The Wireless Constructor

6D MONTHLY

EDITED BY
PERCY W. HARRIS, M.I.R.E.

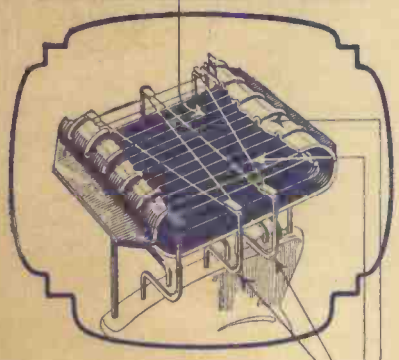
Vol. II SEPTEMBER, 1926 No. 11

SPECIAL ARTICLE

WHERE THE "X's" COME FROM

LOOK

Grid with two supports



5 resilient filament supports keeping filament in permanent alignment.

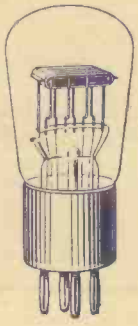
Filament two complete loops.

Anode (with two supports) cut away to show filament and grid.

at this P.M. Filament and you will understand why P.M. Valves are the best value on the market.

THESE

seven P.M. advantages reduce your maintenance costs and give you better results—



1 **GREATER EMISSION SERVICE.** P.M. Filaments have up to 5½ times greater emission surface than ordinary filaments ensuring a much wider range of power for economical operation ; in fact, these new filaments are so conservatively rated that they give ample results at lower voltages than marked and will stand up to a reasonable overload.

2 **LONGER VALVE LIFE.** The special alloy of rare metals that forms the heavy covering of P.M. Filaments is prepared by a patented process that secures a copious flow of electrons and the operating temperature is so low that this precious alloy cannot be discharged, a definite proof of long useful life.

3 **UNBREAKABLE FILAMENT.** P.M. Filaments are longer than ordinary filaments, and retain their ductility even after 1,000 hours life, so that it is possible to tie them in a knot. At no time does the low operating temperature cause sag, and these filaments are specially set round the five strong resilient hooks so that they are free from tension and cannot be broken except by the very roughest handling.

4 **NO VISIBLE GLOW.** The extreme economy in heat of P.M. Filaments can be judged by the fact that no sign of glow can be discerned during operation.

5 **REDUCED CURRENT CONSUMPTION.** P.M. Filaments only require one-tenth ampere filament current, giving up to seven times the life of each accumulator charge, a reduction to one-seventh in your cost of accumulator maintenance.

6 **NO MICROPHONIC NOISES.** The unique method of mounting the filament within the field of the grid and anode, so that the filament lies without tension or sag in its correct position, and all the electrons are utilised and controlled, completely eliminates all microphonic noises, leaving an effective background of silence to emphasise faithful reception.

7 **MAJESTIC VOLUME.** Every P.M. Valve is a master valve in its own class, designed to give you

Perfect Radio Reception

It is the filament that counts and this is what you pay for.

For 4-volt accumulator or 3 dry cells

THE P.M.3. (General Purpose) 0·1 amp. **16/6**

THE P.M.4 (Power) 0·1 amp. **22/6**

For 6-volt accumulator or 4 dry cells

THE P.M.5 (General Purpose) 0·1 amp. **22/6**

THE P.M.6 (Power) 0·1 amp. **22/6**

For 2-volt accumulator

THE P.M.1 H.F. 0·1 amp. **15/6**

THE P.M.1 L.F. 0·1 amp. **15/6**

THE P.M.2 (Power) 0·15 amp. **18/6**

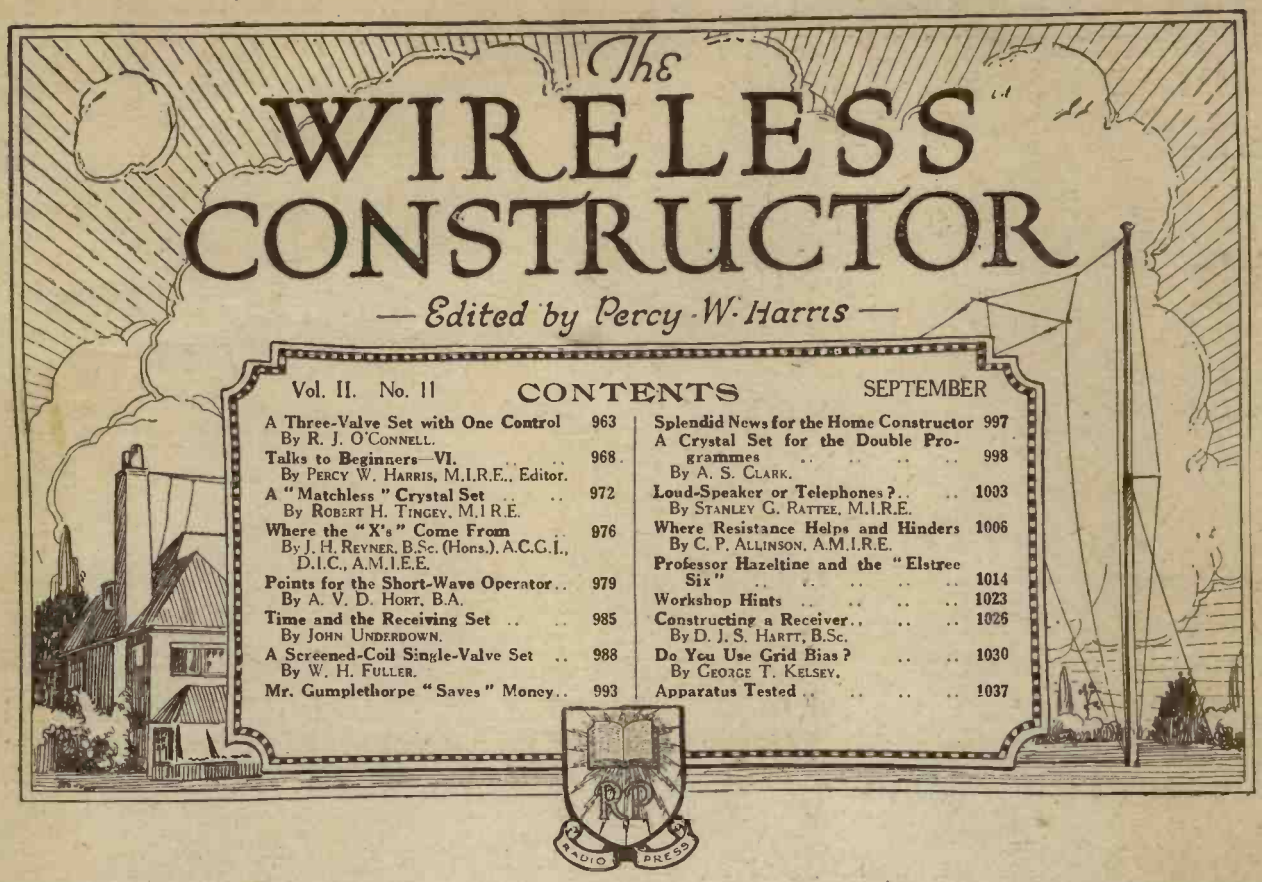
These prices do not apply in Irish Free State

ASK YOUR DEALER FOR THE VALVES WITH THE P.M. FILAMENT

Mullard

THE·MASTER·VALVE

ADVT., THE MULLARD WIRELESS SERVICE CO., LTD., NIGHTINGALE LANE, BALHAM, LONDON, S.W 12.



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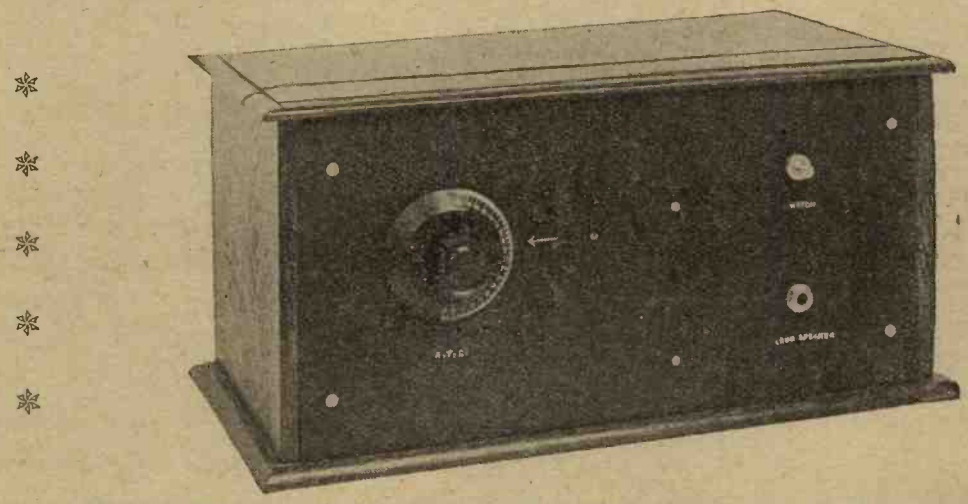
A THREE-VALVE SET WITH ONE CONTROL

By R. J. O'CONNELL

Simplicity of construction and ease of control are features of this receiver. No skill is needed to handle it, it can be always ready for use, and it is capable of receiving quite a number of broadcasting stations in addition to the local transmission.

ONE of the greatest services rendered by broadcasting to the public is that it gives entertainment and a means of passing the time to those who, on account of illness, are unable to enjoy those pleasures which most of us take as a matter of course. A few years ago the bed-ridden invalid was virtually dead to the world, but now, by the aid of a simple wireless receiver he can, in a few moments, transport himself to the theatre, concert hall or church and hear all that is taking place there, better than many of the people in the building.

Of course, if he is to obtain the greatest possible enjoyment from wireless, the receiver used should be simple to operate and capable of giving pure and clear reproduction of the programme received. With the intention of fulfilling these requirements and also the important one of cheapness in construction and running cost, the three-valve set to be described here has been designed, and it is hoped that many readers will find in it the set for which they have been looking.



