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Practical Wireless

3D.

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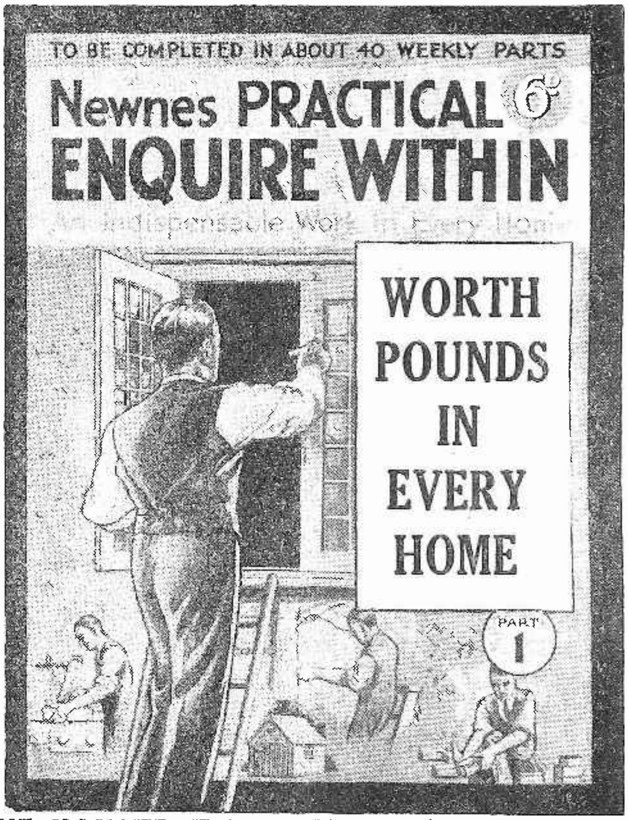

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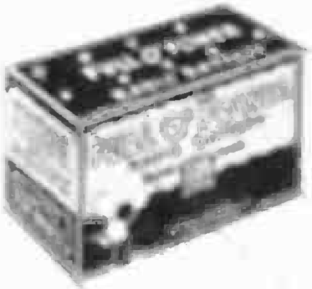

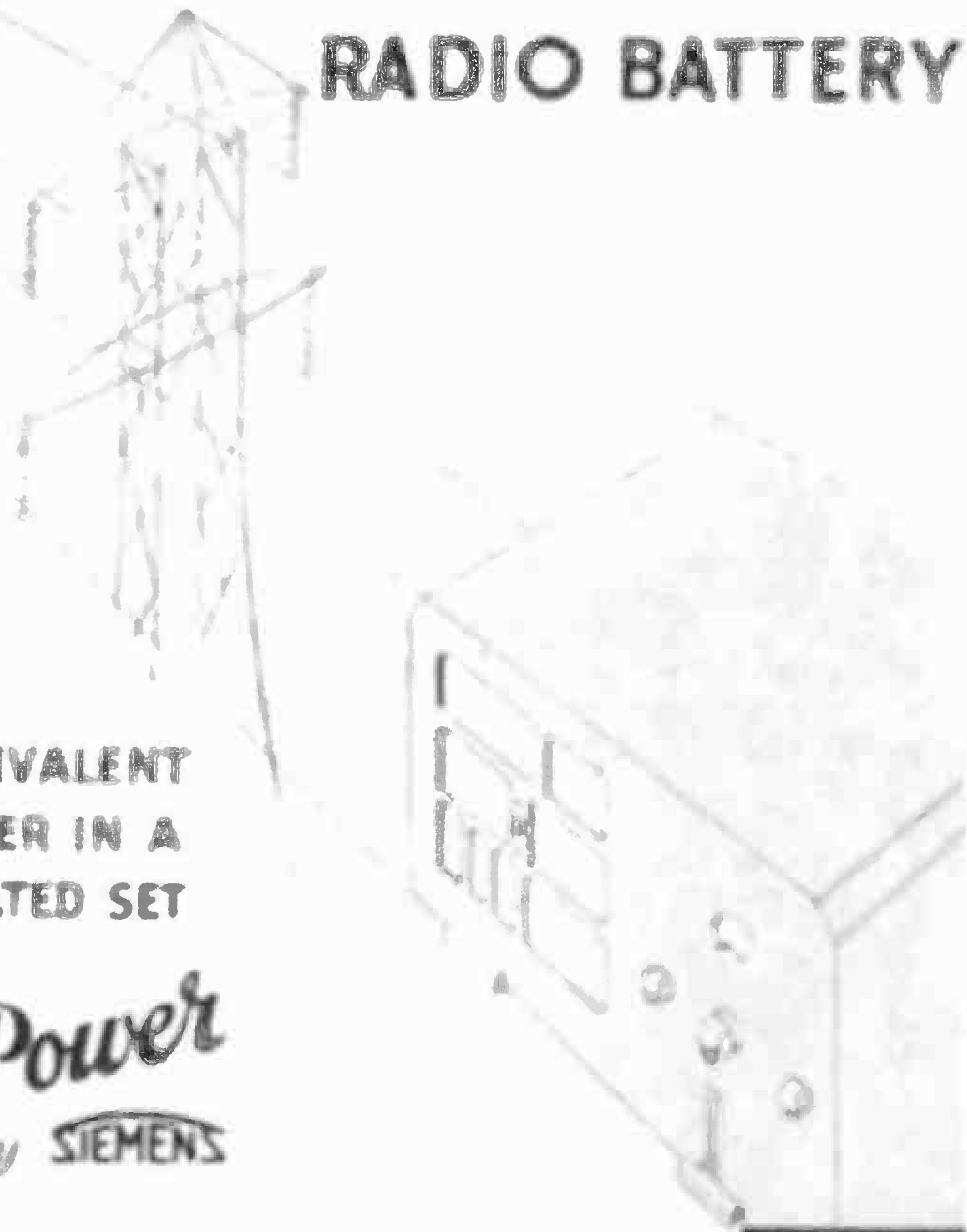

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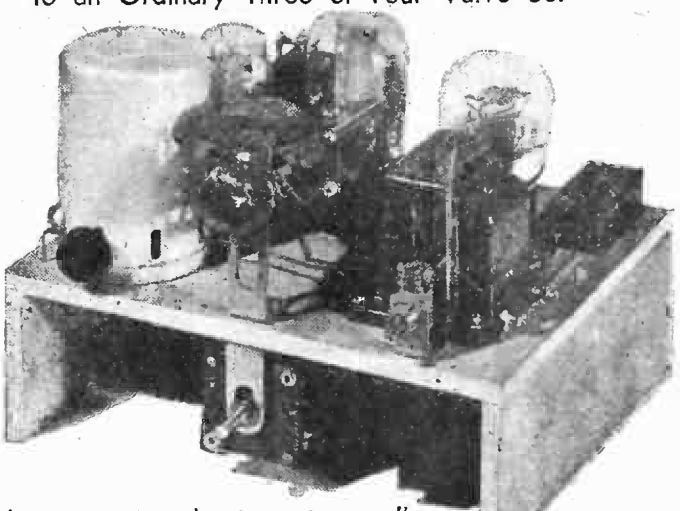
The AC-DC TWO

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.

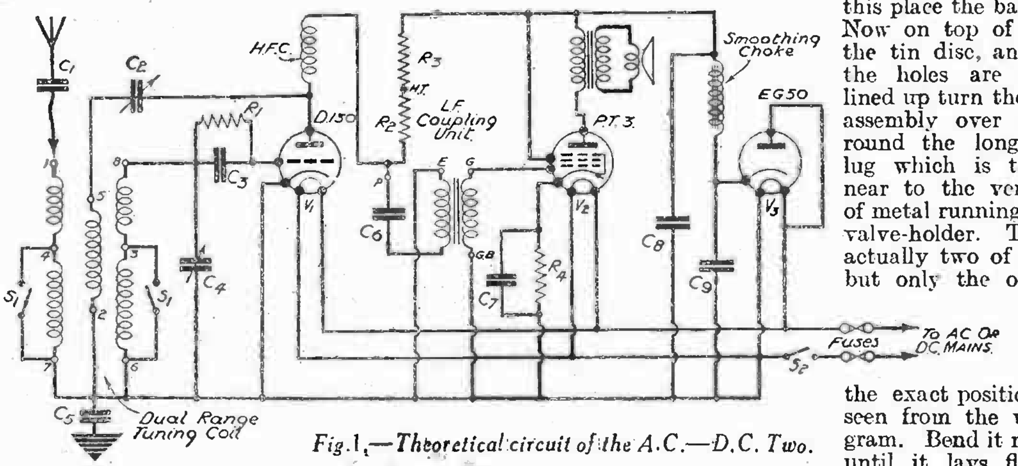


Fig. 1.—Theoretical circuit of the A.C.—D.C. Two.

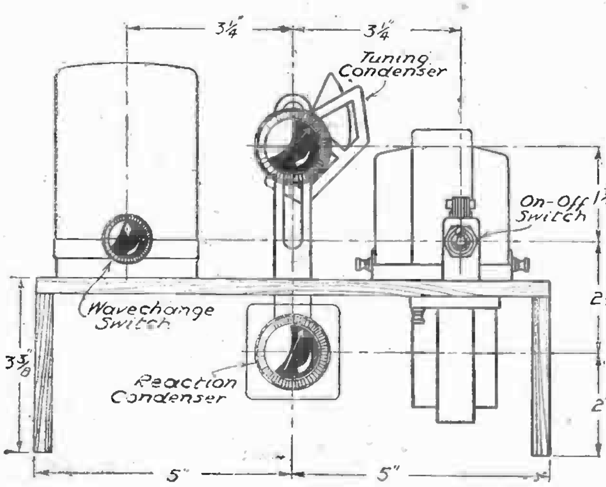


Fig. 2.—Disposition of controls.

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

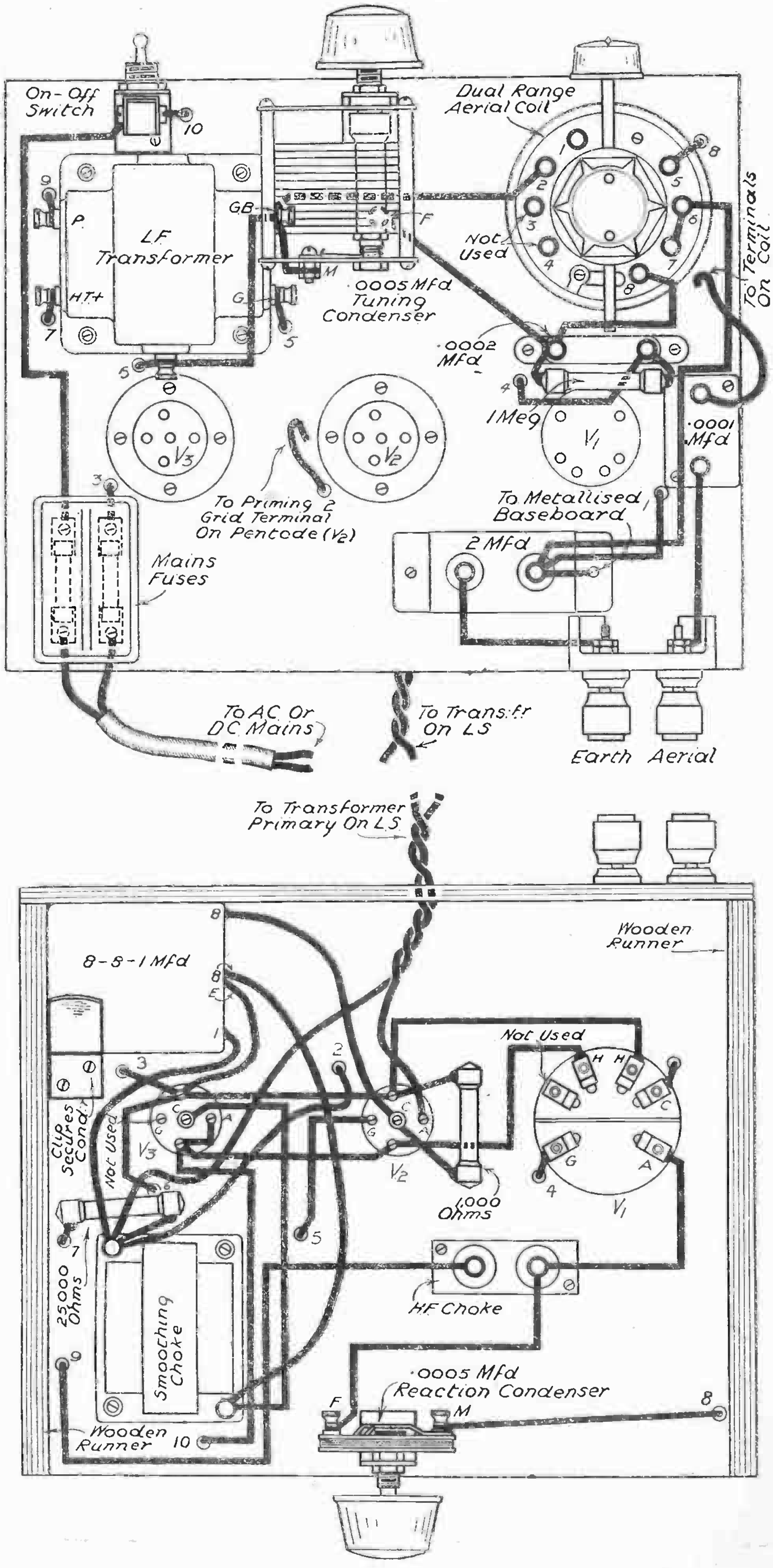
If you have never made a receiver before you may find it preferable to remove one or more of the components when putting the wires into position, as some of the contact points are a little difficult to get at. A little patience, however, will soon help you out of any seeming difficulty, and the wiring 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.

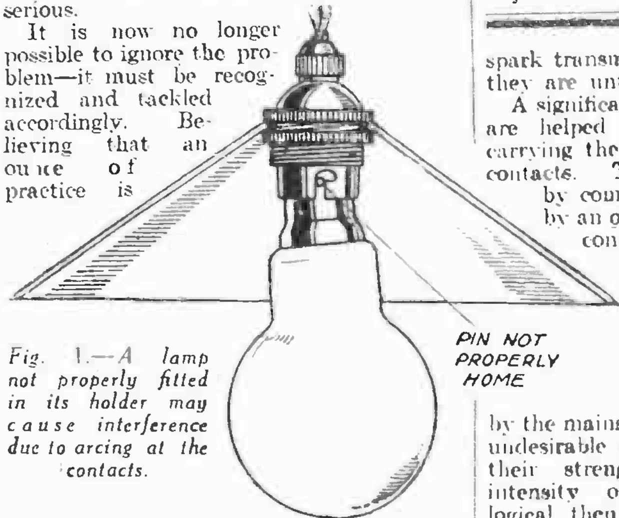


Fig. 1.—A lamp not properly fitted in its holder may cause interference due to arcing at the contacts.

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.

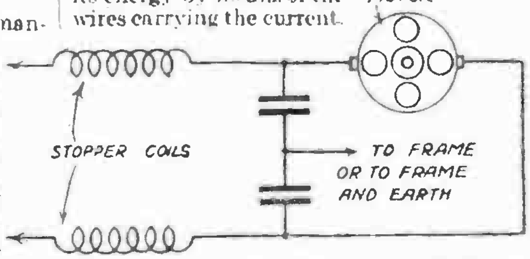


Fig. 3.—Interference suppressor which may be fitted to various domestic appliances.

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.

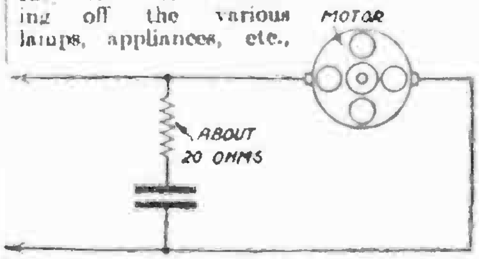


Fig. 4.—Another suppressor circuit.

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

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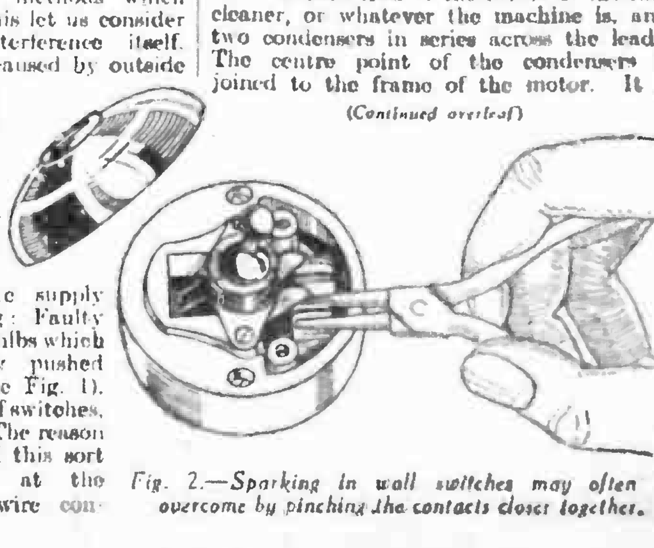

Fig. 2.—Sparking in wall switches may often be overcome by pinching the contacts closer together.

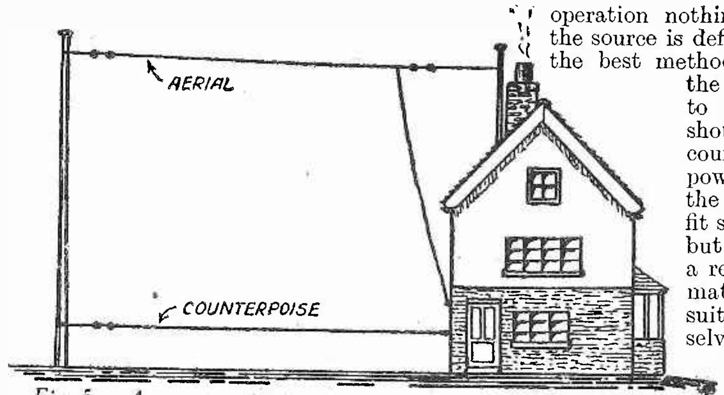

Fig. 5.—A counterpoise is sometimes useful in reducing interference.

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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.

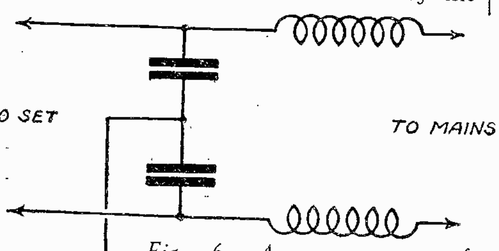


Fig. 6.—An arrangement for stopping interference arriving via the mains

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.

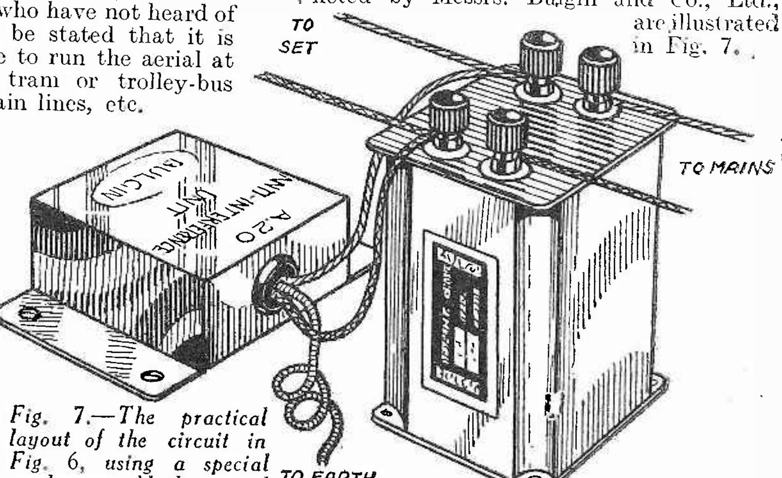


Fig. 7.—The practical layout of the circuit in Fig. 6, using a special condenser block and double choke.

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.

Midday Programmes from Radio Luxembourg

IN addition to the concerts broadcast nightly at 7, 8.30 and 10 p.m. B.S.T., Radio Luxembourg is now on the air with a lunch-hour transmission from 12.30 until 2 p.m. The wavelength is 1190.5 metres and the power 200 kilowatts. The evening broadcasts are destined to foreign countries and follow according to a regular *rota*, namely: Germany (Wednesday and Thursday), France and Belgium (Saturday and Tuesday), Holland (Friday), Great Britain (Sunday) and Italy (Monday). For these transmissions all announcements are given out in two or three different languages.

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.

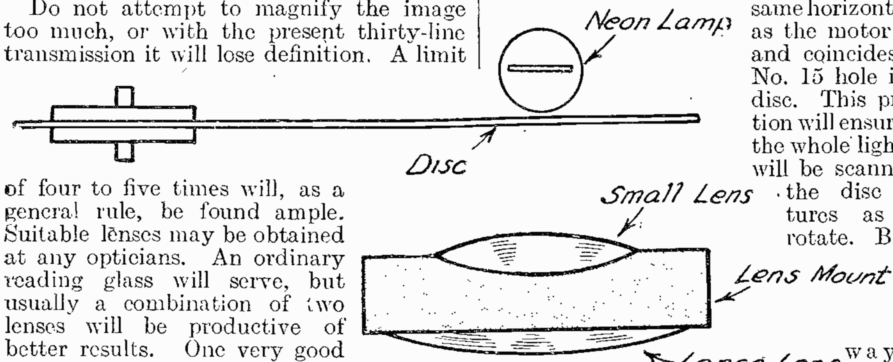


Fig. 1.—Showing the relative positions of disc, neon lamp, and lenses.

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.

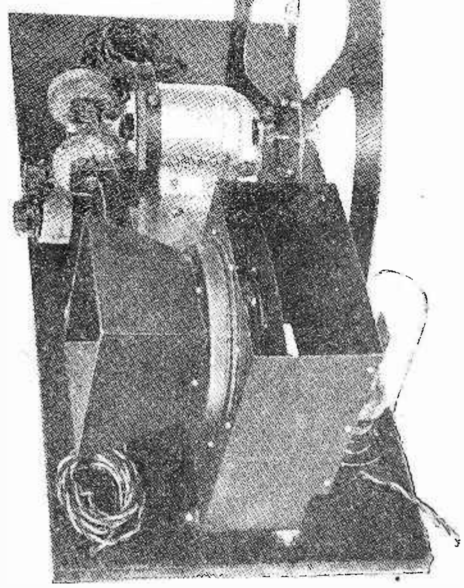


Fig. 4.—Another suggested design for a disc television receiver made up from standard parts.

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.

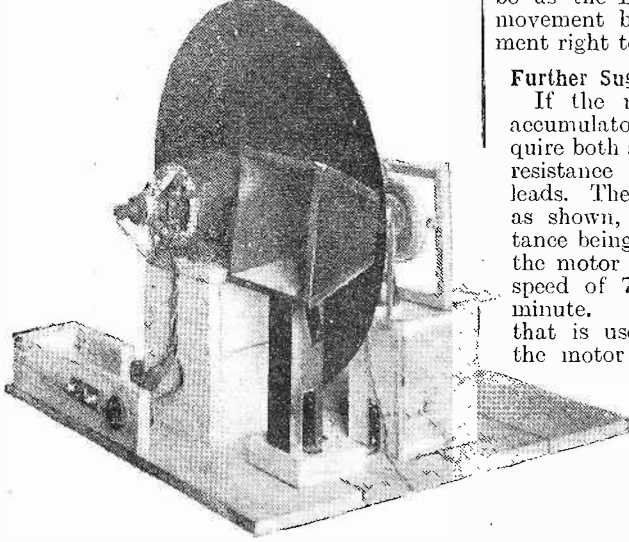


Fig. 3.—A good amateur effort of building disc television apparatus from rather crude materials.

