Fig. 2—Circuit diagram of a cheap H.T. eliminator.

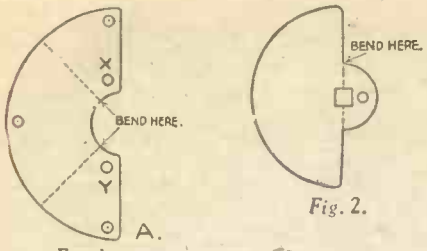
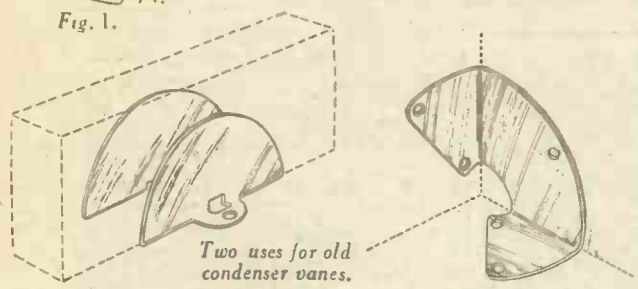


Fig. 1. *Fig. 2.*



Two uses for old condenser vanes.

RADIO WRINKLES

(Continued from previous page)

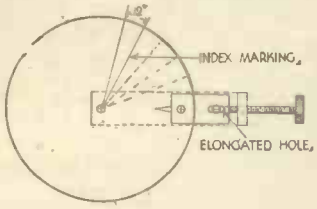
Uses for Old Condenser Vanes

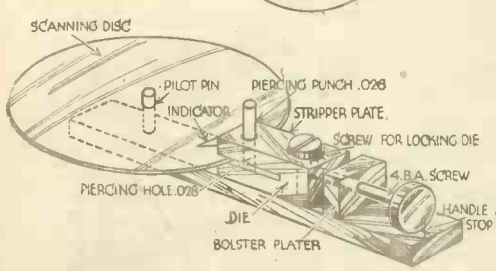
THE vanes of discarded straight-line capacity condensers can be put to two good uses. Firstly, the fixed vanes may be made into panel brackets by bending them as in Fig. 1, and drilling two new holes at X and Y. They can also be made for slanting panels by simply reducing one of the 45 deg. angles.

Two moving vanes can be made to form a grid bias battery holder if bent, and drilled as in Fig. 2, and screwed down at the correct distance apart.—H. PACKMAN (Watford).

Punching Holes in a Scanning Disc

THE accompanying sketches show a tool for perforating a scanning disc with a limit of .003in. After the disc has been marked out—thirty lines at 12°—it is placed on the centre pilot pin so that the lines of the disc coincide with the marker or indicator. Bring the punch through hole in the stripper and pierce the disc. After withdrawing the punch, revolve the 4 B.A. screw one complete turn, using the stop each time. This allows the die to travel .66 mm. (.025in.), which is the pitch of thread. Repeat the operation for each hole. This device will produce thirty holes on a perfect spiral. Centres of first and last hole are .734in. apart.—JAMES FRANKLIN (Liverpool).





Device for punching holes in a scanning disc.

A Method of Using a Short-Wave Converter

MANY users of the superheterodyne pattern short-wave converter find the "station repeating" properties of the oscillator-detector are a nuisance, especially when a record of stations received is kept. For such persons, the "straight" short-wave receiver would be better, and the following notes on the conversion of a superhet adaptor to normal use with a set possessing pick-up terminals may be helpful.

The first step in the conversion is to open up the adaptor and to remove the long-wave H.F. choke which is placed in the anode circuit of the valve, replacing this choke with a resistance whose value will depend on the H.T. supply available; for a 100-volt battery, a 1 watt, 60,000 ohms resistance, will be about right.

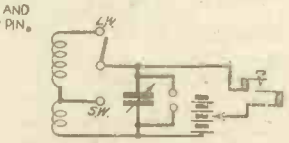
Step number two—remove the low value condenser connected to the output terminal of the adaptor which is marked "aerial," and insert in its place one with a value approximating to .01 mf.; its value is not critical. Finally, connect a high resistance, about 1 megohm, across the output terminals of the adaptor; the conversion is now complete.

In operation, instead of, as formerly, working the receiver in a state of oscillation, with the adaptor connected to the set's aerial and earth terminals, it is used as an ordinary S.W. set, with the adaptor connected to the pick-up terminals of the set, the earth terminal of the adaptor to the negative pick-up terminal, and the aerial terminal to the positive pick-up terminal.—NORMAN ROLLASON (Canterbury).

Constructing and Using a Buzzer Wavemeter

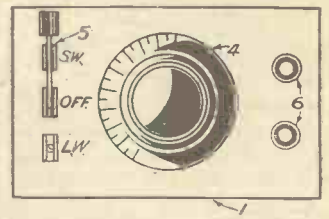
AS an accurate wavemeter is an expensive thing to buy, the following information will enable any reader to construct one which, while not as accurate as a commercial instrument, is quite capable of giving rough results of a good deal of value. The drawing gives the necessary particulars for constructing the instrument. The ebonite panel should be 8in. by 5in. by ¼in., and the baseboard 8in. by 8in. by ½in. An ebonite or paxolin former is used for winding the coils on; these are wound in the same direction.

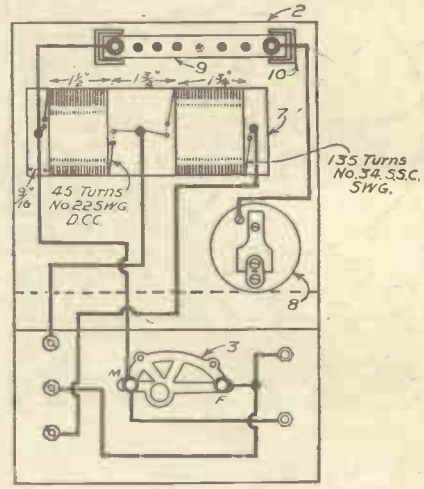
The former is held in position by means of two 2 B.A. countersunk screws inserted from the underside of the baseboard and passing through holes in the former. A spacing washer prevents the turns from pressing on the baseboard. The switch can be any two-way on-off switch, and many suitable buzzers are on the market. A 1½ volt grid bias battery is sufficient to work the buzzer, but a 4½ volt battery will allow a larger voltage to be chosen if necessary. Do not use more voltage than the minimum capable of working the buzzer, or its contacts will rapidly be spoilt.



Circuit diagram of buzzer wavemeter.

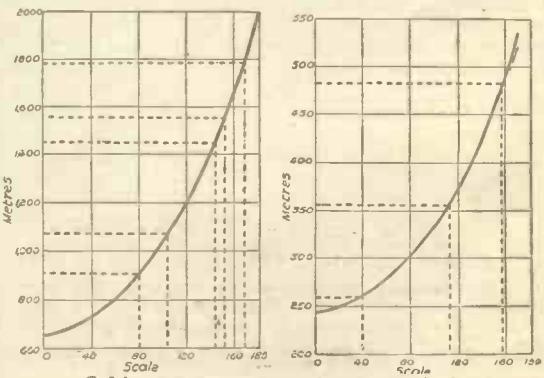
A rough method of calibrating the wavemeter is as follows. Tune a receiver in to a station of known wavelength, such as





Panel and layout of a buzzer wavemeter.

480 metres, and buzz the wavemeter, adjusting the wavemeter condenser until the buzzing is at its loudest. Note the reading on the wavemeter scale. Repeat the foregoing with a number of stations, and plot the positions on the wavemeter scale. It should be noted that the curve actually obtained for any instrument will be slightly different from the specimen given, but will have the same general shape. It is essential that the curve obtained with the actual instrument should be used with it. In using the wavemeter the instrument will radiate radio waves which can be received up to a distance of 15 or 20ft., and is thus very suitable for testing radio receivers when broadcasting stations are not working. As the dial of the wavemeter is calibrated in wavelengths, it can be used to identify the wavelengths of unknown transmissions, or to adjust a receiver to a particular wavelength.—T. HARRISON (Bradford).



Calibration curves carried out with the buzzer wavemeter.

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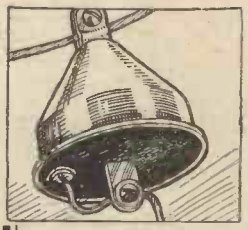

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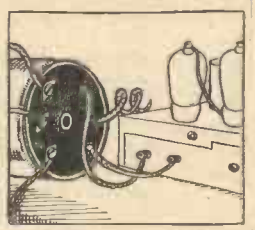

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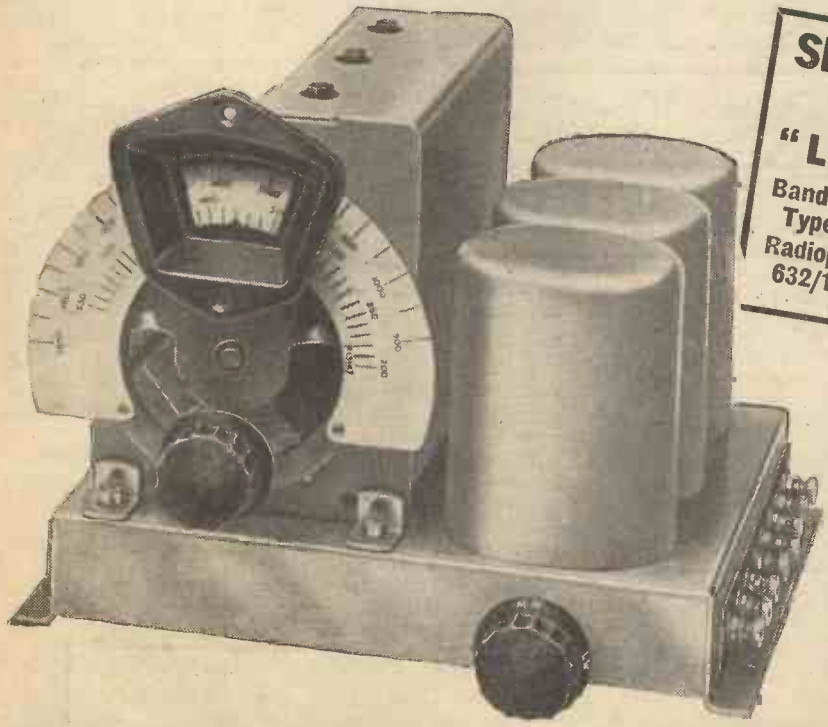

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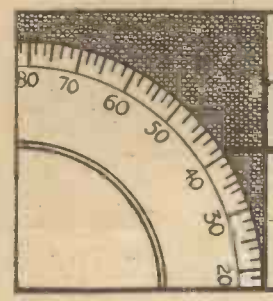

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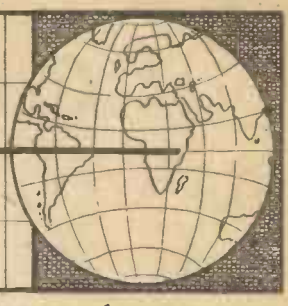

Ways and Means of Doing This by Simple Modifications and Additions to the Tuning Circuit of Your Receiver

By G. W. DAVEY

THE long, dark autumn and winter evenings are, of course, the broadcast band D.X. man's paradise, for, as we all know, wireless waves travel farther in the darkness than in the light. With the increase in power that so many stations have had, it looks as though D.X. ("radioese" for "distance getting") will be better than ever this winter *provided that the set is selective enough to separate* the many stations it is sure to pick up. We had a foretaste of this difficulty towards the latter end of last winter, and on "running round the dials" recently, although early in the autumn, I could see that the selectivity problem was going to be a real one for many this season; for despite the fact that my set is moderately selective, the local National and Regional stations, I find, have a background of interference soon after dark—not enough to interfere with reception of the programmes, but definitely there during an interval. In view of this, I feel a few hints and tips on improving selectivity in general would be of use to some who think theirs inadequate for the coming season.

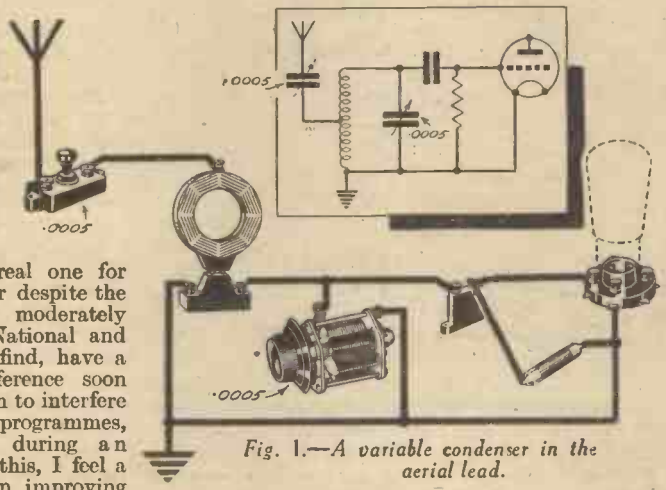

Fig. 1.—A variable condenser in the aerial lead.

Look To Your Aerial

To begin with, I think we should take a look at the aerial. The full 100ft. allowed by the P.M.G. is, of course, rarely used elsewhere than in the heart of the country, because the high power of most stations and the need for selectivity has made it unnecessary. The longer the aerial, the stronger the signal, the greater the damping on the aerial circuit, and the less the selectivity, and *vice versa*. Therefore, if you find you are getting a goodly number of stations at good strength, but that you need a little more selectivity, even at the expense of some of your power, try cutting down the length of the aerial somewhat. In any case, 50ft. should be ample. If you do not want to go to the trouble of cutting a piece out of the aerial wire, you can "shorten" it artificially by connecting a condenser in the lead-in to the aerial terminal (Fig. 1). Try .0003, .0002 or .0001 fixed condensers if you have them by you, using whichever proves best; if not buy a .0005 pre-set type and try that.

Better still, buy a mica-dielectric .0005 variable condenser and mount it on the panel; you then have a variable selectivity adjuster, and also a volume control in a handy position. Many of the special devices sold serve the same purpose. While discussing the aerial circuit, if it is made up of a plug-in coil, either plain or centre-tapped, try an X coil; this should appreciably improve selectivity (Fig. 4).

Tapping the Aerial Coil

If it is not an ordinary solenoid coil, a tap may also help here to improve selectivity. A good way to find a suitable spot for the tap is to connect the aerial lead to a pin or needle, either by soldering or tightly binding with a piece of wire, and just try sticking it through the cotton covering of the wire on the coil so as to make contact with the bare wire beneath. When you have found a spot that gives you good volume and sufficient selectivity, just bare the wire by scraping off the covering with a penknife or razor-blade; now disconnect the wire from the aerial terminal to the coil, connecting instead to the aerial terminal a piece of flex, terminating in a crocodile clip. Just slightly raise the turn of wire you have bared, and connect on to it the crocodile clip. Now take the needle or pin off your aerial lead-in wire and connect it to the aerial terminal. Your tapping is now complete.

Aperiodic Tuning

Another good plan is an aperiodic aerial circuit. This can be arranged by connecting an aperiodic coil to the present coil in the aerial circuit (see Fig. 5). In the case of a plug-in coil, if you have some others handy—such as Nos. 25 or 35—you can mount another coil holder beside your present aerial coil connecting as follows:—One side to aerial, other side to earth terminal (or that side of the present coil which is earthed) and just plug in a coil which

(*Continued overleaf*)

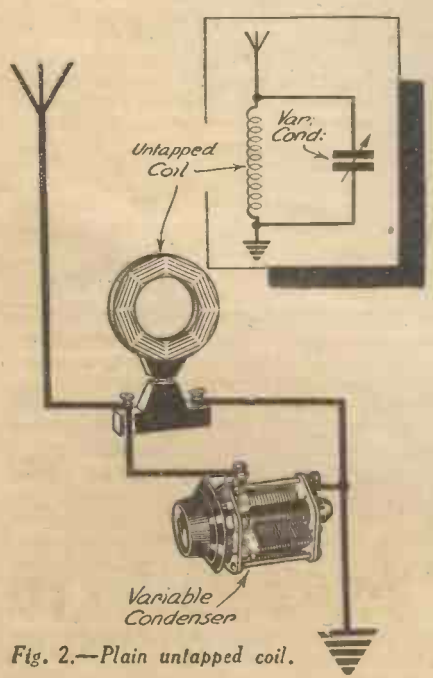

Fig. 2.—Plain untapped coil.

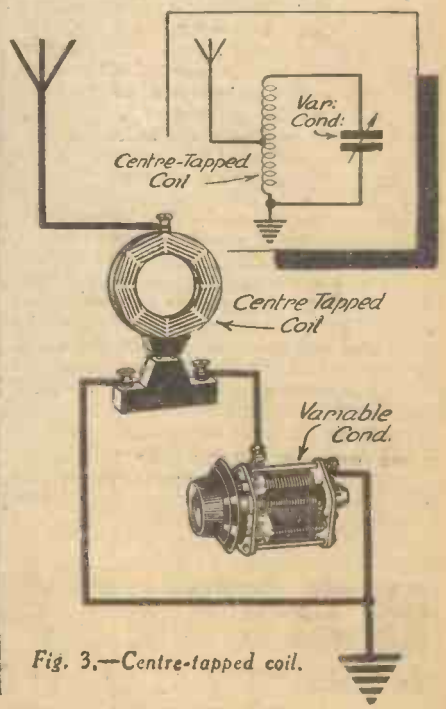

Fig. 3.—Centre-tapped coil.

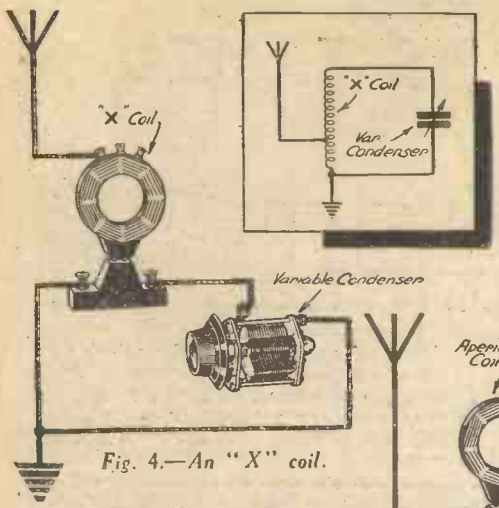

Fig. 4.—An "X" coil.

(Continued from previous page)

gives good selectivity and volume. With an ordinary solenoid you can wind ten to twenty turns (the exact amount can be found by experiment) around the outside of the short-wave winding, again connecting as above. If you have no other plug-in coils handy, or no room to mount one, the following is a good scheme. Wind a hank coil of about twenty turns, roughly, the same diameter as your plug-in coil. This is done by just winding the turns round a tin or tube of correct size. Slide them off and tie the coil in about three places with cotton to prevent it coming unwound, and also tie it with cotton to your plug-in coil. Again connect the ends as above. It does not matter to which terminals the ends of the coil are connected.

Band-Pass Tuning

Band-pass tuning is another possibility which would increase selectivity, but this, I feel, is best carried out by entirely scrapping the present circuit arrangements and fitting a properly designed band-pass unit. In any case, this somewhat lengthy subject has been often dealt with in the pages of this journal, and the interested reader is advised to refer to previous articles on the subject.

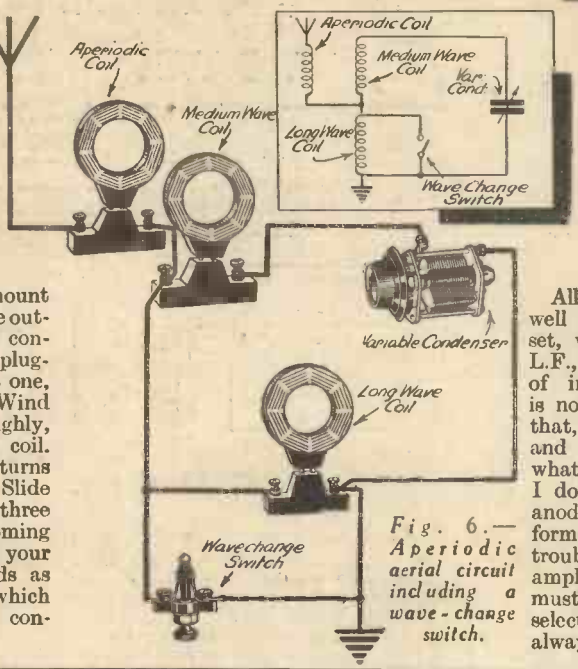

Fig. 6.—Aperiodic aerial circuit including a wave-change switch.