There is nothing in the appearance of the receiver to make the unskilled operator doubt his ability to handle it.

Providing for Distant Reception

When designing a receiver to meet these requirements, two facts must be kept well in mind—the user may desire to operate the set at a fair distance from the broadcasting station and the controls must be as few as possible. In order that the problem of distance may be satisfactorily solved, it is practically essential that one stage of high-frequency amplification should be employed, this necessitating the use of two tuning controls, at least, if tuned stages are to be used.

Simplified Tuning

There are, of course, methods of coupling the high-frequency valve which do not necessitate tuning of the anode circuit, such as the aperiodic method of coupling, to quote a well-known example, and in a receiver so designed, the method of tuning is greatly simplified. The amount of

A Three-Valve Set with One Control—*continued*

amplification may be a little less than that which an experimenter would obtain with a tuned stage, but from the point of view of easy operation it has much to commend it.

and are wound in the manner of the usual barrel type of plug-in transformer. The sizes of the coil L1 and the high-frequency transformer may be changed according to the wave-

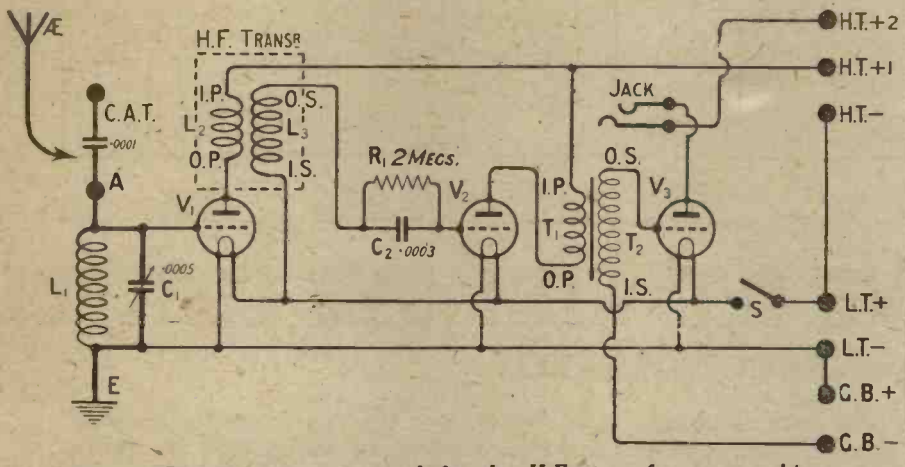


Fig. 1.—Plug-in units are used for the H.F. transformer, making alterations in the wavelength range a simple matter.

Few Controls

In the receiver to be described, an "aperiodic" transformer is employed, thereby eliminating one of the condensers usually found in a three-valve set consisting of one high-frequency stage, a detector and one low-frequency valve. In order that the operation of the receiver should be still further simplified, it was decided to eliminate the filament controls and employ a switch for turning on and off the low-tension current.

Ease of Construction

The vertical panel and baseboard design has been used in order that the valves and coils may be completely enclosed within the cabinet. This method of construction permits of easy wiring of the components, and at the same time affords a protection to the valves which would be impossible if these were mounted on the panel. As will be seen from the photograph, the only components appearing on the latter are the variable condenser, on-and-off switch, and loud-speaker jack.

A Point of Convenience

The constant aerial tuning method of coupling the aerial to the set has been employed in order that, should the reader construct this set for a friend, he may be able to calibrate it approximately on his own aerial and forward it with complete tuning instructions to the person for whom it is intended. The coil L1, which is the aerial coil, is tuned by a variable condenser having a capacity of .0005. The two coils L2 and L3 constitute the aperiodic transformer windings

length which it is desired to receive, the set being suitable for use upon the lower broadcast band or upon the longer wavelength of Daventry.

No reaction has been employed in the receiver, as it was deemed inadvisable to make any departure from the strictest simplicity of operation. In any case, if the reader follows carefully the layout and wiring of the components as shown in the photographs, he should have no difficulty in tuning in a number of distant stations without the help usually obtained from reaction.

Those readers who are desirous of building this set should collect together the following components and materials. Following the components mentioned, the name of the manufacturer or the trade mark is given; this information is intended for the benefit of those readers who wish to duplicate the receiver illustrated, though it must, of course, be understood that other similar goods will do equally well so long as the values are as given in the accompanying list.

Components Used

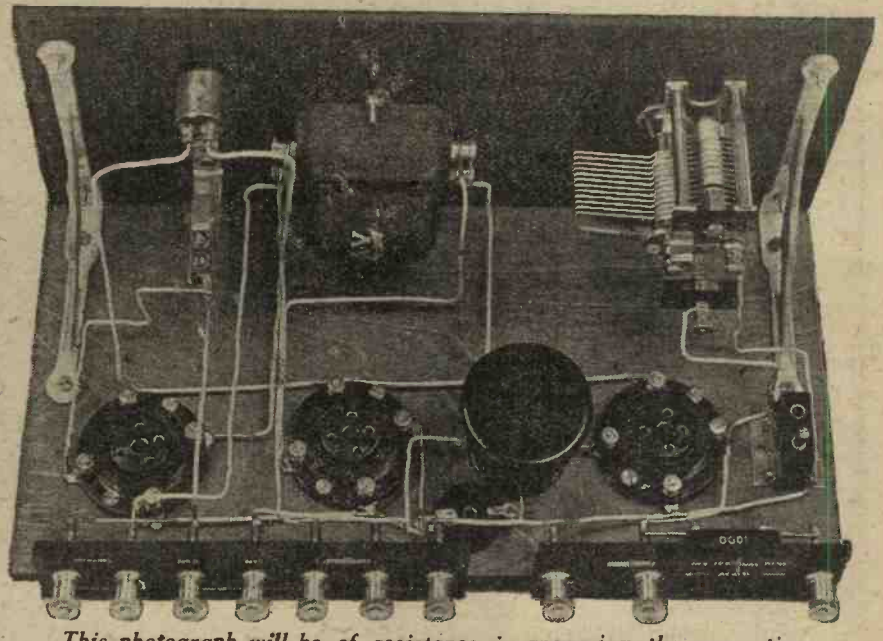
This latter point is one of some importance, for the final design of a receiver is the outcome of careful experiment on the part of the designer. All the values of components have been specially chosen for the best results, and any departure therefrom may quite possibly mean that the set will either not work as well as it otherwise would, or that its tuning range is altered and possibly restricted.

One ebonite panel 14 in. by 7 in. by ¼ in. (Paragon).

One cabinet to take above panel, and baseboard, 14 in. by 7 in. by 6¾ in. (Camco).

Two right-angle brackets (Camco).

Two aperiodic high-frequency transformers (Curtis A and B).



This photograph will be of assistance in arranging the connecting wires. Reference to Fig. 3 will give the further details needed.

Three "Lotus" antiphonic valve holders (Garnett, Whiteley & Co.).

One anti-capacity valve-holder (Burne Jones & Co., Ltd.).

One .0005 variable square-law condenser (Jackson Bros.).

One general-purpose low-frequency transformer (C. A. Vandervell).

A Three-Valve Set with One Control—*continued*

One board-mounting coil socket (Burne Jones & Co., Ltd.).
One on-and-off switch (Igranic Electric, Ltd.).
One loud-speaker jack (Igranic Electric, Ltd.).

As will be seen from the above list, the components required for the construction of the receiver are not expensive, and the total cost, exclusive of the valves and accessories, should not exceed £4.

sions shown will give sufficient clearance. After all the holes have been drilled, secure the panel to the baseboard and ascertain that both are a good fit in the cabinet. Next mount the components on the panel and the baseboard as indicated in the diagrams, after which the wiring may be commenced.

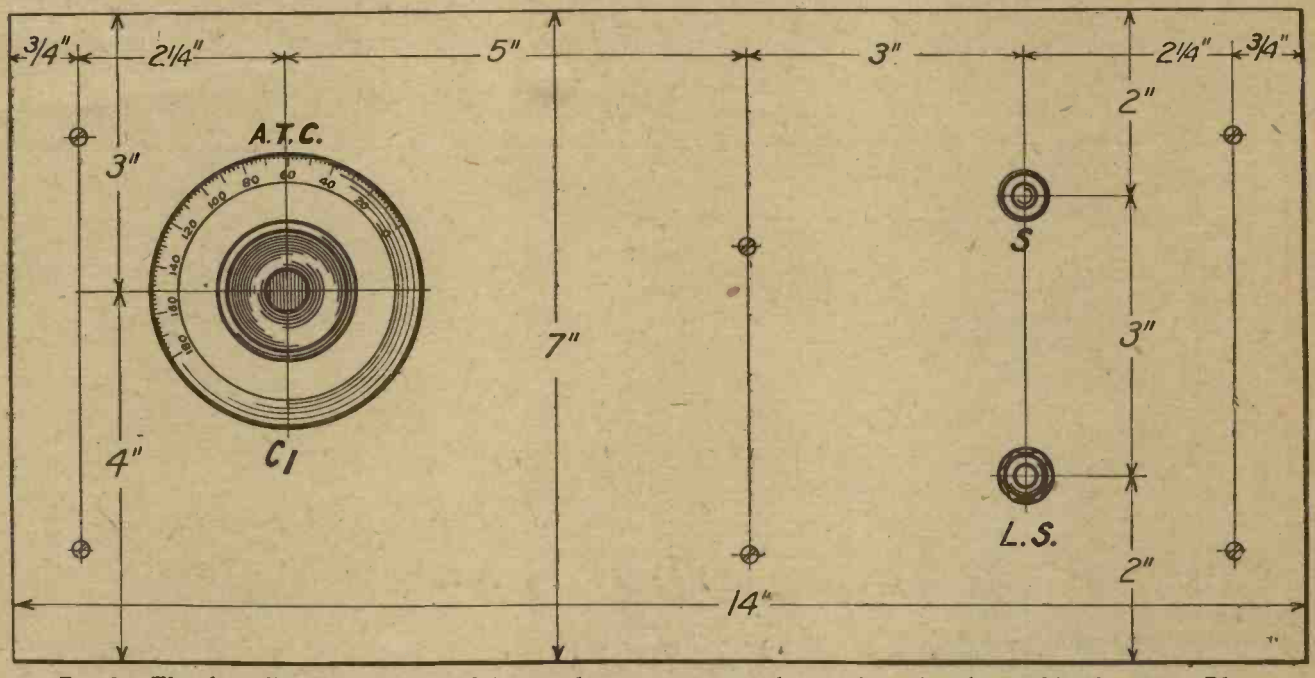
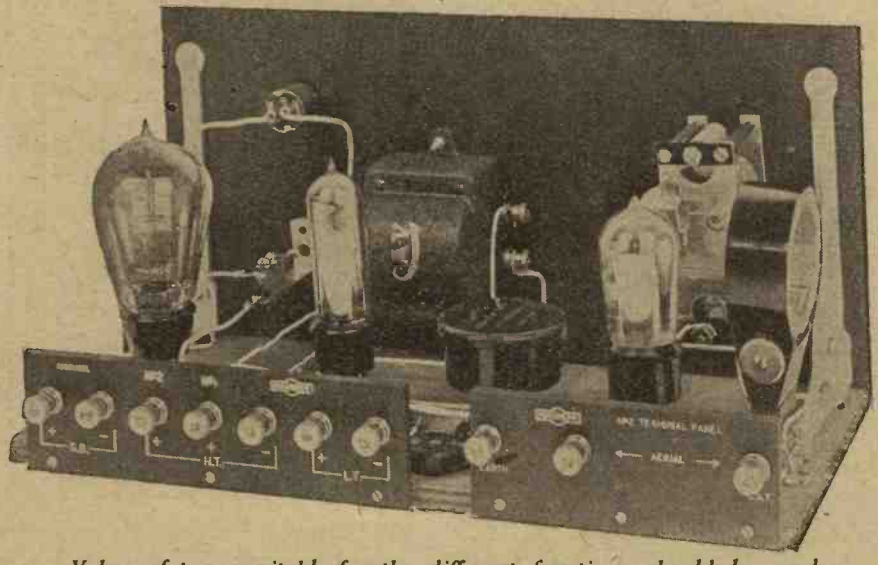