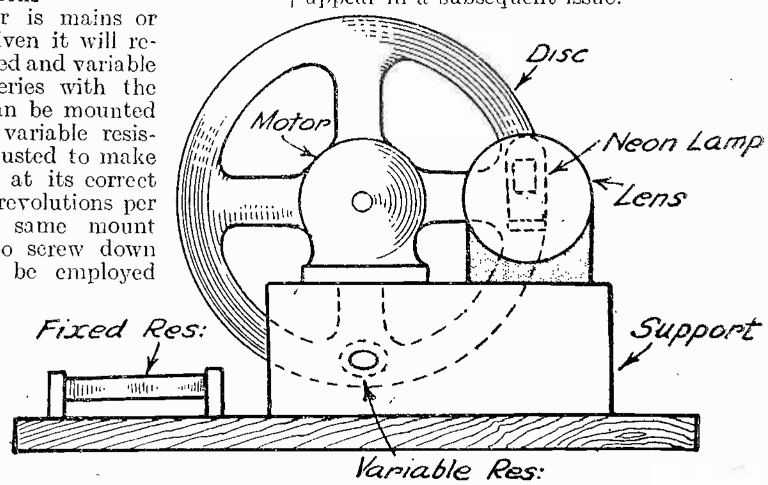
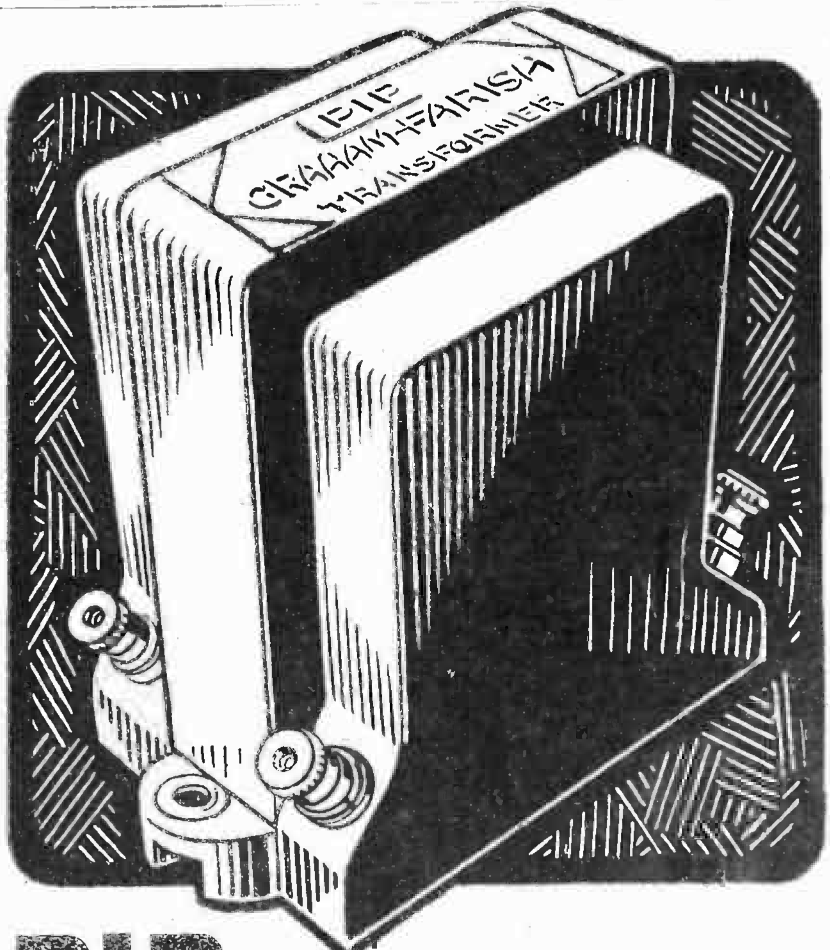


Fig. 2.—A rough layout of the disc model television apparatus.

NEW—
and better than many at double its price



PIP TRANSFORMER

The PIP transformer is thoroughly sound in construction and design and gives a result equalling and often better than others at a much higher price.

In distinctive red case with nickel terminals.

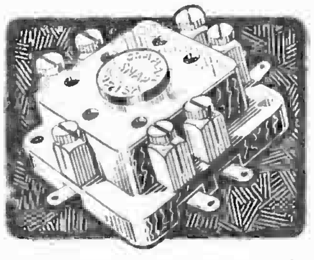
Made in 3 : 1 and 5 : 1 ratios. PRICE **6/6**

MEGITE POTENTIOMETER VOLUME CONTROL

The element is of the fine nickel-chrome wire embedded in bakelite. The action is through a slipper plate, giving a smooth, positive contact, absolutely silent operation and making broken contacts impossible. Three terminal type. Single hole fixing. Complete with operating knob.

PRICE 3/6

25,000 ohms, and over 4/6.



VALVE HOLDERS

These Valve Holders have exceptionally low loss moulded bases, the insulating material between sockets being reduced to a minimum. Contacts are of phosphor bronze, sturdy in design.

Four Pin	Five Pin	Seven Pin
Type, **6d.**	Type, **8d.**	Type **1/3**

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READERS' WRINKLES

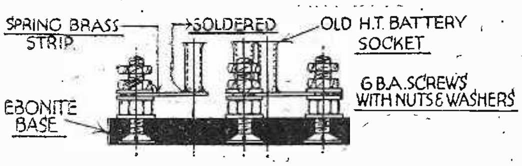
THE HALF-GUINEA PAGE

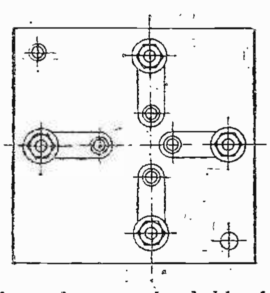
A Valve-holder from Scrap Material

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 countersunk head screw and lock-nuts in the manner illustrated.—GEORGE R. BENT (Reddish).

Cutting Out the Aerial Condenser

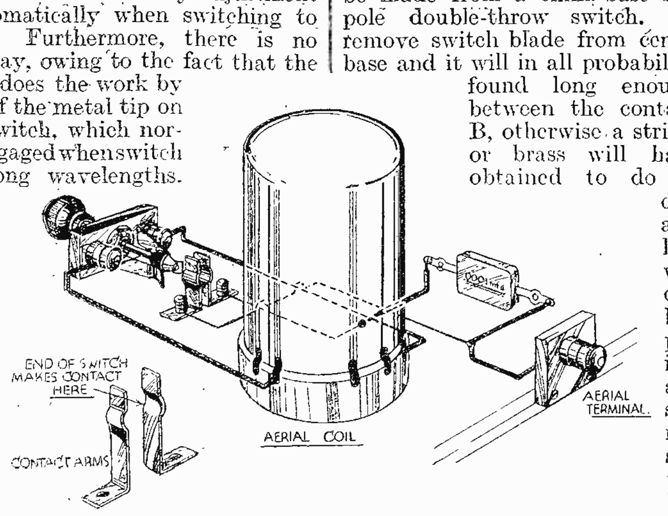
WITH the majority of dual-range coils a difficulty presents itself. A fixed condenser of approximately .0001 mfd. is placed directly in aerial lead, but the





Details for making a valve holder from scrap metal

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).



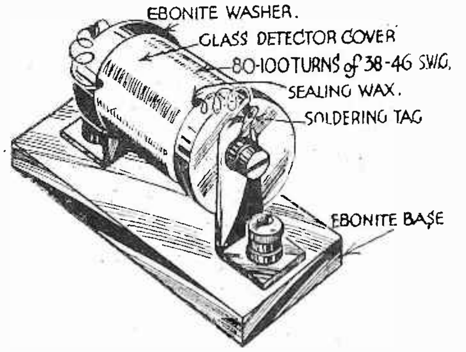
Cutting out the aerial condenser.

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

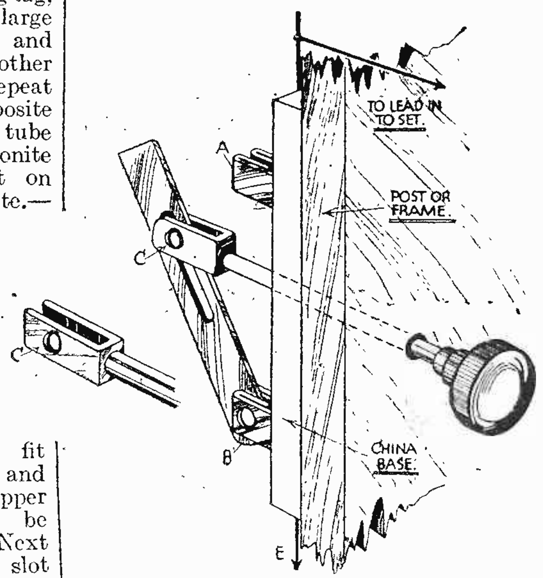
A CHEAP but efficient short-wave choke can be made from an old crystal detector of the glass tube type, two 4 B.A. nuts and bolts, two soldering tags, and a small quantity of wire (silk or enamel covered). First remove the cup and the cat's whisker arm and on the glass tube, starting about 3/16in. from 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).



Making a short-wave choke from a crystal detector.

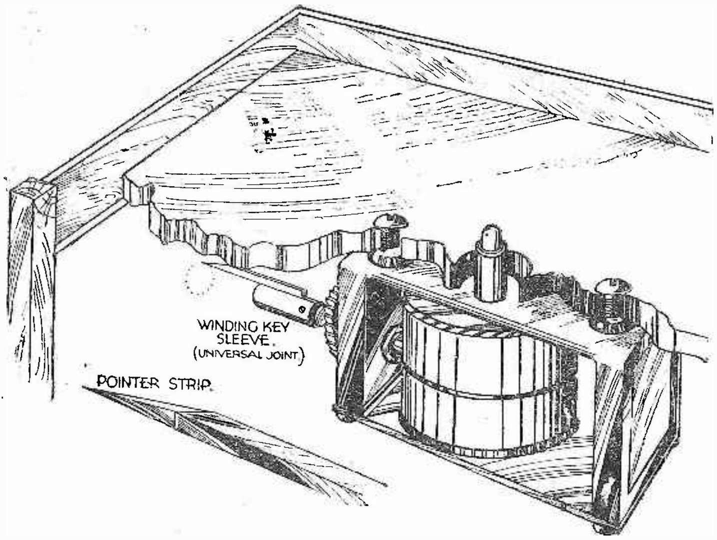
An Aerial Earthing Switch

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).



A simple aerial earthing switch.

(Continued overleaf)



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

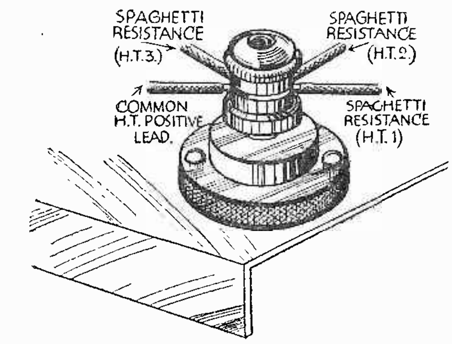
READERS' WRINKLES

(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.

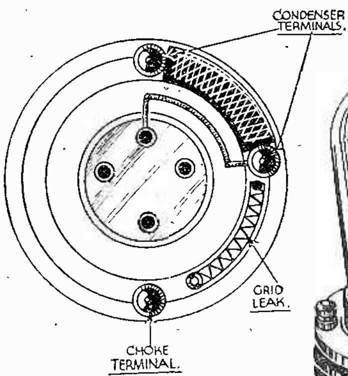
A Simple Terminal Insulator

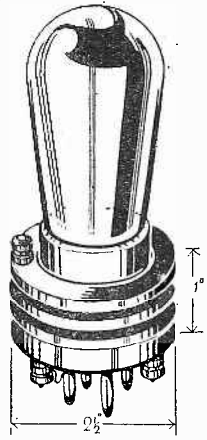
DIFFICULTY is sometimes experienced in making fully insulated connections on a metal chassis. The following suggestion will be found very helpful and an excellent means of using up old-type condenser knobs which are to be found in almost every constructor's junk box. One of these knobs should be inverted 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).

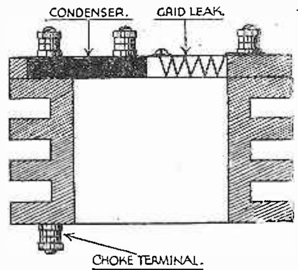
A Useful Component of Compact Design

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.

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

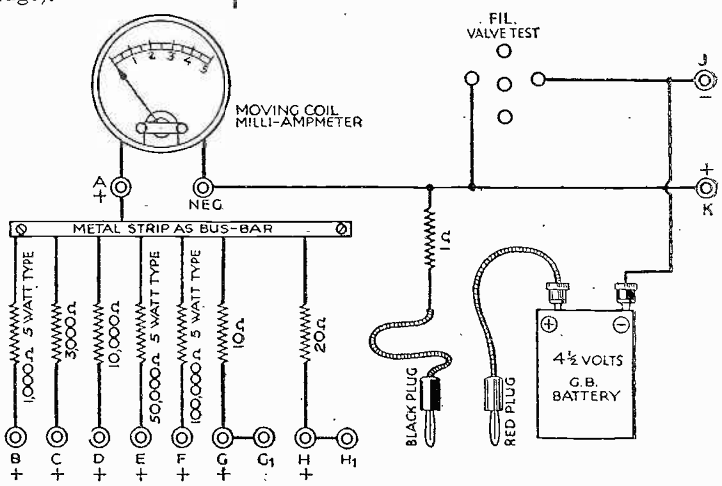
For Resistances less than 1,000Ω red plug in B

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

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

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

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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.

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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 $3\frac{3}{8}$in. 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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If undelivered please return to Geo. Newnes, Ltd., W.C.2

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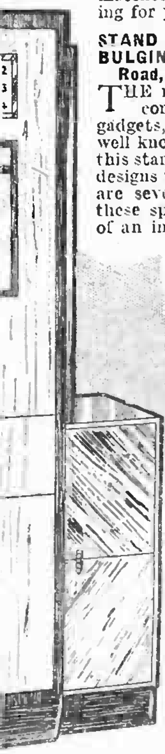
ADIO EXHIBITION (continued)

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

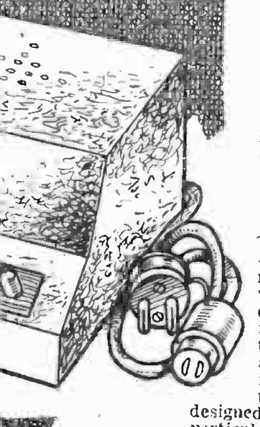
THE most extensive range of home-constructor components and gadgets, for which Messrs. Bulgin are so well known, is attractively displayed on this stand. In addition to last year's designs that are being continued there are several brand-new ones. Among these special mention should be made of an ingenious 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, Port land 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

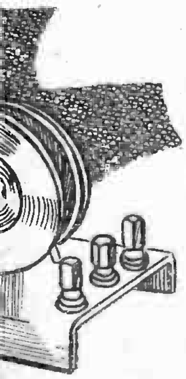


HERE we find a very excellent range of cabinet work suitable for every radio requirement. In addition to various console and radiogram cabinets, a feature is made of a newly-designed foot-rest, which is particularly well suited for use when listening in. All the exhibits are of modern design and make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

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.



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. 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. (Mcr), 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

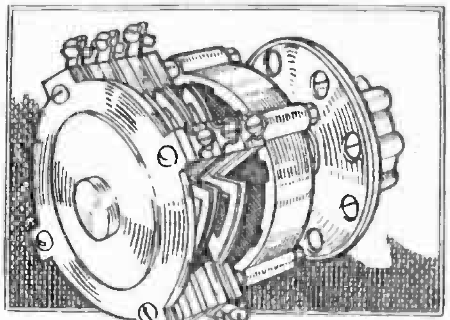
NOT only are Messrs. Colvern showing their extensive range of tuning coils of both "Ferrocart" and air-core types, but they have now a number of well-made complete tuning assemblies comprising the necessary "Ferrocart" coils, ganged tuning condenser and multiple switch. All these components are mounted 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.

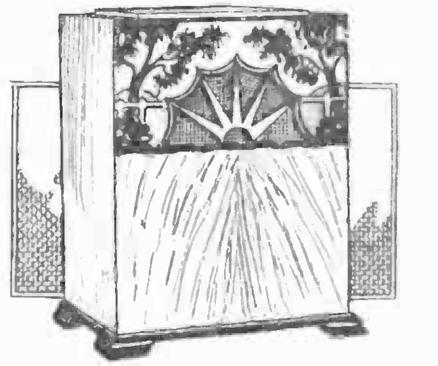


A Multiple Q.M.B. Rotary Switch manufactured by Messrs. Bulgin. This is obtainable in single, bi-polar or tri-polar types, at prices from 3s. 6d. upwards. Definite positions are given by an ingenious type of contact maker.

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.

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.

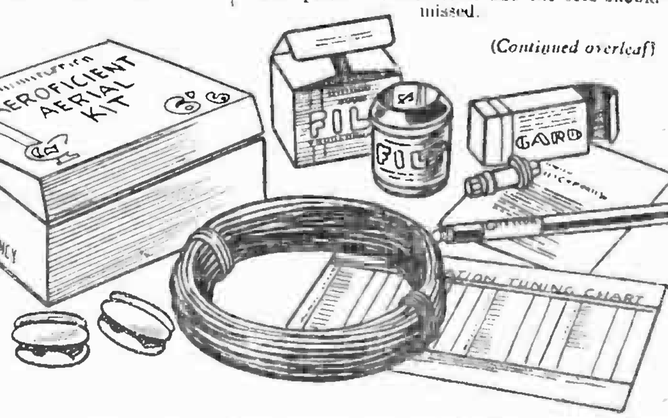


Something new in cabinet design. This is one of Messrs. Osborn's new season's products, and strikes a new note.

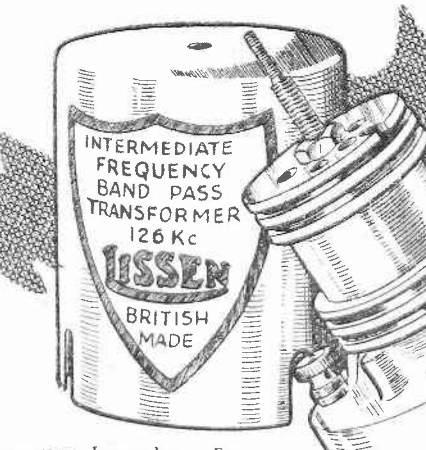
STAND No. 30, Main Hall
CROMWELL (SOUTHAMPTON) Ltd., 32, Brinton's Terrace, Southampton.

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.

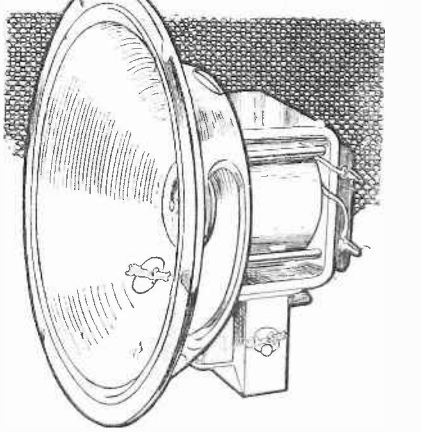
"SPEAKERS for every requirement and at a price that all can afford," describes fairly well the exhibits on the Epoch stand. From the "Super-Dwarf" to the large auditorium speaker high quality and good value predominate. One of the newest lines which is already proving very popular is a combination Class 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 "Aeroficient" 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.

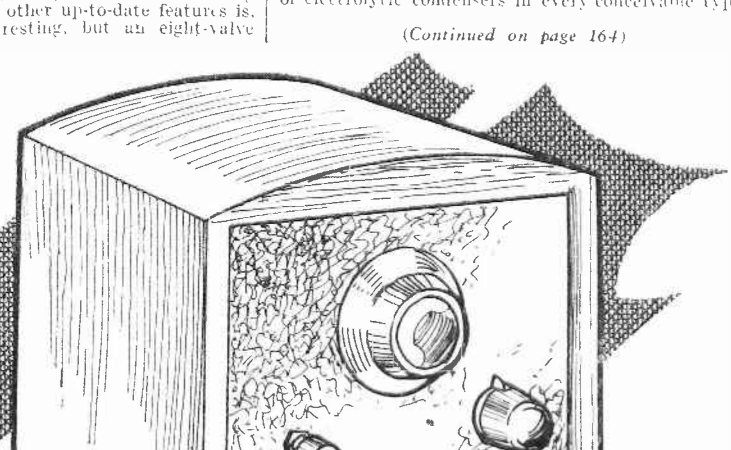
STAND No. 39, New Hall
HEAYBERD, F. C. & CO., LTD., 10, Finsbury Street, London, E.C.2

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.

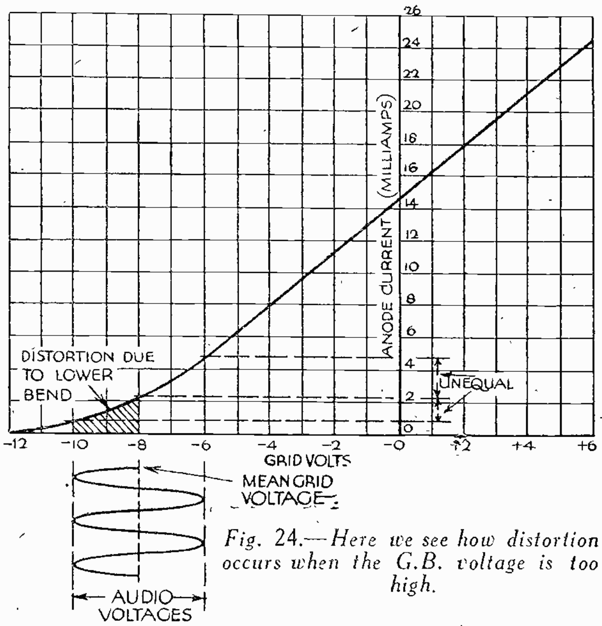


Fig. 24.—Here we see how distortion occurs when the G.B. voltage is too high.

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.

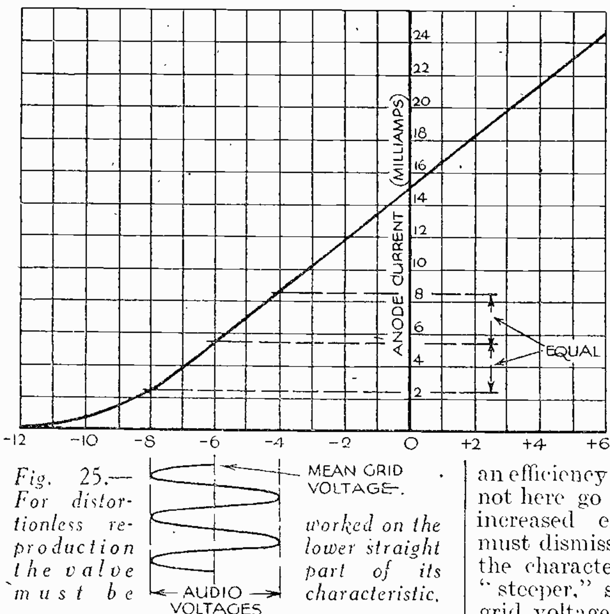


Fig. 25.—For distortionless reproduction the valve must be worked on the lower straight part of its characteristic.

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.

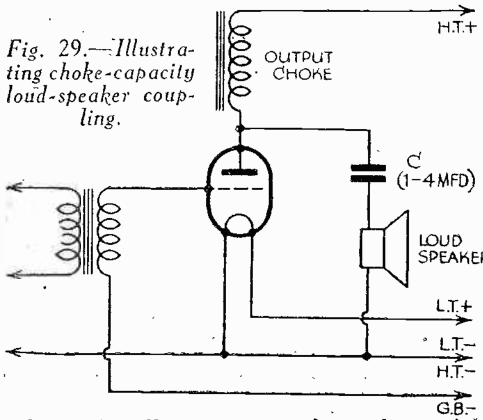


Fig. 29.—Illustrating choke-capacity loud-speaker coupling.

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)

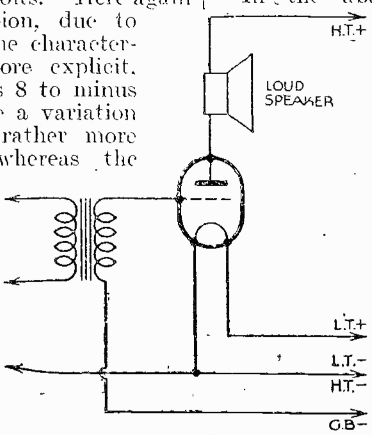


Fig. 26.—The simplest (but not the best) way of connecting a loud-speaker.

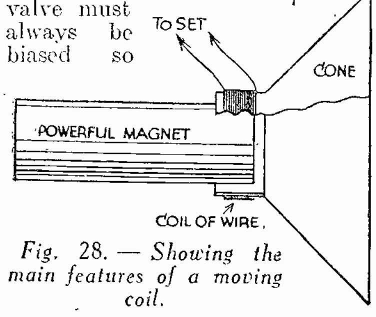


Fig. 28. — Showing the main features of a moving coil.

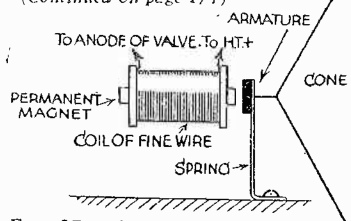


Fig. 27.—This sketch illustrates the general principles of a moving-iron speaker.

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

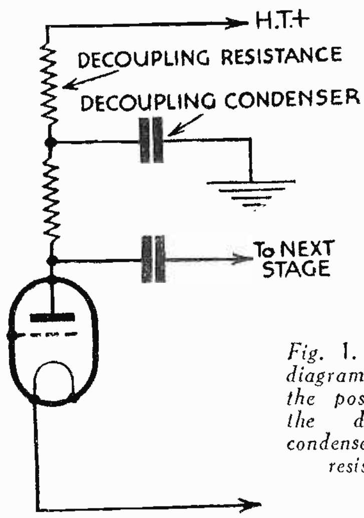


Fig. 1.—This diagram shows the positions of the decoupling condenser and resistance.

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

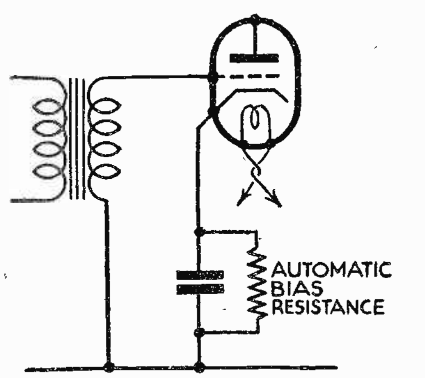


Fig. 2.—The circuit of an indirectly-heated power valve with automatic grid bias.