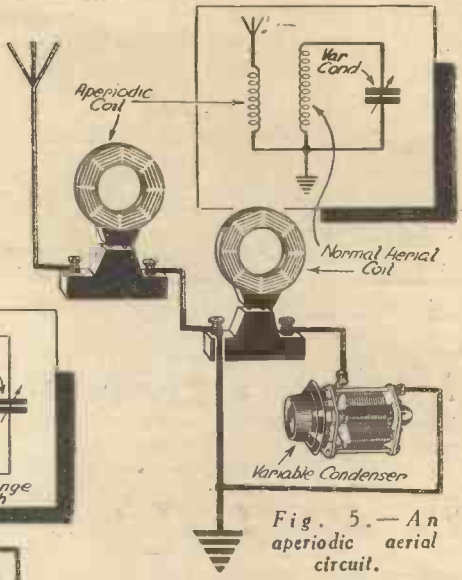

Fig. 5.—An aperiodic aerial circuit.

All the foregoing hints apply equally well to the aerial circuit of any straight set, whether Det. and L.F. or H.F. det. L.F., and should have the desired effect of increasing selectivity. If selectivity is not sufficiently increased, I am afraid that, short of fitting entirely new coils, and probably altering the circuit somewhat, there is nothing that can be done. I do not recommend altering the tuned-anode or tuned-grid coil or H.F. transformer, as this usually introduces other troubles, such as instability, and reduces amplification. Finally, remember there must always be a compromise between selectivity and sensitivity, as selectivity always tends to reduce sensitivity.

By "PHOTON"

RADIO STATIONS AND SYNCHRONIZATION.

THE experiment has been made to broadcast the same programme from two stations distant from one another accurately synchronized.

The first difficulty is one of obtaining perfect synchronization, but even when this is done the difficulties of the problem are only just beginning. Firstly, the whole area served by two stations whose carrier waves are of the same frequency would be covered or mapped out by a whole system of nodes and loops, the nodes being situated where the waves neutralize and the loops where the waves reinforce one another. If, for example, the wavelength radiated be 400 metres, on the direct line between the two stations, there would be a zero and a maximum alternating at every 200 metres distance, and throughout the areas served there would be a maximum at every point situated at exact number of wavelengths from both stations, and a minimum where the distances differ by half a wavelength: it is not difficult to see that reception under these conditions must suffer greatly.

Then the question of modulation arises. If we were to assume the side-bands as well as the carrier waves as strictly synchronous, it is difficult to forecast what kind of interference effect would be experienced. There would be areas where certain side-band frequencies were missing and perhaps where the carrier wave is maximum, and others where the carrier wave may be a minimum and other side-bands maximum, etc., and if, by way of exploring the region, a set were moved from one place to another, the results would differ at every change of position. As stated, however, it would be hardly possible for the side-bands to be synchronized with exactitude; the velocity of the propagation of a change of E.M.F. in a land line is far slower than in the ether, where it approximates to the velocity of light, and although the acoustic lag between one station and another might be no more than sound experiences in passing through two or three feet of air, the extent of the resultant dephasing would be sufficient to invalidate any argument based on exact synchronization of side-bands.

Let us think what would happen if it were possible to emit actual sound-waves from two stations ninety-five miles apart, and examine the interferences taking place between them over the intervening region on the *supposition that sound could travel as fast as light*; we should find that a note emitted by one station having a frequency of 2,000 would reach the other station approximately one wavelength out of phase, and an observer situated half-way between the two stations would receive a given signal simultaneously from both stations. Observers situated between the two stations at a quarter distance, that is twenty-four miles away from each, would receive nothing; they would be situated at nodes where the waves cancel out. For other frequencies the nodes and loops would be differently distributed, but wherever the observer might find himself there would be preferential acoustic frequencies which he would be able to pick up at full strength and others which would be weak or absent. The conception of sound-waves travelling with the velocity of light, and being directly audible in a region hundreds of miles in extent is, of course, imaginary, but the facts realised on this supposition are substantially the same as those consequent on the distribution of a modulated radio signal.

The position can be summarised as follows:—

(1) Difficulty will be experienced in accurately synchronizing two carrier waves from widely separated sources, in which failure involves powerful beats or surges in any receiver tuned in to the carrier frequency. This difficulty can be overcome by accurate crystal control.

(2) With perfectly-tuned and synchronous carrier-waves there will be a distribution of maxima and minima due to interference. At such points as where the carrier waves are of equal strength, the minimum will have a zero value.

(3) Apart from distortions or defects of reception due to (2) above, waves of acoustic frequency will be subject to interference.

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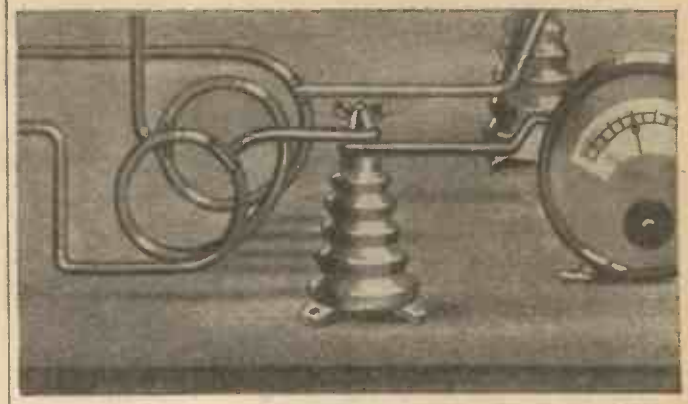

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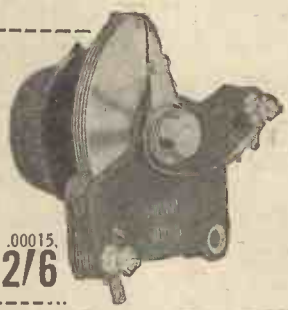

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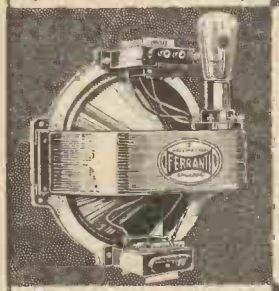

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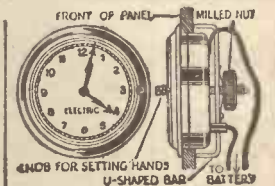

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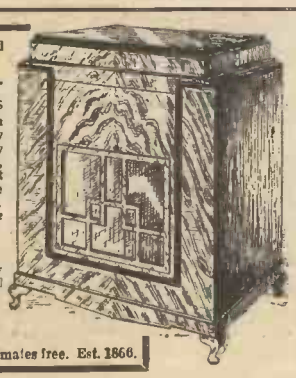

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MORE ABOUT THE ORBIT—F. J. Camm's Latest Success

ONLY FOUR KNOBS! NEW TRANSFER PRINT WIRING SYSTEM!

AUTOMATIC FADING COMPENSATION AT LAST!

LAST week you were given some preliminary particulars of the "Orbit"—the new receiver which every reader simply must build—and next week very complete constructional details will be given by Mr. F. J. Camm himself. An additional feature of next week's issue of PRACTICAL WIRELESS will be the FREE PRESENTATION of a "TRANSFER-PRINT" (Provisional Patent No. 24,584/33), by means of which any and every reader can build the set himself in a minimum of time and with the definite assurance that it will function correctly as soon as the parts have been assembled and the wiring completed.

Further to safeguard the interests of readers, Mr. Camm gives a PERSONAL GUARANTEE OF SATISFACTION to every constructor, and in case of difficulty he will give FREE ADVICE in regard to the cause of trouble.

In the meantime, however, all readers are naturally interested to know something about the set which has been evolved after a considerable amount of research and experimental work in the PRACTICAL WIRELESS laboratories. Briefly, the set has three valves, arranged in the most popular combination of Variable-Mu High Frequency Amplifier, High-Efficiency Detector, and Pentode. At the request of thousands of readers, the "Orbit" has been designed for battery operation, but the high-tension circuits are so arranged that an eliminator of almost any type can be used with every satisfaction where desired.

Selectivity in Plenty

To ensure an ample degree of selectivity for all requirements, iron-core coils have been employed, and the combination specified has been proved to give a sufficiently generous degree of selectivity to enable the local station to be tuned out in a fraction of a degree on the tuning dial. In addition to this, medium-wave breakthrough is non-existent, and thus the bugbear of unsatisfactory long-wave reception has entirely been overcome.

Automatic Fading Compensation

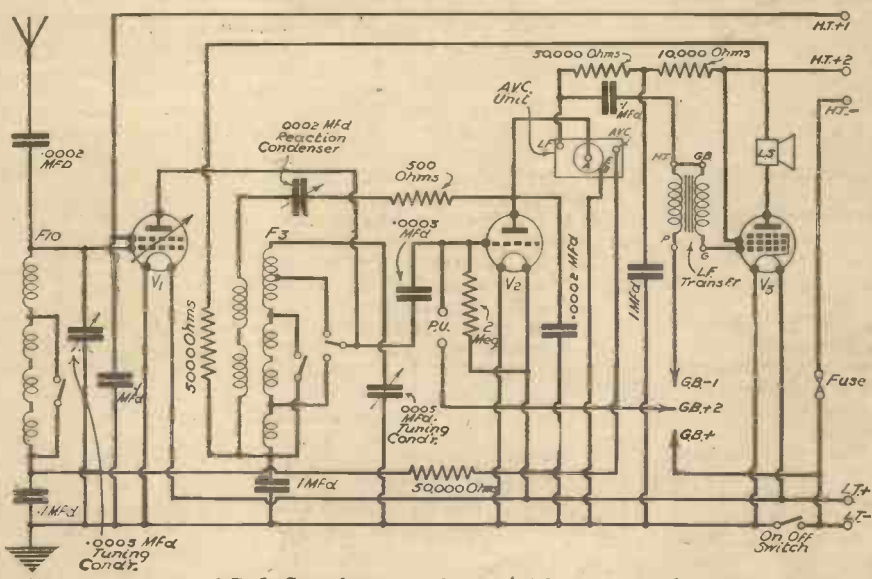
A really new and up-to-date feature of the "Orbit," which is bound to be much appreciated, is the provision of an automatic fading compensator device. The fitting of this is perfectly straightforward and does not complicate the constructional work in the slightest degree. What is still more important is that the device **definitely does fulfil the purpose for which it is intended.** The latter statement might appear superfluous, but readers who have had experience with some of the home-constructed receivers having the refinement of so-called automatic volume control will know that it is not. Despite the utter simplicity of the "Orbit," this new receiver is a real station-getter; not only does it bring in stations, but it enables them to be listened to in comfort and without the usual fading which takes all the enjoyment out of long-distance listening.

The pentode output valve gives an ample output and the volume provided is more than adequate for even a large drawing-room. Combined with the generous output, however, the "Orbit" gives really life-like reproduction.

Simplicity of Operation

Simplicity of operation has been carefully considered by Mr. Camm, and as a result the "Orbit" **HAS ONLY FOUR KNOBS,** which are symmetrically disposed. The single knob for tuning occupies a central position; to the left of this is the wave-change switch, and on the right is the reaction control. An on-off switch is situated away from the other knobs, where it is both unobtrusive and convenient.

The two-gang tuning condenser is provided with an accessible trimming adjustment so that perfect matching and optimum results can be secured in the simplest possible manner.



Theoretical circuit of F. J. Camm's amazingly successful receiver, with automatic fading compensation: "The Orbit."

New Form of Construction

An entirely new form of construction is employed for the "Orbit," the loud-speaker unit being mounted in its rightful place on the receiver chassis. This enables the set to be tested with ease when it is removed from the cabinet and makes the whole instrument particularly neat and compact. The cabinet specified is of unusual style and has been specially designed for the "Orbit"—it certainly makes the receiver look as good as it really is.

In reading through the above remarks you might have come to the conclusion that the "Orbit" must be an expensive set. IT IS NOT. In fact, the total cost of all the components (exclusive of the speaker) is only five guineas. Running expenses are proportionately low, since the H.T. battery current consumption is between 10 and 12 milliamps, and the L.T. consumption only half an ampere.

You will be pleasantly surprised when you obtain your next week's issue of PRACTICAL WIRELESS and examine the illustrations of the "Orbit." It is just the set you want. In fact, if you wish to have the best, cheapest and most advanced type of receiver, you cannot afford not to build the "Orbit."

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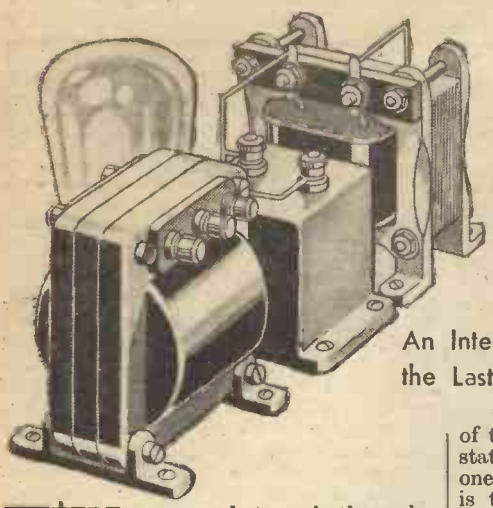

OUTPUT DEVICES

An Interesting Discussion on the Merits of the Methods Employed to Couple the Last Valve of a Receiver to the Loud-speaker.

THERE are several stages in the evolution of the wireless enthusiast. First of all he is content to construct from a blueprint or kit of parts. He knows that if he carefully follows the instructions given the set will function; why it functions is an entirely different question. After trying his hand at this sort of thing for a time he gains confidence, and so begins to glean something about the various parts which constitute a wireless receiver. The third stage is when he tries his hand at working from theoretical diagrams, and can discuss in an intelligent manner the various components and their functions in a receiver.

This is why we all find radio so intensely interesting. It is not necessary to have a knowledge of either science, engineering, or physics to construct a radio set. We can start right away, and definitely get results. Once in the grip of this, the greatest of all hobbies, you want to know more, to know the reason for the inclusion of particular components, or the disposition of components in a certain manner. Thus we grow in knowledge, and as we learn more so we increase in enthusiasm, and the remarkable thing about it all is that we never seem to tire, this enthusiasm gripping all ages. Not only are we keen constructors, but keen listeners, demanding real quality, something approaching the original in performance.

A Link in the Chain

Of course, we all know that there are quite a number of different components in a receiver—all links in the chain—all performing their respective functions—all contributing to the final result—the reproduction of the sounds heard in the transmitting station more or less faithfully. Now one of the important links in the chain is the output valve, to which the loud-speaker is connected. No matter how excellent the circuit or loud-speaker, if they are not correctly linked together results will be unsatisfactory. We are going to discuss this linking together of the output valve and the loud-speaker. As a start, let us consider the output circuit as shown in Fig. 1. This is in its simplest form, and is generally employed with a moving-iron loud-speaker.

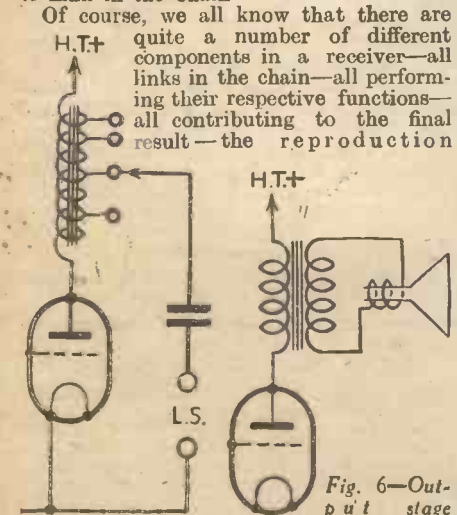

Fig. 5.—Output choke filter circuit using a tapped choke.

Fig. 6—Output stage transformer coupled to moving-coil loud-speaker.

Will this arrangement give the best results? Will it do justice to a really good balanced armature loud-speaker? Now look at Fig. 2! Anything wrong? Have you ever seen a moving-coil loud-speaker connected to the output valve in this fashion? No. Of course not. You ask why, and your informant says it simply isn't done. Quite true! But that does not satisfy you, you wish to know why it isn't done, so we now get down to our subject, output devices.

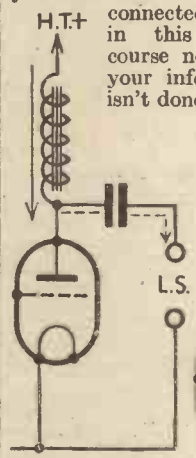

Fig. 3. — Typical choke capacity output filter.

Fig. 4. — Alternate method of employing choke capacity output.

Output Devices

This is an extremely simple arrangement, and there are two principal methods employed to couple the output valve to the loud-speaker, namely, choke capacity and transformer coupling. The former method is shown in Fig. 3, and this diagram will serve to illustrate the principles involved. Transformer coupling will be discussed later. Its purpose is twofold. First of all, it keeps the plate current of the last valve from passing through the winding of the loud-speaker and, secondly, reduces the voltage drop which occurs when direct currents pass through the winding of a high-resistance loud-speaker. These are not the only uses of a choke filter. The speech currents being diverted to earth through the loud-speaker do not pass through the source of H.T. supply, and set up voltages across it which might cause motor boating.

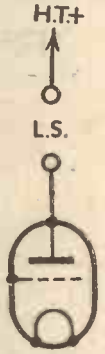

Fig. 1. — A simple output circuit.

Fig. 2.—Incorrect method of coupling output valve to moving-coil speaker.

When Employed

When should an output device be employed? It is desirable in practically any receiver when the output valve takes an anode current of more than 10 milliamperes, or when exceptionally long leads are employed which would cause a relatively large voltage drop. It is also necessary to match the output valve to that of the loud-speaker; this generally applies to a moving-coil loud-speaker, and is absolutely essential for reasons which will be discussed later. Sometimes a tapped output choke is employed, but in this case it becomes, in effect, an auto-transformer.

There is another rather important reason for the employment of an output filter, and that is the prevention of shocks. When an H.T. eliminator or all electric receiver is employed, it is really essential to employ some form of output filter if immunity from shocks across the loud-speaker terminals is to be obtained.

Choke and Condenser Values

The value of the choke should not be less than 20/30 henrys and the usual capacity of the condenser is 2 mfd. A capacity of 4 mfd. is theoretically more desirable, but in actual practice the improvement in reception is not aurally appreciable. Now look at Fig. 3. The dotted line indicates the path of the fluctuating current, while the straight line indicates the path of the direct current to the anode of the valve, the condenser blocking the path of the direct current, but allowing the passage of alternating current. The condenser should offer a low impedance compared with that of the loud-speaker to

(Continued on page 312)

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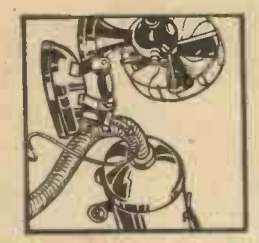

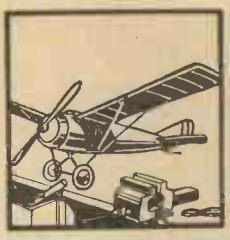


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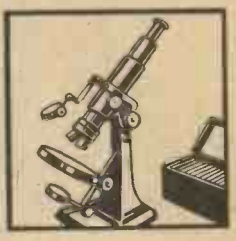
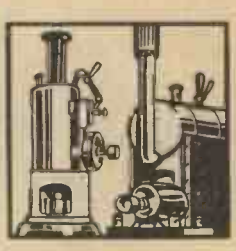


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Every section is the work of an acknowledged expert in his particular sphere, and the contents are entirely up to date. No reader of PRACTICAL WIRELESS can afford to be without this unique volume, *which is available only to regular readers of this journal who comply with the simple conditions given at foot of other page.*

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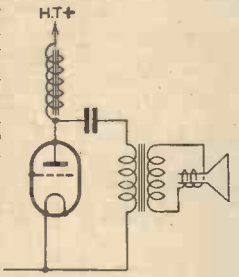
(*Continued from page 308*)

currents of even the lowest audible frequency. Values lower than 2 mfd should not be used, otherwise the response to the lower notes will be reduced.

There is another aspect to this question which applies to either transformer or choke output circuits, and that is the drop in high-tension voltage due to the passage of current through the windings of the loud-speaker. Take a concrete example; your receiver is battery operated, employing a 120 volts (when new) H.T. battery. Assume that the last valve takes 20 milliamperes, rather a big drain on H.T. batteries, but it will serve to illustrate our argument more easily.

If the resistance of the loud-speaker winding be 2,000 ohms, then there will obviously be a voltage drop across the windings. We will calculate this according to Ohm's law:—



20/1,000 amps multiplied by 2,000 ohms will give the voltage drop, which in this case is 40 volts. A pretty large drop, isn't it? There's a third of your H.T. voltage absorbed, and it's not performing any useful function. This leaves us with only 80 volts on the plate of the last valve to operate speaker and give quality results . . . What will the voltage at the anode of the last valve be after the battery has been in use for a while? Work this out for yourself.

Now let us come a little nearer to a concrete case and see what results we shall obtain, assuming the same 120-volt H.T. battery. This time the anode current of the output valve will be 10 milliamps with the same resistance of the loud-speaker windings. Here the voltage drop will be 10/1,000 x 2,000—20 volts. Can you afford to throw away 20 volts?