Fig. 2.—The few dimensions required for marking out the panel may be taken from this drawing. Blueprint No. C1058A may also be obtained if desired.

One three-terminal strip.
One seven-terminal strip.
One combined gridleak 2 megohms, and condenser .0003 (Watmel).
One .0001 fixed condenser (Curtis).

Drilling the Panel

If the components mentioned are used, the drilling of the panel may be undertaken with Fig. 2 as a guide,



Valves of types suitable for the different functions should be used in order to obtain the best results. They must be of similar filament voltage rating, as no resistances are used.

One packet of Radio Press panel transfers.
Quantity of Glazite, screws, etc.

but should any of the parts be of other manufacture, then the reader should assure himself that the dimen-

Wiring

The wiring up of the parts on the baseboard should be done first. It is advisable to connect the filament leads first of all. This may be done with the exception of the connection to the on-and-off switch, which should be left until all the other wiring has been completed.

Next proceed to wire up the connections from the aerial coil to the variable condenser, then those to the low-frequency transformer and jack, and lastly to the filament switch. When connecting the variable condenser, be sure that the moving vanes are connected to earth.

If the wiring as illustrated in the photographs and wiring diagram is carefully followed, no difficulty should be experienced in carrying out this operation.

Valves to Use

This receiver is intended for use with two-volt valves, and all three valves should be of the same type, since no filament resistances are employed.

In the original receiver 2 P.M.1 and 1 P.M.2 type of valves were used, and these gave very satisfactory results. Other two-volt valves which will be

A Three-Valve Set with One Control—*continued*

found quite suitable are the Cossor Point One, Marconi or Osram D.E.R. and D.E.2 and Ediswan A.R.D.E., and other similar valves.

Testing

When the receiver has been completed, the wiring should be thoroughly checked and tested in the following way before any actual tests of reception are carried out.

Place the valves in their respective holders, the high-frequency transformer in its socket, and connect up the low-tension supply. On switching on the filament current, the filaments of the valves should light up at the correct brilliancy. Now connect up the high-tension battery, putting on a small voltage of about 3 volts only at first, and noting whether any change in the brightness of the valves occurs. If the wiring is correct, no change will be observed, and the correct voltage may be applied, the aerial and earth connected up, when the set will be ready for use.

To use this set for the reception on the broadcast band of wavelengths with the aerial connected to the terminal marked C.A.T. a No. 50 plug-in coil should be placed in the aerial socket and a Curtis A or a Magnum No. 1 or similar aperiodic transformer in the transformer holder.

For the reception of Daventry and

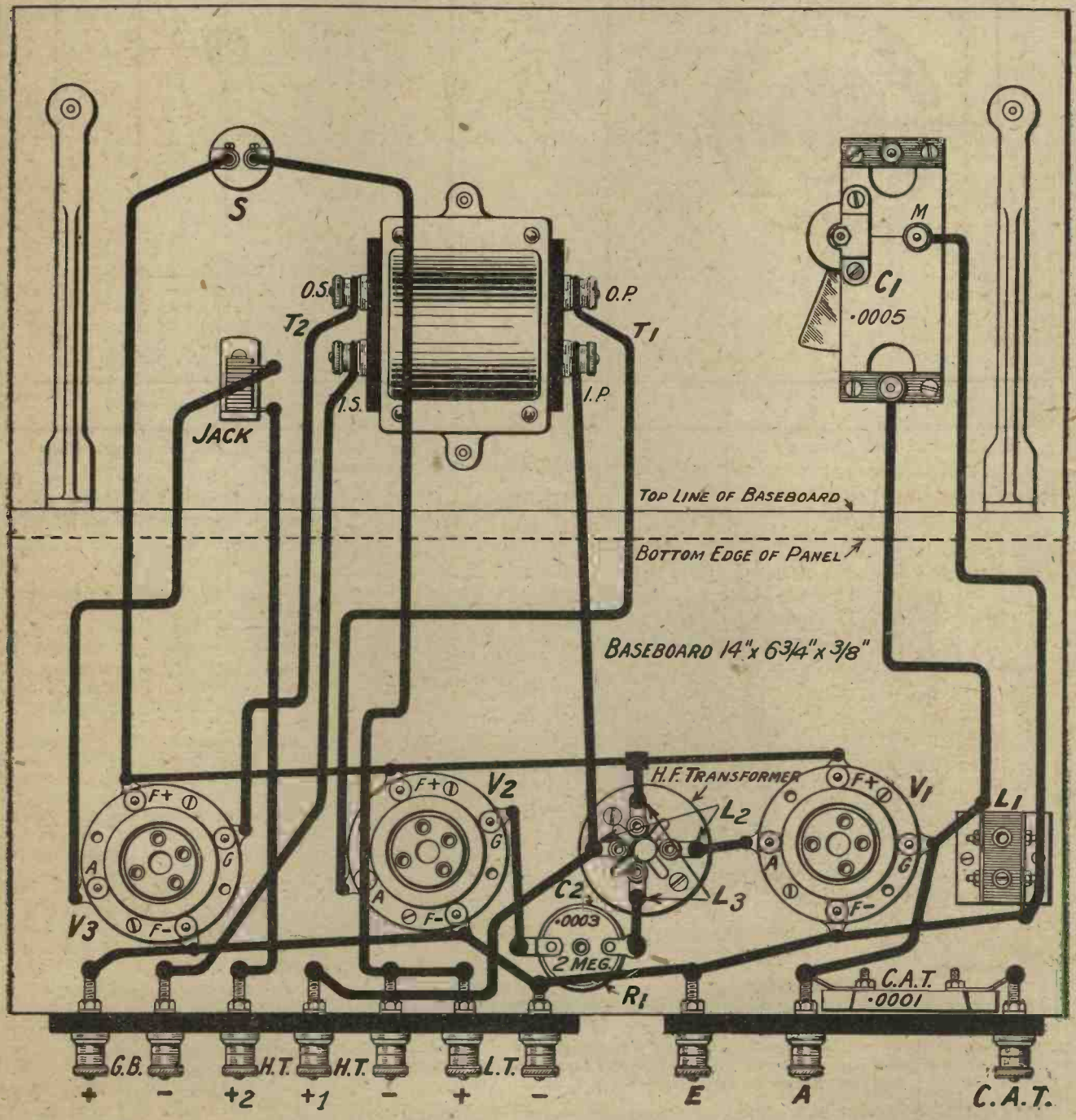


Fig. 3.—This diagram, in conjunction with the special instructions on the opposite page, should make the wiring connections quite clear. This is available in blueprint form, No. C1058B.

A Three-Valve Set with One Control—*continued*

other long-wave stations, a No. 250 coil will be required for L1 and a Curtis B or a Magnum No. 3 for the transformer L2 and L3.

High-Tension Voltages

The high-tension battery should be of the tapped variety, having a voltage of 90 or 100 volts, though excellent results should be obtained with one of novice, and if the correct values of high-tension and grid-bias voltages are used, signals should come in with something of the purity of those received on a crystal set.

Using a coil and transformer, as mentioned above, with 48 volts high-tension on the first two valves and about 80 volts on the low-frequency valve, excellent loud-speaker results

WIRING IN WORDS.

Join C.A.T. terminal to one side of C.A.T. condenser.

Join A terminal to other side of C.A.T. condenser, also to G of V1, and thence to one side of L1 holder and fixed vanes of C1.

Join moving vanes of C1 to either side of L1 holder, and thence to one filament contact of V1, E terminal, L.T.—terminal, one filament contact of both V2 and V3, and G.B.+terminal.

Join together the remaining filament contacts of V1, V2, and V3, and one contact of L3 on the H.F. transformer base.

Join other contact of L3 to one side of C2 and R1.

Join other side of C2 and R1 to G of V2.

Join A of V1 to one contact of L2 on H.F. transformer base.