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 nondescript grid-leak variety is not recommended.

Reserve Your Pocket Tool Kit Now! See Page 143.

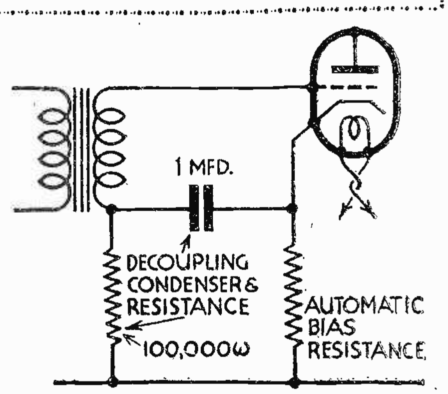


Fig. 3.—Complete decoupling has been added in this modification of the Fig. 2 arrangement

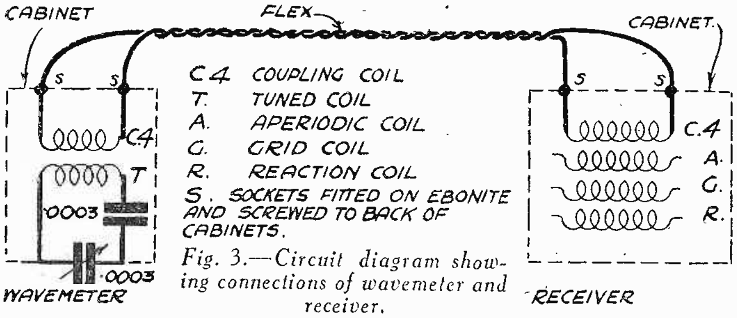


Fig. 3.—Circuit diagram showing connections of wavemeter and receiver.

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

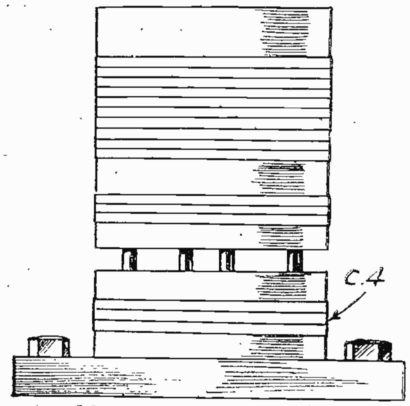


Fig. 4.—Mounting the coupling coil on the same base as the tuning coil.

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.

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.

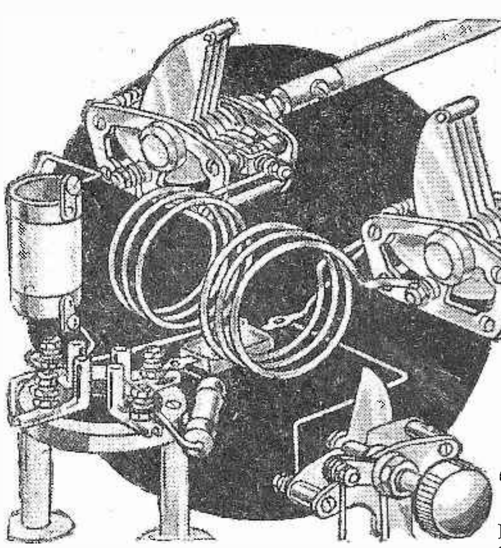
They can supply complete kits for all PRACTICAL WIRELESS receivers, components and manufacturers' kits and receivers—in short, anything connected with radio.

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.



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.

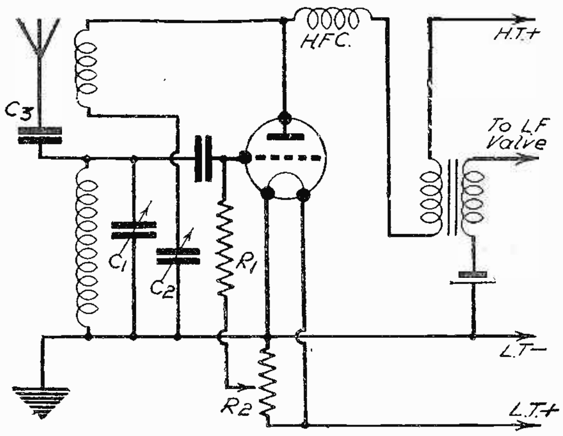


Fig. 1.—A simple reaction arrangement.

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)

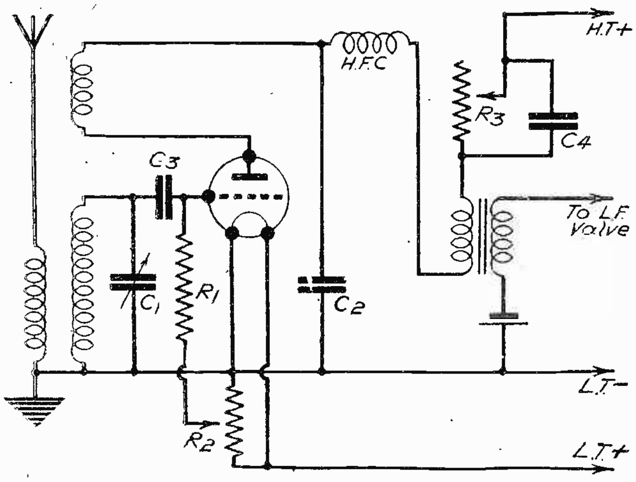


Fig. 3.—Controlling reaction by means of a resistance (R_3).

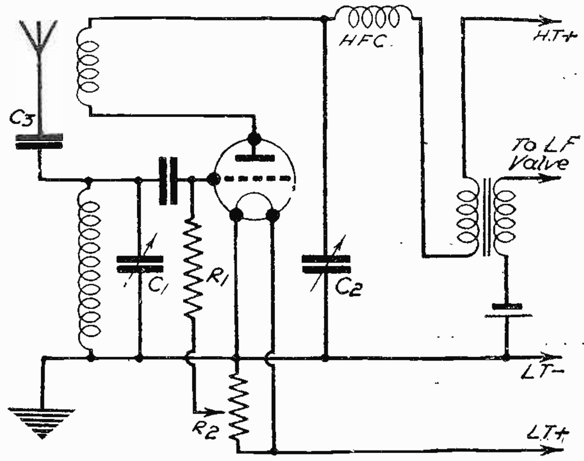


Fig. 2.—A modification of Fig. 1.—This is the throttle reaction control.

FROM THE FLASH LAMP

"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.

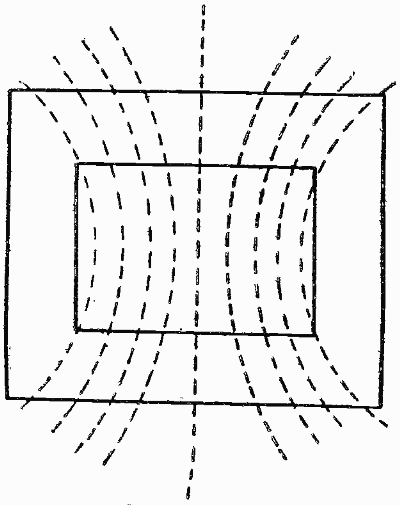


Fig. 1.—The broken lines represent the magnetic field about an "open" coil.

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.m² 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:—

$N^2 = 4{,}200$ Inductance
$D^2 = 25$ $= \frac{4200 \times 25}{12 \times 10^2}$ μh
$l_3 = 12$

$=$ 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 $2\frac{1}{4}$.

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), $\frac{l}{3}$ 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.

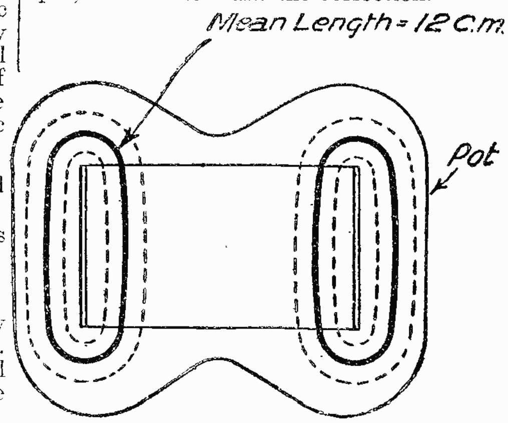


Fig. 2.—This diagram shows the arrangement of the magnetic field round a "potted" coil.

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*)

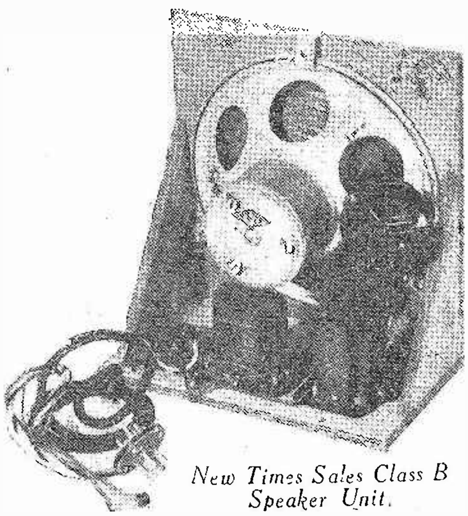
TABLOID TECHNICALITIES

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 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.



New Times Sales Class B Speaker Unit.

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.

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.

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.

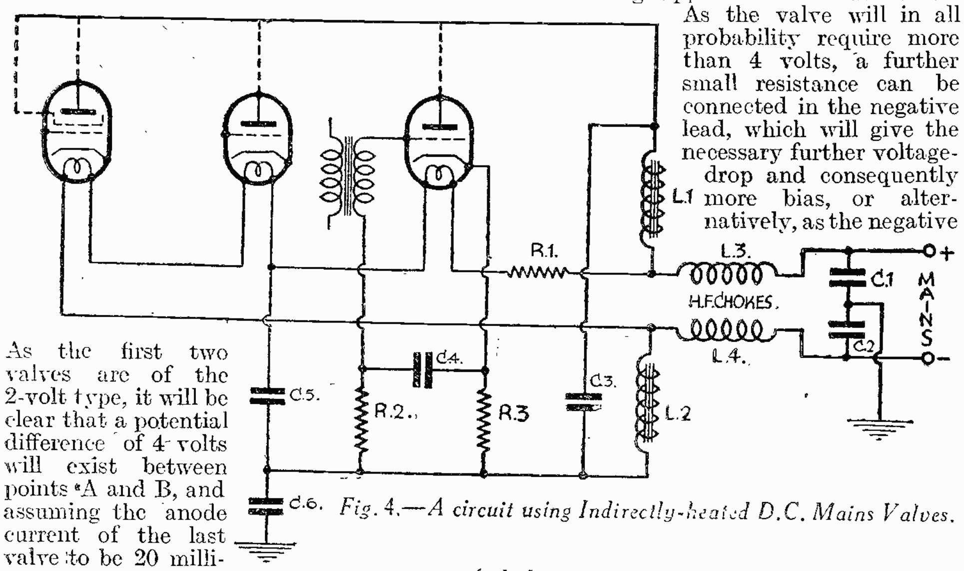


Fig. 4.—*A circuit using Indirectly-heated D.C. Mains Valves.*

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.

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.

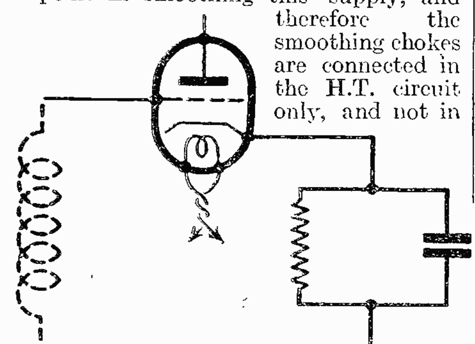


Fig. 5.—*Automatic Bias is obtained by a resistance and condenser in the cathode lead.*

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:

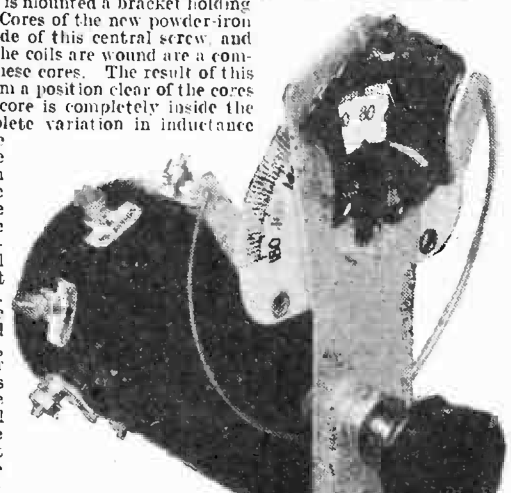
$$\text{Resistance} = \frac{10 \times 1{,}000}{15} = 666 \text{ ohms.}$$

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.

SOVEREIGN PERMEABILITY TUNER

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.

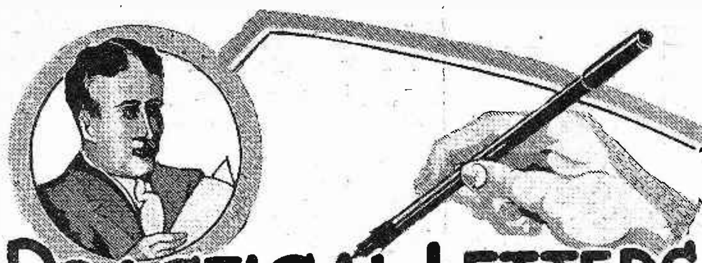
The new British Radiophone intermediate frequency transformer with screen removed to show construction.

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.



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.

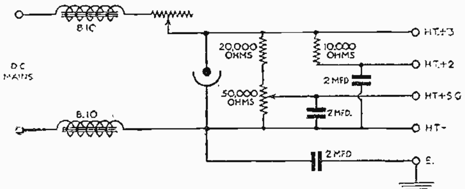
A Soldering Hint

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 letters patent.

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, electro-chemistry, 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.

P. W. Gift Stamp No. 54

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THE MOST PROGRESSIVE CONSTRUCTORS' WEEKLY

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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.

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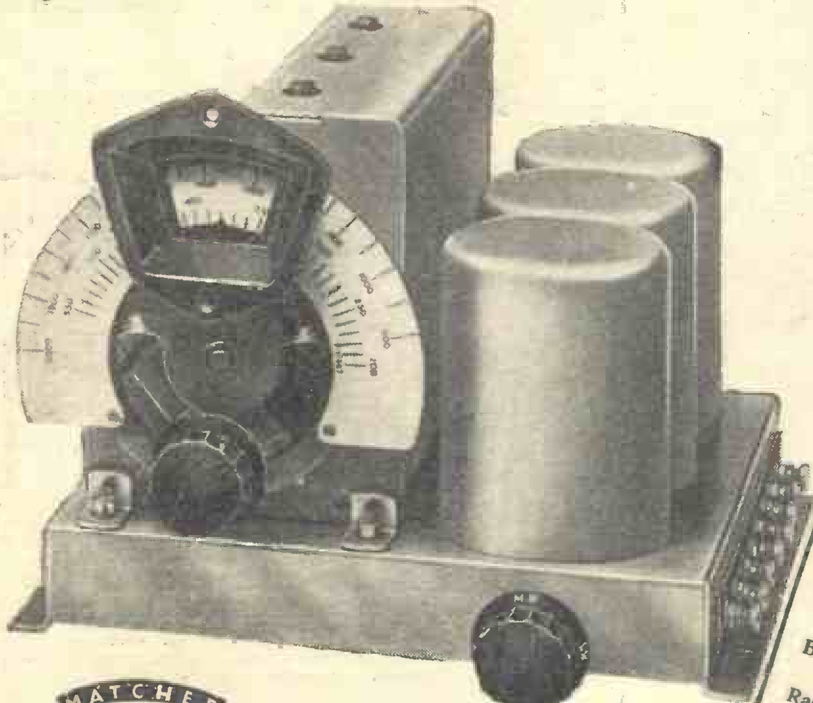
MATCHED PERFECTION

CHOSEN BY THE Leading Designers

Whenever a well-known designer brings out a successful set you can be almost certain that one or another of the Radiophone Matched Perfection range of components is exclusively specified. Such preference is a sure indication of superiority of results that are far ahead of rivals, of absolute reliability and scientific accuracy.

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."



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THE LEADING AND MOST PROGRESSIVE RADIO WEEKLY

EDITOR:
Vol. III. No. 56 || F. J. CAMM || Oct. 14th, 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

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!

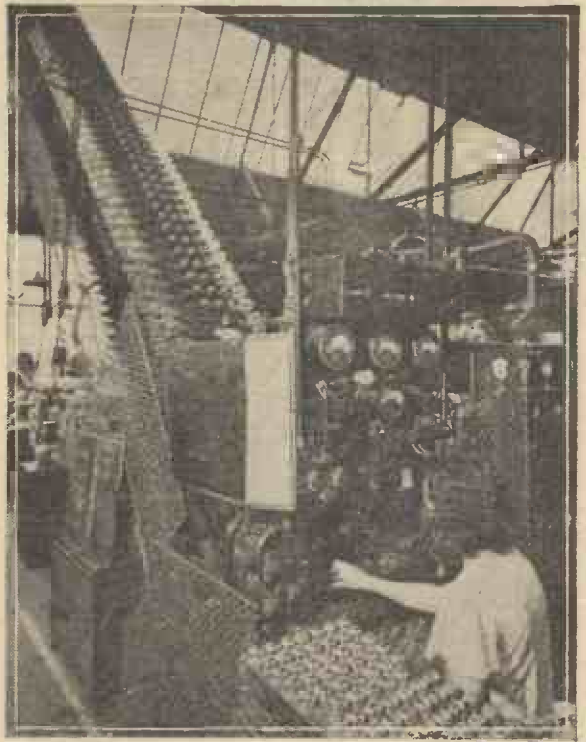
THE small Brussels (Schaerbeek) broadcasting station, having complained to the authorities that an illicit transmitter has marred the reception of its broadcasts, a reward of one thousand Belgian francs has been offered to trace the identity of the culprit.

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.

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. Maister, 28, Chalfont Green, Edmonton, N.9.

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

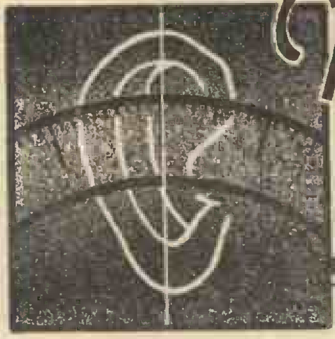
TESTS are being carried out by the London and North Eastern Railway at Parkeston Quay, where the station has been equipped with special wireless telephony apparatus for communication with steamers plying between that port and Holland and Belgium.

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.



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. 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 wave-length 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.

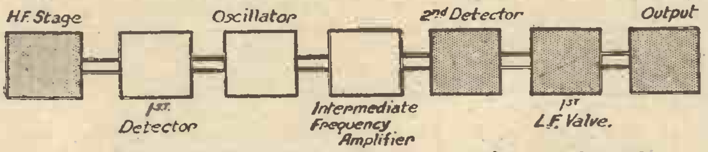


Fig. 1.—Diagrammatic representation of a 7-valve superheterodyne receiving circuit.

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.

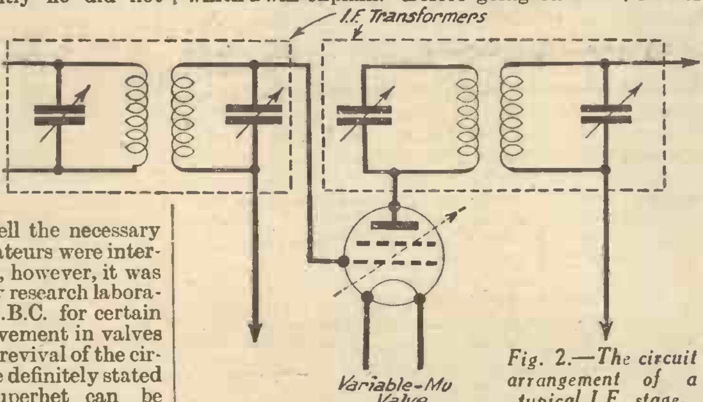


Fig. 2.—The circuit arrangement of a typical I.F. stage.

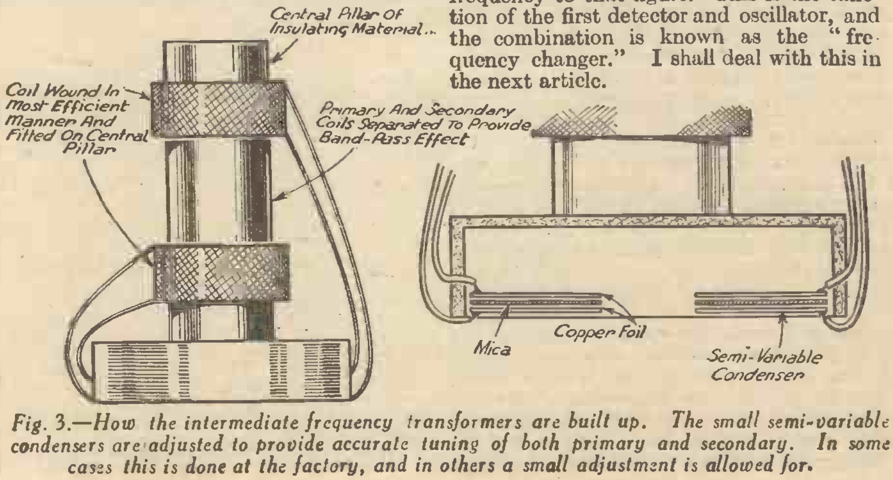


Fig. 3.—How the intermediate frequency transformers are built up. The small semi-variable condensers are adjusted to provide accurate tuning of both primary and secondary. In some cases this is done at the factory, and in others a small adjustment is allowed for.

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.

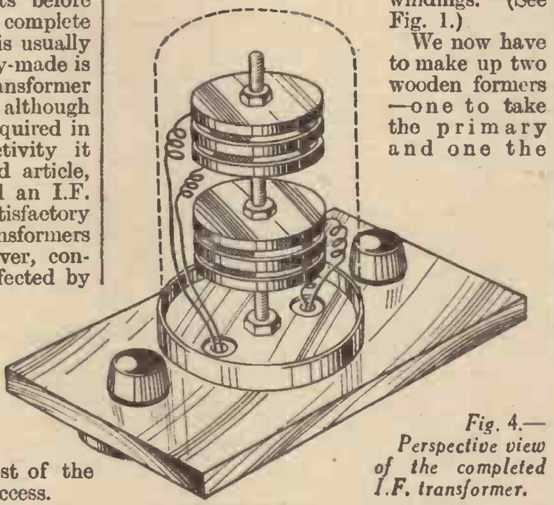


Fig. 4.—Perspective view of the completed I.F. transformer.

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 2¼in. 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.

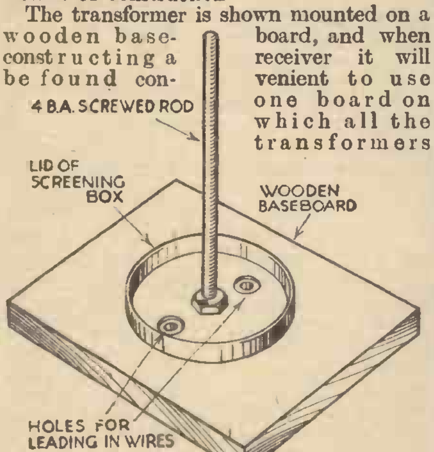


Fig. 1.—Method of attaching lid of screening box to baseboard.

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 ⅜in. plywood; for the complete transformer, six discs of 1⅝in. diameter and four of 1⅛in. 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.

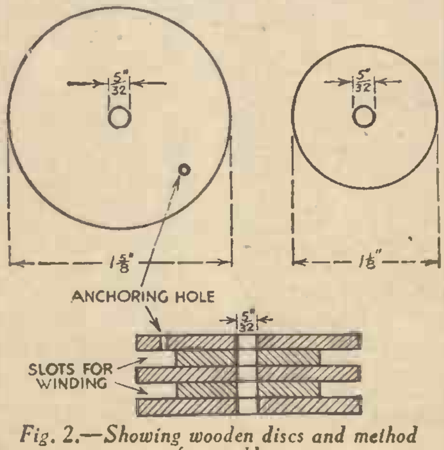


Fig. 2.—Showing wooden discs and method of assembly.

The two bobbins next have to be slipped on to the 4 B.A. rod, and fixed by nuts at a distance of about 1in. 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.

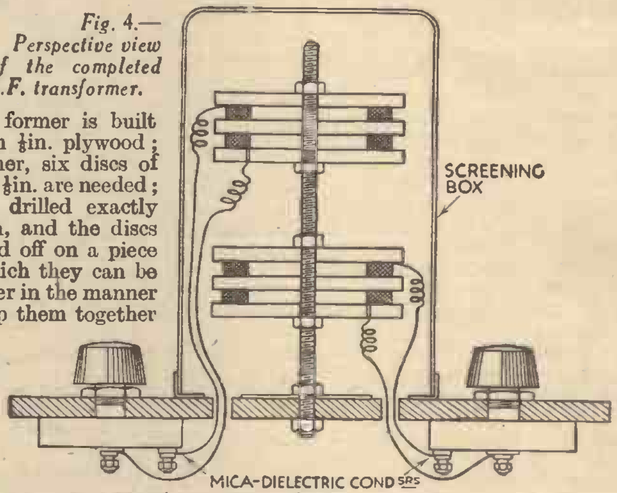


Fig. 3.—Section of complete transformer.