There is still a further aspect to this problem. If no output filter be employed the plate current, of course, passes through the loud-speaker windings. Therefore this winding must dissipate as heat a certain amount of power. The value of the energy lost, in watts, is ascertained by multiplying the resistance of the winding by the current squared, *i.e.* I^2R. Again we take the same value for the resistance of the loud-speaker, and if the anode current of the output valve be 20 milliamps, which is quite likely if a super power or pentode valve be employed with an H.T. eliminator, then the calculation would be:—

20/1,000 x 20/1,000 x 2,000 = 4/5 or 0.8 watts which may or may not be too much for the loud-speaker winding to dissipate in heat depending upon whether the winding was designed to pass a current of 20 milliamps. Some loud-speaker windings will, of course, pass a greater current with safety. If the speaker winding will not pass this amount of current (dissipate this energy in heat) then the windings will become excessively hot and eventually burn out. We might now consider Fig. 3 a little further. It is obvious that the fluctuating currents will pass direct from the loud-speaker to earth, therefore neither of the loud-speaker terminals are at high D.C. potential with respect to earth. One terminal connects to H.T. negative which is at earth potential, while the other terminal is connected to the condenser and is consequently insulated from the high potential point. The condenser employed should be capable of withstanding the voltage of the plate supply, otherwise it will break down and the high-tension voltage will be put across the loud-speaker windings, with probably disastrous results to the loud-speaker.

The other method of connection is shown in Fig. 4. In this case one of the loud-speaker terminals is at high potential, since it is connected to the positive side of the plate supply, which is above earth potential. In this case if the condenser breaks down the plate current will divide between the loud-speaker and choke, most of it going through the latter because of its low D.C. resistance. The voltage across the condenser in this case is lower than that of Fig. 3, since there is no steady voltage due to plate supply but only the audio-frequency voltages, and these will be small owing to the low impedance of the condenser.

Fig. 7.—Choke and transformer coupled output circuit.

A tapped output choke is very useful in matching a loud-speaker to a valve, particularly one of the pentodes, Fig. 5 shows the circuit arrangement. It was previously mentioned that the inductance of the choke should not be less than 20/30 henrys; there is an important reason for this. This choke is in parallel with the loud-speaker and the impedance of both varies with frequency. At the higher speech frequencies the impedance of the choke will be very high compared to that of the loud-speaker and therefore it is of little importance considered from the point of view of fidelity of reproduction. As we get down to the lower frequencies, however, the position is very different. If the inductance of the choke were, say, 5 henrys, its impedance may be equal to or even less than that of the loud-speaker. If the impedance is low the valve load will be reduced, and consequently there will be a reduction in efficiency, the power output falling off.

In calculating the value of the low-frequency choke, do not forget that the inductance must be that obtained under working conditions. If the inductance were 25 henrys with no D.C. flowing it might be very much lower when the plate current was flowing, and as the amplitude of the current varied so would the inductance of the choke, and the lower notes would not be reproduced in correct proportions. If the anode current of the output valve is 20 mA, the inductance of the choke should be such that it does not fall below 20/30 henrys when this current is passing. So much for low-frequency chokes.

Transformer Coupled Output

A transformer, by its very nature, keeps the direct current from passing through the winding of the loud-speaker. Its great advantage, however, is that the difference in impedance, which nearly always exists between the output valve and the loud-speaker, may be adjusted. High ratios, such as 20, 40, or even 60 to 1 not being obtained with a tapped low-frequency choke.

A transformer coupled output circuit is illustrated in Fig. 6; note the difference between this circuit and that of Fig. 2, where a moving-coil loud-speaker is shown connected directly in the anode circuit of the output valve. If we employed this method of coupling, the impedance of the coil would be so low that practically no power would be transferred to the speaker, and signals would undoubtedly be so weak that it is doubtful if they would be audible. You are not advised to try this method of connection, even as an experiment. The direct current which would flow through the coil would very likely force it out of the gap in the magnet, causing the suspension to be tightened, so that free movement would be restricted, if not impossible. By employing an output transformer the D.C. is diverted from the coil windings, and the effective load in the anode circuit of the valve can be stepped down to any desired value. The same principles, of course, apply in the case of push-pull output stages.

The Ideal Combination

If we employ an output valve of very large type there is just a possibility that the primary of the output transformer will not be capable of carrying the anode current, and, consequently, the winding may burn out. The same remedy is therefore applicable as with a moving-iron loud-speaker, namely, employ a choke condenser combination, as shown in Fig. 7. Of course, in the majority of sets this is not necessary, but it is often an advantage to employ choke output in conjunction with a transformer. Any likelihood of distortion arising from the direct current flowing through the primary of the output transformer is obviated, and the primary retains its maximum inductance, with consequent improvement in reception.

Now to sum up. Here are some of the advantages to be derived from the employment of an output device.

1. The diversion of the direct current from the loud-speaker windings.
2. It prevents a serious reduction in plate voltage. The resistance of the choke winding usually being in the neighbourhood of 500 ohms, which is considerably less than that of the speaker winding.
3. The risk of the loud-speaker winding being burnt out is obviated; if the current passing is greater than the winding is capable of carrying.
4. The impedance of the output valve can be adjusted to that of the loud-speaker, thus improving the quality of reception.

If your set does not incorporate an output device, fit one. You will observe a marked improvement in the quality of reception, and the benefits derived will be well worth the outlay involved.

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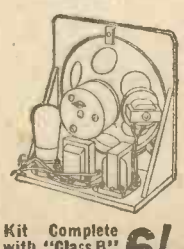

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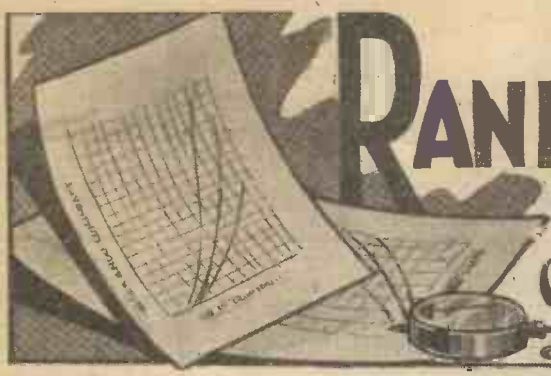

RANDOM REFLECTIONS on the 1933-4 VALVES

Including A.V.C. and Class B Types

By PERCY RAY

NOW that the excitement caused by Class B amplification has turned into a solid appreciation of its value, it would therefore seem an opportune time to review the present types of valves available, carefully ignoring those that are obsolete and of no practical value. Consequently, the screened-grid valve will be our starting-point, it not being our intention to bother the reader with a résumé from the time of Maxwell and Hertz, the true, but often overlooked, pioneers of radio. It is not intended to adhere too closely to the valves themselves, but rather to touch on subjects that are closely linked and consequently often overlooked, being overshadowed by the valve itself.

The valve is the driving-force of a radio receiver, and over-all efficiency must largely depend upon it. Too frequently an unsuitable valve is called upon to fulfil a duty that it was never intended to perform, and consequently becomes a square peg in a round hole.

It is not always fully realized that the amplification developed by each stage is equally dependent upon the valve and the chief component associated with its anode circuit. Consequently, if a good valve is provided with a totally unsuitable coupling it may give results inferior to another valve when the latter is less efficient when compared on a fair basis.

When designing a receiver for a definite purpose, as distinct from screwing a lot of components on a baseboard anyhow, a logical method is to work upwards from the output valve, first of all deciding the output required and then arranging for preceding stages to magnify the incoming signal until the output valve can be adequately loaded to supply the desired output.

Even though it is contended that the output valve is the place to start when designing a set, it does not necessarily follow that this is the best starting-point for our present purpose.

It is probably safe to say that the screen-grid valve in its ordinary form has not got many months to live as far as all-mains sets are concerned. It is already, to some extent, superseded by the variable-mu, which has an imposing list of advantages on paper but cannot be regarded as the last word in valve design, particularly for those people residing at a great distance from the local station and who require genuine selectivity rather than control of the local station. This remark is particularly applicable to listeners in Cornwall and Devonshire, and those parts of Northern Ireland that are well outside the Swamp area of Belfast and Athlone.

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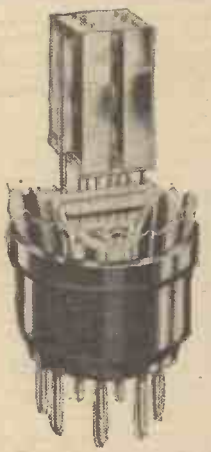

The internal construction of a Cossor Class "B" valve.

H.F. Pentodes

The present vogue of the indirectly-heated variable-mu is somewhat overshadowed by the H.F. pentodes that are making their appearance. The ordinary and variable-mu types will both be available, the latter giving all the advantages of the variable-mu valve, together with an undreamt-of degree of amplification.

The H.F. pentode has been so ably dealt with by Mr. Barton Chapple in a recent issue of PRACTICAL WIRELESS that further remarks will be out of place.

The development of the H.F. pentode is closely connected with automatic volume control, partly owing to the requirements of the latter being very considerable H.F. or I.F. gain. In the first place, the arrival of automatic volume control was heralded with considerable enthusiasm, and it seemed that the whole system was relatively simple until special valves were introduced, starting with a diode-triode, being a two and a three electrode valve in one bulb. This was quickly followed by other types, including a double diode-triode, being two diode valves and a four electrode valve in one bulb with a common cathode, culminating at the time of writing in the Cossor A.V.C. valve, which takes the form of a double diode-pentode, the whole assembly being contained in one bulb with a previously unheard-of number of external connections.

None of these developments will benefit the battery user of modest spending power, owing to the very high gain required to overcome the loss due to A.V.C. We

(Continued on page 316)

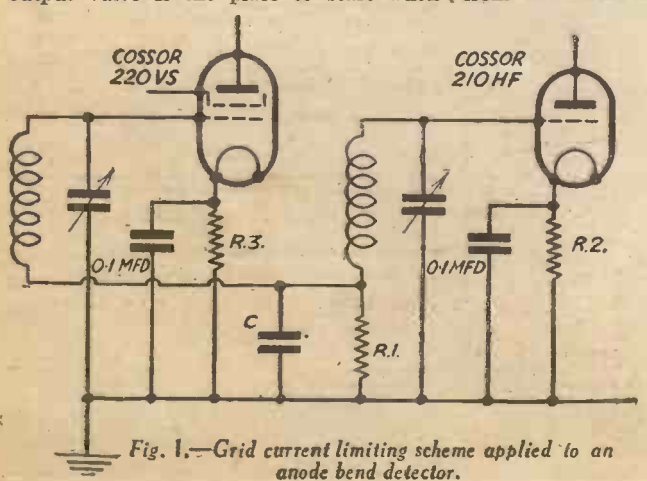

Fig. 1.—Grid current limiting scheme applied to an anode bend detector.

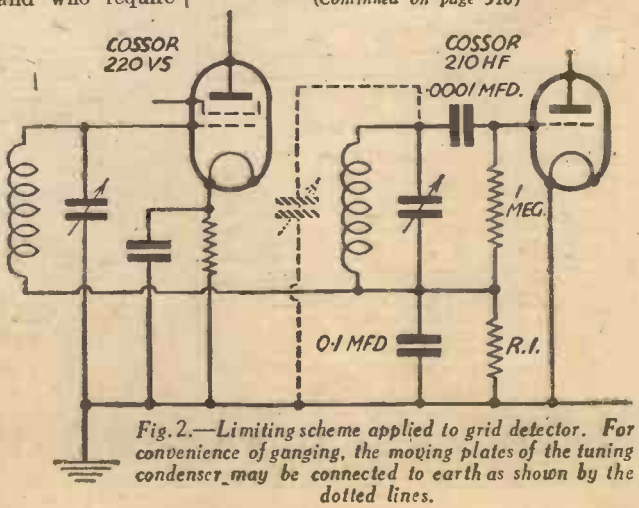

Fig. 2.—Limiting scheme applied to grid detector. For convenience of ganging, the moving plates of the tuning condenser may be connected to earth as shown by the dotted lines.

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RANDOM REFLECTIONS ON THE 1933-34 VALVES

(Continued from page 314)

therefore draw attention to Fig. 1, which shows a voltage limiting device which, although incapable of giving the perfect regulation of true A.V.C., will make many stations previously worthless capable of giving entertainment value.

The fundamental idea is that the greater the input of the detector the greater will be the grid current, consequently the farther back the variable-mu will be biased.

Before leaving the subject of the H.F. stage, it will not be out of place to correct the false impression regarding the amplification available from an ordinary screen-grid valve.

The best possible type of 2-volt battery valve is unquestionably capable of magnifying a signal by 450 times, but before this can be achieved an exceptionally efficient coil would have to be associated with it, wound with Litz wire, and the screening box would have to be made of copper, and at least 1 foot cube, to prevent the efficiency of the coil being lowered.

The very best modern coil, screened in the conventional manner (except Ferrocart) will give a stage gain with the same valve reaching about 140 times. On the other hand, there were many coils on the market that would only give a gain of 50. This loss in itself is serious, but when two stages are used the wastage becomes intolerable, as the 140 and 50 become 19,600 and 2,500 respectively, which is a loss in actual gain of more than 87 per cent.

We may next turn our attention to the detector stage, but here there is very little to be said, as nothing of note has recently been contributed, except special detector valves that cannot be disassociated from automatic volume control. It may not be out of place to mention the Westector or so-called cold valve, but at the present time this component is only efficient with large inputs, consequently we venture to think that its appeal is somewhat limited. Incidentally its use does not permit of reaction.

The output stage has shown lively developments within the last few months: firstly in the form of quiescent push-pull, a development limited to battery work, which enjoyed a very short life before it was crushed by Class B. Class B amplification has been too fully dealt with as a battery output valve to warrant further mention, but some remarks on its possibilities for mains sets will be new to many readers.

It has been often pointed out that as the smoothing device and so forth must be designed to carry the maximum current taken by the valve at any one instant, there would be no point in extending Class B to all mains receivers. But there are two points against this argument which appeal strongly to us.

First of all, Class B has a definite sphere of activity for D.C. mains sets, as the price of D.C. current is often 6d. per unit or even more, and the saving that can be effected by Class B valves over an extended period is considerable, providing that high voltage D.C. mains valves can be used so that there is no appreciable wastage in dropping the filament voltage over a large resistance.

Class B valves also have a definite use on A.C. mains when the output is really large, and although gauge of wire and so on must be adequate for the maximum current, the lowered average current drawn will permit relatively smaller valves being used.

THE EASY ROAD TO RADIO

THE BEGINNER'S SUPPLEMENT

TUNING SIMPLY EXPLAINED. By W. B. RICHARDSON.

IN my article "Wireless Theory Simplified" I gave a brief outline of the various processes of broadcasting. This week I want to tell you more about the receiver. I shall deal chiefly with the practical side of the tuning arrangements.

Every receiver, whether it be large or small, a simple crystal set or a superhet, must have at least one *tuning coil*. There may, of course, be more than one, but no set can do without one. Associated with the tuning coil is usually a *tuning condenser*.

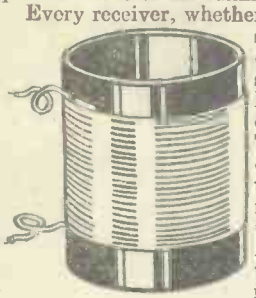

Fig. 1.—The simplest form of tuning coil.

A Simple Coil

The simplest form of tuning coil consists of a length of wire wound round some support such as a cardboard tube, as in Fig. 1. It is usual to use copper wire because copper is a good conductor of electricity. The wire is *insulated* by a covering of enamel, fine silk, or cotton. This is done so that the turns of wire may be wound side by side without touching one another. It is essential that the electric currents which flow through the coil shall not take any short cuts. If the wire were left bare and the turns wound so closely that they touched one another, then the current would simply jump across from one turn to the next without going round and round the coil.

The coils usually seen in a modern receiver may not look very much like the simple coil illustrated in Fig. 1. This is because they are often elaborated with terminals, metal screens, etc. However, they are basically the same, that is to say, they consist essentially of a number of turns of wire round a support or "former" as it is called.

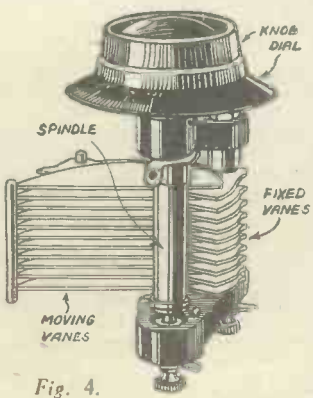

Fig. 4. A typical tuning condenser.

Connected to the tuning coil is the *tuning condenser*. Now a condenser in its simplest form consists of two metal plates placed opposite one another, as in Fig. 2. If these two plates are joined one to each end of the coil, we have what is called an *oscillatory circuit*. This is not as fearsome as it sounds—it simply means that this coil and condenser together form a piece of apparatus which, when connected to the aerial of our receiver, will oscillate or vibrate in sympathy with the wireless waves which strike our aerial. Of course, the vibrations are *electrical*, not mechanical. The coil and condenser do not jump about! It is the electrical currents produced by the incoming waves which oscillate. They rush backwards and forwards from one plate of the condenser, through the turns of the coil, to the other plate. This is shown diagrammatically in Fig. 3.

How Waves are Selected

Now this coil and condenser arrangement, which we call the aerial circuit,

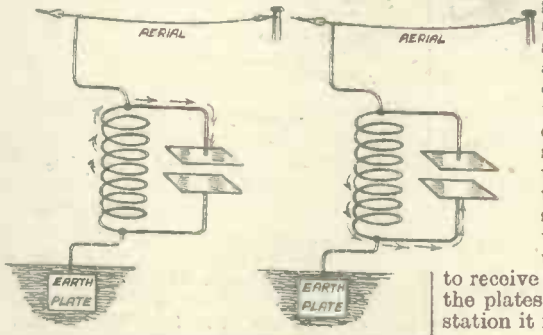

Fig. 3.—Diagram illustrating the action of the transmitting and receiving circuits.

will oscillate very readily in the manner just described when wireless waves strike the aerial at just one certain speed or *frequency*. If the waves follow one another more quickly or more slowly than this particular speed, then the oscillations will not be produced, or at any rate they will not be so intense, the degree of intensity depending on how the frequency of the incoming waves differs from the particular frequency required. For instance, we may have a coil of a certain number of turns connected to a condenser with plates of a certain size and distance apart. This circuit may respond to waves of a frequency of, say, 100 kilocycles (I will explain the derivation of the term "kilocycle" later on), but will not respond to other waves. That is to say, if a station is broadcasting waves which follow one another at a frequency of 100 kilocycles then it will cause electric currents to flow in the tuning coil, but if it happens to broadcast waves at 150 kilocycles it will not succeed in setting up currents. In this case, in order to receive the station, we must alter the value of the circuit until it will oscillate at 150 kilocycles instead of 100 kilocycles. The process involved is called *tuning*.

Tuning may be carried out by two methods—we can either alter the size of the coil or the size of the condenser. The latter is the usual method. Let us see how this can be done.

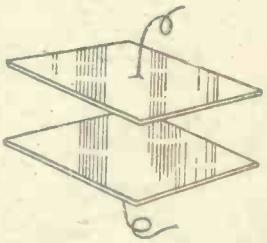

Fig. 2.—The simplest condenser.

Well, one way is to alter the distance between the plates. As we move them nearer together or further apart so the *natural frequency* of the circuit, as it is called, will vary and by careful adjustment we can get this natural frequency exactly the same as the frequency of the incoming waves. That is to say, the circuit will then oscillate in sympathy, and the necessary currents will be produced.

Although there is no theoretical objection to moving the condenser plates together and apart, it is not a very practical method, therefore the condenser is usually made so that the plates, or "vanes" as they are more often called, slide one over the other. The more they overlap the greater becomes the effective size or *capacity* of the condenser. Actually several small plates are used instead of two large ones. Half of these are fixed with a small space between each, while the other half are secured to a spindle in such a way that they interleave with the first set by rotating the spindle. Fig. 4 shows a typical variable condenser such as is used for tuning. When we wish to receive a station we turn the knob until the plates are in such a position that the station it is desired to receive is tuned-in.

Long and Short Waves

You notice that in describing this process of tuning I speak of "frequencies."

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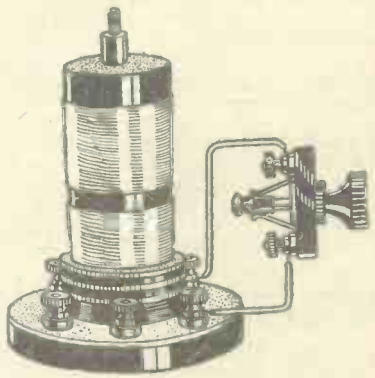

Fig. 5.—A dual-range coil and wave-change switch.