Join other contact of L2 to I.P. of L.F. transformer and also to H.T.+1 terminal.

Join A of V2 to O.P. of L.F. transformer.

Join G of V3 to O.S. of L.F. transformer.

Join I.S. of L.F. transformer to G.B. — terminal.

Join A of V3 to upper contact of Jack.

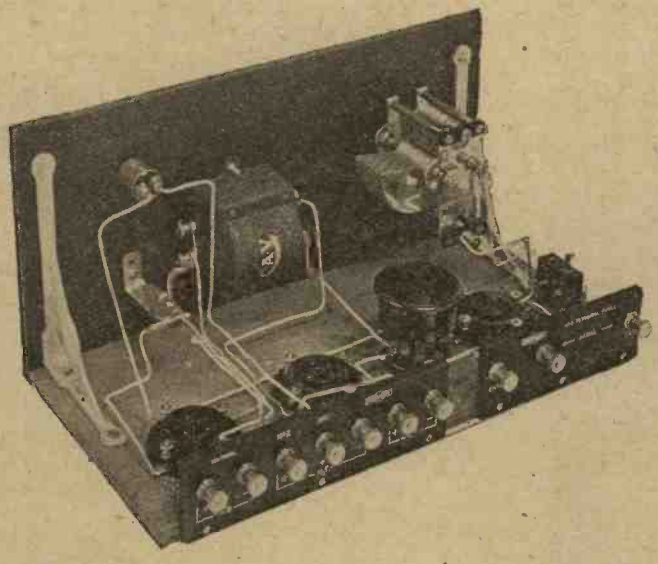
Join lower contact (body) of Jack to H.T.+2 terminal.

Join one side of switch S to H.T.– and L.T.+ terminals.

Join other side of switch S to filament positive tag of V_3 valve holder.

72 volts, the full value being used for H.T.2. For H.T.1 it is not recommended that more than 48 volts be used, as nothing will be gained by increasing the voltage above this figure. If an excessive voltage is applied to the first two valves, it will be found to be impossible to prevent the set from bursting into oscillation.

The grid-bias battery may be one of the tapped type, with the voltage



The wiring of the on-and-off switch should be left until the other connections have been completed.

variable from 3 to 9 volts, as correct adjustment of the grid-bias will be found greatly to improve the clarity and purity of the loud-speaker results.

Operation and Results

The operation of this receiver should present no difficulty to the veriest

were obtained from 2LO at a distance of about 3 miles.

While the receiver was designed chiefly for loud-speaker reception of the local station, the long-distance results obtained were quite satisfactory, Brussels, Petit-Parisien, Hamburg, Madrid and, when London had closed down, Bournemouth and Birmingham, being all received at excellent strength on the telephones.

Mainly for Local Reception

In connection with these results, it is well to point out that while this receiver will receive a number of distant stations, it is not easy to carry out distant reception while the local station is working, since, owing to the method of untuned high-frequency amplification employed, the selectivity is not of a high order.

As already pointed out, once the receiver has been adjusted and tuned in, it may be turned on and off by pushing in or pulling out the switch. The batteries may be left connected until they require to be charged or replaced, and the position of the tuning condenser need not be altered under normal circumstances.

HAVE YOU HAD THIS EXPERIENCE?

SIR,—Having been interested in short-wave reception for some time, I constructed the receiver described by Mr. Percy W. Harris in his article "Australia on Two Valves." I am very pleased with the results I have already obtained (although I have only been using the set for a few days), but have been puzzled and, it seems, baffled, by an annoying audio-frequency howl which occurs as the set is *just* on the oscillation point. As this is, of course, the point at which the set is most sensitive, it is rather difficult to operate it to the best advantage.

I might mention that this fault has been present in *all* my short-wave receivers, and that it is *not* due to a run-down H.T. battery or to a defective grid-leak.

Can any of your readers suggest a cure?

Yours faithfully,

M. S. BENSON.

Cheltenham.

A USEFUL TIP.

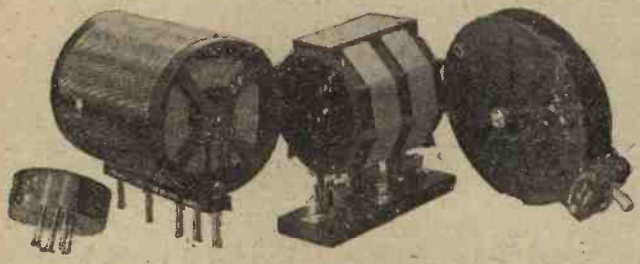
WHEN the proper tool is mislaid, the blade of a hacksaw will often be found to make an excellent screwdriver in an emergency. The blade need not be complete; a few inches of a broken one will do quite well, provided that it includes one of the curved ends. The end will usually be found to be slightly tapered off, so that it will bed down well into the slot of the screw. Very stiff screws cannot very well be turned in this way, owing to the brittleness of the blade. Also care should be taken not to twist the blade too sharply, for the same reason. The breaking of the blade is very likely to entail injury to the hand.

TALKS TO BEGINNERS

By PERCY W. HARRIS, M.I.R.E.

VI.—MORE ABOUT RESISTANCES. THE DEVELOPMENT OF CONDENSERS AND COILS.

IN my last article I told you some of the facts regarding resistance losses in wireless circuits, and explained how the size of the wire used has a bearing on the resistance of the circuit and the losses set up thereby. A little more explanation is needed, for when we are dealing with currents which change their direction so rapidly as those used in broadcasting, the effect on the wire is somewhat different from that found in ordinary electric lighting circuits.



The plug-in coil on the right of this group of modern coil types has the great advantage of compactness as compared with the coil shown in the lower photograph on this page.

The "Skin Effect"

For example, in direct or alternating current electric lighting circuits, the current penetrates to the centre of the wire, and is uniformly distributed through it. In high-frequency circuits, such as those with which we are now dealing, the very brief period of time taken by the current flowing in one direction before it reverses has to be taken into consideration, and before the current has penetrated far into the wire the direction is reversed and the penetration must "start all over again." For this reason we speak of a "skin effect" in radio, meaning that the currents penetrate into only a thin skin of the wire, a large portion of the interior of the conductor being to all intents and purpose useless.

The Importance of Gauge

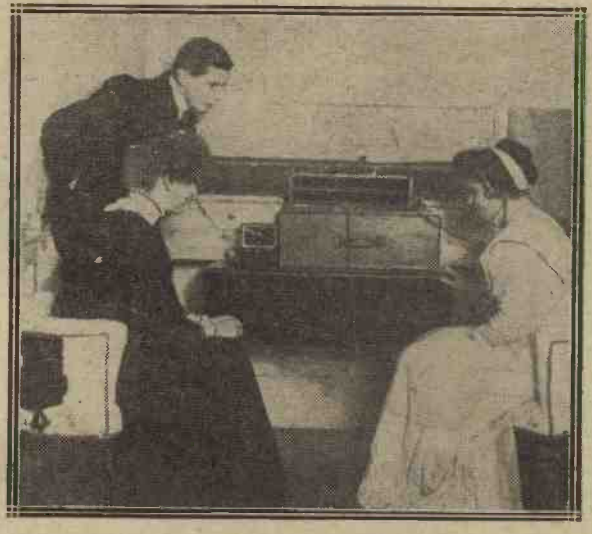
Indeed, as far as high-frequency currents are concerned, the resistance of a tube of copper may be no greater than that of a solid rod of the same external diameter, although the amount of copper in one is far in excess of that in the other. For a given metal (other circumstances equal), the depth of penetration for a given frequency is always the same, so that a relatively thin wire of a thickness equal to twice the distance of penetration at the frequency in use is much more economical to use than a wire in which the central core is left unutilised.

The Cause of Losses

Another effect we have to consider is the loss which may occur, not in the wire itself, but in the material immediately surrounding the wire. For example, let us consider a coil of insulated wire. While the actual ohmic resistance at high frequencies may be low, the coil may be very poor, owing to the losses set up in the inferior insulating material surrounding it. This material, you will remember, is penetrated by the ever-changing magnetic field surrounding the wire. For this reason in coils used for very high-frequency currents, such as occur in very short-wave work, the amount of insulating material other than air is kept purposely small, to avoid what are known as "dielectric losses," or losses in the dielectric material surrounding the wire.

Designing for Low Losses

Low-loss coils are, therefore, coils designed not only to have a low ohmic resistance, but also to avoid other losses which may occur in material immediately adjacent to the wire. Such coils, too, are generally wound in such a way that the maximum inductance is obtained efficiently for the length of wire used. A coil of small diameter and considerable length would be less efficient than a coil of much greater diameter and shorter length, even though the amount of wire used in the two coils was the same.



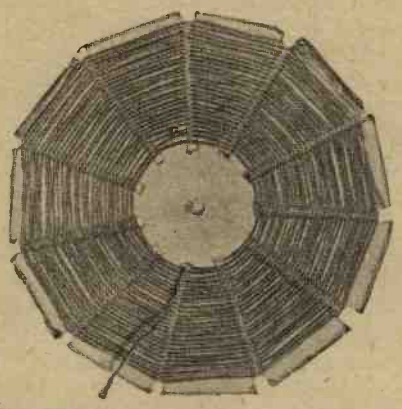
The coils used for reception a few years ago were very cumbrous in comparison with the modern compact forms.

Resistances That Work for Us

We also utilise resistance in wireless receivers as a means of deliberately reducing the currents flow-

Talks to Beginners—*continued*

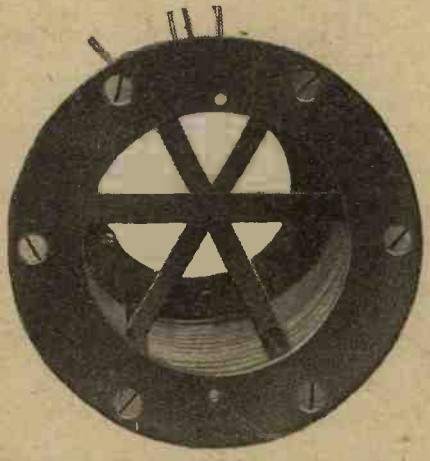
ing through the filament of a valve to the figure desired. Such resistances or "filament rheostats," as they are called, are generally made variable so that the amount of resistance in circuit can be changed at will. We shall learn more of this when considering the valve itself and how it is used.