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.

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.

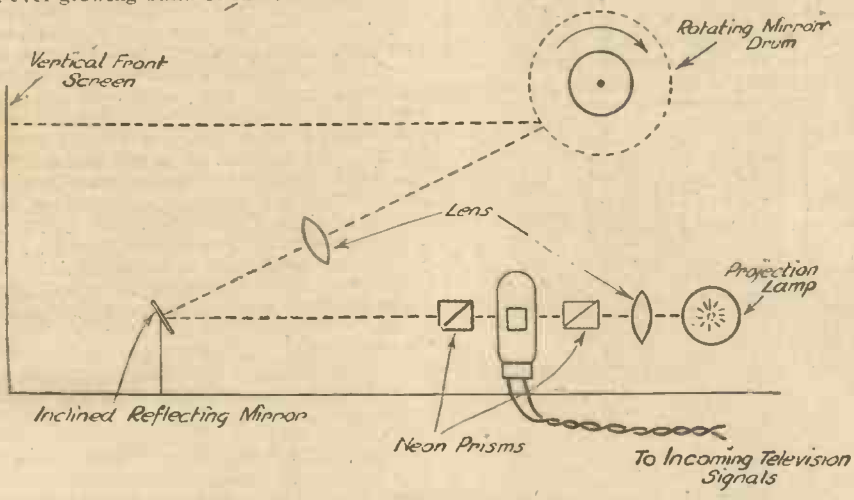


Fig. 2.—The schematic arrangement and light beam path of the Visor-Teledrum.

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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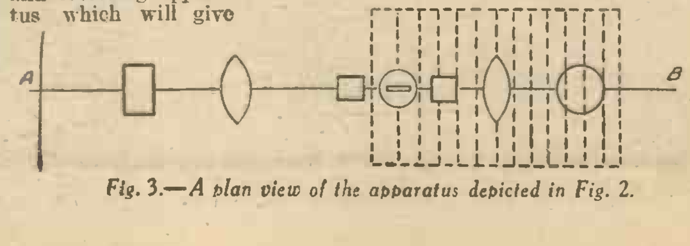

Fig. 3.—A plan view of the apparatus depicted in Fig. 2.

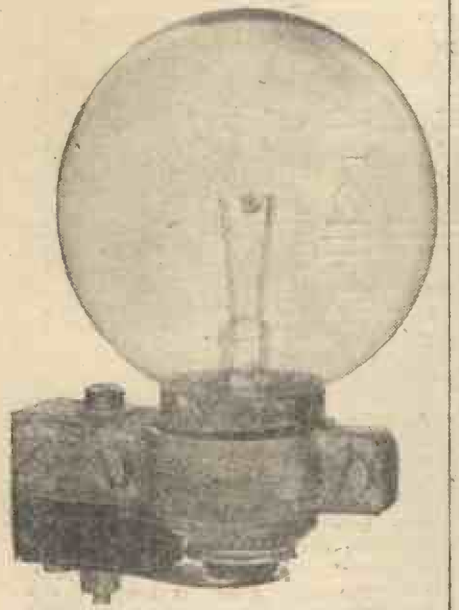

Fig. 5.—The spiral type of 100-watt bunched filament projection lamp used in the Visor-Teledrum.

(*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.

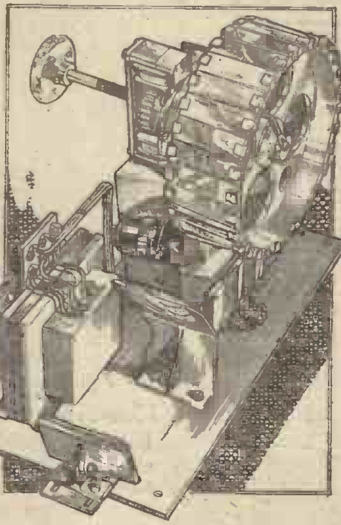

Fig. 1.—The new Baird Televisor. The arrangement of the mirror-drum, the new light valve, the lens, and the synchronizing coils can be seen clearly from this illustration.

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.

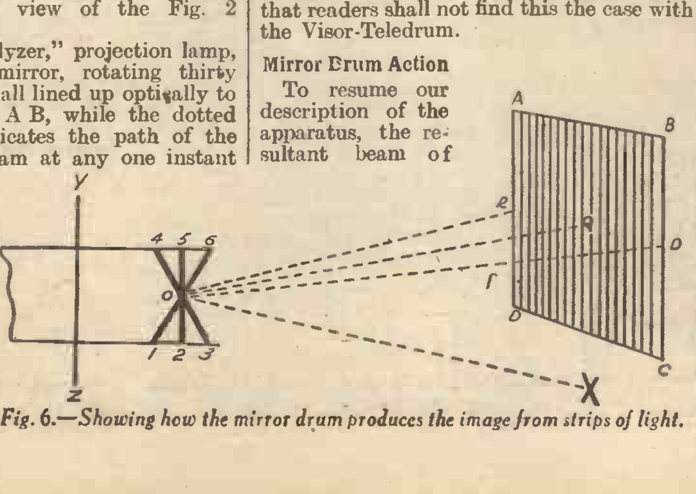

Fig. 6.—Showing how the mirror drum produces the image from strips of light.

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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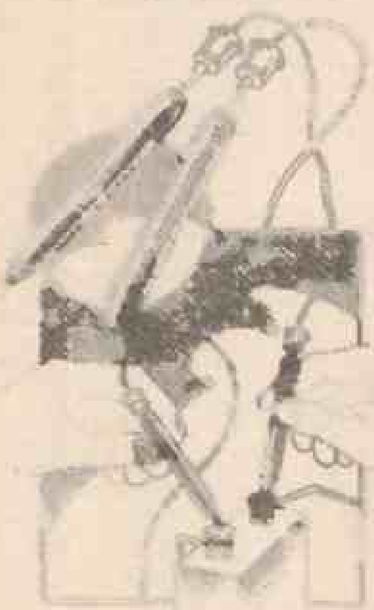
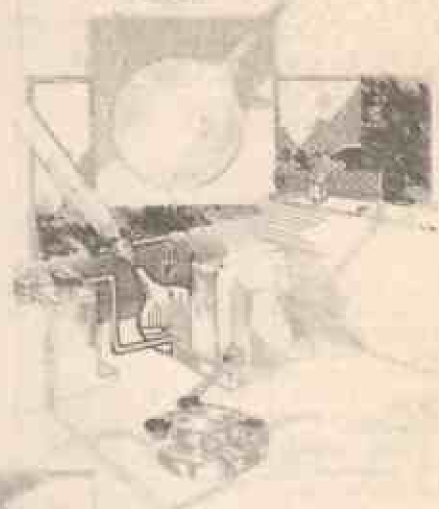
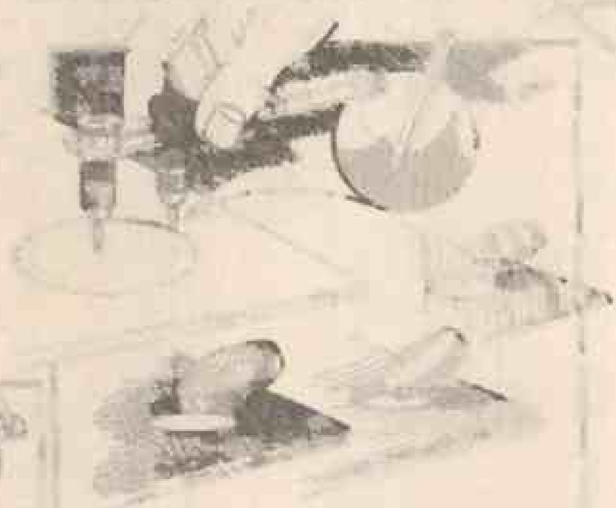
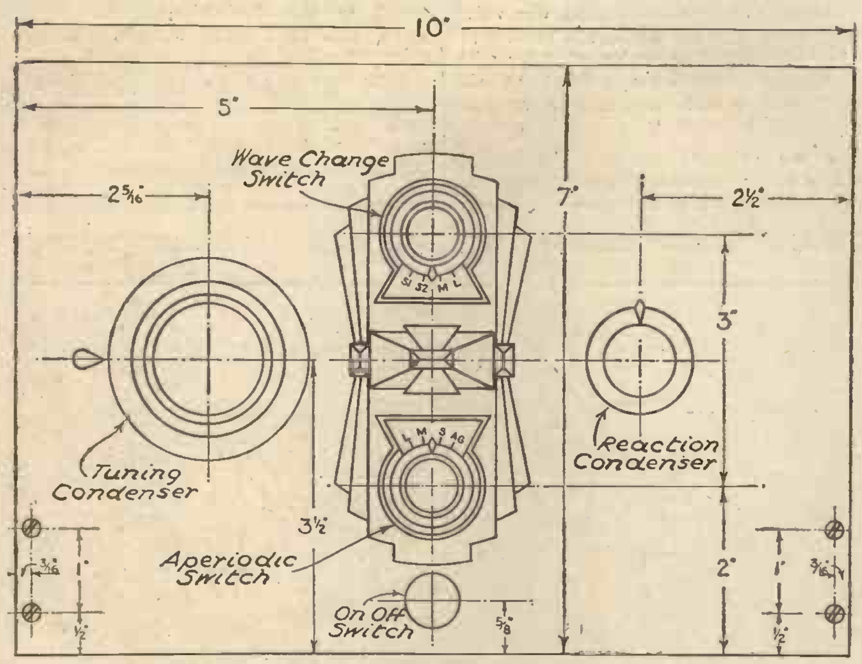








Panel lay-out of the Unipen.

THE UNIPEN

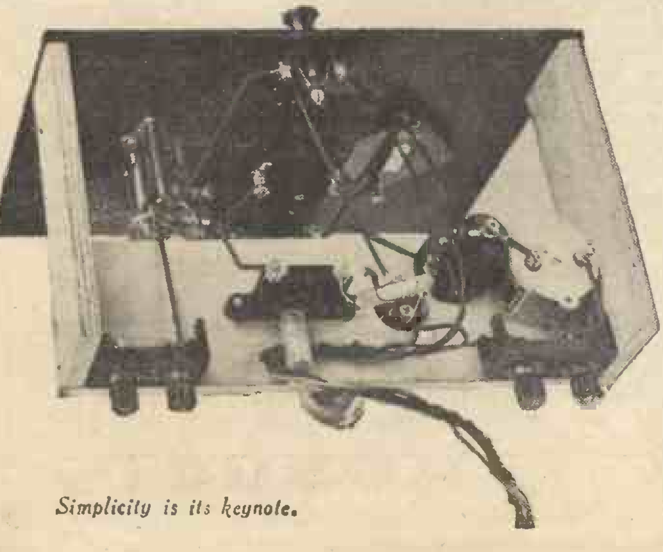
(Continued from previous page)

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.



Simplicity is its keynote.

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."

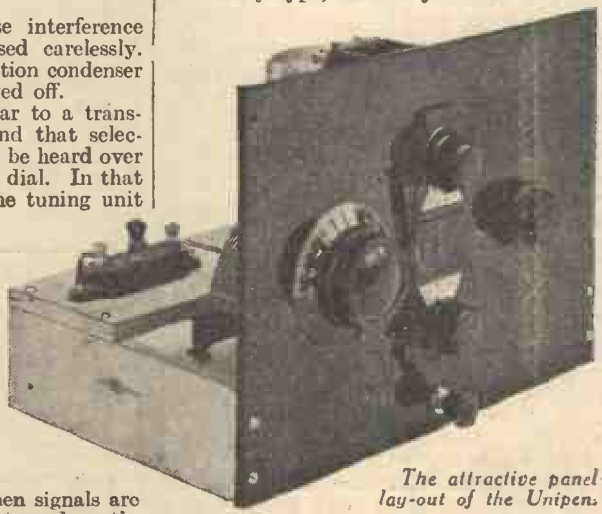
When a loud-speaker is to be used it should be connected to the terminals previously used for the 'phone leads. Unless signals from the 'phones can be heard several feet away, the set will not give satisfactory results on a speaker, but when they are sufficiently loud a sensitive speaker of the balanced armature type (that mentioned in the specification has been found to be the best for this set) will afford pleasing reproduction.

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.



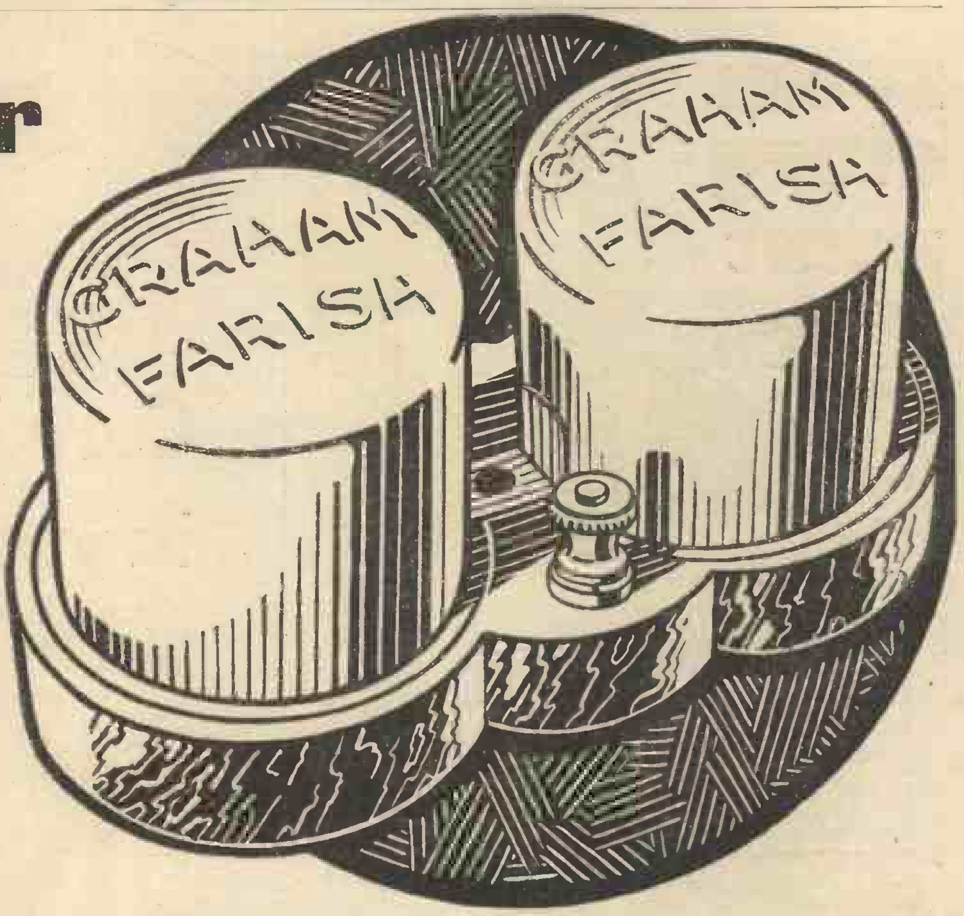
The attractive panel lay-out of the Unipen.

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
H.F. CHOKE**

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**

L (LONG) M (MEDIUM) S (SHORT) TWIN SCREEN H.F. CHOKE

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.

Impedance at 500 metres, 400,000 ohms. Inductance 200,000 micro-henries.

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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.

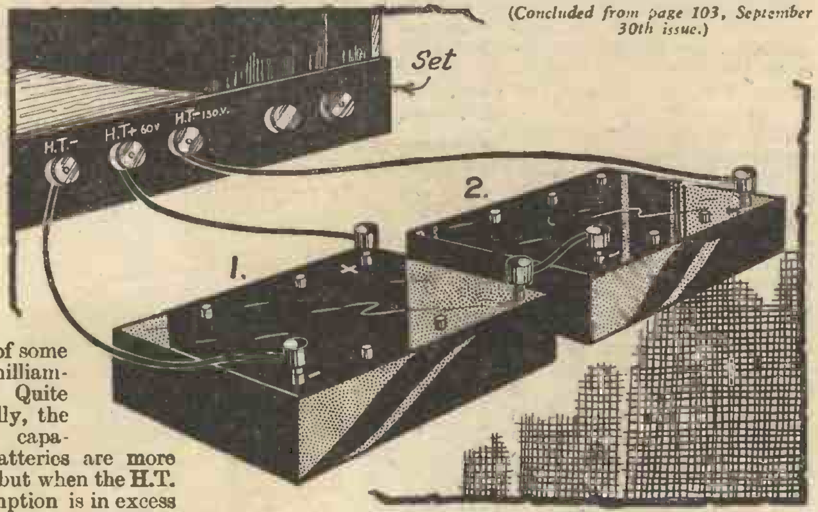


Fig. 5.—This sketch shows how two 60-volt H.T. batteries can be wired in series to effect an economy.

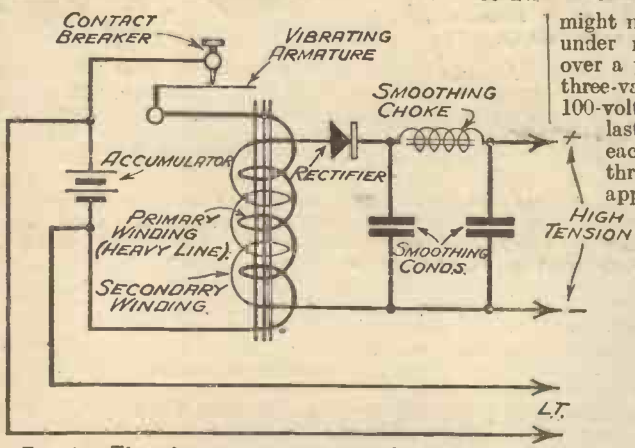


Fig. 6.—The schematic arrangement of the battery superseder.

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.

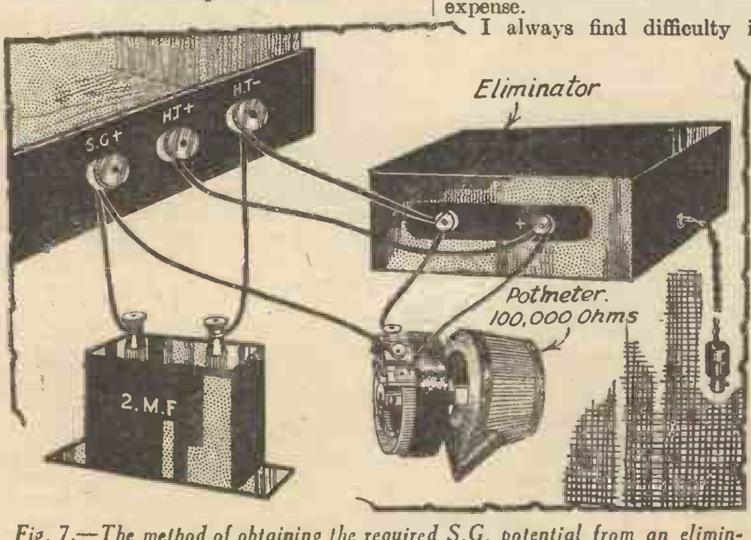


Fig. 7.—The method of obtaining the required S.G. potential from an eliminator not fitted with a special tapping for this purpose.

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.

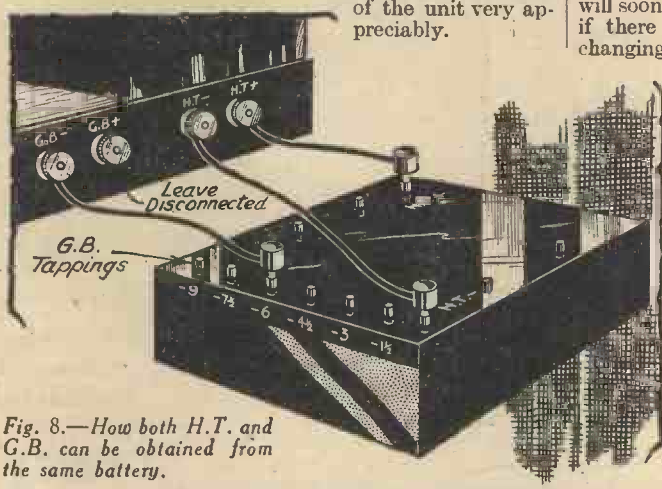


Fig. 8.—How both H.T. and G.B. can be obtained from the same battery.

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 re-charging 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

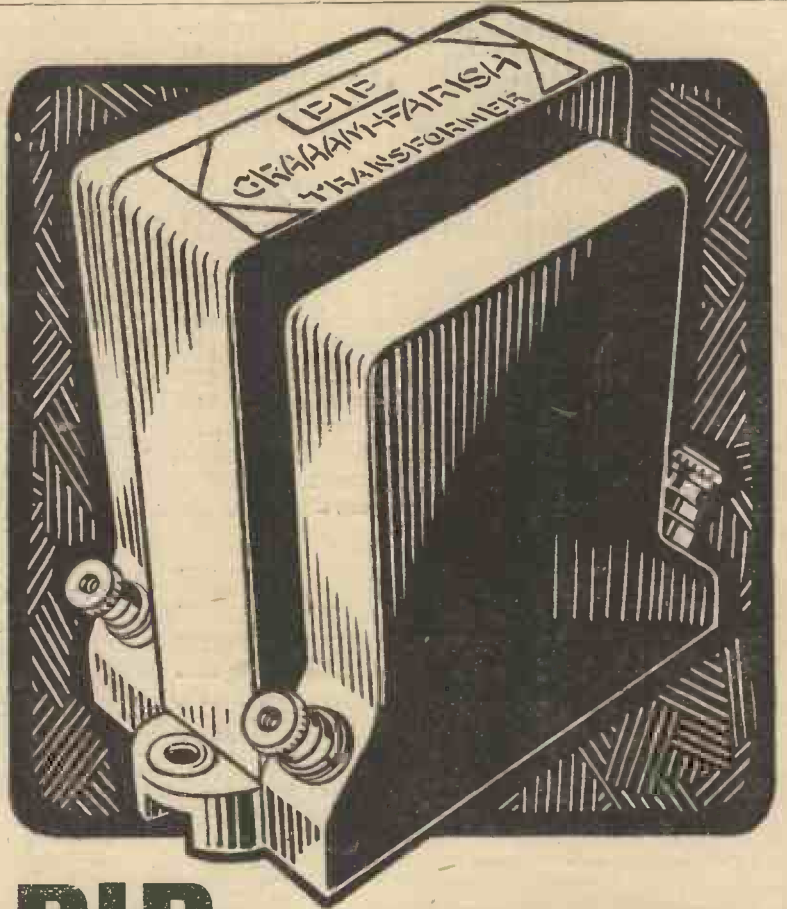
The grid bias supply is just as important as the H.T. and L.T., in fact, from the point of view of economical running it can be even more so. G.B. batteries are cheap but, used correctly, they can considerably increase the life of both the H.T. battery and the valves. As an example, I give the following 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.

NEW— and better than many at double its price



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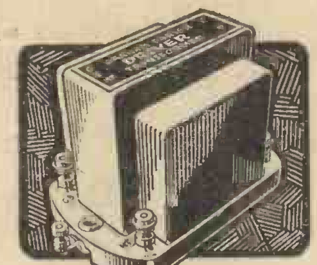

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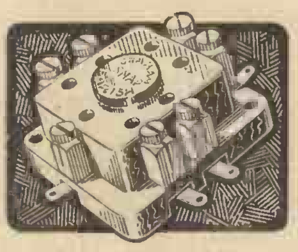
Ratios : 1 : 1, 1.2 : 1, 1.5 : 1. Price **12/6**



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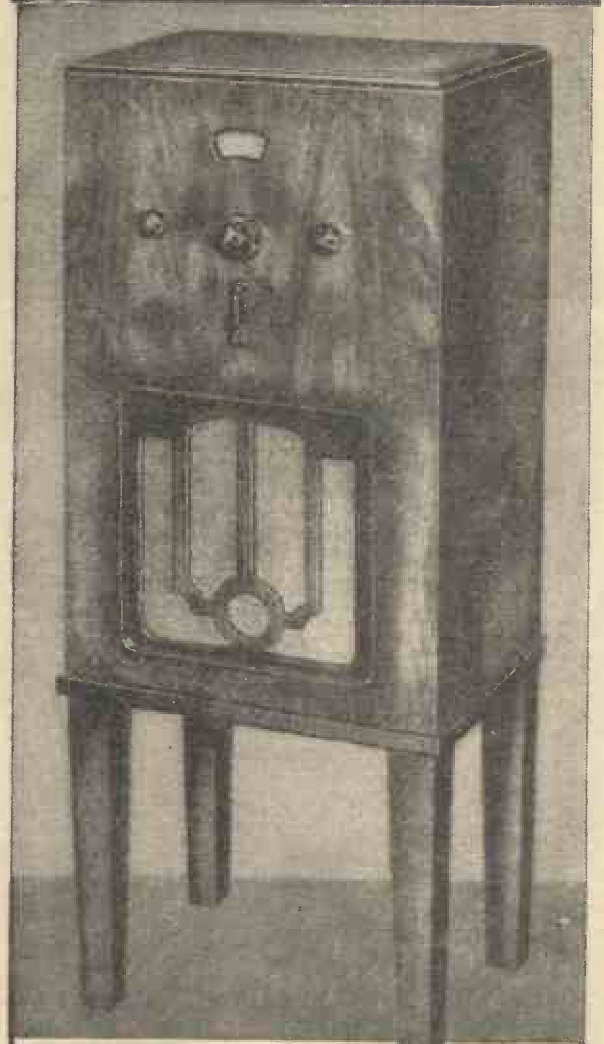

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READERS' WRINKLES

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 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).