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If you have not read my article "Wireless Theory Simplified" you may wonder what is the connection between "frequency"

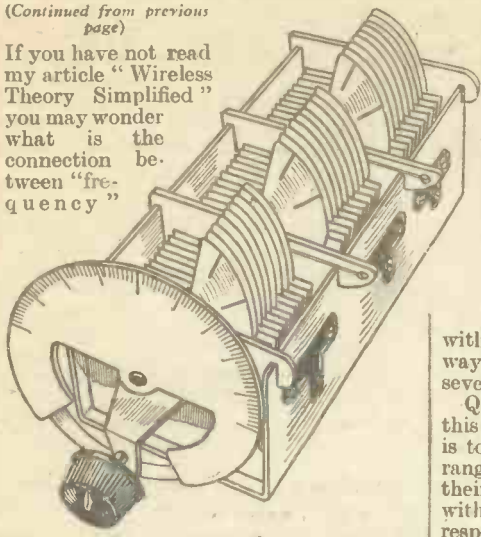

Fig. 7.—For tuning more than one circuit, a ganged condenser is used. This illustration shows a 3-gang condenser.

and "wavelengths" since it is still more usual to refer to stations by their wavelengths. Well, briefly, the difference is this:—All wireless waves travel at the same speed, namely, 186,000 miles per second, but the *length* of the waves, that is the distance from crest to crest, varies with different stations. One station may send out waves 100 metres long, while another will produce waves perhaps 1,000 metres from crest to crest. Naturally, if they all travel at the same speed, there will be a lesser number of waves passing our receiving aerial in a given time if they are long than if they are short. "Frequency" denotes the number of waves which arrive per second. Obviously, the frequency is higher if the waves are short and lower if they are long. Thus, for example, Fécamp has a wavelength of 225 metres, or a frequency of 1,328 kilocycles, while North Regional uses waves of 480 metres, which is equivalent to a frequency of 625 kilocycles. Incidentally, a kilocycle means a thousand cycles per second, that is to say, a thousand complete waves passing our aerial or any other fixed point in one second.

When you come to think that some stations emit waves only a few metres long, and, therefore, thousands of thousands must arrive at our receiving aerial per second, it will give you some idea how quickly the electric currents produced in our aerial circuit must oscillate! Of course, it is these currents which are fed to the first valve of our receiver. Connections are made to the circuit, as shown in Fig. 6. However, I will not go into details regarding the working of the valves, etc., as we are only concerned for the moment with the tuning arrangements.

Wave-Changing

Now we have seen that by rotating the spindle of the tuning condenser we can vary the natural frequency of our oscillatory or tuned circuit until the desired station is received. Well, naturally, there is a limit to the range of the condenser. It may tune from, say, 200 to 500 metres. If, however, it is desired to receive any stations outside this range, then the size of the coil must be altered. You remember that tuning can be carried out by altering the size of either the condenser or coil; well, when we reach the limit of the condenser, we change over to another coil. If, for example, we wish to receive stations using longer waves, say, 1,000 to 2,000 metres, then we switch in a coil with more turns of wire, or else we connect another coil to the end of the present one to increase its size. If, on the other hand, we want to tune in to the "short" waves, we use a coil with a small number of turns. In this way, the condenser can be made to cover several different ranges.

Quite a common way of carrying out this wave-changing process, as it is called, is to use either what is known as a dual-range coil or else a triple-range coil. As their names imply, these are coils wound with two and three sets of windings respectively. By operating a switch one set of windings is brought into action at a time. The switch is called a *wave-change switch*. One of the simpler forms is shown in Fig. 5. It is an ordinary "on-off" or shorting switch. It is

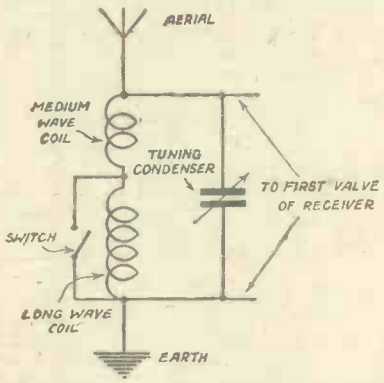

Fig. 6.—The circuit of a complete aerial tuner.

depicted connected to a typical dual-wave coil. Fig. 6 shows diagrammatically the whole tuning arrangement, including coils, condenser, and switch. When the switch is closed it by-passes or "shorts" the current past the long-wave section of the coil so that only the medium-wave winding is in use. When the switch is open the current goes through both coils. Thus, in this case, the long-wave section is composed of the two windings added together.

Different Types of Tuning Coils

As there are several different types of coils in use in modern receivers, I think it will be as well at this stage to describe some of them. The type depicted in Fig. 5 is undoubtedly very common. Apart from the medium and long-wave windings, there is usually another winding placed between the two which is used for *reaction* purposes. The object of this *reaction coil* is to boost up the oscillations set up in the tuning circuit by the incoming waves. Owing to the *resistance* or opposition which is present in all conductors of electric currents, the oscillations are not as powerful as they might be. Reaction helps to overcome this resistance. The currents flowing up and down the tuning coil are, as I have already mentioned, fed to the first valve in your set. The current from this valve is passed to the next, and so on. Now one of the valves is known as the *detector valve*, and some of the current from this is fed back to the reaction coil. In passing through this coil the current has a kind of magnetic influence on the currents in the tuning-coil, and helps to strengthen them. The amount of current passing through the reaction coil can be varied by means of the reaction control. As you know, the more you advance your reaction control, within certain limits, the louder becomes your reception.

The metal cover which is placed over the coil is not there merely to keep the dust out, or to finish off the appearance. Its real function is to prevent interaction between one coil and another (when more than one is used), or between the coil and other components. The magnetic influence of which I have just spoken in connection with the reaction coil is always present wherever there is a coil with fluctuating electric currents flowing through it. This influence may extend some considerable distance from the coil. This is not always a desirable feature, so a metal "can" or screen is placed over the coil. This cuts it off, and so prevents any unwanted reaction or other effects in the receiver.

Other types of coils are wound on rather larger formers, and do not have covers. These are usually only seen on the simpler types of receivers, or else they are shielded by some other means, such as by fixing a sheet metal plate or screen between the coil and the other parts it is likely to influence.

Another type of tuning coil has the wire wound on a special iron composition *core*. Using this instead of a hollow bakelite or cardboard tube increases the efficiency of the coil, and at the same time, enables a considerable reduction in the size of the whole assembly. Actually less turns of wire are needed, and also, finer wire may be used.

Although in the simpler types of receiver only one tuning coil and condenser is used, yet it is quite usual to employ two, three, and even four tuned circuits. In this case, the condensers are usually mounted all on one spindle,

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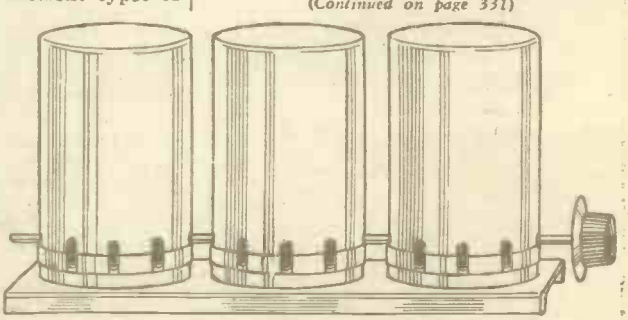

Fig. 8.—To avoid interaction the tuning coils are enclosed in cans. This is a 3-gang coil unit.

A SMALL TESTER

THE tester shown in the accompanying illustrations may interest readers who like to know the condition of their batteries, etc. The materials required are as follows:—

A polished recessed switch block 6½ in. by 6½ in.; one meter (the one shown is a Wates triple reading instrument, costing 8s. 6d.); nine sockets (Clix); three miniature screw bulb holders (metal holders, not china); and three 4½-volt flashlamp bulbs. Also a .25 mfd. fixed condenser may be required across the milliamp section. The method of construction is as follows:—

Drill nine holes, five at the top and

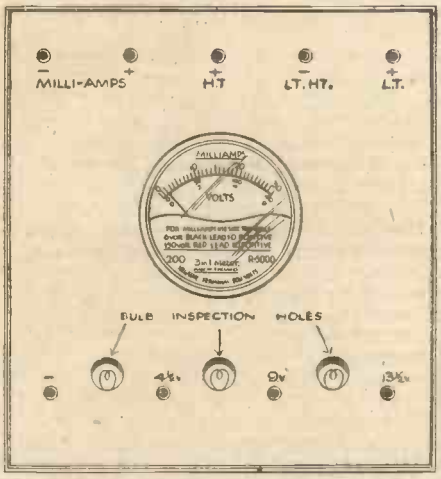

Fig. 1.—Front view of the finished instrument.

four at the bottom of the polished block for the sockets (see Fig. 1). Cut out a hole in the centre of the block large enough for the meter face to slip through. Mount the miniature screw holders on the inside of the rim at the bottom of the block, then screw a bulb in and mark where the bulb rests on the inside of block. Make three marks, one for each bulb and then drill the holes about ⅜ in. diameter. The lighted bulbs will show through the holes, at the front of block.

Wire the three holders in series, the second and third sockets tightening on the connecting wire between the miniature holders. Wire the meter up to the five sockets at

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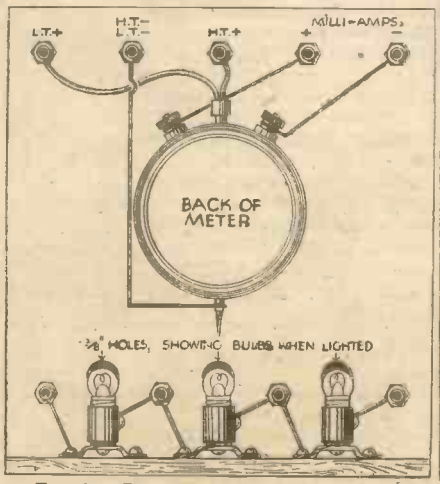

Fig. 2.—Rear view of the tester showing connections.

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By E. REID-WARR

Recruiting New Opera Enthusiasts

A NEW and clever idea from Columbia is likely to cause a real interest in opera amongst those who have been wont to consider this form of musical pageantry as something boring, if not quite unpleasant. The Columbia Company have very accurately assimilated the viewpoint of the ordinary listener to whom the long declamatory passages of the singers have made no musical appeal. When an opera such as *La Tosca* is attended, the action and the picturesque setting helps materially to embellish the "dialogue," which in this opera is somewhat plentiful. When the opera is transferred to a record, ordinary folk are apt to dwell on the comparative scarcity of real sustained melody, and so become dissatisfied. This, I think, is the line of reasoning which has resulted in what Columbia calls "abridged" or "concise" opera. They have picked all the choicest blooms from the operatic tree for your delectation. The first issued is *Il Trovatore* and *Carmen*, to be followed by *Madam Butterfly* and *Aida*. Let us look at the first, Verdi's glorious work, and see what blooms have been culled, and by whose hands. Everybody knows *Miserere*, but do they know the *Anvil Chorus?* Many know *Home To Our Mountains*, but do they know the *Soldiers' Chorus?* If you don't know them *all*, forget the prejudice against Grand Opera and listen to them as glorious tuneful melody. If Lionel Monckton or Franz Lehar had written the *Soldiers' Chorus* for a musical comedy, at least ninety per cent. of the population would have been able to hum or whistle it. In short, all but the best *tunes* have been left out, each record being a complete gem able to sparkle by itself.

Now for the performers. All are from the famous Scala, Milan; the orchestra the Milan Symphony. So you see you have also the best singers as well as tunes. The cast of each opera is different, and naturally, some artists better than others in the leading parts. Manrico in *Trovatore* is very good; the *Carmen* is extremely vivid. The records of each opera are six in number (12 inch) and are enclosed in a free portfolio with a leaflet about the opera. The cost is 24s. for the six, but each record may be bought singly.

Any effort to make people enthusiastic about opera would have been doomed to failure, if the whole had to be absorbed by musically immature listeners. Their power of æsthetic assimilation would break down under the strain. But try the easy way—that of listening to the beautiful melody, or the jolly jingles, of grand opera, selected ready for you in this series.

Some Fine Recordings from the Great Composers

The season is now getting into its stride and the big orchestras are beginning to show up with a few noteworthy performances. Let us take a Beethoven one first—the *Egmont Overture* (*H.M.V. DB*1925). Here is a piece essentially dynamic, much more closely allied to the tone-poem than to the overture. It throws on the screen, so to speak, a portrayal of exploits with restless and moving music. The playing of the B.B.C. Symphony Orchestra is as impressive as usual. Wherever Beethoven comes into the picture, you will sooner or later hear Egmont, so it will be well to hear this version at once.

Another from H.M.V. is the delightful *Nocturne from the Midsummer Night's Dream* (*DA*1318). Mendelssohn receives full justice at the hands of the London Symphony Orchestra on this record. There is, of course, a fairy atmosphere about it which quite transports the listener. This is one of the "standard" classics, and will prove a refreshing draught at any hour. Moving along chronologically, if on a different plane, you will, I think, like a quite simple record of Marek Weber's Orchestra (*H.M.V. B*4428). They play *Love's Dream After the Ball* and *Indra Waltz*. Very tuneful, light numbers, which will merge with a twilight hour splendidly. (Anyway, you ought to like the first, for the sake of the dear old Stephanie Gavotte!)

Quite the most enchanting thing of the month is the *Beethoven Symphony No. 5 in C Minor* (*Columbia DX*516–519). This has always been a great favourite: it is so helpful—so sincere. It always seems to me that the "Fifth" might well be the story of a life (or even a day in somebody's life). The first movement perhaps enunciates the theme, telling of things to be done and hinting at the reward. Here is music important—forthright—impressive. Then the second movement opens with a strain of singular and soothing beauty, with here and there reminders of the central theme. This might perhaps hint at leisure—repose after work. Strains of jollity follow to show that fun counts for something in life, after all. But—a homily breaks in with a dozen or so bars of serious music. Don't overdo it, it says. Then back to merriment, with a melody almost like musical honours at a banquet. A quiet song of thanksgiving closes.

Awakening is the dominant idea on the third record—awakening to pleasant memories. But a call to action follows, more and more insistent. Argument—hurry—getting down to it seems to characterize the third movement. And so to the fourth movement. A successful issue has been won with rich reward. Here you have

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IMPRESSIONS ON THE WAX

(*Continued from previous page*)

music of pomp and real magnificence. But the triumph is arrested by a lovely passage to recall the simple things of life.

Now all that is probably far away from the thoughts which inspired Beethoven when he wrote the fifth, but I prefer to translate it into something which may appeal to ordinary folk. Your interpretation may be different, but the music is unmistakably great; and this undying work has here been faithfully handled by the London Philharmonic under Weingartner in the finest recording of this work ever made. You can get the records in an album, by the way, with a leaflet, all for 20s. if you prefer it, and I don't know any set of better value or more lasting worth.

Piano—Organ

Another important addition to outstanding piano performances is the *Liszt Sonata in B Minor* (*H. Moll*)—*H.M.V. DB*1855–1857. Horowitz treats us to some wonderful playing. He belongs to that type of genius who can strike a single note and convey volumes. This piece contains not only examples of this, but much of the "brilliant" music Liszt often wrote. A valuable work for the student.

An eminently suitable suite—so it turns out—for the organ is the *Peer Gynt*. G. Thalben Ball has done it most pleasantly at the Kingsway Hall on two *H.M.V.* records—*B*4484–85. I am quite sure of its popularity: he interprets it all perfectly, especially *In the Hall of the Mountain King*.

Various Vocals

It is some time since a record of a male voice quartette appeared, but one on this month's Columbia list is well worth while. The McGowran Male Quartette (well known to Midland Regional listeners) have done Kingsley's *Farewell* and two funny things called *Little Tommy* and *A Catastrophe* (*DB*1178). The first is a little known setting by Colman and is most attractive. Their singing is really good, and, with the right stuff, they may be the English combination to give the reigning monarchs (The German "Comedy Harmonists") a run for their money. I heartily recommend this record to you.

You all know Teresa Del Riego's beautiful song *Homing*. Two performances have recently been issued, one by Derek Oldham on *H.M.V.* 4481 (backed by *Still as the Night*) and the other by Eva Turner on *Columbia LB*11 (with *I Love Thee*). It's up to you. Tenor or soprano? Eva Turner's rendering is an improvement on that of Alvarez, and, whilst a good performance, I don't think it is quite suited to her. I like Derek Oldham's better: it means more to me, and his other side is better than the second song of Miss Turner.

Here is a record which is a success because the singer has stuck to his natural bent—opera. Joseph Schmidt is not nearly so good in his recent frivolities as in Meyerbeer's *O Paradiso* (L'Africana) on *Parlophone R*1593. Really, this is a very fine performance, and the reverse side *Penso* (Tosti) illustrates his ability with the rhythm usually associated with Naples. It would be unforgivable to pass over a Melchior Wagnerian record. We have the *Preislied from the Meistersinger* (*H.M.V. BD*1858) in which this famous star shows to considerable advantage. I prefer the Prize Song in every way to Richard Crook's recent record, and the *Siegfried* Forging Song is a stirring effort. If you are a Wagner enthusiast, hear this.

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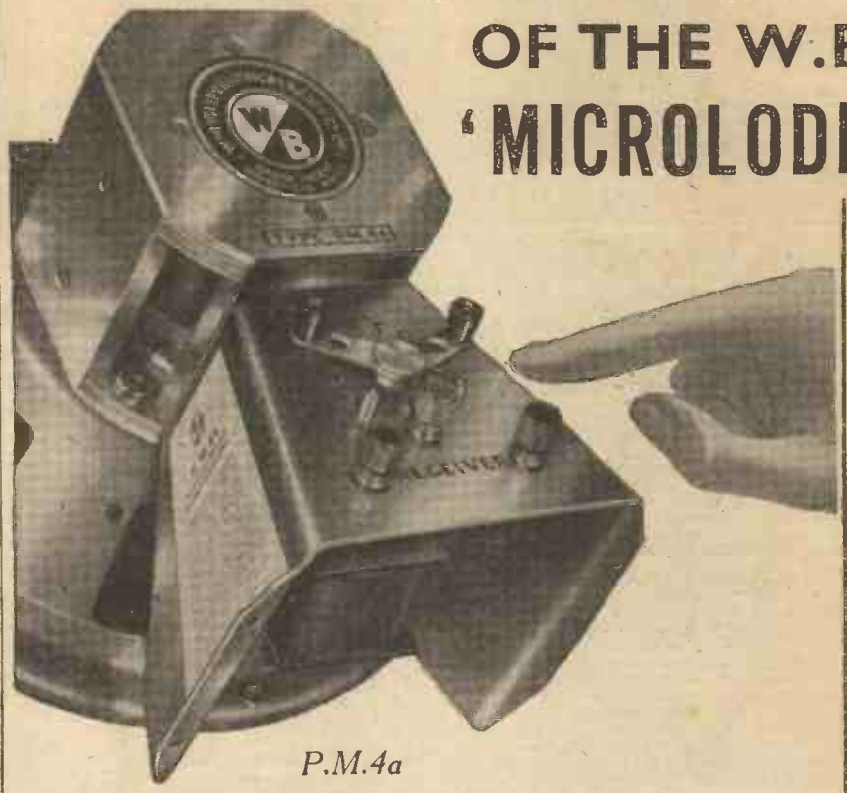

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Pr.W.2. (½d. stamp if posted in unsealed envelope)

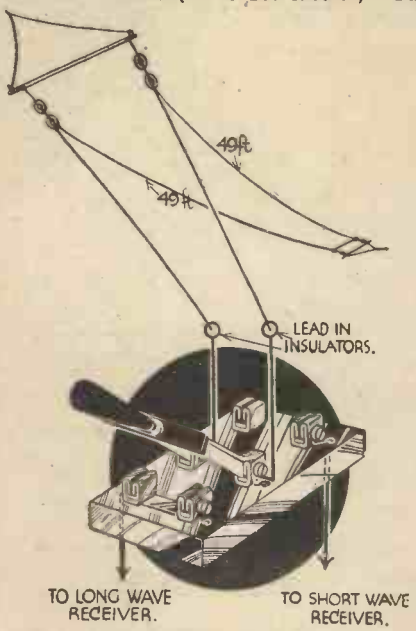
A SMALL TESTER

(*Continued from page 319*)

top of block. Place some cardboard over the meter, bulbs, etc., and then cut a piece of cardboard 6½ in. by 6½ in. and fix it down with drawing pins. The reason for using bulbs is that a more satisfactory test is gained by this method. An H.T. battery may read 50 volts on the meter, but may not have enough current in it to make a 3½-volt bulb even glow. Most H.T. batteries are socketed for 6 to 9 or 12 volts. One, two or three bulbs can be brought into use by plugging in the proper socket. It makes a good all-round and convenient tester and does not take up too much room. The diagram, Fig. 2, shows the connections behind the baseboard. The bulbs, wiring, etc., are all enclosed if the holes are neatly made. The result is a neat little meter, which can be hung up by the side of the set.—H. PALLISER (Bradford).