The flat basket coil is popular owing to its ease of construction.

Other Uses

Sometimes, but not often nowadays, we may deliberately introduce resistance into a wireless circuit to check oscillations and prevent a state of continuous oscillations being set up due to other factors necessarily present in some particular circuit. A further use for resistance is in what is called "resistance-capacity coupling," wherein the pressure required to make the currents pass through a very high resistance of many thousands of ohms is simultaneously applied between the grid and filament of another valve to transfer energy to it.



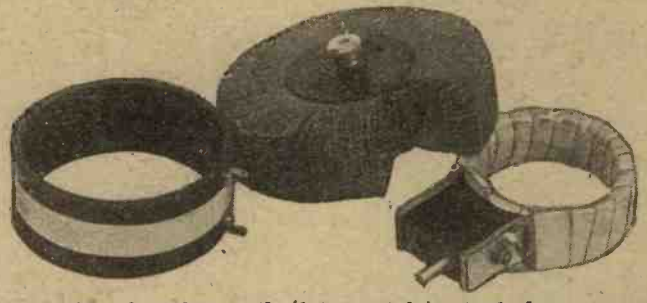
In this type of coil the amount of solid material inside the winding is reduced as far as possible.

Early Wireless Coils

All of the early wireless coils were wound as single layers, and as the wavelengths first used were relatively long compared with those which we are accustomed to-day, the first wireless coils, speaking of pre-broadcasting times, were very large, some being 2 ft. long, 10 ins. in diameter, wound full up with fine wire. For the reception of some of the very long wavelengths, such as those used for high-power stations, coils reaching from the floor to the ceiling of the operating room were sometimes built.

The Coil Develops

Later, however, it was found that by adopting certain criss-cross forms of winding, it was possible to wind concentrated coils having, in a relatively small space, the inductance properties of very long single-layer coils. A very practical form of such coils was invented by Dr. Lee de Forest, the well-known American inventor, to whom so much of the modern success of the valve is due. Owing to the special form of winding adopted by Dr. de Forest, the rather fanciful name "Honeycomb" was given to the coil.



Three examples of modern coils (left to right), single-layer, toroid and standard plug-in.

A Convenient Mounting

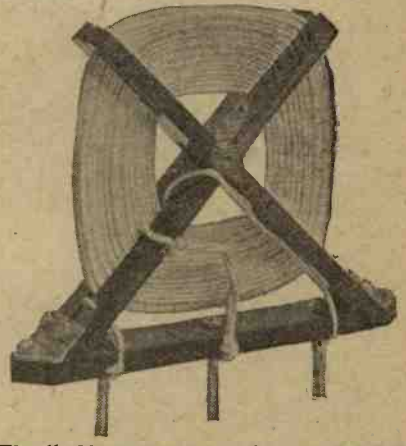
At the same time, Dr. de Forest introduced the pin and socket plug mounting, which has been practically universally adopted for interchangeable coils. Honeycombs were the first of the efficient multi-layer inductance coils, but there are now a number of different makes utilising different styles of winding just as efficiently. All, however (and fortunately), have settled down to the same size of plug mounting, so that the popular makes of plug-in coil are all interchangeable, much to the advantage of the experimenter. For work of the highest efficiency, however, it is customary to use single-layer coils, for it has been found impossible to equal the results obtainable with such single-layer coils (provided they are properly designed) by using any other form of multi-layer inductance.

Variable Condensers

Within the last year or two, variable condensers used for wireless purposes have been changed in design quite considerably. A few years ago all variable condensers were made so that one set of plates meshed with the other progressively, the increase of capacity from zero to the top of the scale being uniform throughout. Expressed in another way, if we drew a chart with a line along the bottom marked off in the 100 degrees of the condenser scale, and a vertical line marked off in units of capacity, we should find that at 0 the capacity would be very low (not quite zero, for there is always a certain amount of capacity between the two sets of plates, even when these are not interleaved), and when the plates were completely inter-meshed the capacity would be at a maximum.

Making a Calibration Chart

If now we drew a line from the value of the capacity at, say, 5 degrees, on the scale to the point indicating the capacity at 100 degrees of the scale, we should get what would be called a "calibration curve," from which we could read off the capacity at any given setting of the condenser scale, or read off what part of the condenser scale corresponded with the particular capacity on the vertical scale. Such a condenser is called a straight-line-capacity condenser.



The "X" former may be conveniently adapted to a plug-in form of mounting. The mount shown here carries a third pin for the tapping on the coil.

Special Plate Shapes

Now as practically all variable con-

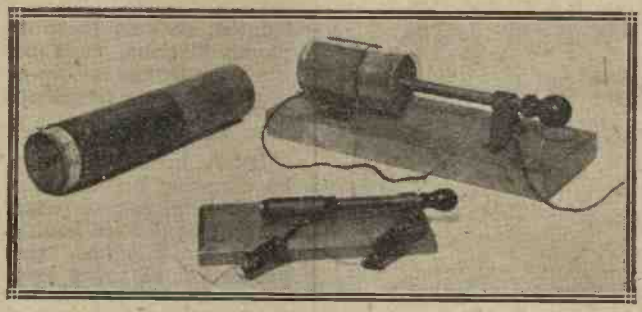
Talks to Beginners—*continued*

densers are used for tuning wireless circuits, to bring them into resonance with some particular frequency or wavelength, there are certain disadvantages in using straight-line-capacity condensers. For example, if with a given coil five units of capacity tuned to a given wavelength, by placing ten units capacity across the coil we should not get double the wavelength, but some figure considerably below that. In order that we may obtain calibration curves in which the wavelengths are equally distributed according to the degrees of the scale, it is necessary so to shape the plates that the capacity increases more rapidly as we progress along the scale than is the case with the ordinary condenser with semi-circular plates, both fixed and moving.

There are many condensers on the market in which the plates have been so shaped that instead of getting a crowding of wavelengths on the bottom half of the scale and a much too wide distribution on the upper half of the scale, they can distribute *wavelengths* uniformly throughout the whole scale. Such condensers are generally called "square law" condensers or "straight-line-wavelength" (S.L.W.) condensers, and are more used perhaps than any others at the present time.

Another Type

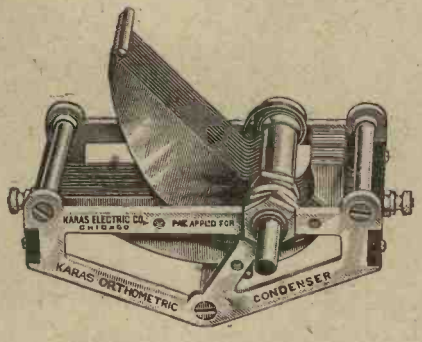
There is still another form of condenser, known as the "straight-line-frequency" (S.L.F.) condenser, in which the plates are shaped differently again, so that the *frequency* difference is constant throughout the scale. By this I mean that a difference in frequency corresponding to 2 degrees at the top of the scale is exactly the same difference of frequency as that for 2 degrees at the bottom end of the scale. On the straight-line-wavelength condensers there is the same wavelength difference between stations separated 2 degrees apart at the top of the scale, as between stations separated by 2 degrees at the bottom end.



These early Marconi condensers seem quaint in appearance when compared with the modern component.

In Rome . . .

When, as in Europe, stations are arranged by wavelength separation, then the straight-line-wavelength or square law condenser is the more useful. When, as in the United States, the stations are separated by frequency differences, then the straight-line-frequency condenser is the more practical. There is no difference of efficiency between straight-line-capacity (the oldest form), straight-line-wavelength and straight-line-frequency condensers. By this I mean that you will not get better or stronger signals by changing from one kind to another. What you will get is a difference of distribution of wavelengths throughout the scale.

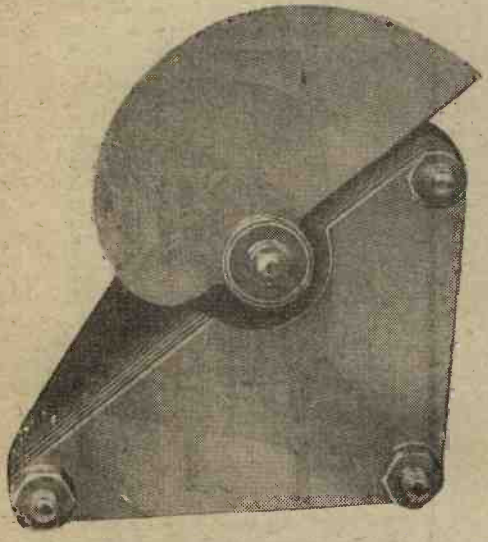


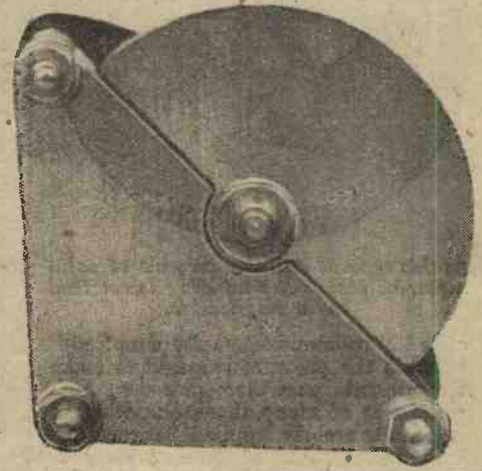
Three Types Compared

To recapitulate: on the straight-line-capacity or oldest form of condenser, you will get a crowding of wavelengths at the bottom of the scale; with a straight-line-wavelength condenser you will get a more uniform distribution throughout the scale, and with straight-line-frequency condensers, the stations will be distributed on the basis of frequency comparison.

Which is the Best?