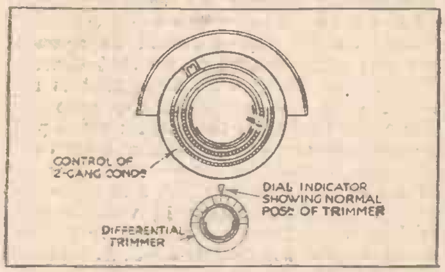


Fig. 1.

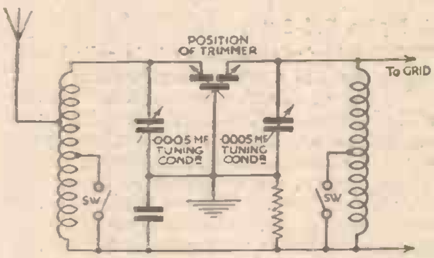
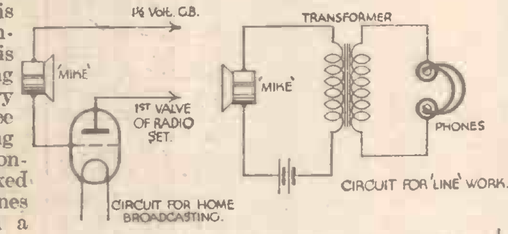


Fig. 2.—A trimmer for 2-gang condensers.

THAT DODGE OF YOURS!

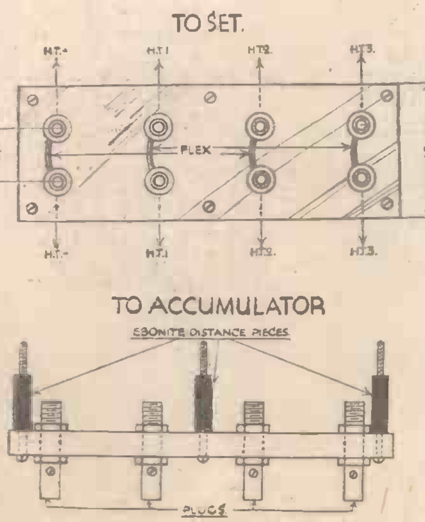
Every reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best wrinkle submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending 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

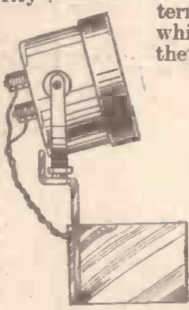
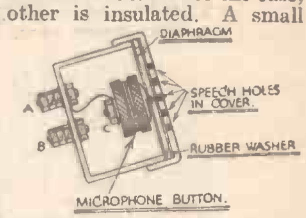
THE following dodge may be found useful for those readers who possess an H.T. accumulator. It is usual to have two batteries of 50 or 60 volts placed one above the other, consequently when making adjustments or alterations to the set the top crate has to be taken off in order to remove the plugs from 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.)

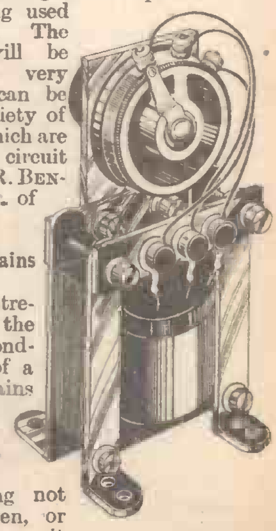



An outside view and section of a home-made microphone.

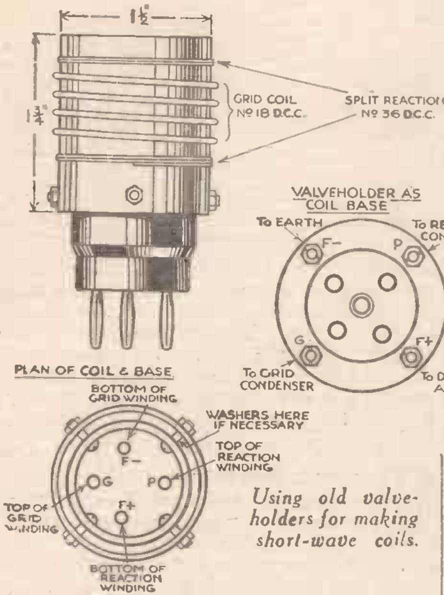
Reducing Mains Hum

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.

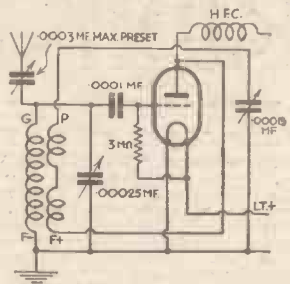
often repays the constructor to try connecting a low resistance potentiometer across it, and to use the sliding contact to find an artificial centre tap which will definitely reduce mains hum.

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.

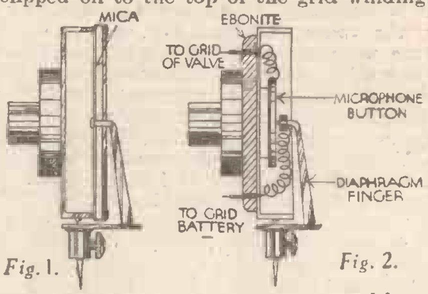
As the resistance of the potentiometer is about 24 ohms, the current passed at 4 volts is approximately 1/6 ampere, which is insufficient to cause undue heat, and will not place much extra load on the transformer; actually it is less than 1 watt. —H. G. SLADE Malta).

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.



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).

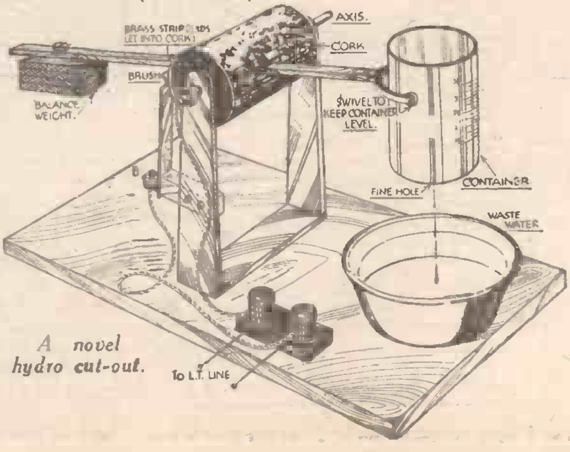
Making a Pick-Up From a Gramo. Sound-box

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).

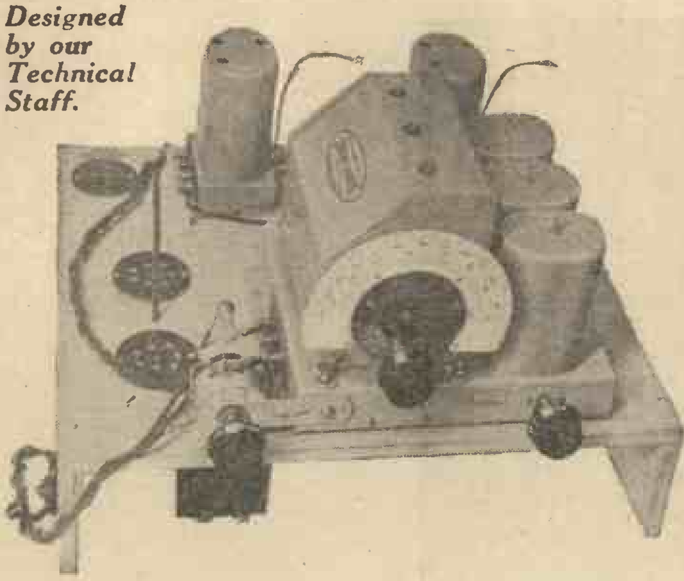


A novel hydro cut-out.

Designed by our Technical Staff.

THE LUXUS A.C. SUPE

A High-class, Four-valve Mains Receiver, Employing Automatic Volume Contro Valve, and the New H.F. Pentode. The Mains Portion Will Be Dealt



Three-quarter front view of the A.C. Superhet showing the professional appearance of our latest receiver.

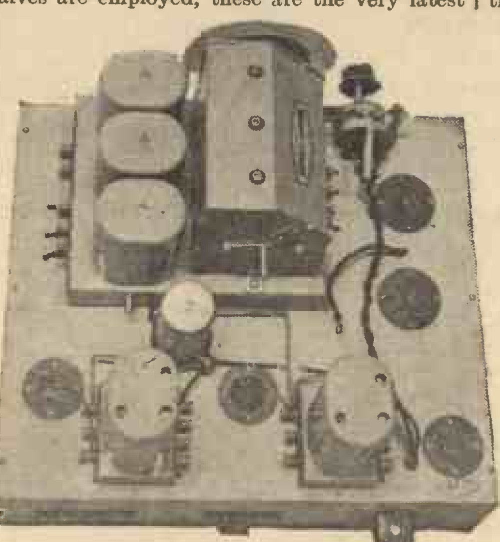
IN the past, all the receivers which have been produced by PRACTICAL WIRELESS have been built at the very minimum of expense, consistent with efficiency. That is to say, when the design has been considered, the various components have been chosen so that the essentials of the particular design could 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

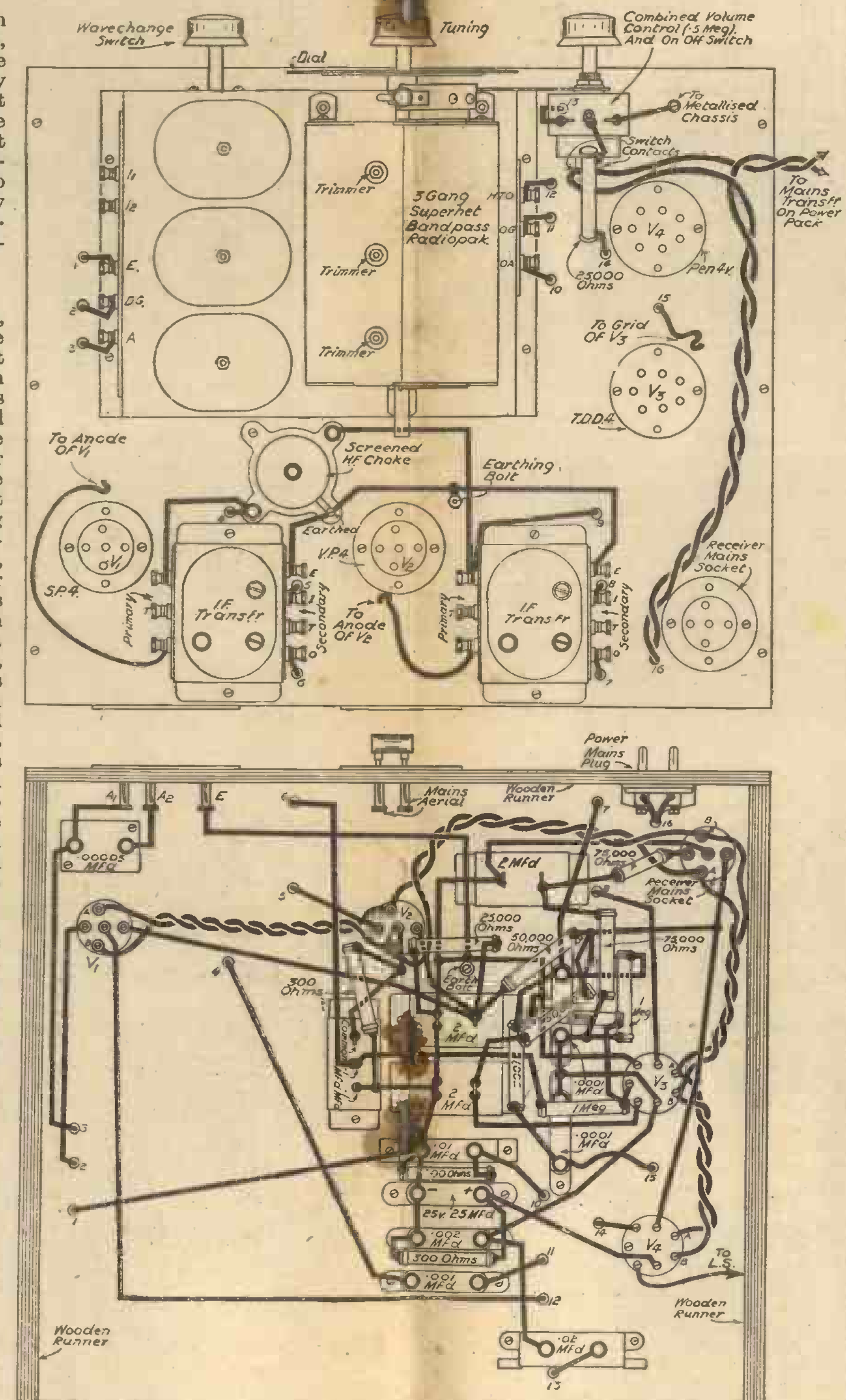
Before going any farther, perhaps the circuit should be explained for the benefit of those to whom such details appeal. Band-pass tuning circuits are employed between aerial and first valve, which is an H.F. pentode acting in the double capacity of first detector and oscillator. The band-pass coils and 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.

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



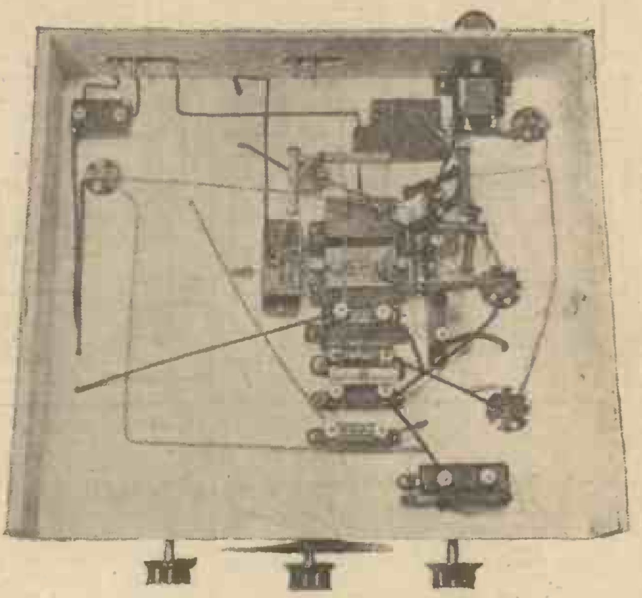
Top view of the A.C. Superhet.



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.

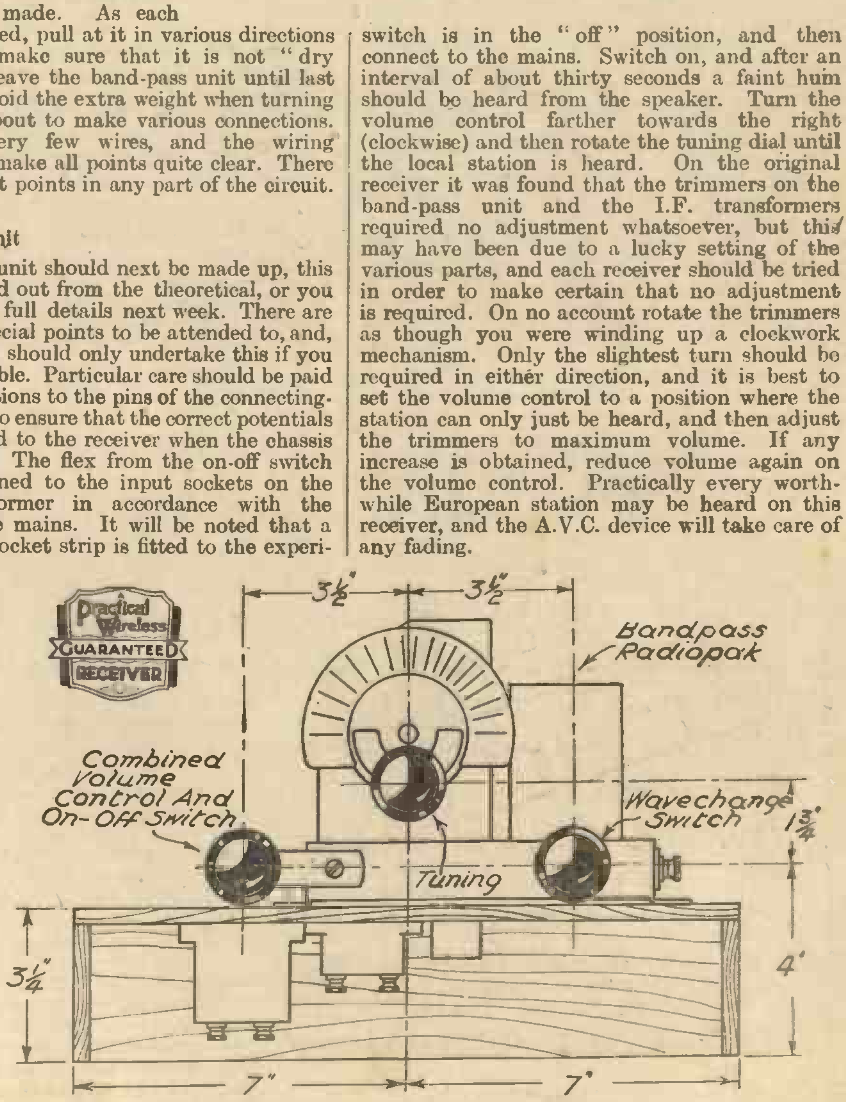
The Mains Unit

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.

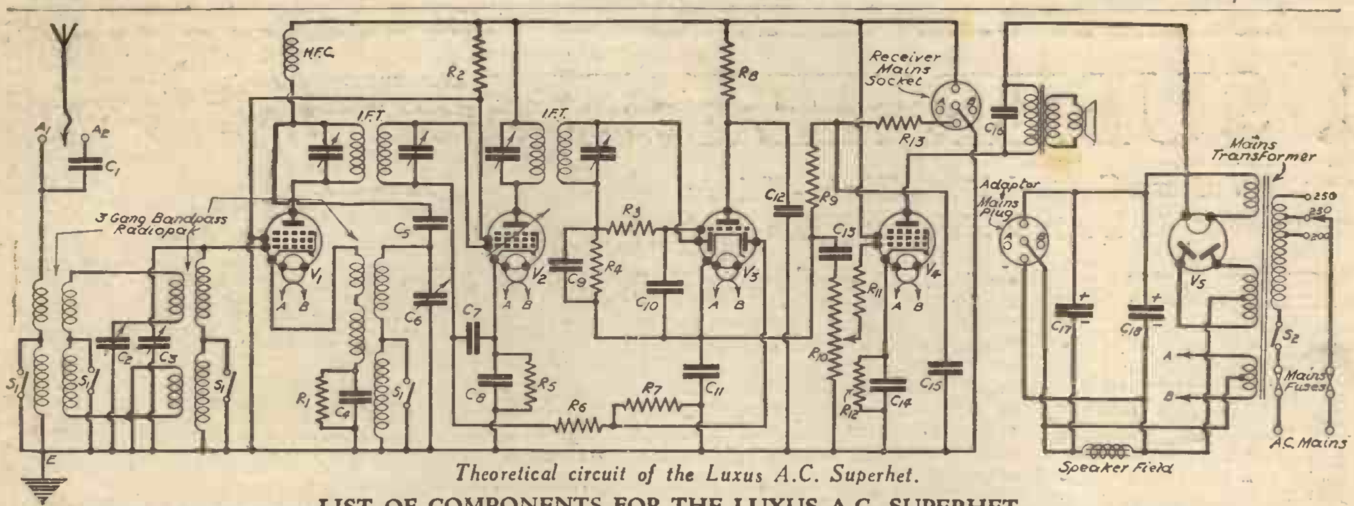
Practical Wireless GUARANTEED RECEIVER

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.

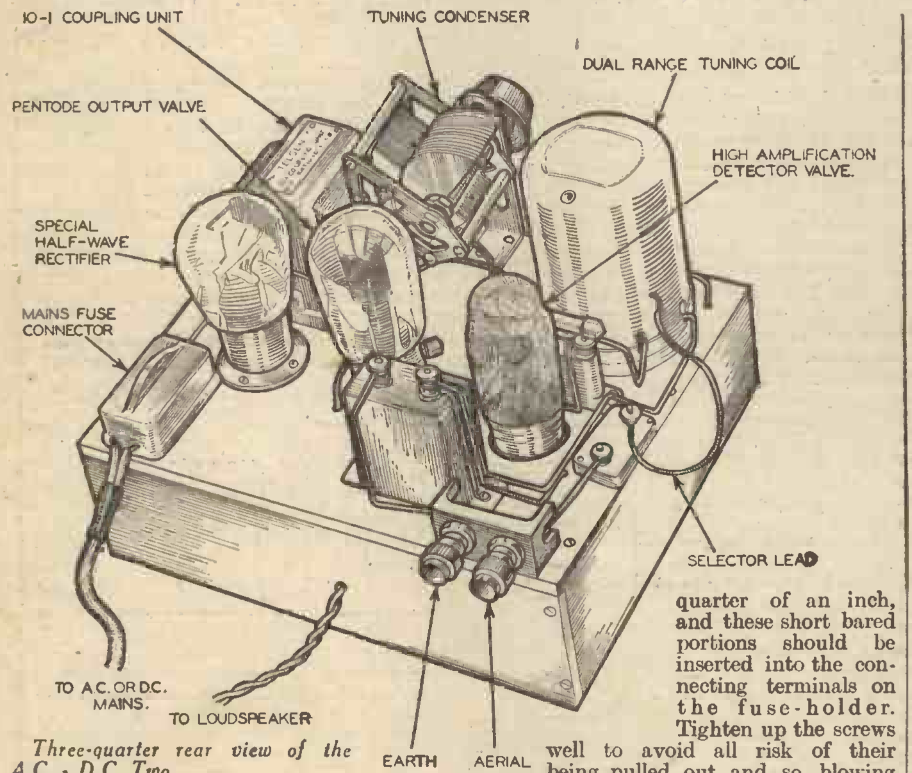
LIST OF COMPONENTS FOR THE LUXUS A.C. SUPERHET.

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 Condenset, 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.

FROM THE FLASH LAMP

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.

ONLY the wealth of detail and the lavish production of Lissen "Skyscraper" Charts has made it a PRACTICAL proposition for any home constructor to build

A 7 VALVE SUPERHETERODYNE

with 6 Stage Band-pass Tuning – 9 k/c channels Amplified Automatic Volume Control-Class B output

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 band-pass 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 Loud-speaker—glorious rich tone and majestic volume, actually more faultless in its reproduction than anything you ever heard from even the most powerful mains receiver, 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 below, or your radio dealer can supply you. Get your FREE CHART now!

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LISSEN "SKYSCRAPER" 7

SEVEN VALVE SUPERHET

N.B.

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.

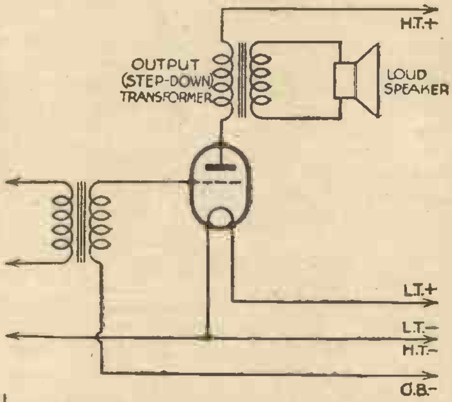


Fig. 30.—Matching the speaker and output valve by means of a step-down transformer.

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_5; R_5 is a 10,000 ohm decoupling resistance, and C_6 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_5 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.

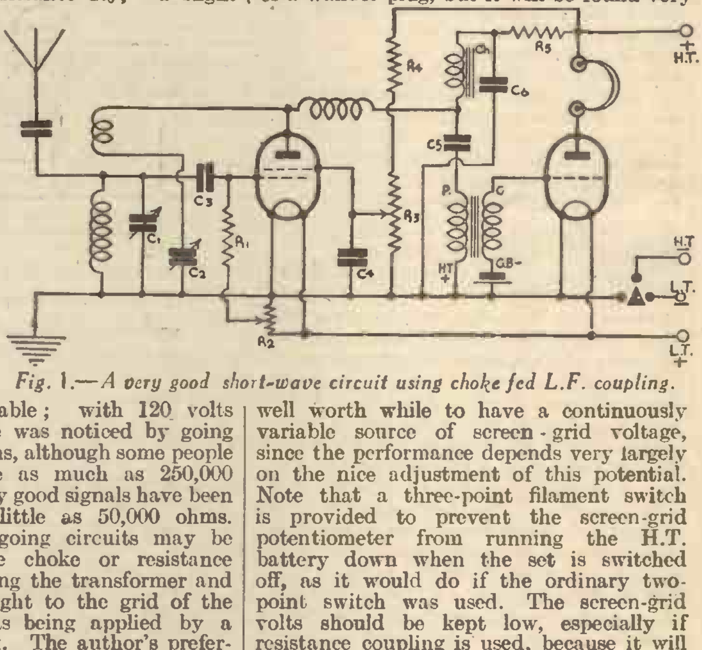


Fig. 1.—A very good short-wave circuit using choke fed L.F. coupling.