A Duplex Aerial for Long and Short Waves

Here is a useful aerial arrangement used for listening on widely differing wavebands. The original idea was used for the long waveband (600 to 4,000 metres), and short waves (10 to 160 metres). The



A duplex aerial arrangement for long and short waves.

aerial consists of a twin wire inverted "L" type, 49ft. in length (from free end to aerial switch), each limb being spaced by 6 foot spreaders. Good results are obtained on short-waves using one limb, long-wave reception being carried out by throwing over the double-pole double-throw switch to the opposite position, when both limbs are paralleled. The improvement noticed on the longer waves was very marked, yet short-wave reception was not marred. The accompanying sketch makes the arrangement clear and, when erected, apart from being of symmetrical appearance, it avoids the necessity of aerials being unsightly.—ROBT. E. GREENE (Fawdon).

MAKE THE ORBIT.
Specially Designed for You.
See Page 307.

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The cobalt steel magnets fitted to Celestion Speakers are ***accurately*** proportioned. The proportions are such that wasteful magnetic leakage is reduced to a minimum and the whole of the cobalt steel used to its fullest advantage. As a result, Celestion Speakers are much more efficient—are much more sensitive—than other speakers fitted with far larger magnets less accurately designed. It is such ***attention to detail*** that puts Celestion in the forefront of modern loudspeaker design. The name Celestion stands for high-quality reproduction combined with unfailing efficiency. Celestion speakers can be supplied to match any set or type of output. Ask your dealer to demonstrate, or write for illustrated details.

PPM9	Chassis Model	£1-15-0
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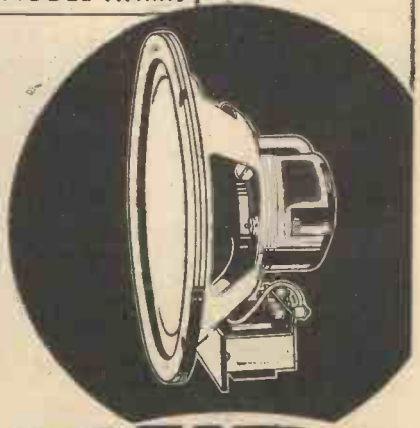
Celestion Ltd., London Road, Kingston-on-Thames.

MODEL P.P.M.9



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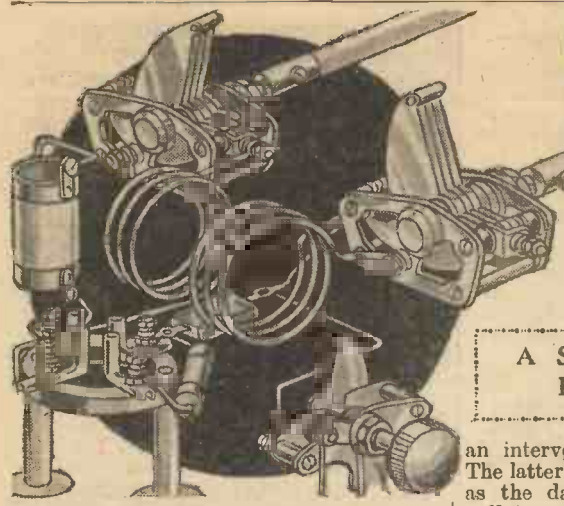

Short Wave Section

A SHORT-WAVE PORTABLE

SHORT-WAVE transmissions are so readily picked up on simple apparatus that a small portable receiver to cover the 13 to 80-metre wave band is quite a practical proposition. If the listener is prepared to be content with headphones, then two valves are usually sufficient for normal working. A stage of high frequency before the detector has not been included because the cost, weight, and space taken up by the extra components has to be considered, and a larger H.T. battery would be required. Such a stage has certain advantages, and would provide a certain amount of amplification and easy reaction control also, if the receiver is to be used on various holiday trips the aerial arrangement is likely to be different each time the set is used. The height and length of aerial would depend on local conditions, and in connection with such aerials it is worth noting that a supply of spare wire should be taken; the writer has often been compelled to abandon quite a good length of wire on packing up for the day, after getting the free end placed nice and high in a convenient tall tree. Readers must not conclude that it is a common practice to leave the countryside festooned with odd lengths of wire, but there are times when there is no alternative. If conditions only allow for a very short aerial, it should be tried connected to the grid end (terminal No. 6) of the tuning coil, with or without an intervening series condenser. The latter may not be necessary, as the damping should not be sufficient to prevent the receiver oscillating. With the particular type of dual range coil used in the receiver described here, an aerial loading inductance winding has been incorporated with the aerial coupling coil, and by shorting terminal No. 3 to No. 2 either with a piece of wire or another switch, this coil can be cut out and only the usual small aerial coupling winding used. The wave-change switch used in the receiver shorts terminals No. 8 and 5, so that only part of the tuning coil is used. This is just an ordinary "on and off" push-pull switch, and when closed the range covered by the coil is about 12 to 30 metres, and when open 25 to 80 metres. It may also be noted that the high-frequency choke has not been connected in the circuit exactly as specified on the instruction sheet sent with each dual-range coil; both methods have been tried and the one shown, which includes a fixed condenser of .001 mfd., has been retained. Constructors can use the other method if a .001 mfd. condenser is not available. Experiments with the aerial connected to the grid coil resulted in "head capacity"; the receiver oscillated smoothly as before, but touching the 'phone cords or any part of the headphones upset reception. Another short-wave choke and fixed condenser connected to the

(Continued overleaf)

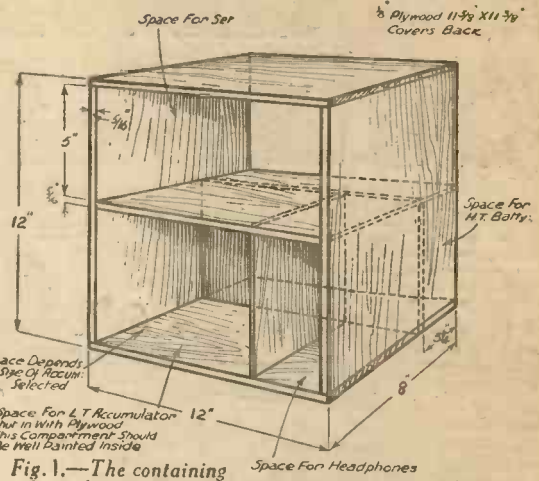

Fig. 1.—The containing cabinet for the short-wave portable.

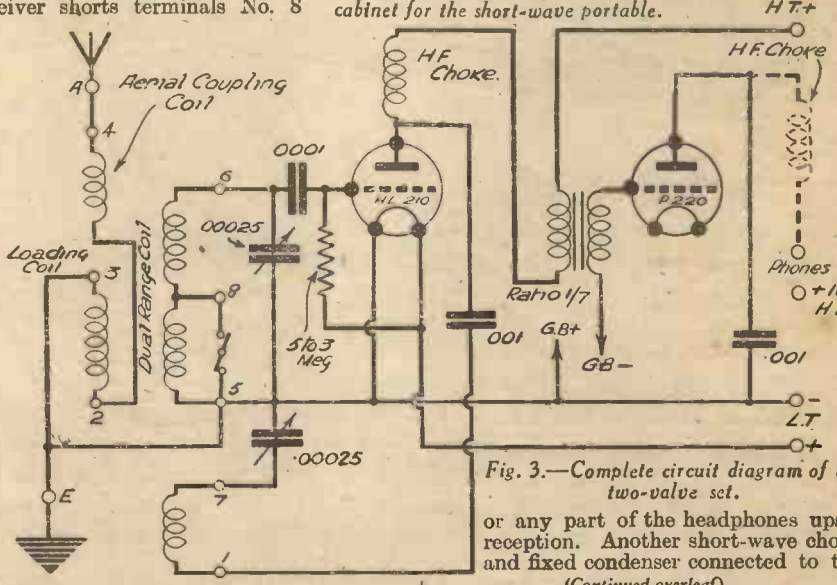

Fig. 3.—Complete circuit diagram of the two-valve set.

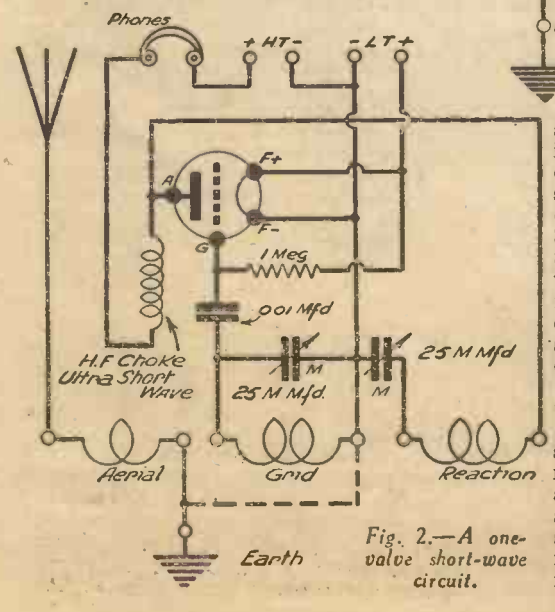

Fig. 2.—A one-valve short-wave circuit.

LIST OF COMPONENTS FOR PORTABLE

One Wood Case with Plywood Panels and Divisions and Baseboard.
One Metal Panel.
One Antinodal Short-wave Coil Unit (Radio Instruments, Ltd.).
Two Valve-holders (one short-wave and one ordinary), or two short-wave type.
One .00025 mfd. Variable Tuning Condenser (Utility).
One Slow Motion Dial, Type No. W181, for above (Utility).
One .00025 mfd. Slow Motion Reaction Condenser (Eddystone).
One Short-wave High-frequency Choke (Eddystone).
One .0001 mfd. Grid Condenser (Lissen).
One .001 mfd. Condenser (Lissen).
One Grid Leak, 3 to 5 meg. (Lissen).
One L.F. Transformer, Ratio 1 to 7 or 5 to 1 (Telsen).
Two On and Off Push-Pull Type Switches.
Four Terminals, Phones, Aerial, Earth (Belling-Lee).
2-Volt non-spill Accumulator and 100-Volt H.T. Battery. Extras to prevent hand capacity effects as per circuit diagram, Fig. 3.
One Short-wave High-frequency Choke and .001 mfd. Condenser, is required. The Eddystone taper type H.F. choke is suitable for both positions

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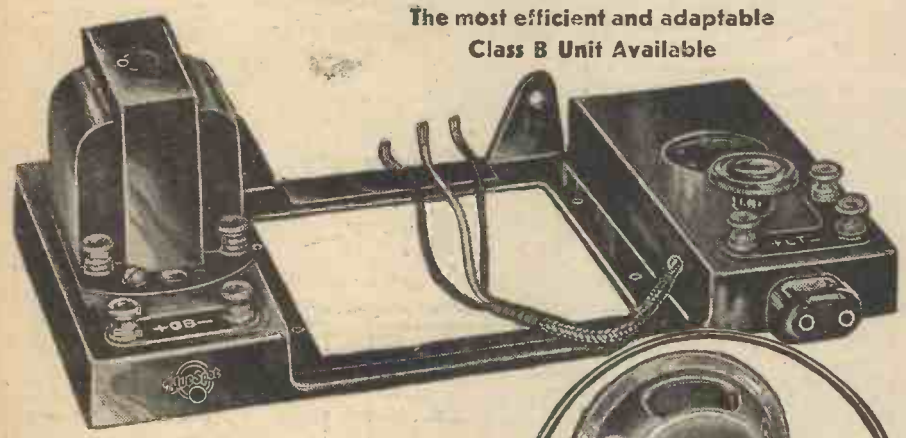

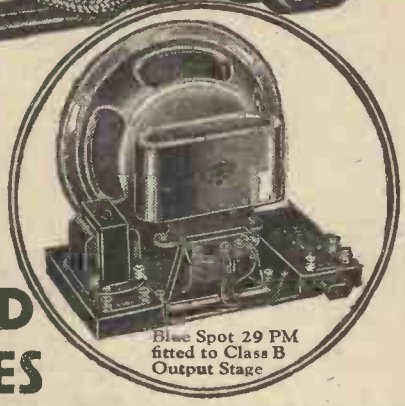

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The unit can be fitted in a few seconds and in the case of Blue Spot Speakers simply by means of bolts which bind unit and speaker together as a complete rigid unit. The assembly is then ready for fitting to the Speaker baffle, to the baseboard, or fitting inside any Blue Spot Speaker cabinet. Among the features of the new Unit are: Tone control to match Unit with Set and minimise high frequency disturbances such as heterodyne whistles or background noises. Provision for Grid Bias for Class B valve where required. Full particulars and instructions are contained in Leaflet No. P.R.24.0. which will be sent post free on request.

Price without valve . 29/6

Price with Osram B21 . 43/6

The British Blue Spot Company Ltd., Blue Spot House, 94/96 Rosoman Street, Rosebery Avenue, London, E.C.1. *Telephone: Clerkenwell 3570. Telegrams: "Bluospot, Isling, London"* Distributors for Northern England, Scotland and Wales: H. C. RAWSON (Sheffield and London), Ltd., 100 London Road, Sheffield; 22 St. Mary's Parsonage, Manchester; 177 Westgate Road, Newcastle-upon-Tyne; 37, 38, 39 Clyde Place, Glasgow.

Blue Spot REGISTERED TRADE MARK

A SHORT-WAVE PORTABLE

(Continued from previous page)

last valve as indicated by dotted lines (Fig. 3) should help to prevent this trouble or at least reduce it. Using the aerial on terminal No. 4 gave the best results, and no capacity effects. The special short-wave reaction condenser is very compact and contains its own slow-motion gear, which makes reaction control perfectly smooth and easy to adjust.

The case is of quite simple construction, and is perhaps larger than that used for two-valve portables for medium and long-wave broadcast reception, but as a first experimental short-wave portable it was considered best not to crowd the components too much. The whole of the top compartment is used for the receiver; the H.T. compartment will take a 100-volt battery measuring 10⅛in. long, 5¼in. wide, and 3⅛in. deep, when placed on its 3⅛in. side with sockets towards the outside. The L.T. compartment should be ample for a 2-volt non-spill type accumulator, or no doubt constructors will wish to use any type they have to save purchasing a special one; in any event, the accumulator is not left in the case when the set is not in use. An "on and off" L.T. switch is fitted in the side of the case where the leads from the valveholders pass through the component shelf to the battery compartment.

Two H.F. positive wander plugs are used to allow for feeding the detector with its own value of H.T. Trials should be made at various tapping sockets between 36 and, say, 60 volts, for the detector, leaving the last valve connected to the 100-volt socket. The valves used were HL.210 detector and P.220, both Mazda. Stations heard, apart from plenty of morse, have included: Vatican City, Rome, Moscow, Sydney, Australia, the Empire programmes to the African Zone, Zeesen, Amsterdam; others, French, German, and Italian stations and ship to shore talks with the ships *Bremen* and *Homeric*. The main reason for making this short-wave portable was to try short-wave reception away from the house clear of machine-made interference; the idea has also appealed to would-be short-wave listeners who live, for example, on a main road where trams and buses pass all day up to a late hour. Medium-wave reception is spoilt at many such homes owing to this, and on a short-wave set any motor-car in the street quite spoils reception; even an electric door bell sends out a "signal" or buzz which comes through at any setting of the short-wave tuning. An all-metal case would be desirable, but here again cost is a consideration.

Experimenters may not wish to have a short-wave portable if they have a plug-in adaptor unit in use, and it is suggested that apart from the fact that this receiver can be used indoors or out as a self-contained set, a slight modification would allow the first valve only being used, with suitable connections, to form a plug-in adaptor, which could be used with any medium and long-wave broadcast receiver with or without high-frequency stages, but taking its H.T. and L.T. supply from the larger set.

The accumulator compartment has been well painted as a protection against the possible action of fumes, the remainder of the case being stained and polished. A future improvement will be a waterproof canvas cover to enclose the whole case during travelling.

B. P.

(Continued from page 296)

the chassis can be seen from the revised wiring plan. To simplify the location of the parts I have divided up the chassis into 1in. squares.

You will see that the two terminals to which the reaction winding was previously joined are now connected to the high-frequency choke. One terminal of the reaction condenser is also connected to that terminal on the H.F. choke which goes to the anode of the detector valve. One end of the reaction winding is joined to a second terminal on the condenser, whilst the third terminal is left free for the time being. The second reaction coil lead is connected to the same terminal as is the lower end of the tuning coil.

To make use of the new system of reaction control, you should move the reaction coil until it is directly over the end of the tuner, and then vary the degree of reaction coupling by means of the condenser. You will find that the condenser produces almost exactly the same effect as did moving the coil itself, but considerably more accuracy will be possible. Incidentally, it is still necessary that the reaction coil should be wired up the right way round, so you might have to reverse the connections before proper working is obtained.

Differential Reaction Gives Still Better Results

The chief objection to plain capacity reaction of the kind we have just experimented with is that tuning is affected by variations of the reaction condenser. Another difficulty sometimes occurs due to the fact that oscillation starts with a "plop" instead of building up smoothly. Both these difficulties can be overcome by making use of differential reaction. For this we shall make use of the third terminal on the reaction condenser; it must be connected to earth.

It will be understood by following the connections that the reaction condenser is in series with the reaction coil, the two being joined between the anode of the detector valve and earth. Thus, as the reaction setting is reduced, the capacity also is made less; it is this which affects the tuning. But by joining the third terminal to earth, the capacity between the detector anode and earth remains constant irrespective of the reaction setting. This is because the condenser has three sets of vanes, one moving and two fixed; the moving vanes are always in mesh with one set of fixed vanes and generally in mesh with both, so that as the capacity between the moving and one set of fixed vanes is reduced the capacity to the other set is increased by the same amount.

Next week we shall rebuild our tuner, making it somewhat neater and suitable for covering both medium and long waves. The two new components we shall require will be a push-pull switch and a small angle bracket, so the cost will be one-and-sixpence only. In the meantime I hope you will find plenty of interest in experimenting with the three alternative forms of reaction.

NEW COMPONENTS REQUIRED FOR THIS WEEK'S EXPERIMENTS

One "Goltone" Super H.F. Choke.

One British Radiogram .0003 mfd. Differential Reaction Condenser.

One British Radiogram Component Bracket, type No. 22.

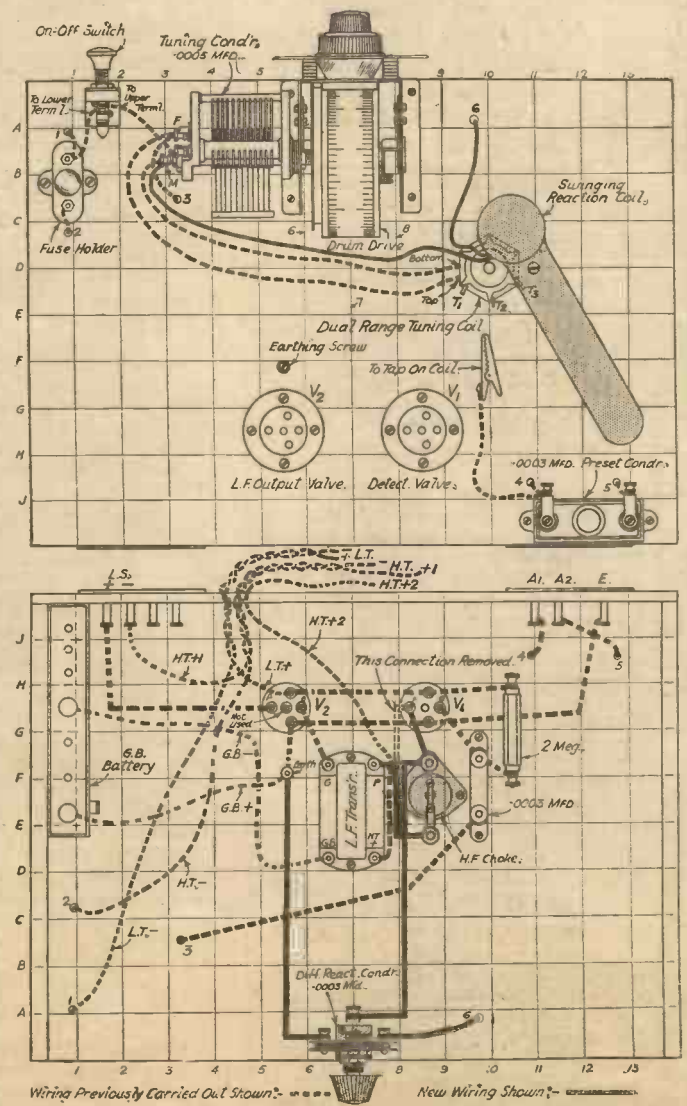

Fig. 7.—The wiring plans above clearly show the new wires which have been added during this week's experiments.