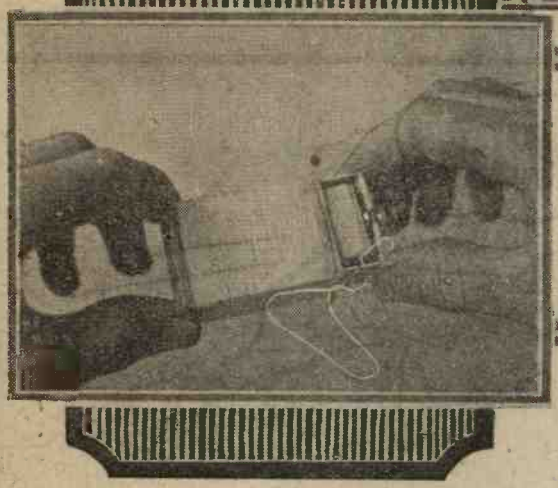
Some experimenters, and particularly newcomers to the art, have gathered the idea that the straight-line-frequency condenser is the "latest improvement," and that it must therefore necessarily be better than the older straight-line-wavelength form. So far as novelty is concerned, the straight-line-frequency condenser scores, but experts at present hold differing opinions on the relative usefulness of the two types.





The three types of variable condensers discussed in the article—(top) straight-line-frequency; (left) straight-line-wavelength; and (right) straight-line-capacity.

IT'S DIFFERENT WHEN IT HAPPENS TO YOU



A "MATCHLESS" CRYSTAL SET

By ROBERT H. TINGEY, M.I.R.E.

If you are away on holiday and have left your set behind, don't worry. Search in your pockets for one of the components and a few coins to buy the others, and make this set. It is a set which no one would hesitate to call "portable"!

A SHORT time ago I was, curiously enough, on my holidays, which I spent in the neighbourhood of a somewhat obscure village on the South Coast, known as B . . . . . - m. . . h. Moreover, as I had gone away primarily to enjoy a complete rest, my main thoughts when packing had been of things such as tennis, golf and bathing.

Something Missing

All of which I got in due course, but I found after a few days that there

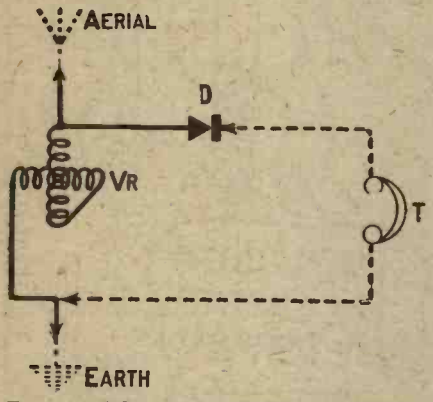


Fig. 1.—The two matchbox windings form the tuning variometer.

was something missing in the menagerie—I mean *ménage*—namely, the evening news bulletins, and even more important, the weather forecast. It gives one such a sense of confidence, having planned a picnic or other outing for the next day, to be told that a very deep and subtle depression, which has hovered around for some time, has at last waddled (moved slowly, I believe, is the technical term) out to sea and is not expected to return for some days.

This being granted, the question was how best to ensnare and enchain the mystic words, waiting to be tapped each day at the allotted time, the said obscure village being already provided with a broadcasting station. Obviously something cheap and simple was required, and after a little thought the present masterpiece was evolved.

Components

The components were easily obtained. The first requirement is an ordinary matchbox about 2 ins. long by 1¼ ins. wide—the usual penny box. Inside this a second matchbox will be required. This is of the smaller type, about 1½ ins. by 1 in. in size—the vest-pocket size, in fact. This is not obtainable at every tobacconist's, but may usually be acquired fairly easily.

The most expensive item of the equipment is the crystal detector. For this we require one of the semi-permanent types, of which there are several now on the market. I went out and purchased a Liberty detector, made by the Radiare Electrical Co., and this is the component shown in the photographs. I have subsequently tried out the well-known R.I. detector, made by Messrs. Radio Instruments, Ltd., which fits in the same space, and this also gave very good results.

No Drilling Required

There is no reason for the use of a permanent type of detector, except that of convenience. As will be seen later, the construction is ludicrously simple with the arrangement adopted, but if it is desired to use an ordinary type of crystal there is no reason why this should not be done.

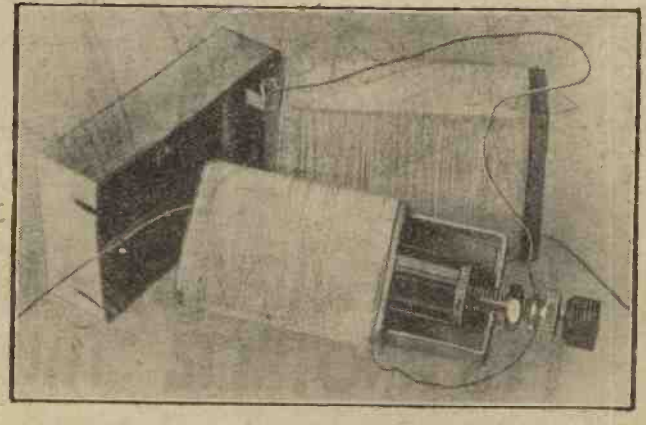
In addition, a small quantity, about 1 oz., of No. 30 gauge d.c.c. wire will be required. Telephones and an aerial will also be needed, of course.

Do Not Overlook This

This completes the stores, and we are now ready to put the model into production. First of all, remove the matches from the interior of the matchboxes. This is important, as otherwise the components are apt to be cramped. Take the inside tray of the small box, and cut two slots in the ends with a penknife. This then serves as a mount for the crystal detector, which should be placed in position and the fixing at one end screwed up, as can be seen from the photographs. The nut at the end nearest the adjusting knob is left loose for the time being.

Winding the Windings

Now take the outside case of the small box, and, treating it as if it were an ordinary former, wind on about 60 turns of the 30 gauge d.c.c. wire. The ends of the winding are brought through pin-holes in the side of the box, and should be left at least



The interior of the larger matchbox serves to contain the smaller box and to enable the latter to slide easily in and out for tuning.

A "Matchless" Crystal Set—*continued*

6 ins. long, since they will ultimately serve as flexible connections.

Insert the small tray containing the detector in position inside the case. Take the end of the winding near the short end of the detector (i.e., the end opposite the adjustment), bare a short portion and insert it under the terminal of the detector, as shown in the diagram.

Fixing the Detector

Next take the inner tray of the larger matchbox, and again cut two slots in the ends as shown. Take the smaller matchbox complete with its winding, and with the crystal detector inside, and place it in position so that the long end of the crystal detector (the end carrying the adjustment) projects through the slot in the tray. By means of the two nuts normally provided for fixing the detector to the panel or to a bracket of some sort, the whole of the inside portion may be clamped in position, so that the tray of the large box and the small box

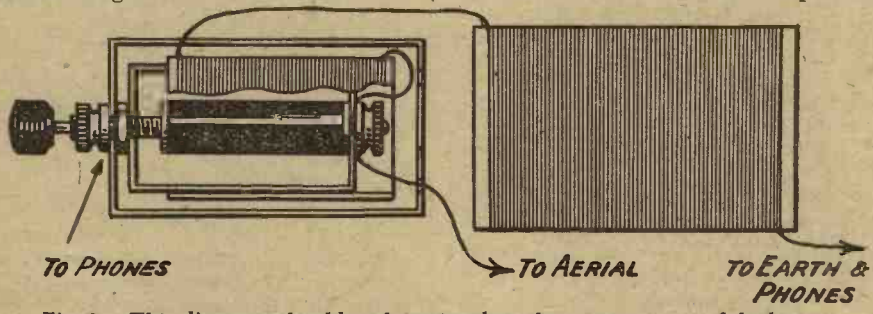


Fig. 2.—This diagram should make quite clear the arrangement of the boxes and the detector.

complete with crystal detector form a complete and more or less rigid unit.

Easy Tuning

The outer case of the large box should now be taken and wound with 90 turns of the No. 30 d.c.c. wire in a similar manner to the winding on the inner box. This completes the winding. The ends of the wires should be brought through pin holes in the side of the box as before.

To complete the receiver, take the free end of the winding on the inside box, i.e., not the end already connected to the detector, and connect this to one of the ends of the winding of the outside (larger) box. Then place the tray of the larger matchbox (complete with the inside winding and crystal) inside the case in the usual manner, when it will be capable of sliding in and out quite easily. This motion is used for tuning, as will be seen.

Wiring

The two remaining ends of the winding are now connected to aerial and earth respectively. The wire which is already connected to the crystal should be connected to the aerial, the other lead being the earth connection.

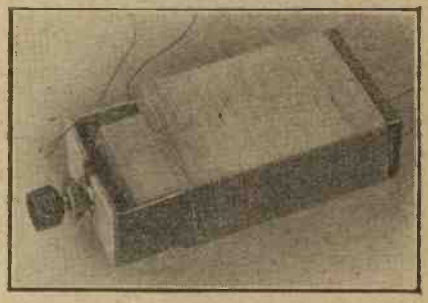
The telephones are connected between the other end of the crystal, where the adjustment is, and the earth. This gives a simple variometer tuned circuit, as shown in Fig. 1.

By sliding the inner box in or out of the case, the required station may be tuned in quite easily, provided, of course, that it is within crystal range.

Actually the arrangement on an average aerial tunes approximately to the London station with the two halves separate, i.e., with the inner box completely removed. For other stations the inner box should be inserted in position and moved up and down till the tuning point is obtained. According to which way the box is inserted, so the wavelength will be above or below that of London.

Wavelength Range

In one direction the coils help each other, while in the other they oppose, giving an increased or decreased wavelength respectively. Consequently, if the station does not tune in one way, remove the inner tray and insert it at the other end of the outer case. It may be necessary to vary the number of turns one way or the other to suit the particular aerial in use; i.e., a long aerial might require less turns in order to enable it to tune to the low wavelengths, while with a short aerial the set might not quite tune to the higher wavelengths unless a few more turns were added. This can easily be found out by trial.