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_3, 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-

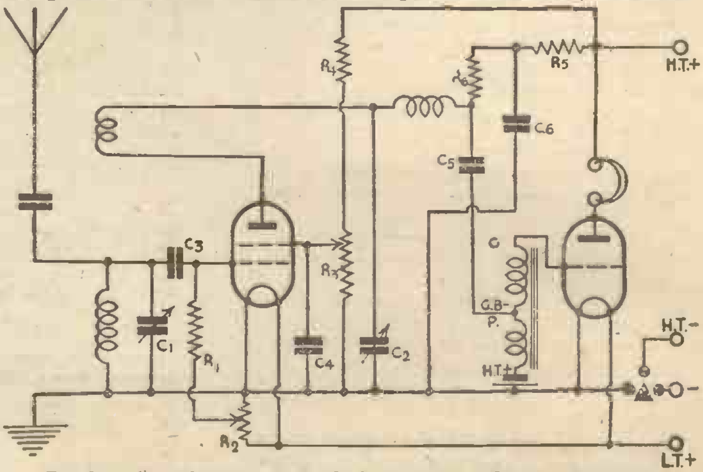


Fig. 2.—A similar circuit in which resistance fed L.F. transformer coupling is used.

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.

OUR VIEWS ON RECEIVERS

The Philips Type 634A Superinductance Receiver

The new Philips receiver Type 634A

IN view of the almost universal adoption of the superheterodyne circuit by makers of modern high-class receivers, we found the experience of submitting the Philips "Superinductance" receiver to a very thorough test most refreshing. This set is definitely in the de-luxe category, and we would say right away that it is one of the best we have had in our laboratories. So far as the sequence of valve stages is concerned, the circuit is perfectly "straight," but the results are at least equal to those given by any superhet we know having the same number of valves.

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 900 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, of handsome appearance, 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.

A guinea extra is charged for the D.C. set, to cover the additional cost of the second output valve and the necessary coupling components.

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 waveband, 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 superhet 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.

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.

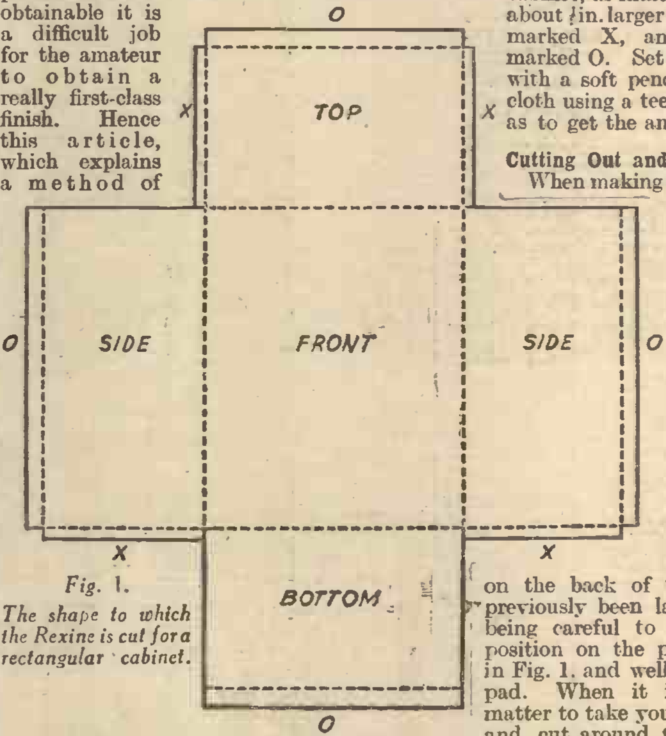


Fig. 1.
The shape to which the Rexine is cut for a rectangular cabinet.

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 ½in. thick, it should be quite suitable for covering, and will make a very strong job, especially where batteries are contained in the cabinet.

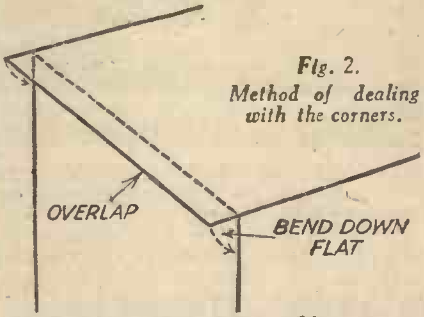


Fig. 2.
Method of dealing with the corners.

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 ½in. 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 saucepan 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 ½in. 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 he 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 ½in. 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 ½in. 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.

TELSEN

cover every COIL requirement

Illustration actual size

At the new reduced prices, the wonderful Telsen range of components represents more than ever radio's finest value. Whatever your coil requirements, be sure and insist on Telsen for lasting efficiency at the lowest cost consistent with quality.

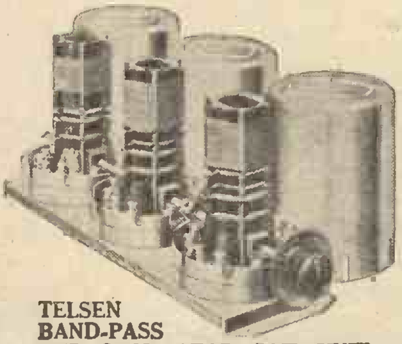
TELSEN IRON-CORED SCREENED COILS

The result of extensive research, these Coils employ an iron-dust core, achieving greatly reduced size, with considerably higher efficiency than that of the majority of air-cored coils. Magnification and selectivity are correspondingly improved, the metal screening also preventing inter-action. For use either as aerial tuning coils or H.F. transformers, a reaction winding being included.

		Price
No. W.349	Single Coil	8/6
No. W.422	Twin Matched Coils	17/-
No. W.423	Triple Matched Coils	25/6

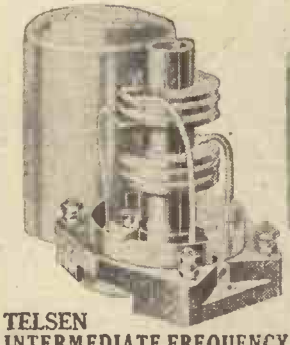
TELSEN DUAL-RANGE AERIAL COIL.

Incorporates a variable selectivity device, making the coil suitable for widely varying reception conditions. This adjustment also acts as an excellent volume control, and is equally effective on long and short waves. The wave-band change is effected by means of a three-point switch and a reaction winding is included.
Price 5/6



TELSEN BAND-PASS AND OSCILLATOR COIL UNIT

Comprises the Band-Pass Coils and Oscillator Coil combined into a single compact unit. All wave change switches are ganged, with single knob control. Ideal for any Superheterodyne circuit.
Price 21/6



TELSEN INTERMEDIATE FREQUENCY TRANSFORMER COIL

Consists of two tuned circuits comprising a Band-Pass intermediate frequency filter tuned to 110 kc. by two pre-set balancing condensers. Adjustable for different values of stray capacities, with variable filter coupling. Price 7/6

TELSEN SCREENED TUNING COILS

With separate coupling coils for medium and long waves. Highly suitable for use as aerial coils or as anode coils following a screened grid valve, giving selectivity equal to that of a well-designed band-pass filter. Price 7/-
Twin Matched 14/6
Triple Matched 21/6

TELSEN H.F. TRANSFORMER COIL

May be used for H.F. amplication with Screened Grid Valve, either as an H.F. Transformer, or, alternatively as a tuned grid or tuned anode coil. It also makes a highly efficient Aerial Coil where the adjustable selectivity feature is not required. Price 4/6

TELSEN SUPER-HET. COILS (TYPE No. S 330)

For Superhets which do not employ band-pass tuning in their pre-detector H.F. stages. Mechanical construction and wave-change switch assembly almost identical with standard Telsen Screened Coils .. .. .. Price 21/6

TELSEN BAND-PASS COIL UNIT

Comprises two accurately matched Screened Band-Pass Coils, on a single rigid plinth base. The coils are independent of each other and can be wired for any of the three types of Band-Pass Filter to give exceptional quality with selectivity. Price .. 14/6

TELSEN OSCILLATOR COIL

Particularly suited to Superheterodyne circuits in conjunction with the Telsen Band-Pass Coils. Operates at a frequency separation of 110 kilocycles from the Band-Pass tuning range. Price .. 7/6

TELSEN FOR EVERYTHING IN RADIO

ANNOUNCEMENT OF THE TELSEN ELECTRIC CO., LTD., ASTON, BIRMINGHAM

A USEFUL TEST APPARATUS

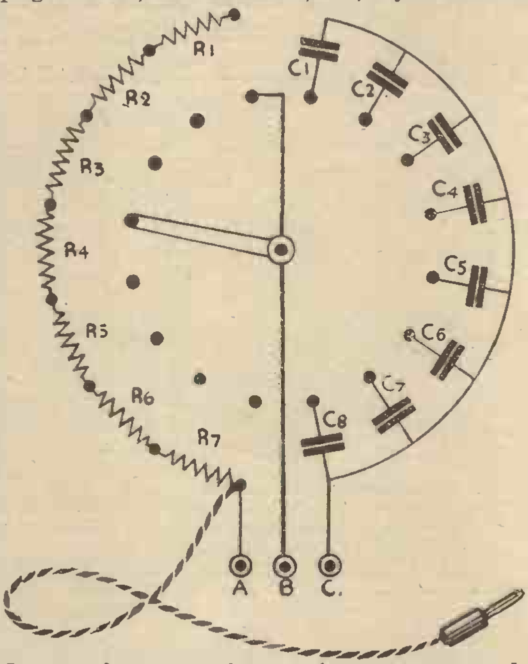
For Quickly Determining the Value of Resistance or Capacity for Any Particular Purpose. By H. J. HARVEY.

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.

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.



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

Diagram of connections for a simple test apparatus, and table of resistance and capacity values.

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.

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.

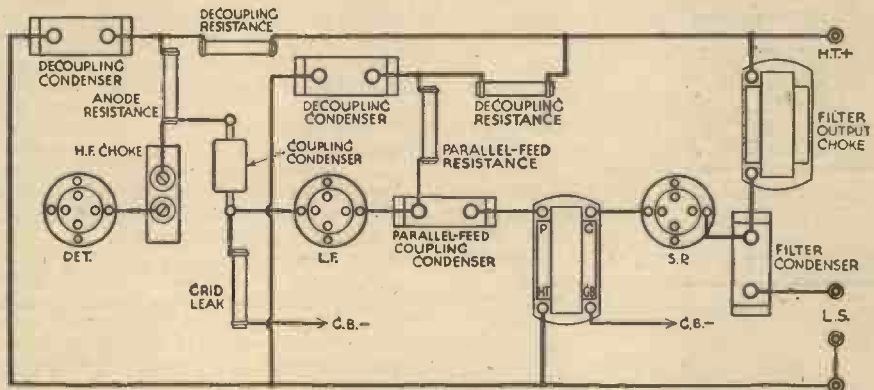


Fig. 1.—Showing anode circuit decoupling, parallel feed transformer coupling, and choke filter output.

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)

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.	Decoupling.	Grid leak	Grid Con.
.0001–.0005.	1,000 ohms/.5mfd.	.25–2 meg.	.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.

	Couplg. Con.	Transfmr.	Detector. / L.F. Valve.	Parall. Feed Res.	Decoupling.
First Stage (Transformer).	5–1mfd.	3/1	15,000 (GP)	25,000	15,000 2mfd.
			25,000 (HL)	30,000	15,000 2mfd.
Second Stage (Transformer).	1–2mfd.	3–5/1.	10,000 (LF)	15,000	5,000/2mfd
			15,000 (GP)	20,000	10,000/2mfd.

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.

NEXT WEEK!
A Fascinating New Feature
The Progressive Experimenter

(*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 $\frac{4}{8}$, 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 ½lb., is used.—NORMAN ROLLASON (Canterbury).

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.

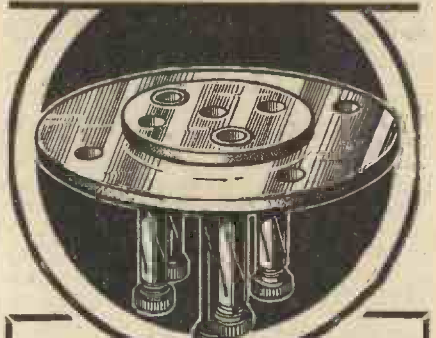
—THAT a clear glass valve which is turning black, or a silvered bulb which is developing a rainbow effect, is probably nearing the end of its useful life.

—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.



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.

REPLIES TO QUERIES and ENQUIRIES by Our Technical Staff

LET OUR TECHNICAL STAFF SOLVE YOUR PROBLEMS

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	— · — · — ·
Colou	— — — · · ·
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.

FREE ADVICE BUREAU COUPON

This coupon is available until Oct. 21st, 1933, and must be attached to all letters containing queries.

PRACTICAL WIRELESS, 14/10/33.

CATALOGUES RECEIVED

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

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, anode 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.

ADVERTISEMENT INDEX

JUST ANOTHER WAY OF SAYING —

Whatever the circuit, the experienced constructor will always choose "J.B." For tuning iron-cored coils, in particular, the accurate matching found in J.B. Gangs becomes imperative; and the mechanical rigidity of "J.B." *ensures the permanence of this matching.*

Illustrated is the new J.B. "DILECON CONDENSER" with fitted terminals, soldering tags and one-hole fixing. This is of the solid dielectric type, the vanes being interleaved with bakelite. The J.B. model is shakeproof and rigid to a degree seldom attained, and yet is no more expensive and is as small as any. If economy or space demands solid dielectric condensers, the Dilecon will ensure best possible results. Write for complete new catalogue.

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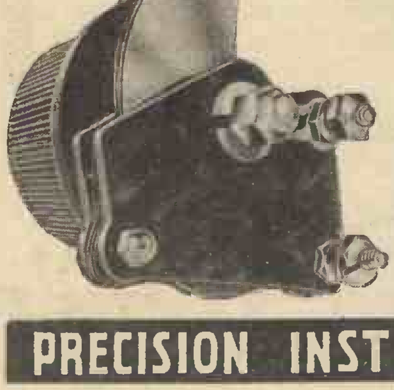


THE NEW "J.B." "DILECON" CONDENSER

Price .0003 .0005 2/6

PRECISION INSTRUMENTS

Advt. of Jackson Bros. (London) Ltd., 72, St. Thomas' St., London, S.E.1. Telephone: Hop 1837.

From every point of view R&A Reproducers lead

design, construction, performance, price.

Design is of paramount importance, the foundation on which depends the ultimate performance of a reproducer. For this reason the R. & A. research department is constantly studying the problems of sound reproduction, and the result is to be found in the uniform high quality of performance inherent in every R. & A. Reproducer.

Ask your dealer to demonstrate any R. & A. model. Compare its performance with that of any similarly priced instrument and you will appreciate a superiority which is acknowledged by the leading Set manufacturers who are fitting them as standard in their 1934 models.

The complete range comprises:—

TYPE '60' Differential Armature	21/-
'BANTAM' P.M. Moving Coil (two models) ...	27/6
'CHALLENGER' P.M.M.C. (five models) ...	35/-
'ALPHA' P.M.M.C. (two models)	52/6
'VICTOR' P.M.M.C. with 6 ratio Transformer ...	70/-

Each model (except Type '60') is fitted with Transformer specially designed to match the impedance of the valve with which it is to be operated.

REPRODUCERS & AMPLIFIERS LTD., WOLVERHAMPTON

R&A

BRITAIN'S FOREMOST REPRODUCERS

304 Holdens

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.

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.

OUR LATEST SUCCESS

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

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

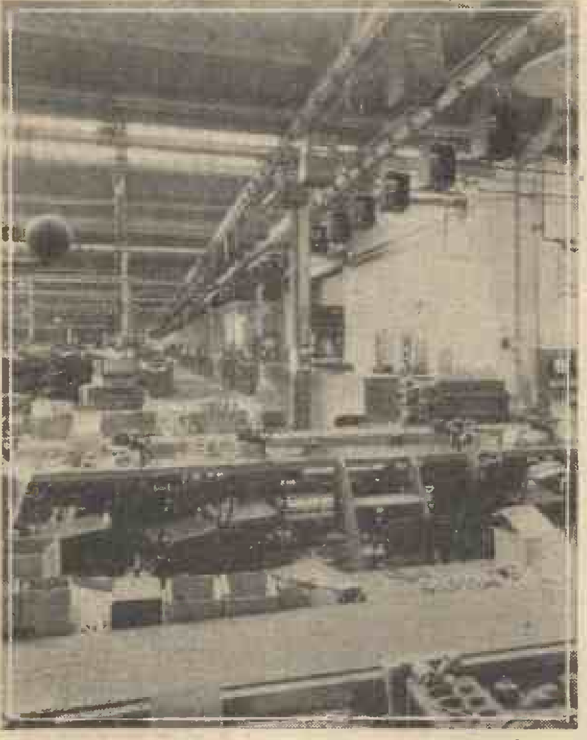
RADIO Vitus, Paris, which has recently completed the building of a high-power station at no great distance from the French capital, has been forbidden to broadcast through it. According to the new law, no private concern may bring new stations into operation nor may the existing ones be worked at greater 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.

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.

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 transatlantic 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.

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.

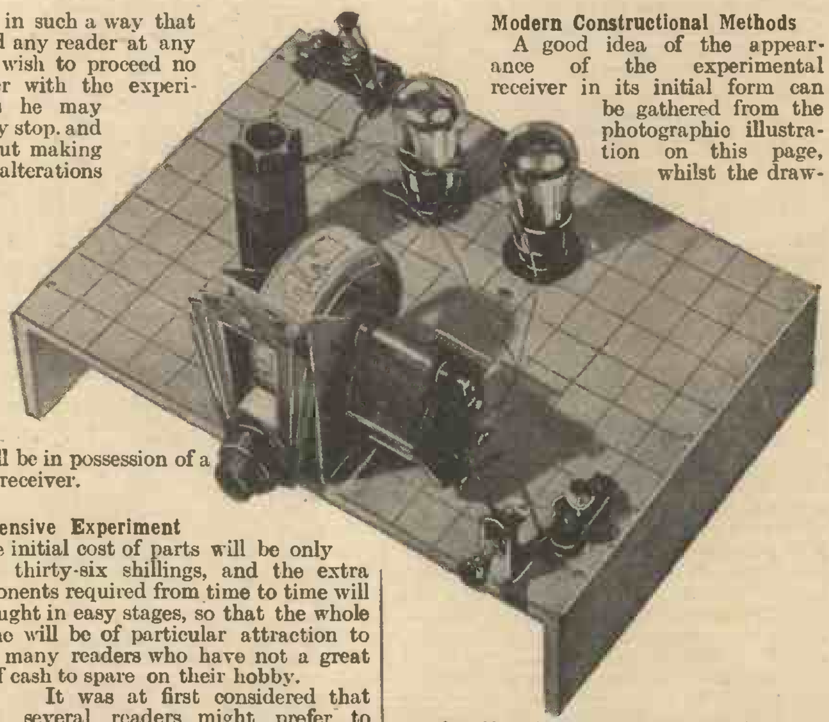


Fig. 1.—*This illustration gives a good idea of the set ready for the preliminary experiments.*

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.

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.*

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.

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-

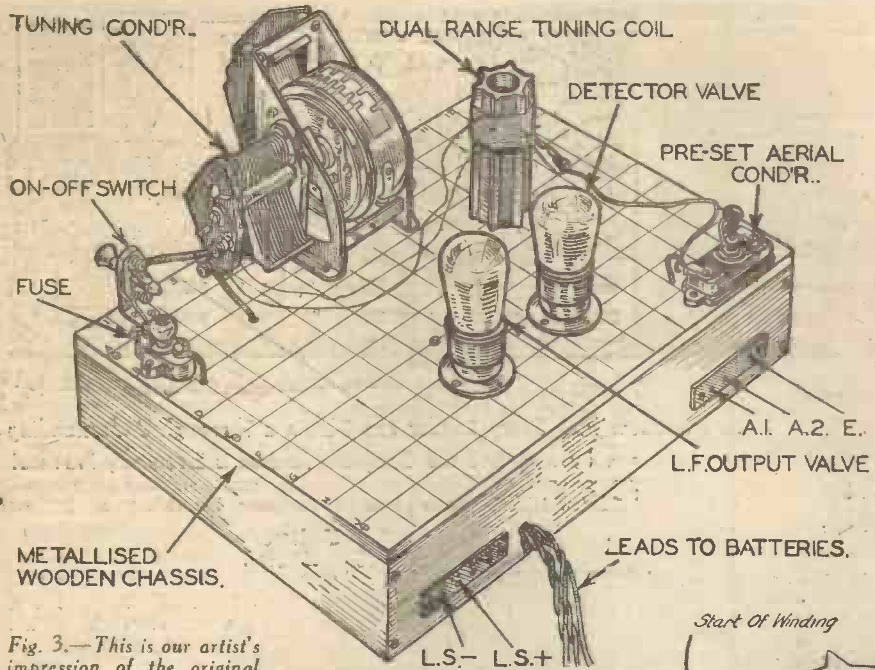


Fig. 3.—This is our artist's impression of the original receiver. The names will enable you to recognize the components.

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 1¾in. 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.

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 ¾in. 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.

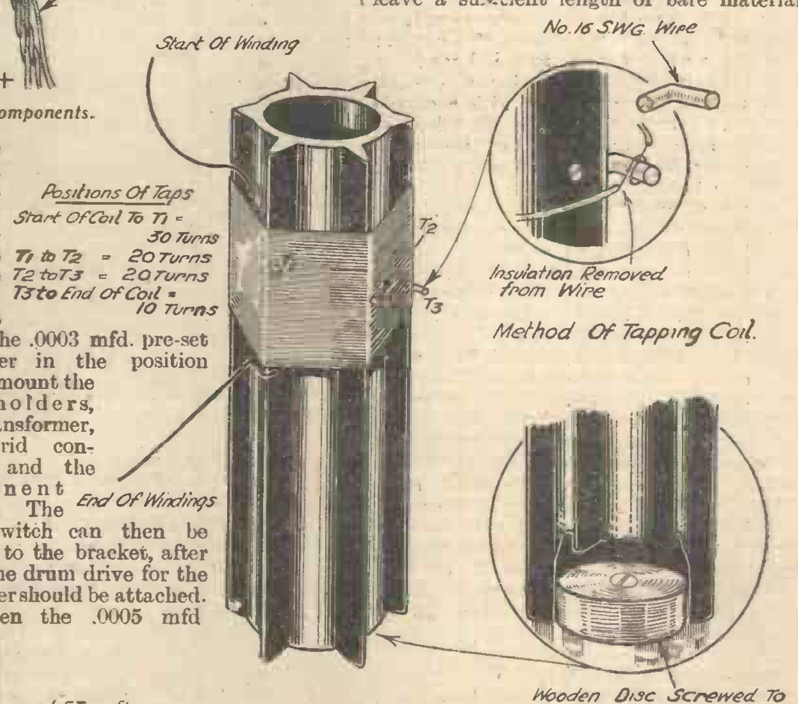


Fig. 4.—All constructional details for the tuning coil may be obtained from the above sketch.

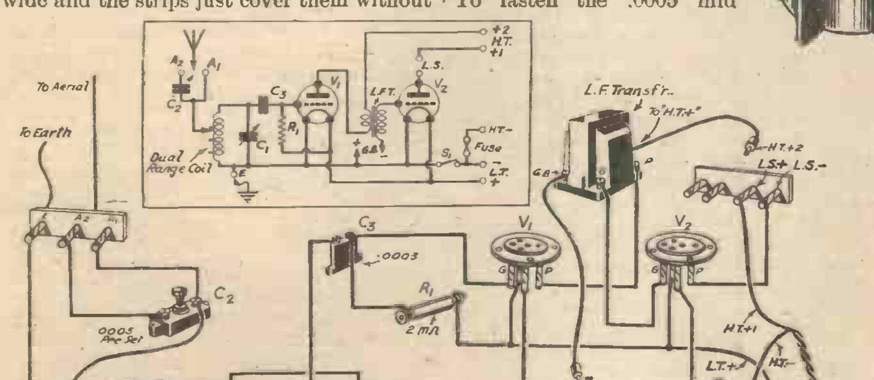


Fig. 5.—Here you have a pictorial circuit diagram, whilst the corresponding theoretical circuit is shown inset. By comparing the two you will be able to improve your knowledge of circuit diagrams.

A MOST IMPORTANT ANNOUNCEMENT

THE ORBIT

Here You Are Given Preliminary Details of an Entirely New Receiver, Designed by Mr. F. J. Camm, Which Will be Fully Described Next Week.

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

The latest type of iron-core coils are used to ensure ample selectivity for any and every requirement, and the carefully "balanced" circuit makes long-distance reception a matter of utter simplicity. Of course, we all know perfectly well that long range and selectivity combined are of little use in the normal course of events for receiving stations that are subject to fading. CONSEQUENTLY THIS NEWEST SET IS PROVIDED WITH A SIMPLE ANTI-FADING DEVICE *WHICH WORKS*. As a result you can make full use of the selectivity and sensitivity properties in a manner that has hitherto been impossible with any but the most expensive and elaborate receiver.