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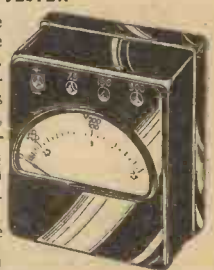

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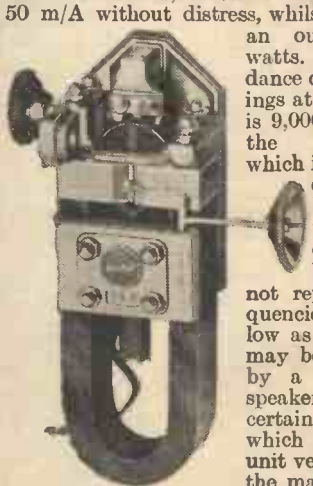
FOR *ALL* REPAIRS!

BLUE SPOT SPEAKERS

EVERYONE cannot afford a good moving-coil speaker, and there are also many listeners who have receivers which are not really capable of doing justice to a speaker of this type. It might be thought that to these listeners high-class reproduction is barred, but there is no reason at all why it should be.

Blue Spot Model 45 P.M., showing how the stand is built into the chassis.

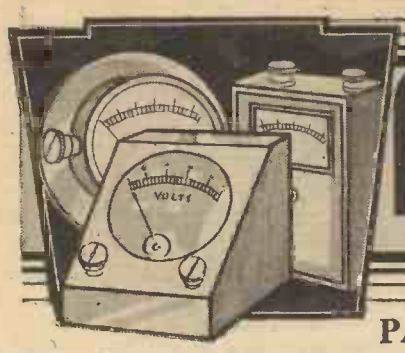
Amongst the extensive Blue Spot range of speakers is a unit known as the 66R. This costs 27s. 6d., so that some idea of its elaborate make-up may be gauged. It is of the four-pole balanced armature type and is of massive construction. It is wound to a resistance of 1,000 ohms and will handle 50 m/A without distress, whilst delivering an output of 3 watts. The impedance of the windings at 1,000 cycles is 9,000 ohms, and the transformer which is fitted to it enables it to be matched to any type of valve. Whilst it will not reproduce frequencies quite so low as those which may be dealt with by a moving-coil speaker, there are certain features which render this unit very useful to the many listeners who require a high-class reproducer capable of handling power and delivering really high quality. Fitted with a good cone and arranged on a suitable baffle, the results will excel those which are obtained by means of a cheap moving coil.



A substantial moving iron unit. Model 66 R.

In a better class, and for those who prefer the moving-coil type of speaker on account of its bass handling capabilities, is the 45 P.M. This is a permanent magnet speaker having the entire magnet system enclosed to prevent the entry of dust, etc., into the gap. This will also handle 50 m/A, but will deliver an output of 4 watts. The speech coil impedance is only 1.9 ohms,

(*Continued on page 331*)



ABOUT METERS

PART 2 ——— By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc.

In This Article the Author Explains the Uses of Various Measuring Instruments, and Gives Examples of Simple Tests

WE have seen that the deflections of the pointer in either a moving-iron or moving-coil instrument depend upon the strength of the current passing through the meter. By suitable design of the coil, and of the magnetic circuit, instruments can be made to give a full scale deflection for any given current—2 milliamps, 20 milliamps, 200 milliamps, 2 amperes and so forth. The scale can then be divided up or graduated, and the instrument is termed a milliammeter or ammeter, according to its range, its readings being direct in milliamps or amps, as the case may be.

A milliammeter, even if only an inexpensive one, is quite the most useful instrument which a radio experimenter can possess. For battery operated sets a range of 0–30 milliamps is recommended, but for mains receivers 0–60 milliamps is preferable. If possible, a second milliammeter reading 0–2 or 0–5 should be obtained, as this is very valuable for testing the anode currents of earlier stage valves, such as detectors, which usually take only a milliamp or so. As we shall see later, such an instrument can also be used for a variety of other tests.

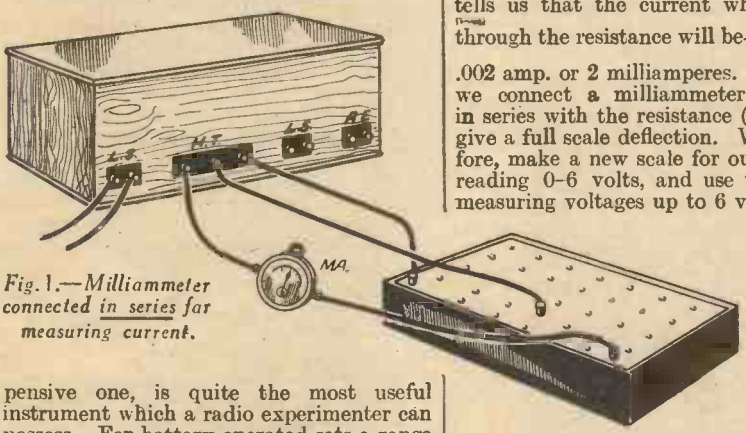


Fig. 1.—Milliammeter connected in series for measuring current.

An Important Test

But a milliammeter will only tell whether the various currents flowing in a receiving circuit are of the correct value, and in Fig. 1 we see an instrument of this type joined directly in series with an H.T. lead. While this gives a useful guide to the condition of the set as a whole, and to the location of any trouble which may exist, further tests are necessary to trace faults to their source.

Of these tests the most important is a test of voltage, and for this purpose another instrument, called a voltmeter, is required, see Fig. 2. It is at this point that I must explain that a voltmeter is simply a milliammeter in disguise, and my explanation will assist you to understand why very often a single instrument can be made to read both in milliamps and in volts. I will also explain why many of the cheaper sort of high reading milliammeters cannot successfully be used as voltmeters, and why some of the cheaper sort of voltmeters are almost valueless for radio work.

Suppose we connect a 3,000 ohm resistance across the terminals of a 6-volt accumulator. Our old friend, Ohm's Law, tells us that the current which will flow through the resistance will be $\frac{6}{3,000}$ amp. or .002 amp. or 2 milliamperes. If, therefore, we connect a milliammeter reading 0–2 in series with the resistance (Fig. 3) it will give a full scale deflection. We can, therefore, make a new scale for our instrument, reading 0–6 volts, and use the meter for measuring voltages up to 6 volts, provided we keep the 3,000 ohms resistance in series with the instrument for all voltage tests.

Similarly, if we connected a 125,000 ohms resistance in series with the 0–2 milliammeter, we could calibrate the instrument to read 0–250 volts, because if 250 volts be applied to a resistance of 125,000 ohms, the current flowing will be just 2 milliamps. Other ranges can be arranged for in the same way, by employing different values of line resistance, the scheme being shown diagrammatically in Fig. 4.

A Point to Watch

It must be noted in this connection that the total value of the resistance in the voltmeter circuit, *including the resistance of the instrument itself*, should be such that, when applied to a source of voltage equal to the maximum voltage to be measured, the current, calculated according to Ohm's Law, will be equal to that required to give a full scale deflection of the instrument.

For example, suppose you require to use a milliammeter scaled 0–5 milliamps as a voltmeter to read 0–250 volts. From Ohm's Law, the total resistance required will be $\frac{250}{.005}$, or 50,000 ohms. If the instrument has a coil resistance of, say, 200 ohms, the line resistance should, strictly speaking, be 50,000–200 ohms, or 49,800 ohms. But, bearing in mind the fact that 200 ohms is less than 1 per cent. of 50,000, the error introduced by using a standard 50,000 ohm resistance is negligible.

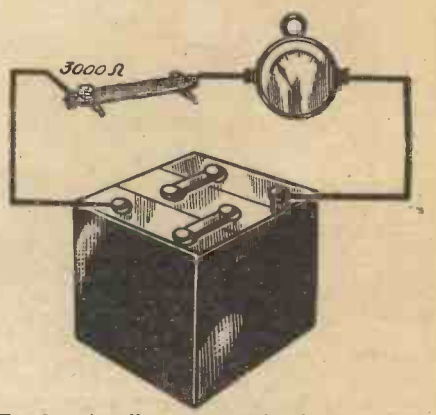


Fig. 3.—A milliammeter with a line resistance in series will act as a voltmeter.

Note also, in the case of an instrument calibrated in volts, it is important to ascertain what current the instrument requires for a full scale deflection. Many cheap voltmeters take a current as great as 30 milliamps. It is quite useless to attempt to measure the voltage of, say, a small H.T. battery with such an instrument, as the load of 30 milliamps imposed by the voltmeter would cause a serious drop in the battery voltage, and result in an erroneous low voltage reading.

Meter Resistance

In this connection it must be remembered that the voltage of a high-tension battery,

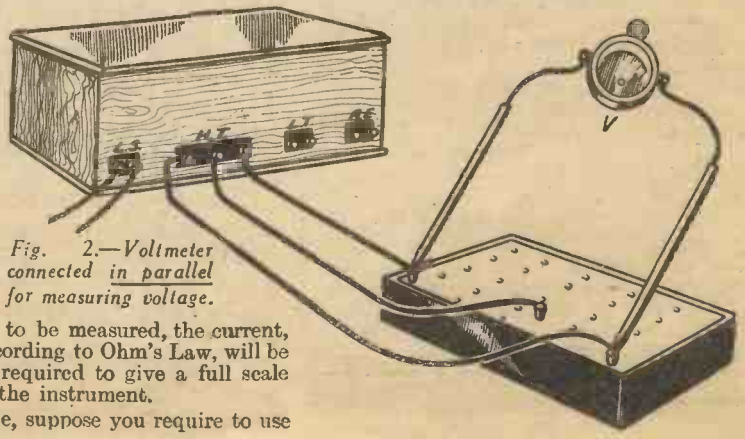


Fig. 2.—Voltmeter connected in parallel for measuring voltage.

AMPLION CHOKE RANGE

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(Continued from previous page)

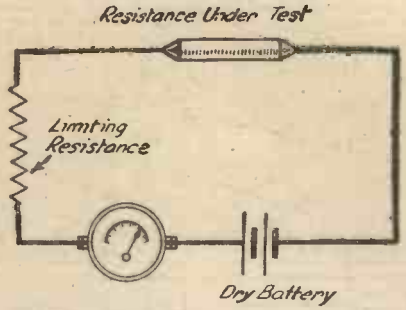


Fig. 5.—A milliammeter in series with a limiting resistance and small dry battery can be used to measure resistances.

measured while on load, *i.e.*, with several valves operated from it, is lower than the nominal or "no-load" voltage by an amount equal to the voltage dropped due to the internal resistance of the battery. If, in addition, a heavy drain is taken by the voltmeter, a further drop in voltage will be registered. On the other hand, if you wish to test the voltage of a H.T. battery when disconnected from the set, a voltmeter taking a current approximately the same as that taken by the set will give a fairly accurate measurement.

We have seen, then, that a high resistance voltmeter is very desirable, and it is important to remember that an instrument having a resistance of 1,000 ohms *per volt of scale reading* will draw only 1 milliamp; 500 ohms per volt, 2 milliamps; 200 ohms per volt, 5 milliamps; 100 ohms per volt, 10 milliamps; 50 ohms per volt, 20 milliamps, and so on.

It frequently happens that one requires to measure currents beyond the range of an existing milliammeter. For example, suppose your milliammeter reads only from 0 to 5, and you wish to measure a current of about 30 milliamperes. This can be very easily arranged. All that is necessary is to connect what is called a "shunt" across the terminals of the milliammeter, so that only a known fraction of the current to be measured passes through the instrument. The first thing to do is to obtain or measure the *actual* resistance of the milliammeter. Then obtain or wind a resistance equal to one ninth of the instrument resistance, and connect it in parallel with the instrument. Now only 1/10 of the actual current will pass through the meter, the other 9/10ths going through the shunt. The value of the total current will thus be obtained by multiplying the milliammeter reading by ten.

Thus, if your instrument has a resistance of 180 ohms, a shunt of $\frac{180}{9}$=20 ohms will multiply the readings by ten. Similarly a shunt of 1/99 of the meter resistance (in this case 1.82 ohms), will multiply the reading by 100.

A very important type of test which most amateurs require to make at one time or another is the accurate measurement of resistances. This can be done very simply by means of a milliammeter and a 4½-volt flash-lamp battery.

The first thing to do is to obtain a resistance which, when connected in series with the milliammeter and the 4½-volt battery, will limit the current to the full scale reading of the instrument. Thus, if your milliammeter reads 0–5 milliamps, a total resistance of $\frac{4.5}{.005}$=900 ohms will be required. If the instrument has a coil resistance of 180 ohms, the external resistance will have to be 900–180=720 ohms.

To measure the resistance of any piece of apparatus, connect the milliammeter, the limiting resistance (in this case 720 ohms), the resistance to be measured, and the 4½-volt battery in series, as shown in Fig. 5. Note the reading of the current, and calculate the total resistance (*i.e.*, unknown resistance + limiting resistance, and resistance of the instrument) as follows:

$$\text{Total Resistance} = \frac{4.5 \text{ volts} \times 1{,}000}{\text{current in milliamps.}}$$

For example, if the meter in the above example reads 2 milliamps, the total resistance in circuit would be $\frac{4.5 \times 1{,}000}{2}$ = 2,250 ohms.

From this value you must now deduct the resistance of the instrument and of the limiting resistance (in this case 900 ohms), so that the actual resistance of the apparatus under test is 2,250–900=1,350 ohms.

The final type of test which can be applied with even a cheap milliammeter is a test of circuit continuity. Connect a battery, resistance, meter and a pair of testing prods in series, and apply the prods across the points between which continuity is to be tested. A deflection of the pointer will denote that the circuit is intact.

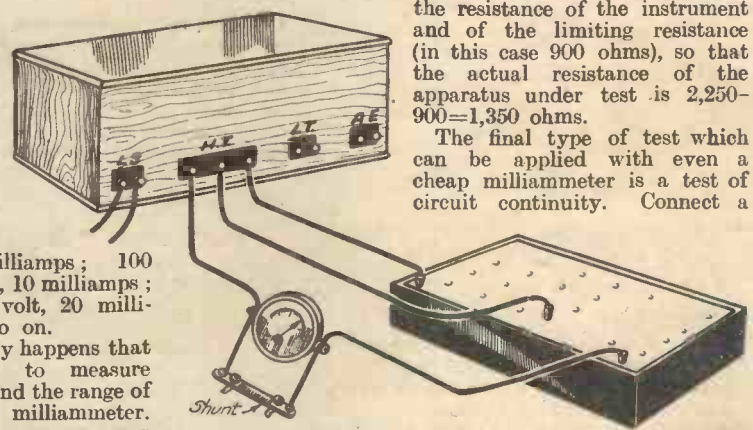


Fig. 4.—A shunt connected in parallel with a milliammeter measures its range.

It may easily happen that in testing between two points more than one path is available. Thus, in Fig. 6, continuity would be indicated between the points A and B, even though the transformer secondary had broken down.

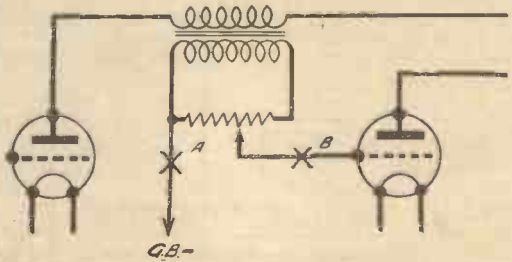


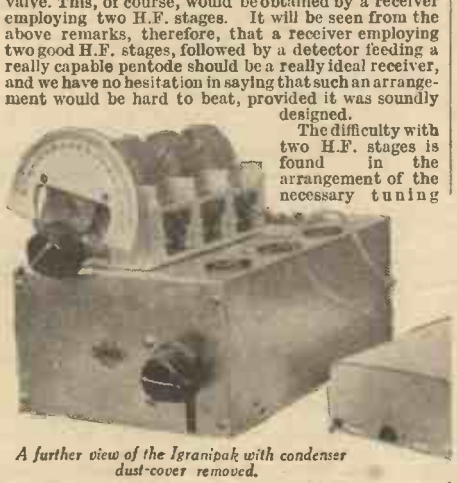
Fig. 6.—Make sure in continuity tests that there is not an alternative current path.

THE IGRANIPAK

THE requirements of the present-day listener are first and foremost, selectivity, and secondly, quality. The most certain way of obtaining the first mentioned is by means of the superheterodyne circuit, but there are certain drawbacks to this arrangement which are difficult to overcome unless the circuit is thoroughly sound and well designed. The only other way to obtain selectivity is by means of a number of tuned circuits. The band-pass circuit has done much to improve matters, but there is no doubt that two good H.F. stages, with well-designed coils, require a lot of beating, even by a superhet. The principal requirement for quality is a good volume fed into a really capable output valve. This, of course, would be obtained by a receiver employing two H.F. stages. It will be seen from the above remarks, therefore, that a receiver employing two good H.F. stages, followed by a detector feeding a really capable pentode should be a really ideal receiver, and we have no hesitation in saying that such an arrangement would be hard to beat, provided it was soundly designed.

The complete Igranipak with valves in position.

The difficulty with two H.F. stages is found in the arrangement of the necessary tuning coils, and the problem of ganging the circuits is one which, although not insurmountable, is rather beyond the home constructor. The Igranic Company, fully realizing the above points, have endeavoured to cater for the listener who requires a receiver on the lines mentioned, and who wants the construction to be brought down to the very minimum. In the Igranipak we have a really substantial metal chassis upon which is mounted not only the gang condenser and the tuning coils, but *all* the remaining parts for two H.F. stages and a detector. By all the parts we mean the valve-holders, fixed condenser and leak, wires, etc. In fact, the complete pack is a three-valve set ready wired. To complete it all that is necessary is the detector anode component and a further valve (preferably pentode), with, of course, the required voltage supply source. The pack may be obtained for battery-operation or for A.C. mains operation, and it puts in the hands of the home constructor a highly tuned and efficient piece of apparatus which will take a lot of beating so far as selectivity and range is concerned. The price is only 57s. 6d.



A further view of the Igranipak with condenser dust-cover removed.

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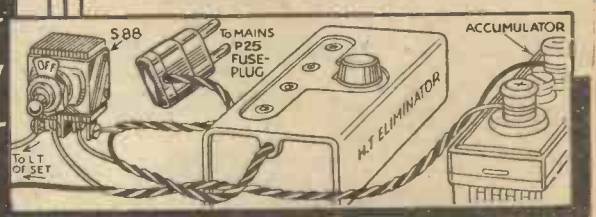

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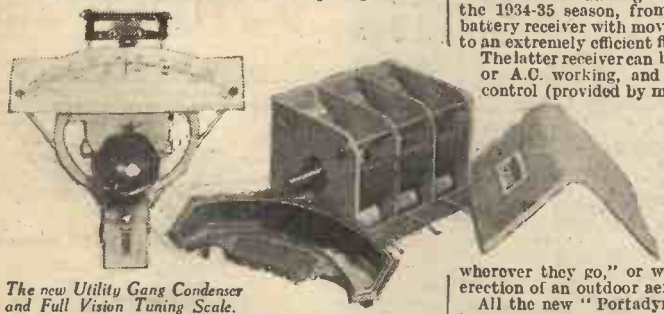
FACTS & FIGURES

Components tested in our Laboratories

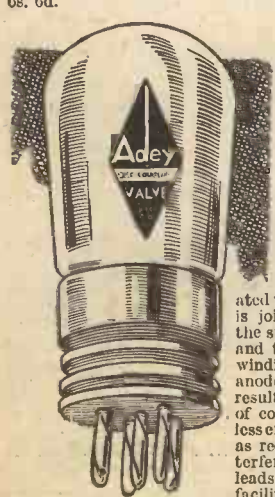
UTILITY GANG CONDENSER

ONE of the neatest gang condensers which we have had the pleasure of inspecting has just been received from Messrs. Wilkins and Wright. Although this is of the three-gang type, the length is only 3¾in., whilst the width and height are each 2¾in. The comparison with the dial, as may be seen from the photograph, gives some idea of the neatness of this component. The actual structure is very rigid, and the moving plates are joined all along one edge by a solid mass of metal, whilst the usual spacing washers



The new Utility Gang Condenser and Full Vision Tuning Scale.

are also embedded in solid metal. The spacing is unlikely, therefore, to vary under any normal use. A neat dust-cover is provided, and this is of this metal and clips into position, thus totally enclosing the whole assembly. For connection purposes lengths of 18-gauge wire are brought out from the fixed sections of the condenser, and these project just over half an inch. To prevent short-circuits, a thin strip of bakelite material is provided with three holes, and this prevents the wires being bent into contact with any of the metal casing, etc. Solid feet are cast into the body, and for trimming purposes a vertical adjustment is provided on the left-hand side of the case. Ordinary machine screws engage on a cam device which operates with a very small movement and thus enables a really fine adjustment to be made to the trimmers. A movement of nearly a quarter of an inch is possible on the screws, which, of course, is ample for all normal purposes. The price of the condenser is 19s. The dial is of the parallel movement type, the scale being fixed and a pointer moving across it on the same lines as the original Utility Straight Line dial. The movement is nice and smooth and free from any form of backlash, whilst the scale is marked in wavelengths (medium at the upper edge and long at the lower edge) with a 0 to 100 scale in the centre. An adjustment is provided so that the scale may be fitted to various types of condenser, irrespective of the height of the spindle above the baseboard. The scale costs 6s. 6d.