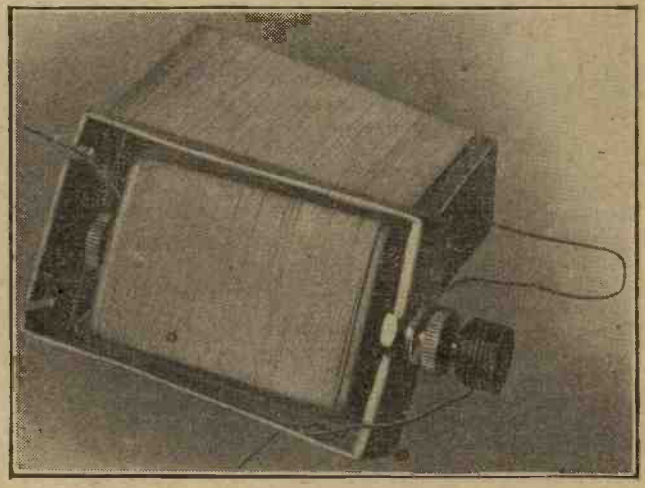
The milled nut on the detector is used to fix the detector in the box and as a terminal for one telephone tag.

Experiments

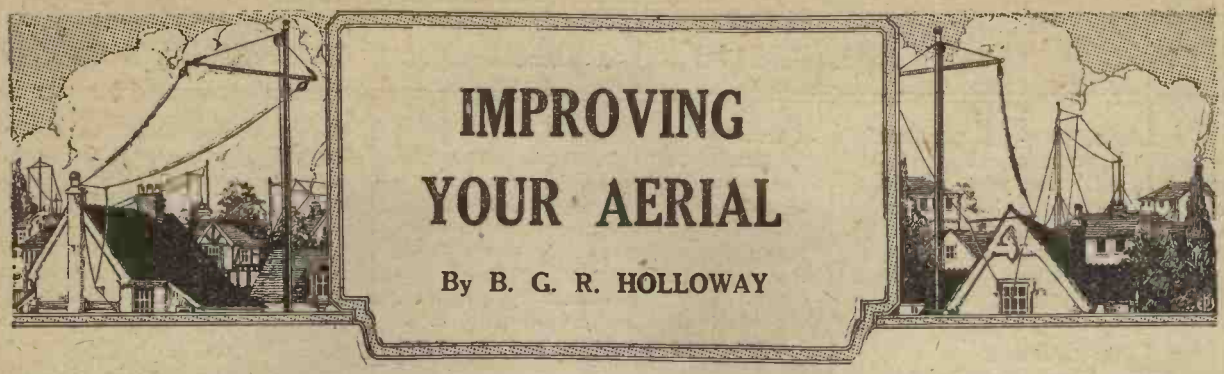
Those who wish to experiment may try the effect of using a tapped crystal circuit. This may be done by a slight alteration of the connections. Instead of taking the free end of the winding on the inside former and connecting this to the outside winding, the end connected to the crystal should be used. The free end is then connected to the aerial, the other connections remaining the same. This circuit may give appreciably louder signals.

Try it and See

This is due to the removal of the crystal damping from the tuned circuit, but the signal strength obtained with the other arrangement is quite as good in the majority of cases. At any rate, I was enabled to listen to the winged words of wisdom with comparative ease, and I have no doubt that my readers will obtain just as good results.



The slots cut in the larger box provide freedom of movement for the leads from inside.



IMPROVING YOUR AERIAL

By B. G. R. HOLLOWAY

Are you erecting a new aerial, or are you dissatisfied with your present one? The practical hints given here may prove useful to you, and may help you to the possession of an aerial which is both neat and efficient.

IT is becoming quite a common practice nowadays with some builders to erect with a house suitable wireless masts and supports. For those who wish to have such masts and fittings built in conjunction with a house, this article may, it is hoped, provide some useful information.

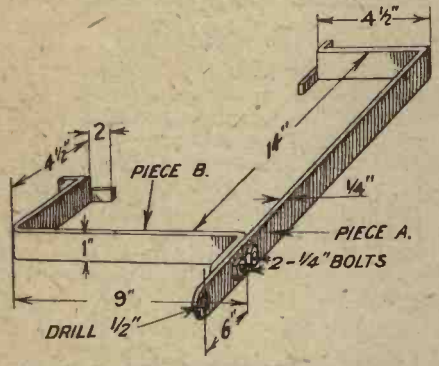


Fig. 1. Showing how a strong chimney bracket may be constructed.

A Chimney Attachment

In the writer's case one of the chimney stacks is in a convenient position to support one end of the aerial. Consequently the pulley bracket, illustrated in Figs. 1 and 2, was constructed and built into the stack during the bricklaying.

The materials required for the bracket are as follows:—Two pieces of strip iron 1 in. wide × ¼ in. thick, one piece being 28 in. long (piece A, in Fig. 1), and the other 20 in. long (piece B).

Construction

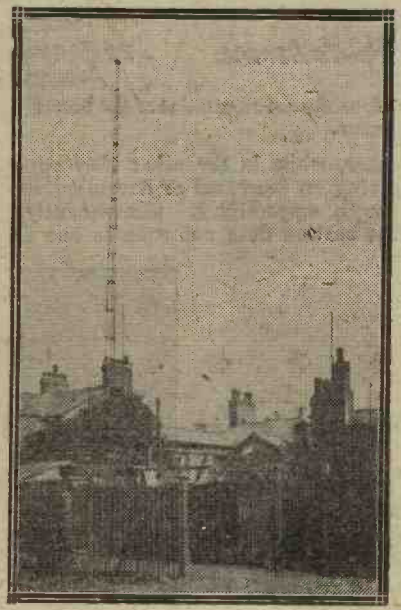
Fig. 1 shows how the pieces are bent and bolted together with two ¼-in. diameter bolts, 1 in. long. The bending must be done by hammering the iron, when at a red heat, over the edge of an anvil or a suitable substitute. If, however, access to the necessary tools for this job is impossible and great strength of the finished bracket not essential, the bracket may be made of iron half the thickness quoted above. It can then be bent quite easily without heating.

The diagram, Fig. 2, shows how the bracket fits between the bricks, the split ends preventing it from being pulled away.

The actual bracket made up by the writer was fitted in the fifth course of bricks from the top of the stack, so that there should be enough weight above to allow it to take a considerable strain without damage to the chimney.

Erecting the Mast

The constructional details of the 45-ft. mast are quite straightforward and need not be detailed here, but as the number of helpers available to erect the mast was only two, excluding the writer, a description of the manner in which the difficulty of erection was overcome may be helpful to those who find themselves in a similar predicament.



Aerial masts of the "lattice girder" type find favour with many enthusiasts, owing to their strength and workmanlike appearance.

Digging the Hole

The erection was greatly assisted by digging the hole of the shape indicated approximately in Fig. 3.

The advantages of this shape are obvious, the slope allowing the base of the mast to be placed at the bottom of the hole before the erection is commenced, thus allowing a little extra leverage to be obtained. The step at the bottom of the hole and the vertical side prevent the mast from falling in the direction of the arrow "A." Any side movement may also be checked by keeping the width of the hole as narrow as possible.

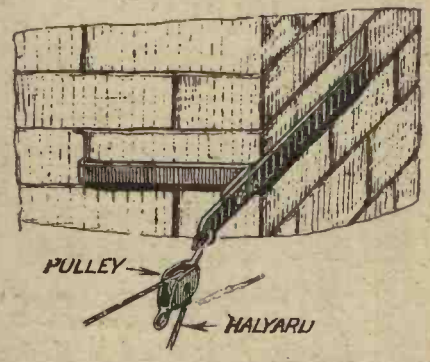


Fig. 2. The method of attaching to a chimney the bracket illustrated in Fig. 1 is shown here.

A Simple Stay Tightener

The chief advantage of the makeshift strainer illustrated in Fig. 4 is its simplicity of construction.

The anchor, which should be about 4 ft. long, is driven into the ground at right-angles to the guy rope. The bolt used should not be less than 6 in. long and a large washer prevents the adjusting nut from biting into the wood.

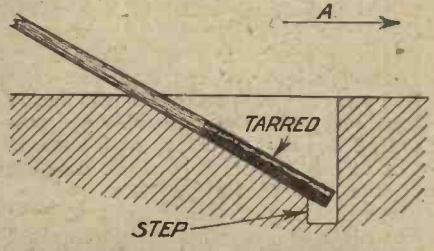


Fig. 3. This shape of hole will greatly simplify the erection of an aerial mast. The base of the mast may be tarred to give it a longer useful life.

IMPROVING YOUR AERIAL—*continued*

Adjusting the Tension

The guy rope is fastened to the bolt by means of a strip of hoop iron, drilled and bent round the bolt head as shown (Fig. 4A).

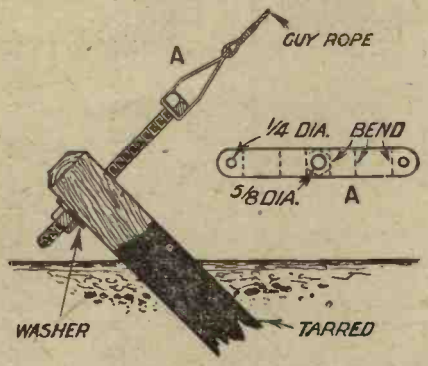


Fig. 4. A convenient form of stay tightener can readily be constructed in the manner indicated here.

A stick thrust between the two arms of the connector will prevent the bolt from turning when the nut is adjusted.

Reducing Leakage

The writer has spent much time in devising a waterproof lead-in insulator, as it is found by experience that it is at this point in the aerial system that most leakage occurs.

Fig. 5 shows the general arrangement. The main insulator consists of a gauge glass about ¾ in. in diameter and 15 ins. long, but any glass or ebonite tube of approximately the same dimensions will serve equally well. It must be a tight fit in the hole drilled in the window frame, and also the hole should be drilled to slope outwards at about 5 to 10 deg. from the horizontal.