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

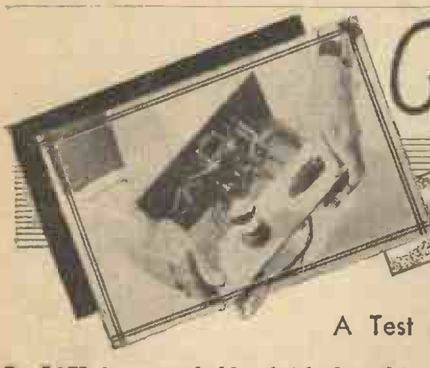
The number of controls has been reduced to the minimum without making any sacrifice of efficiency, and they consist of a single tuning knob which drives a slow-motion condenser dial, a wavechange switch and a reaction control. There is also an on-off switch, but this is so positioned that the symmetrical 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.

YOU PAY FOR THIS 11/- 120 VOLTS

YOU GET THIS FOR NOTHING

50·2% EXTRA LIFE

A well-known British set-maker was placing large orders for Hellesen Hi-Life batteries. First he put them on test. The result of his test showed that their life was no less than 50.2% longer than any other battery working under identical conditions—a figure even greater than that shown by our own tests in the factory.

That is the result of over 40 years experience in the manufacture of dry batteries. Since 1887 Hellesen batteries have been the best in the world. Now the new Hi-Life batteries, the latest addition to the Hellesen range, have reached an even higher standard of performance than before, and are offered to you at a price competitive with any other quality battery.

BRITISH MADE BY BRITISH LABOUR

HELLESENS

HI-LIFE BATTERY

Hellesens Limited, Morden Road, South Wimbledon, S.W.19.

Arks

HOW CLEAR IT IS ! WHEN

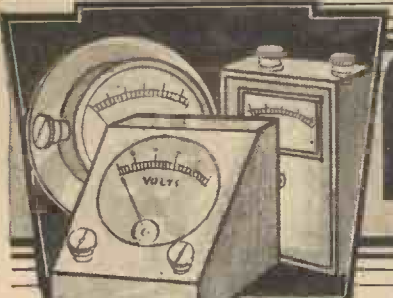
EVER READY

REGD. TRADE MARK

WIRELESS BATTERIES ARE POWERING YOUR SET

HAVE YOU A MARCONI 55 ?
Then you need Ever Ready Batteries: H.T. Port. 17; G.B. 4; L.T. 2169—all made specially for it. Or simply ask your dealer for the Ever Ready List, showing all popular makes with their special Ever Ready Batteries. Your set will be powered perfectly by its appropriate Ever Ready Batteries.

The Ever Ready Co. (Gt. Britain) Ltd., Hercules Place, Holloway, London, N.7.



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.

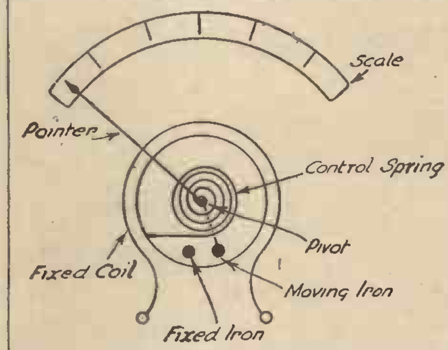


Fig. 1.—Simple diagram explaining the principle of a moving iron instrument. This illustration does not show the actual form of movement.

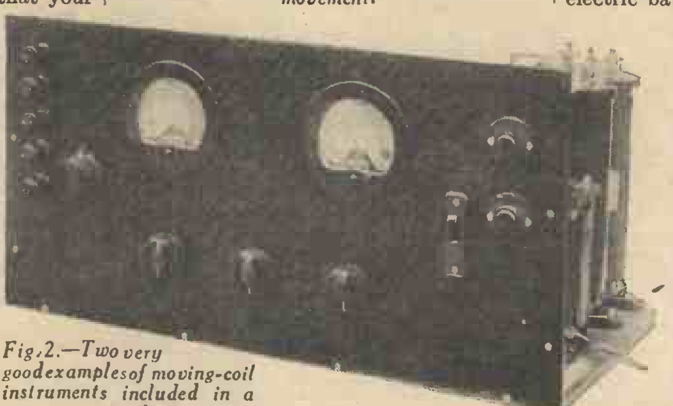


Fig. 2.—Two very good examples of moving-coil instruments included in a wireless receiver.

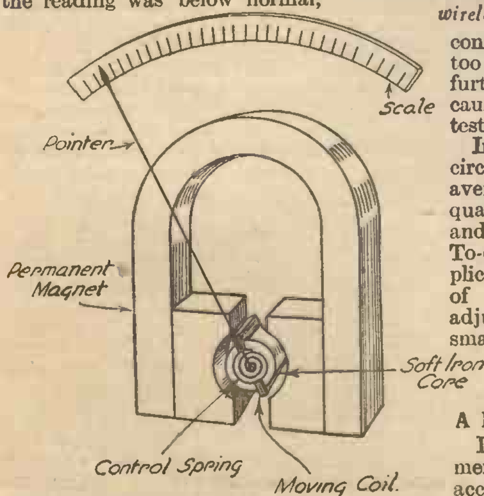


Fig. 3.—Illustrating the elementary principles of a moving-coil instrument.

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,

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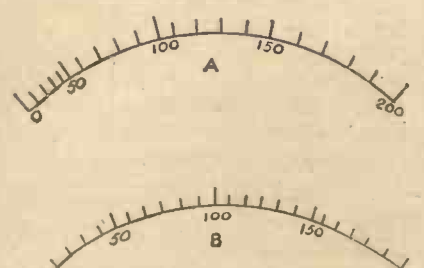
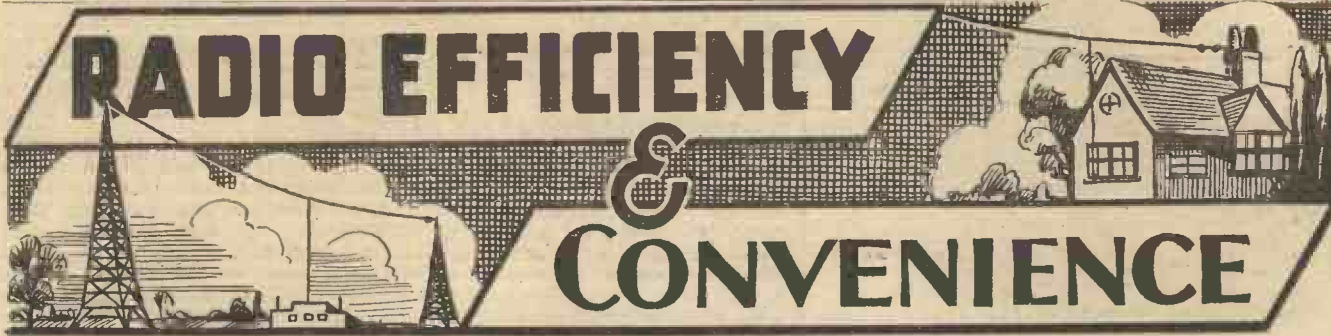


Fig. 4.—Comparison between scale of moving-iron and moving-coil instruments. A. Moving iron (crowded at bottom). B. Moving coil (equally divided).



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.

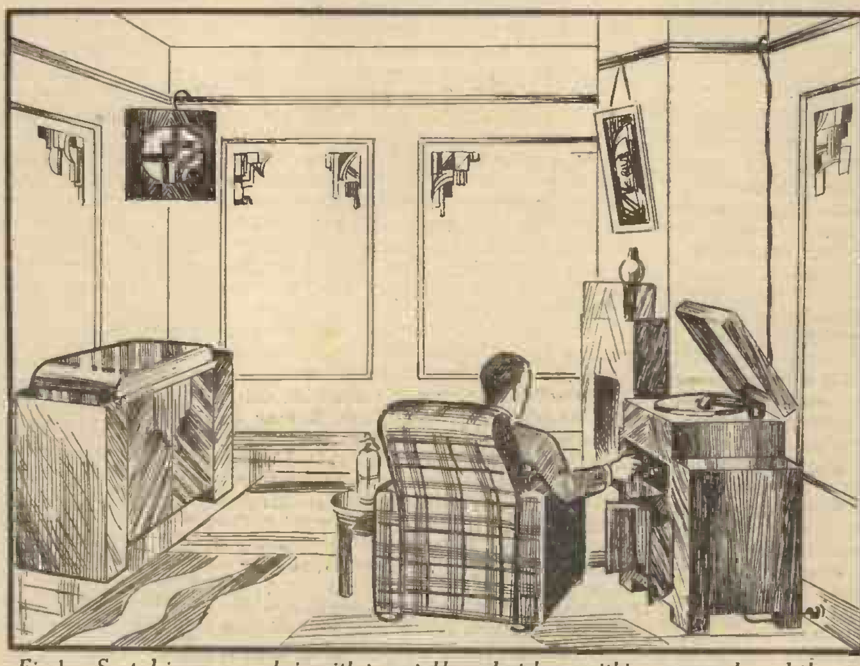


Fig. 1.—Seated in an arm-chair with turn-table and pick-up within easy reach, and the set situated in another part of the room for best acoustical effects.

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.

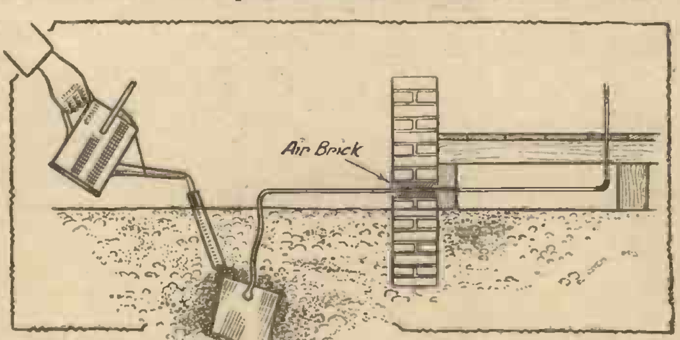


Fig. 2.—Earth plate (or bowl) with tube for watering, and lead from earth taken through air-brick of house and then through hole in floor-board to set.

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

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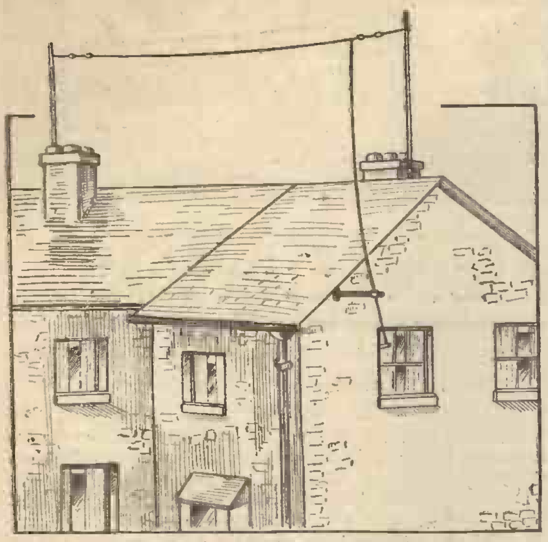

Fig. 3.—High aerial masts between two chimney stacks, with down lead held well away from the walls.

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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.

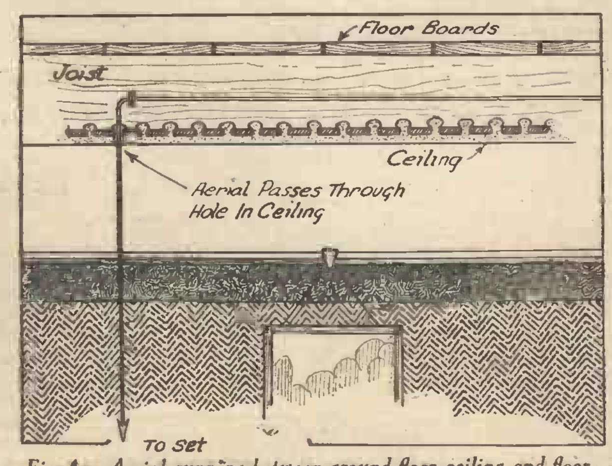


Fig. 4.—Aerial running between ground floor ceiling and floorboards of room above.

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.

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.

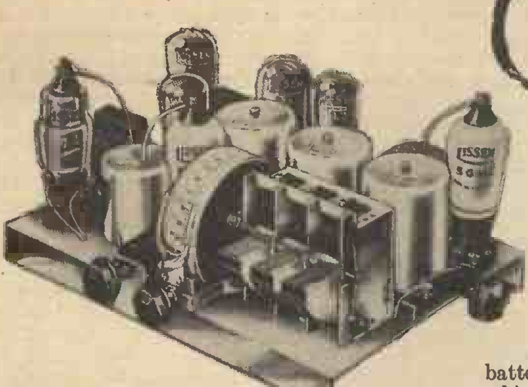
The second type of instrument is known as the moving-coil instrument, two good examples of which are shown in Fig. 2. It consists of a permanent magnet, usually of the horse-shoe type, between the poles of which is pivoted a coil of wire as indicated in Fig. 3. The current to be measured passes through 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.

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

(Continued on next page)

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.

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.

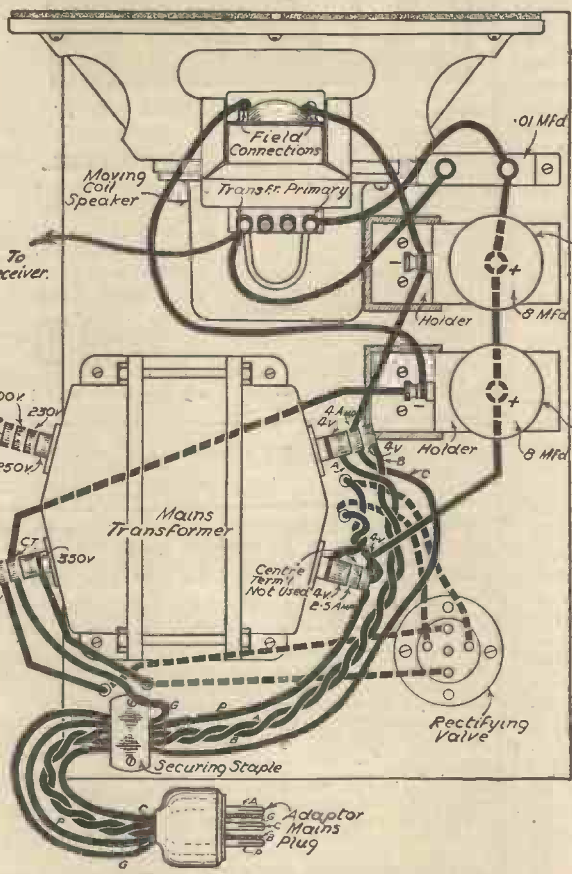


Fig. 2—Wiring diagram of the Mains Unit.

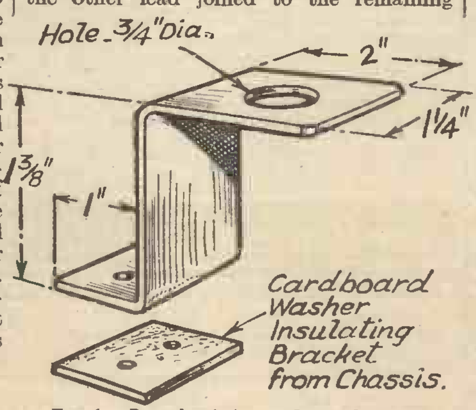


Fig. 1—Details of the condenser brackets.

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.

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.

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

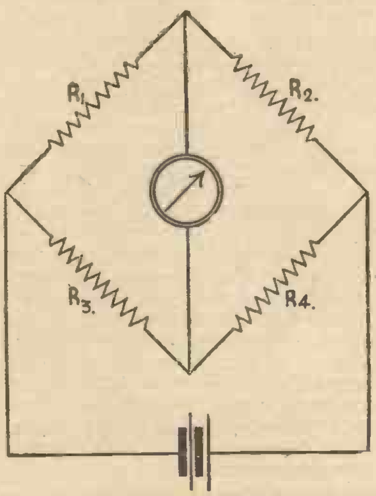


Fig. 1.—The circuit arrangement of a standard bridge.

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

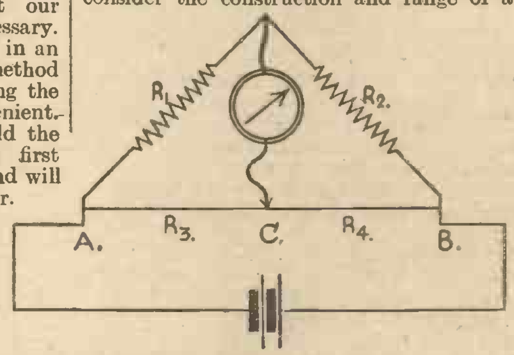


Fig. 2.—The two arms, R3 and R4, of Fig. 1 replaced by a fixed wire and adjustable contact point.

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.

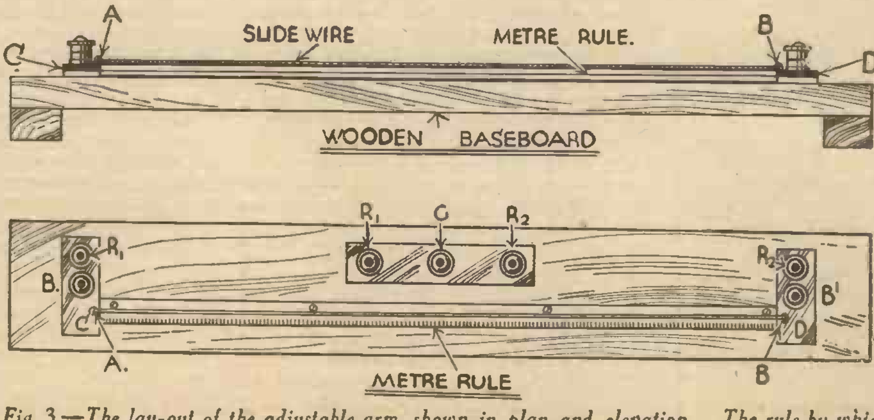
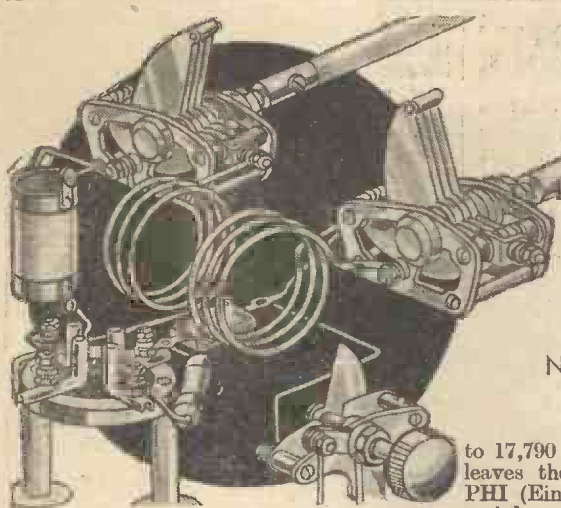


Fig. 3.—The lay-out of the adjustable arm, shown in plan and elevation. The rule by which values are computed may be seen.



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.

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.

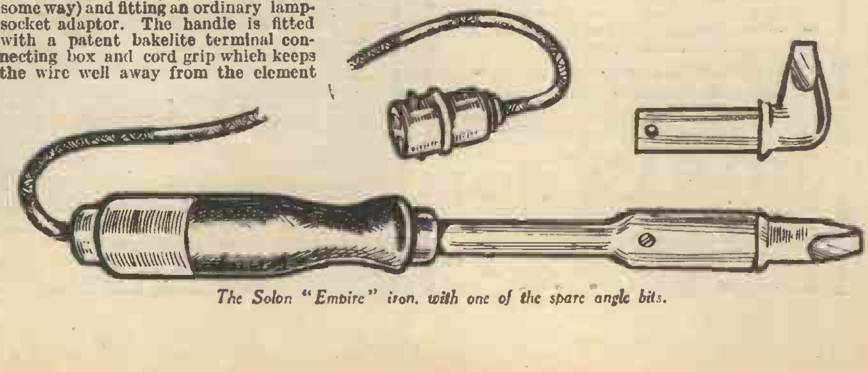
SOLON "EMPIRE" SOLDERING IRON

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. Henley'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 ½in. 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, D.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.

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.

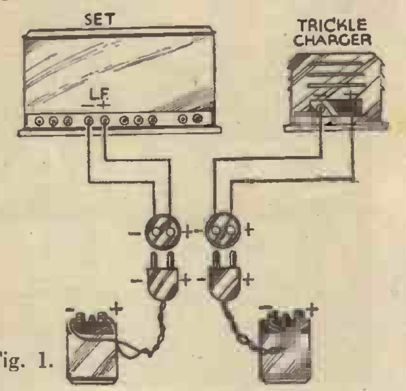


Fig. 1.

Figs. 1. & 2.—Diagrams accompanying Mr. Cole's letter.

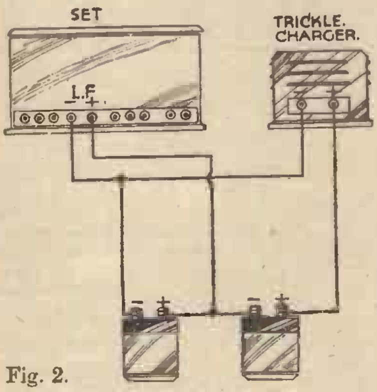


Fig. 2.

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.

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AI 768850	AL 682038	AM 880976	AN 695814	AO 944272	AP 383760	AQ 792659
AJ 429274	AL 468023	AM 370328	AN 538111	AO 350928	AP 843641	AQ 343727
AJ 918962	AL 741515	AM 365302	AN 920763	AO 846218	AP 415275	AQ 242140
AK 163602	AM 400000	AN 180261	AN 635524	AO 387442	AP 658857	AQ 175887
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This offer applies to licences which are actually in force on Saturday, October 21, 1933.

Before the awards are paid, claimants will be asked to undertake a simple publicity service in distributing leaflets to encourage the sale of licences amongst those who at present do not fulfil their obligations by taking out a Post Office Licence before receiving broadcast programmes. Claims cannot be considered in connection with any Licence the date of issue of which is after October 19, 1933

For full particulars for claiming awards and a complete list of numbers see

TIT-BITS

ON SALE EVERYWHERE SATURDAY OCTOBER 21.

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THE ORBIT—F. J. CAMM'S LATEST SUCCESS

Practical Wireless

3^D

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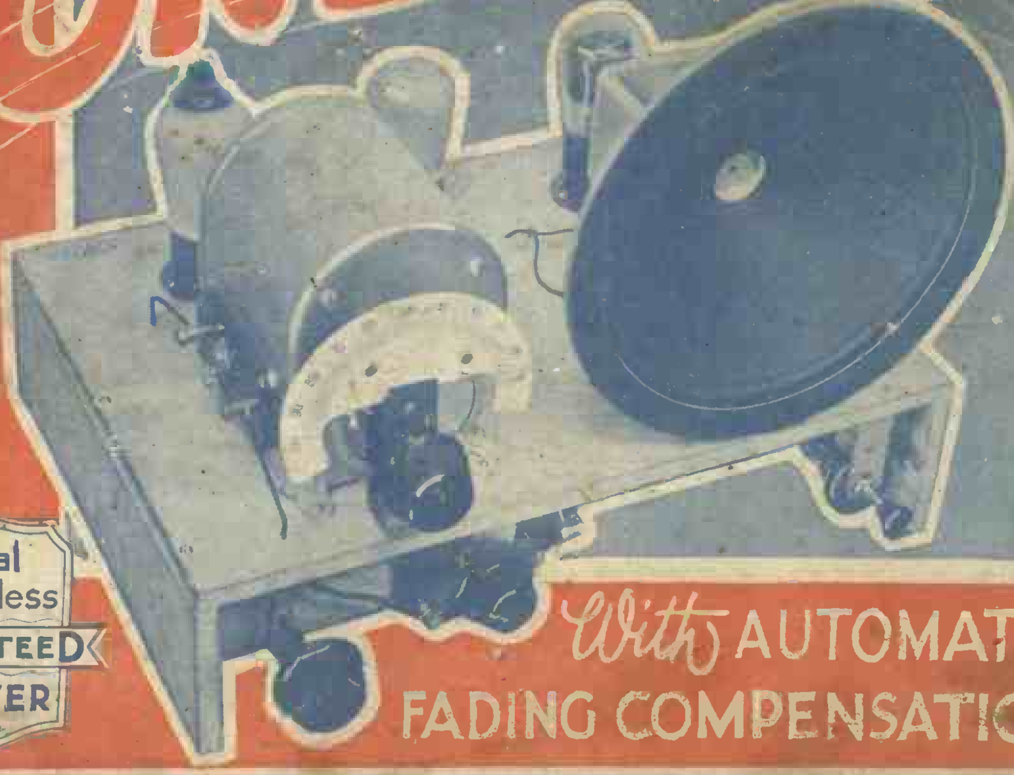
EDITED BY F. J. CAMM.

FURTHER DETAILS OF F. J. CAMM'S ORBIT 3



A Practical Wireless GUARANTEED RECEIVER

With AUTOMATIC FADING COMPENSATION


IGRANIPAK

MAKE YOUR SET SELECTIVE

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.