The Adey Valve.

"ADEY VALVE"

A NOVELTY in valve design which has been developed by Mr. Adey, proprietor of Adey Wireless. This valve, as may be seen from the illustration, has a choke coil wound round slots provided in the ebonite base, and it is provided with five pins, although only of the battery-operated type. The centre pin is joined to one end of the special choke winding, and the other end of this winding is joined to the anode of the valve. The result of this novel method of construction is to give less external wiring, as well as reduce the risk of interference due to long leads. It also greatly facilitates the construction of a receiver as it is practically two components in one, and thus avoids the necessity of fitting one component and carrying out the necessary connecting leads. It cannot be purchased except in the special Adey Portable illustrated below.

PORTADYNE RADIO—1934 MODEL

IT has been pointed out that a slight misstatement occurred in our report on the Northern Radio Exhibition regarding the products of Messrs. Portadyne Radio.

This firm is making a wide range of receivers for the 1934-35 season, from a two-valve self-contained battery receiver with moving-coil speaker at £6 19s. 6d. to an extremely efficient five-valve superhet at £15 15s.

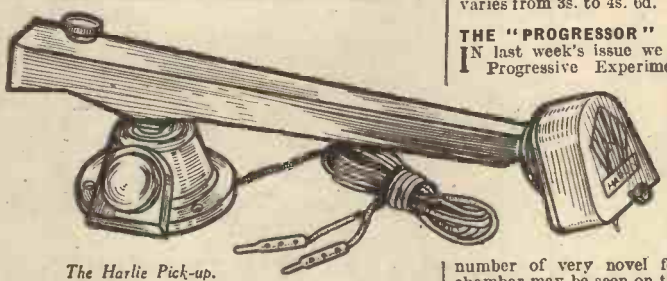
The latter receiver can be obtained for either battery or A.C. working, and includes automatic volume control (provided by means of a double-diode-triode valve) and other up-to-date features.

Another interesting "Portadyne" receiver is the type "P.B.," which is a very efficient portable receiver with Class B output. Priced at £13 13s., it is sure to prove extremely popular with those who like "music wherever they go," or who have no facilities for the erection of an outdoor aerial.

All the new "Portadyne" sets employ single-knob tuning controls, and are especially easy to operate.

THE HARLIE PICK-UP

THIS is a very sensitive type of pick-up, delivering sufficient volume to enable good loud-speaker results to be obtained with only one L.F. stage preceding the output valve. It includes a volume control, and is provided with an adjustable counter-balance. The method of armature suspension relieves record wear, and yet avoids rattle or chatter.



The Harlie Pick-up.

BULGIN TRI-POLAR Q.M.B. SWITCH

THE difficulty of arranging a switch to operate a number of circuits has always been in the method of separating the various contacts. Several successful schemes have been devised from time to time, but the latest Bulgin switch appears to have overcome a number of defects which were previously experienced. The dial is very similar to the type which is fitted to the modern automatic telephone, and behind this is a disc of paper bearing two sets of markings. In one position the dial shows wave-change switching and "Off" positions, whilst in the other position numbers are visible through the holes, and may be used for any particular form of switching. The control knob turns through a few degrees before the contact mechanism comes into effect, with the result that the arms of the switch fly into the next position in a very sudden and forceful manner. Owing to the particular method of construction, and the metal employed for the arms and the contacts, the method of make-and-break is very good indeed, and a fair amount of current could be carried by the switch without introducing any troubles. For any purpose where more than one switch is at present required, this arrangement will be found very useful indeed, and the wiring of a receiver will be greatly simplified by its use. The price is 3s. 6d. for a single-pole type; 5s. for a bi-polar type, and 6s. 6d. for the tri-polar type, the differences existing only in depth behind panel. Thus the bi-polar type employs two layers of the single-pole type, whilst the tri-polar has three layers, or sections, of the single-pole mechanism.

VARLEY 4-VALVE SUPERHET MODEL A.P. 46

IN our issue dated October 7th last we gave a test report on the above receiver, and it was stated in this report that the circuit followed more or less orthodox lines. We now learn from Messrs. Varley that instead of a band-pass input circuit, this receiver employs a separate H.F. stage, combined frequency changer, and no I.F. valve. We shall be glad if readers will note this alteration.

GRAHAM FARISH DRIVER TRANSFORMER

A NEW line in the Graham Farish productions consists of a neat driver transformer for Class B working. This is finished in a neat red bakelite case, and a label of black bakelite on the top carries all the identifications in clear gold lettering. The ratio is 1.2 to 1, and the D.C. resistance of the primary is, approximately, 250 ohms. The transformer works very well in all the normal types of circuit, and the quality is perfectly satisfactory for all normal requirements. The price is 12/6.

TELSEN SCREENED SHORT-WAVE CHOKE

THE Telsen Short-Wave Choke is an interesting component, and, unlike the majority of chokes for this special purpose, it is provided with a metal screen. A substantial moulded bakelite base is provided with two terminals, one of which is joined to one end of the choke winding, whilst the other is provided with a soldering tag which makes contact with the metal screen when this is placed into position. The winding is accommodated in a triple bobbin mounted centrally on the base, and the other end of the winding is connected to the threaded rod which passes through the choke. An ebonite spacer is fitted to the top of this rod and prevents the screen coming into contact with it and so short-circuiting the winding. The choke is intended for use on the 10 to 100-metre waveband, where it was found to work very well indeed. The price is 3s. A standard type is built up on very similar lines, but is intended for use on the 100 to 2,000-metre band, and costs 2s. 6d.

BULGIN POWER RESISTORS

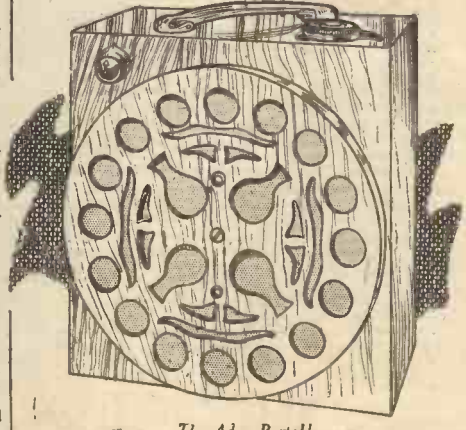
IN last week's issue we referred to Bulgin Spirohm resistances on the Facts and Figures page. The name "Spirohm" is, of course, the registered name employed by Messrs. Dubilier for their resistances of this type, and we regret any inconvenience that may have been caused by the confusion of these names. The actual report referred, of course, to the Bulgin resistors and these should have been referred to as Twenty-Watt Power Resistors. The prices of these components have, incidentally, been reduced, and the price for values from 50 to 25,000 ohms is now only 2s. 6d., whilst from 30,000 to 100,000 ohms the cost varies from 3s. to 4s. 6d.

THE "PROGRESSOR"

IN last week's issue we gave a list of parts for the Progressive Experimenter in which two Clix *baseboard* mounting holders were specified. This should, of course, have read *chassis*-mounting valve-holders.

"ADEY PORTABLE"

ONE of the smallest portables which are made. This is the Adey Portable, and it employs a number of very novel features. The loud-speaker chamber may be seen on the front of the cabinet, and this develops a really remarkable tone for such a small instrument. The circuit arrangement embraces the special valve shown on the opposite side of the page, and amongst other interesting features may be



The Adey Portable.

mentioned the special form of reaction and locking-key which is included. It is a real lightweight, and employs the very minimum, so far as batteries are concerned, yet has a wonderful range and gives splendid quality for such a small receiver.

BEGINNERS' SUPPLEMENT

(*Continued from page 318*)

so that they may be operated by one control. This is called a *ganged condenser*. One such is illustrated in Fig. 7. The coils are all carefully matched, otherwise, if they differ slightly in characteristics, the condensers will each need different settings and it would not be possible to work them from one control.

The object of using several coils and condensers is to cure "flatness" of tuning. With a set in which the tuning is flat you will find that instead of hearing a station at only one particular point on the dial of the tuning condenser, it can be heard for several degrees on either side. Naturally, this makes tuning-in very easy, but it has the drawback that two stations may overlap. For instance, say you have tuned in a station at one point on the tuning dial or scale, and you then turn the knob until you pick up another station. If the setting for the second station is only a few degrees from that of the first one, then you may still be able to hear the first one when the second one is tuned-in. You will be receiving two stations at once!

By using several tuned circuits the tuning is made "sharper," so that each station can only be picked up at one particular point on the dial. The various circuits act like a succession of filters, letting through only that which is required. There are various ways of connecting the circuits together, but we have not space enough to go into details here. Suffice it to say that sometimes two sets of coils and condensers are connected in front of the first valve, so that the currents flowing in one generate currents in the other (as in a *band-pass* tuner), and then these are passed on to the valve, or the currents in one circuit may be first amplified by a valve and then passed on to the next circuit, and so on.

BLUE SPOT SPEAKERS

(*Continued from page 326*)

and a matching transformer is fitted so that any type of output valve may be accurately matched. The cone is of a new moisture-proof material, and the method of mounting the cones ensures that a perfectly faithful rendering of all frequencies is obtained. The price is 45s.

For the reproduction of gramophone records the Blue Spot pick-up is an attractive model. With a D.C. resistance of 2,900 ohms and an output of 1 volt, this pick-up may be used with a single L.F. stage to deliver a really useful volume for domestic purposes. The method of mounting the armature permits full movement in either direction, and at the same time reduces wear on a record to a very minimum. A counter-balance is fitted to the rear of the carrier arm to remove some of the weight from the record, but in this case the weight has been adjusted so that there is sufficient weight on the pick-up to ensure good reproduction without distortion. A volume control is built in to the support. The price is 35s.

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TWO-GANGED CONDENSER

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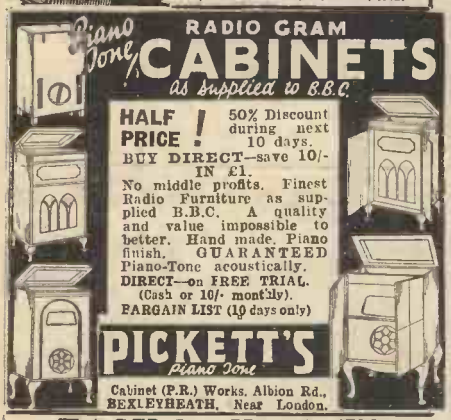

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PRACTICAL LETTERS FROM READERS

The Editor does not necessarily agree with opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication.)

The Selectone Three

SIR,—I built one of your sets, the Selectone Three, and have had very great satisfaction from it, and I believe it to be one of the best straight three sets ever designed, both for selectivity and volume, but being one of those persons looking for something better, I have tried to convert my set to a screened four, but with very little success. I would like your advice on the matter. Would you please tell me if it is possible to make a satisfactory conversion with this set, and if there is any screened four diagram carrying much the same components that I could follow when rebuilding as a screen-grid four.—JAMES PHILIP (Perth).

[*The Variable Mu amplifier, described in* PRACTICAL WIRELESS, No. 20, *can be added to this set and will prove effective in increasing the range of reception.*—ED.]

A Somerset Reader's Appreciation

SIR,—I have sent in my application form for one of your tool kits, as advertised in PRACTICAL WIRELESS. I am a keen reader of your valuable book, and have taken it from the start. Wednesdays would seem a complete blank to me if there was no PRACTICAL WIRELESS. One thing that I should like to ask is—when are we going to have some more data sheets? I am looking forward to seeing more in the future, as they are very helpful to me in my work as a radio engineer, and I would not be without them, or the "Wireless Constructors' Encyclopædia." I am convinced that there is no other paper that deals with wireless as your weekly does; it is a great help both to the novice and the expert, and I waste no time in introducing it to many of my friends, most of whom have already placed a standing order. It needs no pushing, and I shall be only too pleased to introduce it to as many as I can, feeling assured that they will be as satisfied as I am. Wishing you every success in the future.—F. C. PALMER (Bridgwater).

The "Fury Four" in India

SIR,—I am sure it will be of interest to you to know that I am receiving all the powerful European S.W. stations with the combination of your "S.W. Superhet-Converter and the "Fury Four." We all find here that Radio-Coloniale is about 50 per cent. more powerful than the B.B.C.

I am very pleased with both sets, and they have reached every expectation. I have also built the cabinet from the illustration of the A.C. model.

I think that if you gave an article on "How to modernize PRACTICAL WIRELESS sets." it would be of great interest to readers who have built them. Even if readers do not actually modernize at the time, a good deal would be learnt by knowing what is necessary.—H. PERKS (Kirkee, India).

[*We have in mind such an article, which will be published in the near future.*—ED.]

The "Fury Four" and "The Orbit"

SIR,—I was glad to read last week details of Mr. F. J. Camm's new set, the Orbit. I shall certainly make it, for I have a Fury Four at home which has been the admiration of my friends ever since I built it some months ago. You will doubtless recollect that I had a little trouble with it, but, thanks to the efficiency of your technical advice bureau, the mistake I had made in the wiring was speedily revealed to me, and the Fury Four ever since has functioned in a manner which makes your claims regarding it extremely modest. I like the helpful nature of your paper and the promptitude of your service. I have five friends all interested in radio, and every one of them now takes PRACTICAL WIRELESS. I am eagerly awaiting details of the Orbit.—H. G. (Aston).

Index to Vol. 2 Now Ready

SIR,—When will the index to Vol. 2 be ready? I am anxious to get Vol. 2 of PRACTICAL WIRELESS bound, and much appreciate the splendid index you issued for Vol. 1, which saves me a great deal of time in looking up back articles.—N. F. (Eton College).

[*Index and Binding Case is now ready, and an announcement will be made in the next issue!*—*Ed.*].

CUT THIS OUT EACH WEEK

DO YOU KNOW?

—THAT hum troubles may often be traced to interaction between L.F. transformers and energized loud-speakers.
—THAT acoustic reaction is also often responsible for hum troubles.
—THAT a powerful mains receiver should be mounted on sponge rubber feet to avoid the above trouble.
—THAT a receiver for wavelengths shorter than one inch is not difficult to construct.
—THAT aluminium paint is of no use as a metallizing medium for baseboards, etc.
—THAT a complete "pack" is now obtainable in which all components and wiring for two H.F. stages is completed.
—THAT a receiver may be constructed with a 5 k/c separation, and perfect quality obtained.
—THAT for the above purpose a special tone-corrector valve and circuit is employed.
—THAT an ammeter cannot be converted into an accurate reading milliammeter.

NOTICE.

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

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

THE WIRELESS CONSTRUCTOR'S ENCYCLOPÆDIA

By F. J. CAMM.

5/-, or 5/4 by post from Geo. Newnes, Ltd. 8-11 Southampton Street, Strand, W.C.2.

RADIO CLUBS AND SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

CATFORD RADIO AND TELEVISION SOCIETY

This Society held its first meeting of the season on Thursday, October 5th, at the newly acquired premises at 257, Bromley Road, S.E.6, for the purpose of reviewing the activities of last season and electing new officers. The Chairman, Mr. H. S. Ryland, first called upon the treasurer, Dr. Bannounah, to give his report. After giving details of the actual income and expenditure, the treasurer said that while he was glad to say that the Club was in a sound position, he felt the need for a larger reserve to meet the expenses of the new rooms and the new apparatus which it was hoped to purchase. He therefore proposed that the rate of subscription be increased to 10s. per year, and this was agreed to without dissent.

The election of officers was proceeded with, the result being as follows :—

President : Prince de Mahé.
Chairman : Mr. H. S. Ryland.
Treasurer : Dr. Bannounah.
Secretary : Mr. H. Floyd.
Attendance Secretary : Mr. G. B. Dodd.
Publicity Secretary : Mr. M. W. Jones.

The programme for the forthcoming season formed the next object for discussion, and in accordance with general opinion it was decided that a greater part of the Society's time should be devoted to work of a practical nature. All meetings this season are to be held on Wednesdays, and those interested are invited to come along, or communicate with the secretary, at 38, Como Road, S.E.23, who will be pleased to supply any information that is required.

ILFORD AND DISTRICT RADIO SOCIETY

At the twelfth Annual General Meeting recently held, the Hon. Secretary reported that the progress of the Society was still being maintained, and also that the attendances at the forty-four meetings and seven visits had proved to be the best on record the largest attendance being seventy. The finances were reported to be in an excellent state by the Hon. Treasurer, and eleven new members were gained during the year. Mr. F. E. Collinson was unanimously re-elected President, and all the retiring officers were re-elected with two exceptions. A successful Junk Sale was held on Thursday last, to open the new session, and enthusiasts should write for a copy of the syllabus for 1933-1934, to the Hon. Secretary, Mr. C. E. Largen, 44, Trelawney Road, Barkingside, Ilford.

KETTERING RADIO AND PHYSICAL SOCIETY

Kettering's "Radiomains" Relay system was the subject of a lecture to the Society on October 9th by Mr. Paul Taylor, owner of the service, and Mr. Thomas H. Hall, his engineer. Mr. Taylor traced the history and development of the system, and described the many troubles and pitfalls he had encountered. Mr. Hall dealt with the technical aspect, and detailed the construction of the receivers, amplifiers, and distributing panels. Not only were the circuits explained in detail, but reasons given for the choice of all the gear. The planning of the trunk lines was described, and samples of all material used for outdoor wiring exhibited. Both lecturers are well known to the Society. Mr. Taylor is a vice-president, and Mr. Hall one of the founders of the Society. —Secretary, Mr. R. J. Pankhurst, 9, Shakespeare Road, Kettering.

RADIO PHYSICAL AND TELEVISION SOCIETY

Recent activities of this Society have resulted in a considerable increase in the membership. Lectures have been given by Mr. Ogden on the Construction of Condensers, and other Radio Components, and by Dr. C. G. Lemon on various physical subjects, including Five-Metre Transmission and Reception, and A, B, and C Amplification. The meetings of the Society are held at 72a, North End Road, West Kensington, on the second and fourth Friday evenings in each month. Amongst others, further interesting lectures will also be given on "The Spectrum of Radiant Energy," with full demonstrations, and "The Measurement of Light." New members are cordially welcomed, and inquiries should be made to the Secretary, Mr. F. J. Bubear, of 67, Nassau Road, Barnes, S.W.13.

SLADE RADIO

"150,000 volts" was the title of a lecture given by Mr. C. J. Peakin at the meeting held last week. After giving some details of the early life of Tesla, inventor of the coil bearing his name, a description was given of induction coils and contact breakers of various types. The Tesla H.F. transformer was then described together with the circuit used ; also some details were given of early experiments with coils, and various oscillatory circuits were explained. In the demonstration which followed members were able to see how high voltages are developed and under what conditions these can be handled. The lecture proved very interesting and was enjoyed by all those present. Details of the Society will be forwarded to anyone interested.

(*Continued on page 334*)

GRAHAM FARISH PRODUCTS

CLASS B DRIVER TRANSFORMER

Meets the needs of Class B amplification. Massive silicon iron core permitting large primary currents without loss of primary inductance. Wound extra heavy gauge high-conductive wire, affording minimum D.C. resistance. Designed expressly for B.V.M.A. Valves. In handsome red bakelite case, with connections clearly marked. A thoroughly reliable component. Ratios : 1 : 1, 1.2 : 1, 1.5 : 1. Price 8/6

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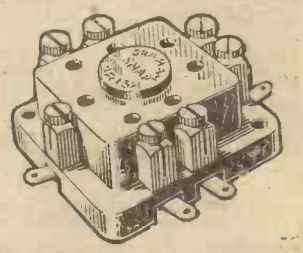
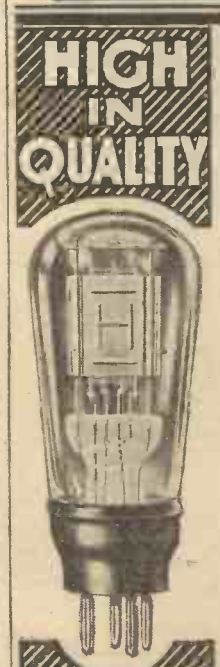


Advertisement of Graham Farish, Ltd. Bromley, Kent.



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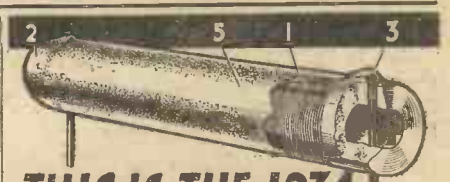

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PEAK CONDENSERS

THE needs of present-day radio demand a high standard of excellence in the components used, including condensers of fixed capacity. In the manufacture of Peak condensers, only the finest raw materials are used, which are subject to rigorous tests both before and during use. Particulars of a comprehensive range of Peak condensers are given in a folder issued by Wilburn and Co., Wheatsheaf House, Carmelite Street, London, E.C.4. Various types of condensers are shown, with soldering tags or terminals, the capacities ranging from .01 to 8 mfd. Tubular condensers, with wire or terminal ends, and electrolytic condensers for high voltage working are also listed. A copy of the folder can be obtained from the address given above.

NEW BAKER "JUSTONE" LOUD-SPEAKER

ALL discriminating listeners who insist on sound engineering design, combined with great flexibility of tone, matching, and volume control will be interested in the new Baker "Justone" moving-coil speaker, which embodies many noteworthy features. Special selecting devices on the output transformer allow no less than twenty different ratios for triodes and pentodes, and four ratios for Class "B," Q.P.P., and Push-Pull combinations. Tone selecting devices incorporated enable a large number of variations of tonal quality. The moving-coil is the multi-layer Baker "Nucoil," which has a greater impedance than the two-layer coil. The "Justone" is capable of handling an input of 5 watts if necessary, but owing to its high efficiency and sensitivity, considerably less power will give ample output for ordinary room listening. The price of the chassis model is 45s.; full particulars are given in a folder, which also includes a range of other Baker speakers, cabinets, and a Class "B" converter. Copies of the folder can be obtained from Baker Selhurst Radio, 75–77, Sussex Road, Croydon, Surrey.

HANDBOOK OF TUNING COILS

CONSTRUCTORS will welcome the third edition of this useful book, which is issued by The British Ebonite Co., Ltd. It is full of information on the construction and winding of various types of coils used in present-day practice. All the coils described are wound on the well-known Becol Ebonite Formers, and the clear explanatory diagrams in the book make the task of coil winding a comparatively easy matter for the amateur. Amongst the coils dealt with are a Universal Dual-range Tuner, H.F. Chokes, Band-Pass Tuner, a Matched Dual-range H.F. Tuner, and a Triple-range Oscillator Coil. A handy table of wire gauges and turns per inch is included in the handbook, a copy of which can be had for 6d. post free. The address is Nightingale Road, Hanwell, London, W.7.

EDISWAN BATTERIES

A NEAT little booklet, issued by the Edison Swan Electric Co., Ltd., gives some useful hints concerning Edison H.T. and grid-bias radio 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. A leaflet giving particulars of the new Ediswan Multi-circuit charger is included in the booklet, a copy of which can be obtained from 123, Queen Victoria Street, London, E.C.4.

Replies to Broadcast Queries

TWIDDLER (Pool): Monte Ceneri (Switzerland), now testing on 1,126.6 m. (265.75 kc/s). Concert from the San Lorenzo Cathedral (choir and organ). NIGHTRAKE (Peterborough): We can trace the following call signs: PAOAV, G. C. Das, Anjellerstraat 13, The Hague, Holland; PAOLL, H. A. Veringa, Nassaukade 93, c/o T. B. van Klaveren & Co., Amsterdam, Holland; PAOGA, Th. C. van Braak, C. 245A, Varsseveld (Gld.), Holland; PAOBL, O. A. J. van Lin, Herungerweg 120, Venlo, Holland; G6SR, S. W. Rowden, "Rosebank," Pilrig Street, Edinburgh, Scotland; G2DL, R. H. Lauderdale, "Kilwinning," Sutton Avenue, Hornchurch, Romford, Essex; F8BI, Cassaigne, rue Sadi-Carnot, La Magistère (T. et-G), France; F8AM, R. Vallas, 3, Avenue Madeleine, La Varenne-Saint-Hilaire (Seine); F8DC, Jacques Oehmichen, 16, rue de Villiers, Valentigney (Doubs), France; F8CP, Tassigny, 1, rue Gattinat, Mascara, Oran (Algeria); F8KE, Gamet, Place de la Republique, Cambrai (Nord), France; F8BU, R. Larcher, 17, rue Fessart, Boulogne-Billancourt (Seine), France; ON4AU, J. Mahieu, "Le Manoir," Peruwelz, Belgium; ON4AJ, A. Redemans, 150, Chaussée de Charlerol, Brussels; CT1CQ, Manuel J. Santos da Canha, Rua da Ponte, Braha, Portugal; CT1EM, Togo das Neves e Mello, 36, Rua Correia Telles, Lisbon, Portugal; OK2KO, A. Kolar, Radiostanic Svinov u Moravske Ostravy, Slezsko, Czecho-Slovakia; W6SP, W. B. Fageol, 6001, Allston Avenue, Oakland, California. J. O. (Port Glasgow): We can trace the following call signs: G5BD, A. C. Simons, "Lynwood," Mablethorpe, Lincolnshire; G5OG, C. I. Orr-Ewing, "Pond Cottage," Weald, Sevenoaks, Kent; G5MM, R. F. J. Maidment, Red House, Hoo, Kent; G2GS, J. G. Maitland Edwards, 127, Ashley Gardens, Westminster, London, S.W.1 G6IB, H. N. Miles, 325, King's Park Avenue, Rutherglen, Glasgow, Scotland; G5XH, L. W. Hooke, 104, North End, Croydon, Surrey; G5PK, A. J. Peck, 21, Geere Road, West Ham, London, E.15; G6AP, Arthur C. Porter, "Southside," 12, Stanhope Road, Sidcup, Kent; G6UI, W. T. Bassage, "East Lynne," Joynson Street, King's Hill, Wednesbury, Staffordshire; G2NU, A. J. Hall, 33, Hazelbrouck Gardens, New North Road, Hainault, Ilford, Essex; G5FA, J. A. Farrer, "The Willows," The Park, Buxton, Derbyshire; G6VP, Alan Smith, 12, Ferres Avenue, West Drayton, Middlesex; G2PJ, College Wireless Society, Loughborough, Leicestershire; G2NI, F. Akister, A.M.I.E.E., "Redcliffe," The Downs, Bowden, Altrincham, Cheshire; G2XN, Downside Wireless Society, Downside School, Stratton-on-the-Fosse, Bath, Somerset. 3 VALVER (Westbury): Scheveningen-Haven (Holland); commercial reports only.

TABLOID TECHNICALITIES

Wavelength (λ) and Frequency (f).

WIRELESS waves travel with the speed of light, namely 186,000 miles per second. The waves consist of undulations, that is, they rise and fall in the same "shape" as the sign which is used to denote alternating current, namely ~. The distance from the top of one crest to the top of the following crest, or in other words the distance between each "wave" is known as the wavelength, and this is generally measured in metres. Thus a station which employs a wavelength of 300 metres is sending out a series of waves which measure 300 metres (984.3 feet) from the top of one wave to the top of the next. One metre is approximately 3.28 ft., and therefore one mile is equal to 1,305 metres. By converting the speed of light, namely 186,000 miles per second, into metres, we see that this works out to approximately 300,000,000 metres per second. From this figure we can convert wavelengths into frequency, bearing in mind that 1 kilocycle is 1,000 cycles, and that 1 cycle is the complete oscillation from zero to maximum, back to zero and on to minimum and thence back to zero. This complete operation is shown by the sign above referred to. Thus a wavelength of 300 metres is equivalent to a frequency of 1,000 kilocycles (300,000,000 divided by 300). Frequency in kilocycles may therefore be ascertained by dividing 300,000 by the number of metres, and conversely wavelengths on metres may be obtained by dividing 300,000 by the number of kilocycles.

In order to meet the requirements of readers who prefer the work from a full-size blueprint when building up any of the "Practical Wireless" Receivers, we can now supply full-size Blueprint Wiring Diagrams of all the "Practical Wireless" receivers for 1s. each, post free. When ordering, quote the number. Copies of the paper containing descriptions of the particular receiver cost 4d. each. Address orders to: The Publisher, George Newnes, Ltd., 8-11, Southampton Street, Strand, W.C.2.

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2.	Long Range Express Three.
3.	Mains Express Three.
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5.	Bijou Three.
6.	Argus Three.
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9.	Midget Two (6d. only).
10.	Selectone Battery Three.
11.	Fury Four.
12.	Featherweight Class B Four-valver.
13.	Q.P.-P. Three-Four.
14.	Alpha Q.P.-P. Three.
15.	Ferrocart Q.P.-P. Hi-Mag Three.
16.	Supersonic Six.
17.	Beta Universal Four.
18.	A.C. Twin.
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27.	The Auto-B Three.
28.	The All-Wave Two.
29.	The A.C. Three.
30.	Premier Super.
31.	A.C.—D.C. Two.
32.	Luxus A.C. Superhet.

CLUBS AND SOCIETIES

(Continued from previous page)

SMETHWICK WIRELESS SOCIETY

At a recent meeting of the above Society, Mr. Simmonds gave an interesting lecture on "Tuning Coils." He described the early history of the coil, and defined the properties necessary for efficiency. He went on to examine modern requirements, and explained the action of the band-pass filter. Dual range coils, iron-cored coils, screening, and superheterodyne couplings were also explained. The Society has arranged an attractive programme for the winter session. Lectures by various manufacturers are included, and a special elementary class in "Wireless Theory and Practice" for new members is an interesting feature. Intending members are invited to the weekly meetings which are held on Friday evenings. Hon. Sec.: Mr. E. Fisher, M.A., 33, Freeth Street, Oldbury, Nr. Birmingham.

THE CHESTER-LE-STREET AND DISTRICT RADIO SOCIETY

The above Society has just begun its new session, and everyone interested is invited to join, the subscription being 3d. per week. A full programme of novel demonstrations is being arranged, some of the titles being: "Photocell applications," "Types of Transmitters," and "Home-made Components." For particulars apply to Hon. Sec., Mr. K. Bowe, 60, Lancaster Terrace, Chester-le-Street. At the last meeting, Mr. K. Bowe demonstrated his all-mains short-wave receiver and a very interesting evening was spent.

YOUR DISCARDED SET IS WORTH REAL MONEY

PART EXCHANGE EXPERTS

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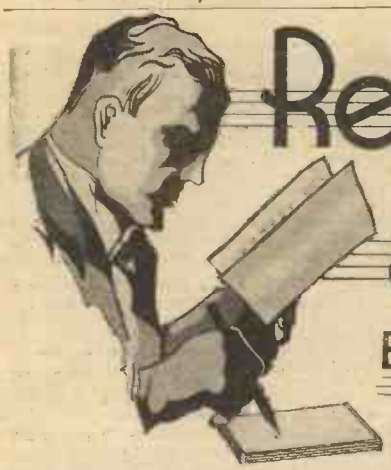

Replies to QUERIES and ENQUIRIES

By OUR TECHNICAL STAFF.

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 LUXUS SUPERHET

"I am very interested in the Luxus circuit which you recently published, but I should be very glad to know why you have not made provision for a gramophone pick-up in this circuit. It seems to me that an otherwise good circuit has been spoilt by this means."—A. B. (Southport).

We quite agree that it would have been an improvement to have been able to use this receiver for gramophone record reproduction. When the duo-diode-triode is used for A.V.C., however, and especially when it is connected as in this particular circuit, there are certain difficulties which arise. To obviate these a rather complicated change-over is required for record reproduction, and it was thought undesirable to complicate the receiver by doing this. Of course, if a highly-sensitive pick-up is employed it should not be difficult to arrange to include it in the grid circuit of the output valve and thus use a pentode valve only for amplification.

SUPERHETERODYNE CIRCUIT

"I am attempting to construct the seven-valve superheterodyne circuit described in "Fifty Tested Wireless Circuits," but find that I am unable to complete this. I am doubtful how to connect up my components, namely, one set of Telsen superhet coils, input and output transformers, etc., and should be glad if you could let me have a circuit for this purpose. The terminals are not marked for the circuit."—R. G. H. (Ashley, Ringwood, Hants).

We regret that we cannot give you a complete wiring diagram for a seven-valve circuit to suit your requirements. If you are unable to associate your components with the circuits in the book in question we think the best method is for you to purchase the Telsen Radio-mag. (or, alternatively, to write to the makers of the coils, etc.) in order that you may see how the coils which you have purchased agree with those used in the circuit in question. You appreciate, of course, that we do not know what other components you have, and probably if we gave you a circuit you would find the same difficulty in identifying various parts. As you have bought the parts named, the best procedure is to follow the makers' recommendations (and circuits) in order to get the arrangement correct.

STANDARDIZED COMPONENTS

"I have followed all of your constructional features, and although I have not yet been in the lucky position of being able to make up one of your star sets I have carefully studied each one. In every case I have been struck by the fact that the panel layouts, which are in themselves very nicely and symmetrically arranged, are spoilt because the control knobs differ. Could you not arrange to use the same maker's parts for panel layouts so that the 'amateurish' look would be obviated? Alternatively, why not use your powers to compel makers all to make the same sort of knobs."—Y. T. (Harrow).

We agree that there is a difficulty in arranging the panel layout to avoid an amateur-built appearance, but it is simply overcome. Several firms who advertise in our pages make a speciality of supplying separate control knobs from 3d. upwards, all having the same style and finish, so that it is a simple matter to replace those which are fitted to a component and thus obtain a match. You appreciate, of course, that we choose the components from an efficiency point of view rather than appearance, but we certainly agree with you that the makers should get together and decide to make one type of control so that various parts could be easily interchanged.

DATA SHEET No. 58

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

TUNED CIRCUIT DATA

In the table given below various short wavelengths are given, together with the inductance and parallel capacity which will tune to them.

Wavelength	Frequency	Inductance	Capacity
10 metres	30,000 kc/s	2.5 μH	12 $\mu\mu$F
20 "	15,000 "	5 "	22.5 "
30 "	10,000 "	7.5 "	35 "
40 "	7,500 "	10 "	45 "
50 "	6,000 "	12.5 "	58 "
60 "	5,000 "	15 "	68 "
70 "	4,286 "	17.5 "	80 "
80 "	3,750 "	20 "	90 "
100 "	3,000 "	25 "	125 "

From the above table it will be seen that to tune to a wavelength of 100 metres with a 25 microhenry coil, a tuning condenser with a maximum value of 125 micro-microfarads would be required. Any range of wavelengths may thus be chosen from the figures given.

SOLDERING

"I have tried to make a set recently, and thought it would be a good idea to solder all the leads. I am only an amateur and found that I had great difficulty in getting the solder to stick when near to a terminal. Does the terminal take away the heat of the iron in any way, or was it that I had not got the iron hot enough? I should like a few wrinkles if you could give me them so that I can improve at this method of construction as I believe it is the best."—S. L. (Yelverton).

Whilst the presence of a large metal surface will tend to conduct away a small amount of the heat of the iron we do not think this was your trouble. You had undoubtedly not heated the iron sufficiently. The best method is to heat the iron and then hold it 2 or 3ins. from your face, and then, when you have noticed the degree of heat, try and solder. After a few tries you will find the degree of heat which is necessary and then, in the future, you will be able to tell instantly, by holding the iron in this way, whether it is hot enough. As regards wrinkles, the only point is absolute cleanliness, and you will find that the solder will run and make a perfect joint, provided the iron is hot enough.

WHAT IS A RELAY?

"I have been reading some books lately, and have seen reference to a 'relay.' I should be glad if you could tell me in a few words just what this device is."—T. B. (Birmingham).

In its simplest form a relay is nothing more than an electro-magnet and an armature. That is, a core of soft iron is wound with a fairly large winding, and when a current is passed through this winding the core becomes a magnet, and therefore has the property of attracting iron. Suspended near the end of this core is a short iron bar (the armature) and a spring is fitted to one end to hold the armature a short distance from the core. When the current is passed through the magnet winding, the armature is attracted and held against the core, and in doing this two contacts are opened (or closed). Thus the relay may be made to operate any device by means of a current passed through it.

TYPE OF AERIAL

"I am building for myself the Progressive Experimenter in order that I may obtain a real working knowledge of wireless, but I am in rather an unfortunate position. My father has a wireless set with an aerial running down the garden, and my neighbours on each side also have good aerials in the garden. I cannot, therefore, put up one for myself, and I cannot use father's. Do you think the set would work off an indoor aerial efficiently, or is there any other way of using the set?"—T. G. (Blackheath).

With the Experimenter in its initial form you would need a fair aerial in order to hear any signals in your district, but as it grows you will find that a good indoor aerial will be quite good with the set. We think you can erect the indoor aerial, making it as efficient as possible and use this all through your experiments. Remember that as you have to avoid losses, you should keep the wire clear of all walls and other earthed objects, and it should preferably be arranged so that the total length, from aerial terminal to the end of the aerial is not more than about 25 to 30ft. The earth should also receive close attention, and you should also endeavour to keep that short. So long as you are able to hear some sort of signal with the set in its first stages you will be able to follow the construction right through, and be able to observe all the points which are raised. You will no doubt be able to borrow the outdoor aerial on odd occasions in order to test some particular point which may arise.

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COMMANDER-OF-THE-AIR 8-valve Superhet, Medium Waves only. Amazing Performance. A.C. Mains, Console Cabinet with Moving Coil Speaker, £8.—Box 202, Baldry's, 52, High Holborn, W.C.2.

RYALLS RADIO, 33, Chancery Laue, London, offer guaranteed new goods. Resistances 1 watt wire ends. 100, 250, 500, 1,000, 2,000, 5,000, 6,000, 10,000, 15,000, 20,000, 25,000, 40,000, 50,000, 75,000, 100,000, ½ meg., 2 meg., 6d. each.

MAINS TRANSFORMERS. 250v. 60 ma., 4v. 1 amp. 4v. 3/4 amp., 10/6, 350v. ditto 12/9, 4v. 3/4 amp. only, 6/9. Chokes. 25H at 60ma. resistance 430 ohms. 6/9. 20H at 100ma, 8/9.

CONDENSERS. TCC 2mf. 350v. working, 1/6. 1 mf. ditto, 1/3. TCC blocks 4 x 4 mf., 4/-. H.M.V. 4 x 4 mf., 3/6. TCC 4 x 4 x 1 x 1 x ½ mf., 4/9. H.M.V. ditto, 4/-, all 250v. working. TCC .01 mica type M, 6d. Telsen .05 mica, 2/3. Radiophone 4-gang condensers, new, 10/9. Output transformers similar. R. & A. 18/23/32 to one at half price, 6/-.

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BRAND-NEW Loewe A.C. Mains Receivers incorporating 3 valves in one with P.M. Moving Coil Speaker. Cost £9 10s. 0d., sell for £4 15s. 0d.—Peto-Scott Co., Ltd., 77, City Road, E.C.1.

EDISON BELL Gramo-Motors Double Spring 10in. Turntable—worth 35s. For cash 18s. 6d.—Abrahams, 80, Dartmouth Road, Hendon, W.4.

THE new "Microlode" feature fitted to W.B. Moving Coil Speakers enables you to correctly match your output valve. Seventeen transformer ratios for really accurate matching to any power or pentode valve and four ratios for Class B or Q.P.P. all available on one speaker by a simple switch adjustment.—Write for details to Whiteley Electrical Radio Co., Ltd., Mansfield, Notts.

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WEARITE Universal Mains Transformers input 200-240 A.C. Output 60 m.a. tappings, 350-0-350 2 volt 2 amps. C.T. and 2 volt 3 amps. C.T. Shrouded. Made for Set Manufacturer, worth 35/-; to clear, 12/11.

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TRIOTON Magna 4-pole balanced armature loudspeaker units, type P. Listed at 27/6, special offer, 9/3.

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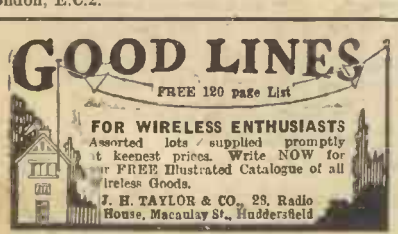

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SPEAKERS.—Rola F6 permanent magnet, 28/- (listed 49/6); D.C. mains energised, 2,500 to 6,500 ohms, complete with humbucking coils and transformers, 16/6 (list 39/6); G.E.C. Stork speakers, complete in magnificent cabinet, 19/6 (listed £3/15); Ormond speakers, complete in cabinets, 10/- (listed 25/-); Ultra-permanent magnet speakers, 95 P.M., 35/- each, a really hefty job (listed £4/15); Blue Spot, 100 U, 13/6 (list 37/6).

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READY Radio "303" A Kits, complete with cabinet, M.C. speaker, less valves, £2/5; with 3 Mullard valves (P.M.1LF., P.M.2D.X., P.M.2), £3/5 (list £6/17/6).

READY Radio Meteor "A" 3-valve Screen Grid Kit complete with cabinet, M.C. speaker, less valves, £3/7/6; with 3 Mullard valves (P.M.12A., P.M.2D.X., P.M.2.A.), £4/10 (list £8/7/6).

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WATCH movements from Gold Rush. Interesting parts and material. Send 7d. for sample.—Merkel, Pilgrim Street, Newcastle-on-Tyne.

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