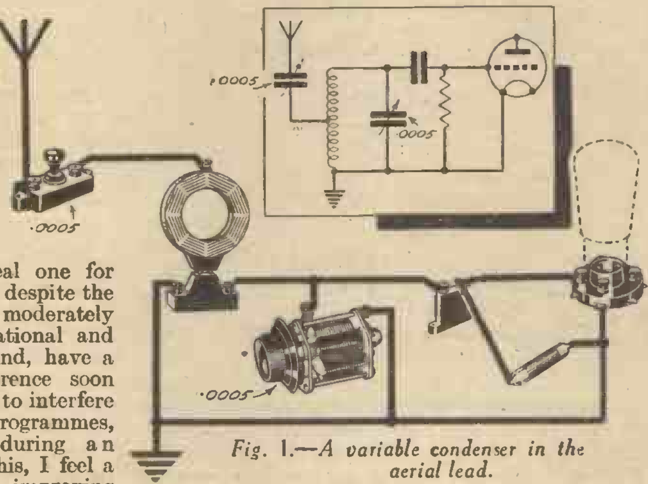


Fig. 1.—A variable condenser in the aerial lead.

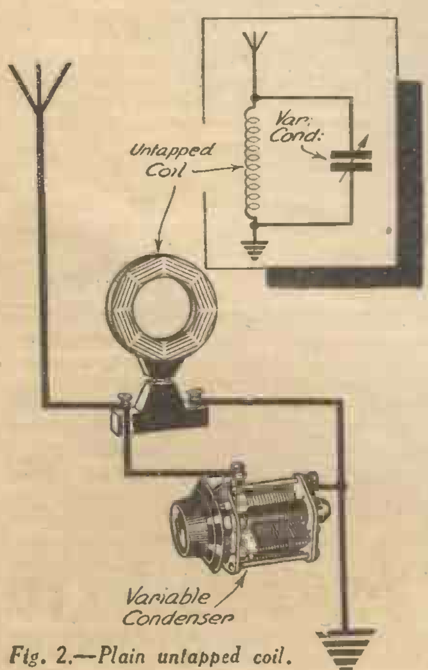


Fig. 2.—Plain untapped coil.

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)

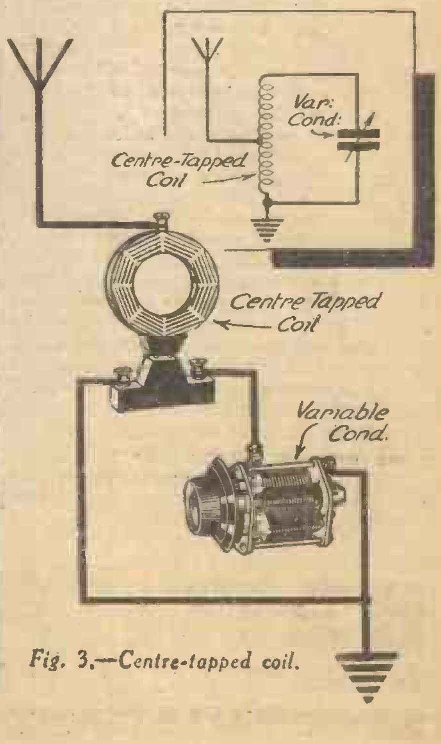


Fig. 3.—Centre-tapped coil.

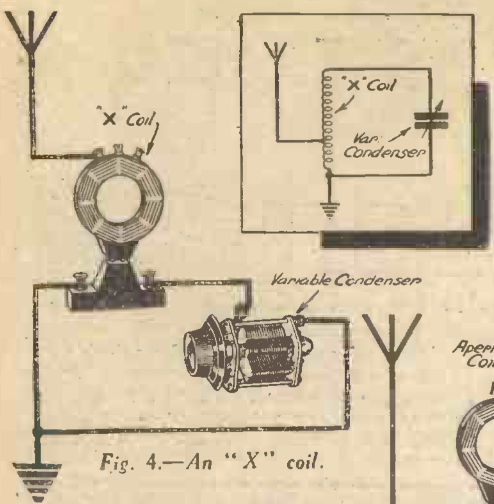


Fig. 4.—An "X" coil.

(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.

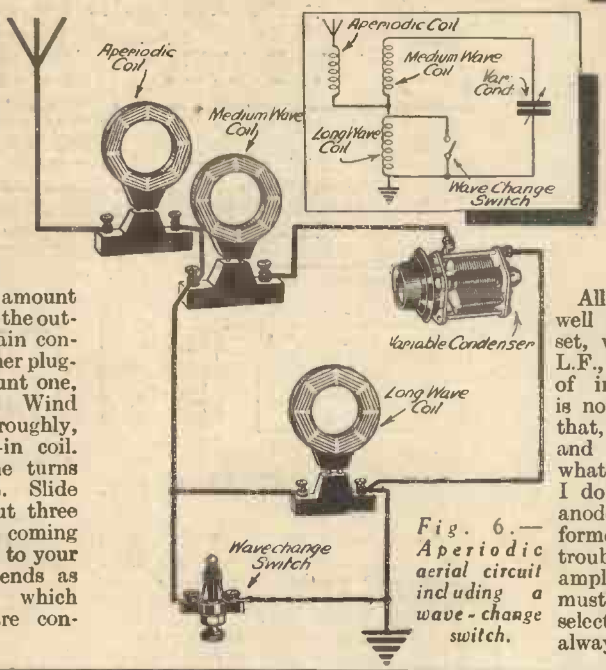


Fig. 6.—Aperiodic aerial circuit including a wave-change switch.

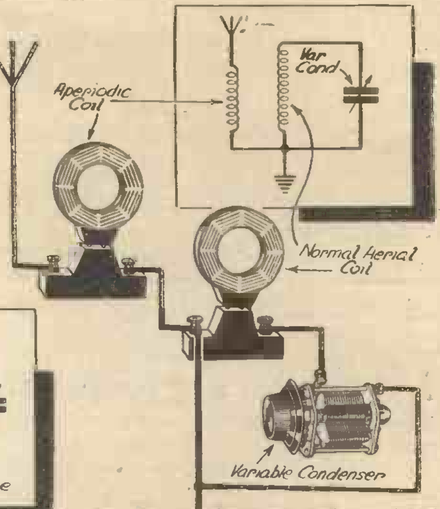


Fig. 5.—An aperiodic aerial circuit.

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.

FROM THE FLASH LAMP

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.

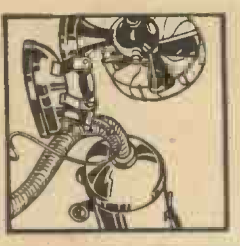
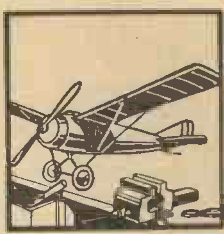
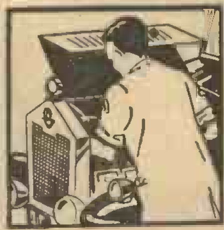
Let us think what would happen if it were possible to emit actual sound-waves from two stations ninety-five miles apart, and examine the interferences taking place between them over the intervening region on the *supposition that sound could travel as fast as light*; we should find that a note emitted 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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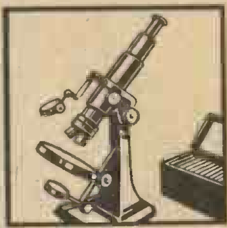

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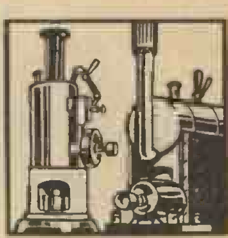

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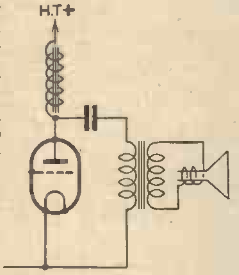
(*Continued from page 308*)

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.

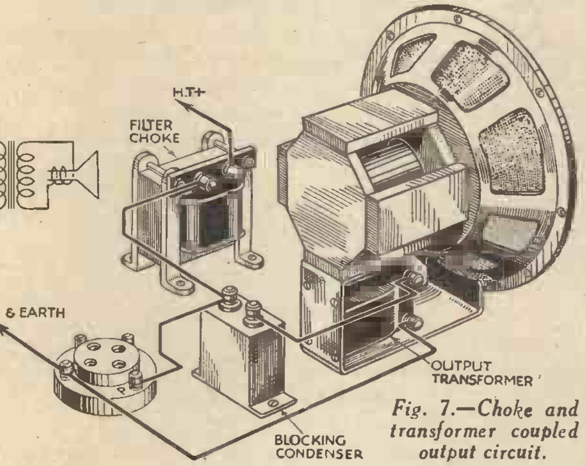


Fig. 7.—Choke and transformer coupled output circuit.

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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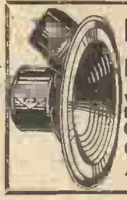

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RANDOM REFLECTIONS on the 1933-4 VALVES

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.

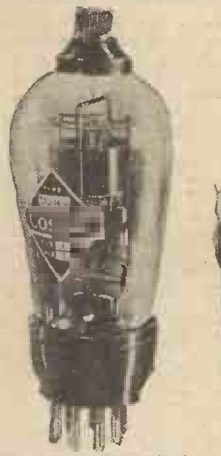
The valve is the driving-force of a radio receiver, and over-all efficiency must largely depend upon it. Too frequently an unsuitable valve is called upon to fulfil a duty that it was never intended to perform, and consequently becomes a square peg in a round hole.

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.

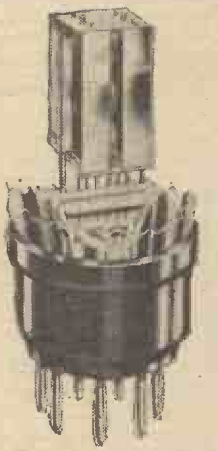
When designing a receiver for a definite purpose, as distinct from screwing a lot of components on a baseboard anyhow, a logical method is to work upwards from the output valve, first of all deciding the output required and then arranging for preceding stages to magnify the incoming signal until the 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.



The Cossor DD/PEN, a double-diode variable-mu L.F. pentode evolved for true A.V.C.



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)

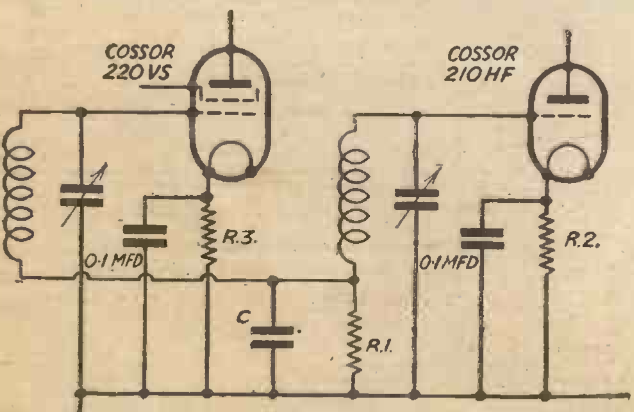


Fig. 1.—Grid current limiting scheme applied to an anode bend detector.

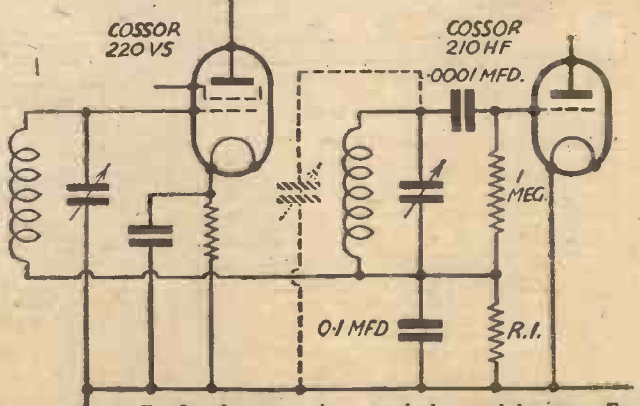


Fig. 2.—Limiting scheme applied to grid detector. For convenience of ganging, the moving plates of the tuning condenser may be connected to earth as shown by the dotted lines.

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.

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

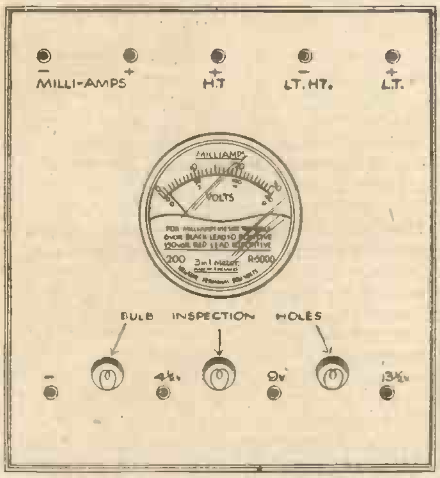


Fig. 1.—Front view of the finished instrument.

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

(Continued on page 322)

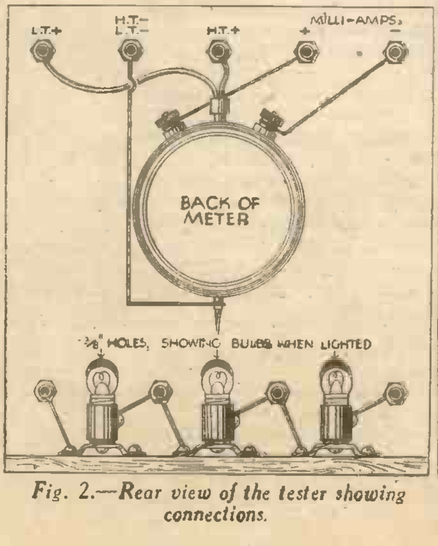


Fig. 2.—Rear view of the tester showing connections.

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 mélody 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

(Continued on facing page)

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.

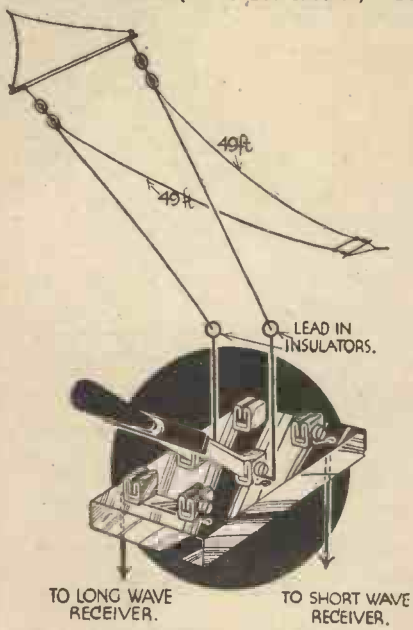
A SMALL TESTER

(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

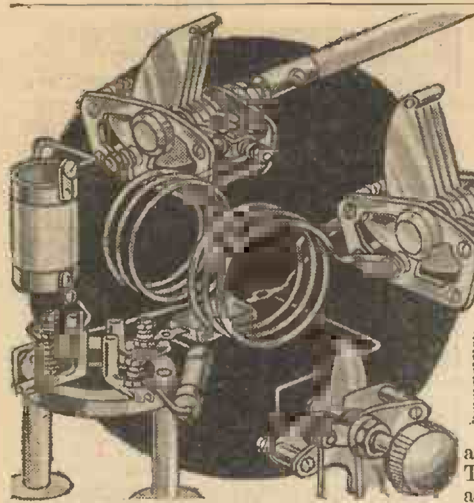
Here is a useful aerial arrangement used for listening on widely differing wavebands. The original idea was used for the long waveband (600 to 4,000 metres), and short waves (10 to 160 metres). The



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).

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

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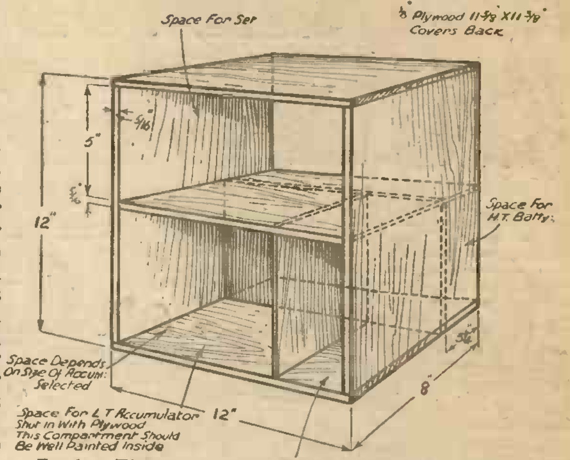


Fig. 1.—The containing cabinet for the short-wave portable.

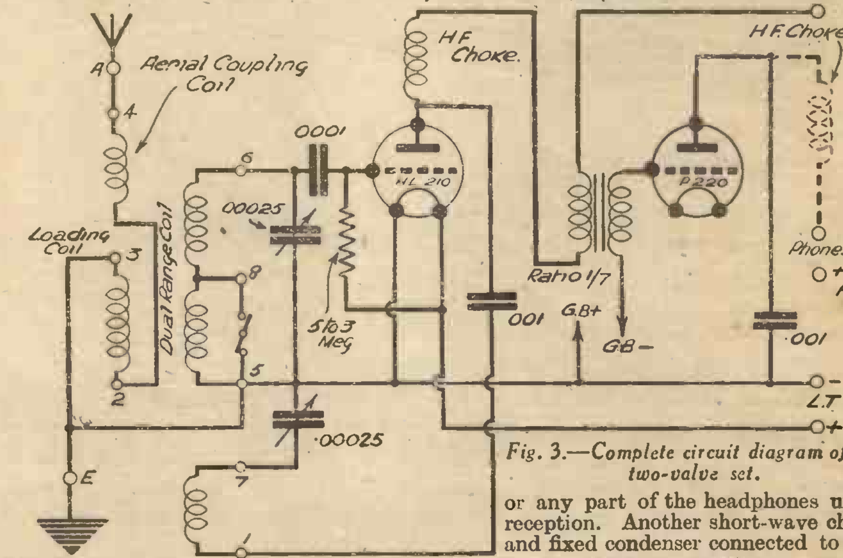


Fig. 3.—Complete circuit diagram of the two-valve set.

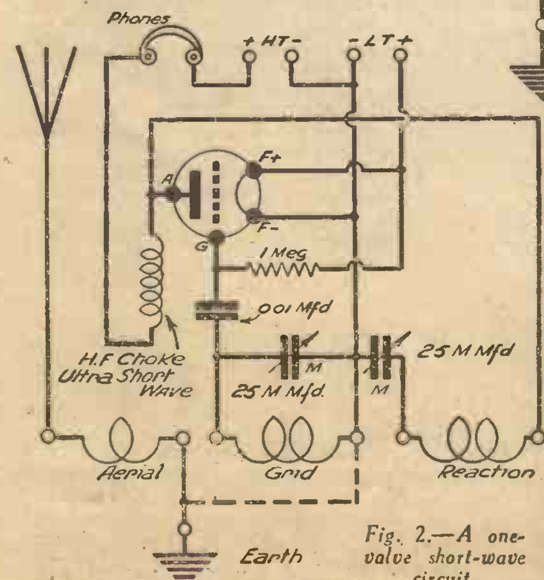


Fig. 2.—A one-valve short-wave circuit.

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

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 10¾in. long, 5¼in. wide, and 3½in. deep, when placed on its 3½in. 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.

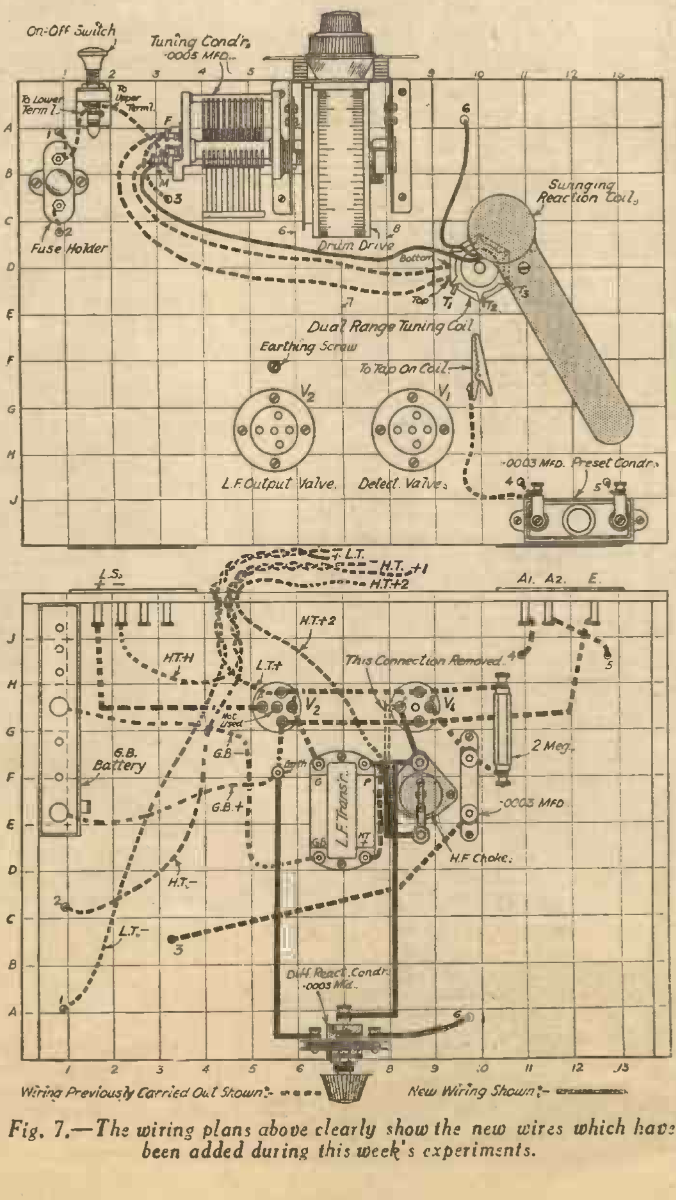


Fig. 7.—The wiring plans above clearly show the new wires which have been added during this week's experiments.

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.

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)

CATALOGUES RECEIVED

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

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.

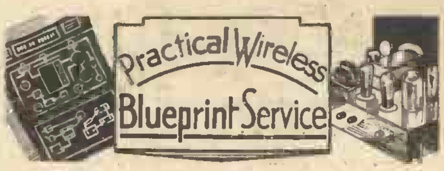
Replies to Broadcast Queries

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 Charleroi, 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, Bowdon, 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.

Blueprint. No.	Receiver.
1.	Dolphin Straight Three.
2.	Long Range Express Three.
3.	Mains Express Three.
4.	Sonotone Four.
5.	Bijou Three.
6.	Argus Three.
7.	Empire Short-Wave Three.
8.	Solo Knob Three.
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.
19.	Selectone A.C. Radio-Gram Two.
20.	A.C. Fury Four.
21.	Radiopax Class B Four.
22.	Three Valve Push-Pull Detector. (6d. only.)
23.	Double Diode Triode Three.
24.	Three-Star Nicore.
25.	The D.C. Ace.
26.	The Superset.
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)

(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.

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.

FREE ADVICE BUREAU
COUPON
This coupon is available until Nov. 4th, 1933, and must be attached to all letters containing queries.
PRACTICAL WIRELESS, 28/10/33.

PRACTICAL WIRELESS MISCELLANEOUS ADVERTISEMENTS

Advertisements are accepted for these columns at the rate of 3d. per word. Minimum charge 3/-. All advertisements must be prepaid.

PETO-SCOTT Q.P.P. 4-valve Guardian Kit without Valves or Cabinet. Cost £3 19s. 6d.—my price 59s. 6d.—Peto-Scott Co., Ltd., 62, High Holborn, W.C.1.

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 Lane, 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/-.

MAINS VALVES, slightly used, tested here for callers, MS4B, AC/SG, S4VA, MSG/HA, MSG/LA. AC/P1, 41MXP, 8/9. MS4, S4VB, DC/HL, AC/P. 41MP, 7/6. Mazda VMSG/AC, 10/6. Close 1 o'clock Thursdays, open all day Saturdays.

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.

PEARL & PEARL. All the following bargains guaranteed new goods.

FAMOUS Lincoln Stewart Permanent Magnet Moving-Coil Speakers, Wonderful Performance. List price, 47/6—special price, 16/11.

THE well-known Lincoln Stewart dual range shielded coils, 200-550 metres and 800-2,100 metres. List price, 6/6—our price, 2/11.

LIMITED number "Daptacon" pick-ups and tone-arms, specially designed to prevent wear and eliminate scratch, list price, 9/11. Reduced price, 6/11.

BRITISH GENERAL Aerial bandpass 10 K.C. tuning unit with full constructional details for building bandpass 3 receiver. List price, 14/6, special price, 3/11.

K.B., A.C. or D.C. Pup. Self-contained, simple, safe, trouble-free. The K.B. 2-valve, all-electric "Pup," excellent and reliable, mains-operated receiver for A.C. or D.C. mains. List price, £7/10/0. Our price, £3/12/6.

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.

STOCK of Telsen Major Chassis. This is a super bargain and is available while stock lasts. Usually 10/6—our price, 3/3.

REVEAL D.C. H.T. Unit 200-250 input, 25 m.a. output with 3 positive tappings in handsome metal case, complete with adaptor. List price, 39/6, bargain price, 16/11.

TRIOTON Magna 4-pole balanced armature loud-speaker units, type P. Listed at 27/6, special offer, 9/3.

PEARL & PEARL, LTD., all above bargains sent cash or C.O.D., carriage paid; 190, Bishopsgate, London, E.C.2.

GOOD LINES

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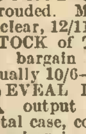

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