Assembling

Before the lead-in wire is passed through the tube, it is threaded through an aerial insulator. The wire is held centrally in the tube by means of two tight-fitting ebonite blocks. The outermost of these is pushed about 2 ins. up the tube, while the other is fitted flush with the end. A panel pin thrust through the strands of the wire will prevent it from slipping when the lead-in is tightened.

Keeping Out the Rain

The porcelain aerial insulator is fastened, in series with two others, to a stake in the ground. The tension of the wire connecting the insulators to the ground must be adjusted until the lead-in is sufficiently taut to prevent swaying, and also to hold it in a central position in the tube.

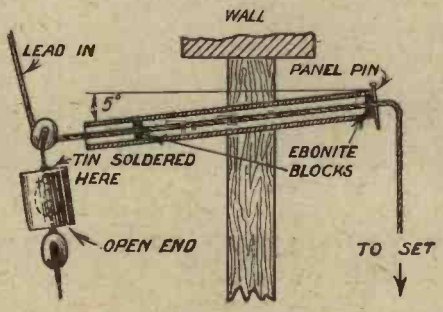
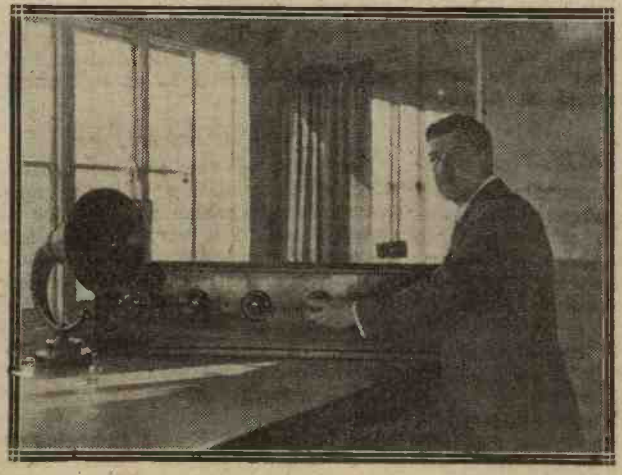


Fig. 5. This lead-in arrangement will prevent rain from running down the lead direct on to the wall, with consequent loss of efficiency.

When this adjustment has been made, the aerial insulator can be tied to the lead-in, to prevent it slipping.

An inverted tin, soldered over the middle aerial insulator to the wire joining the first and second insulators serves as a shield from the wet.

The writer's aerial embodying these hints has proved extremely satisfactory in practice.



Professor L. A. Hazeltine operating the "Elstree Six" on the occasion of his recent visit to the Radio PressLaboratories. His opinion of the "Elstree Six" will be found on page 1014.

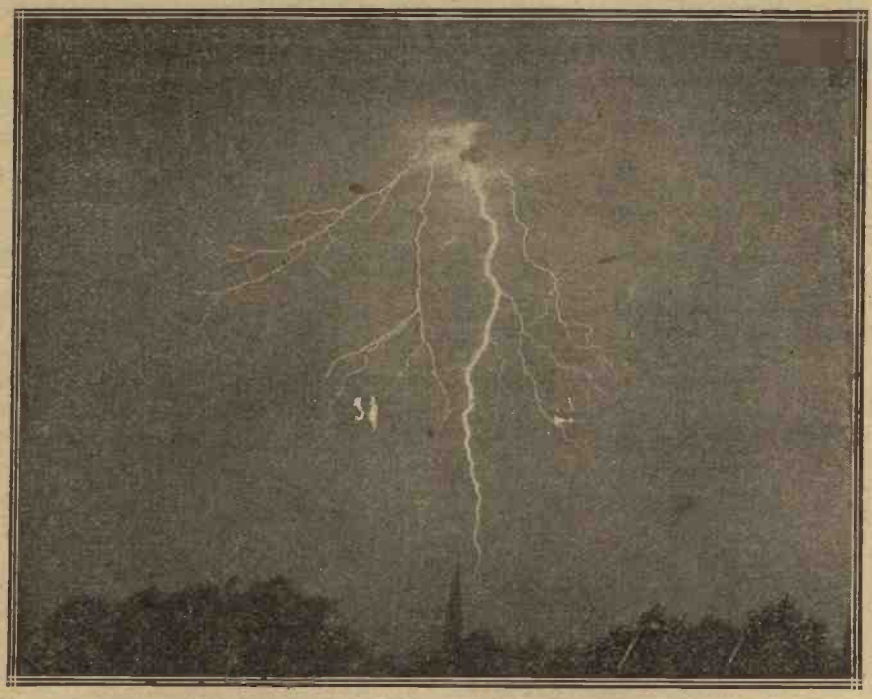
MAKE A NOTE OF IT

The National Radio Exhibition will be held in the New Hall, Olympia, from September 4 to 18. Do not miss the opportunity of seeing the latest British radio products.

LOOK TO YOUR H.T. SUPPLY

Any multi-valve receiver employing two stages of L.F. should be used with a high-tension battery large enough to give the necessary plate current without its imposing a heavy strain on the cells. Those who can afford it will no doubt prefer a high-tension accumulator, and here care should be taken to see that a reliable make is obtained. I recently had one that after about six months' use showed a ridiculously low voltage when tested; this notwithstanding the fact that it had recently been charged.

An examination of the cells showed that half the positive plates were buckled or disintegrating, several of the cells sulphated and one or two of the negative plates were beginning to shed their paste. In the process of dismantling the battery for closer examination, the lugs practically fell off half a dozen of the positive plates and the whole battery was not worth repairing.



WHERE THE "X's" COME FROM

By J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

Every listener is probably familiar with the noises caused in a receiver by the approach of thundery weather. Do you know the reasons for the rushing and crackling noises which you hear when there is no sign of a storm? Whence do these disturbances come? Mr. Reyner, in this special article, describes the nature of "X's" and the manner in which they affect a wireless receiver.

ONE of the remarkable features of long-distance reception this summer has been the prevalence of atmospheric disturbances, or "X's." Every reader will have encountered those unpleasant clicks and crashes which so often mar the reception of long-distance stations.

In particular cases these atmospheric disturbances may be so heavy as to render the wearing of telephones almost a physical impossibility. The continual shock to the ears caused by the appalling succession of crashes is unpleasant in the extreme.

This Summer's Experience

This, of course, is by no means new, the trouble having been experienced on commercial wavelengths ever since the beginning of wireless. The developments in the direction of broadcast reception, however, have enabled longer ranges to be achieved, and as soon as distant reception is undertaken, then atmospheric disturbances begin to be noticeable. It is probably for this reason that atmospherics appear to have been more prevalent on the broadcast band during the past summer than in previous years, but actually I doubt whether there has been any serious increase in atmospherics generally.

The Source of "X's"

The question which naturally arises is, where do these extraneous disturbances come from? In other words, what causes the atmospheric disturbances, and what can be done to reduce the interference caused thereby? Another interesting question is whether the wavelength employed has any connection with the severity of the atmospheric disturbances.

One of the earliest ideas concerning atmospheric disturbances was that they were actually produced by lightning discharges. Lightning is caused by an accumulation of electricity on clouds or in the upper atmosphere. As this charge builds up, so the voltage gets higher and higher until a point is reached at which the electrical strain becomes too great and a discharge takes place, either between the clouds and earth or between one cloud and another. Such discharge is accompanied by a vivid flash of light, commonly referred to as lightning.

A Spark Discharge

Now one of the earliest types of wireless transmitters was the spark transmitter in which a condenser was charged up to a very high voltage. Across this condenser was placed a spark-gap consisting of two metal balls separated by a small air gap. When the voltage of the condenser reached a certain limit, the electrical strain across this gap became too great, and a spark discharge took place across the gap.

It will be seen that a lightning discharge is in effect only a very much larger model of a simple spark transmitter, and consequently wireless waves will be produced by the lightning discharge. All my readers will also know the peculiarly penetrating nature of spark signals, so that it will readily be appreciated that a lightning discharge will produce interference over a very wide band of wavelengths.

Where the "X's" Come From—*continued*

Audible Range of Discharges

There is no doubt that certain types of very violent crashes are produced by lightning discharges of this nature. Moreover, the discharge need not be local, but it will be heard even if the actual disturbance is some 100 to 150 miles away from the receiving station. It appears, however, that definite lightning discharges do not produce interference at greater distances than this, so that the thunderstorm theory does not supply all the necessary interference which is known to exist.

The Nature of "Clicks"

There are, however, many atmospheric disturbances, known generally as "clicks," which are similar in general character to those produced by an actual lightning discharge, either local or distant, and it is probable that these disturbances are produced by more or less continuous redistribution of potential in the upper atmosphere.

A visible discharge of this kind would cause a deafening noise in the telephones of a receiver within a few miles.

Any point in the atmosphere is at a certain potential to the earth. That is to say, there is a certain definite voltage existing between that point and the ground. Moreover, it is found that the potential difference between the atmosphere and the earth increases as the height above the ground is increased. Nearer the ground the increase is very rapid, the potential increasing 200 to 300 volts every yard, but it falls off as the higher regions are reached.

Effects of Weather

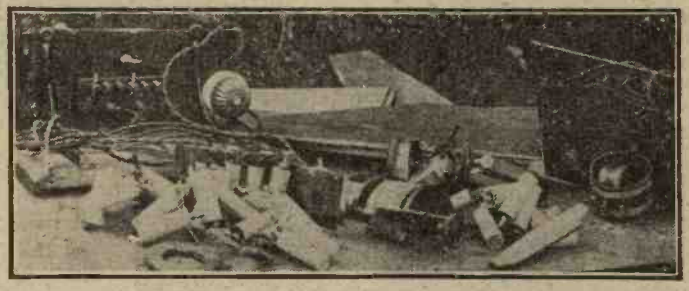
The actual value of the potential at any given point depends very considerably upon the atmospheric conditions. It may be comparatively low in fine weather, but if the atmosphere becomes moist or misty, a very large increase may take place. Thus we could have a point perhaps a thousand yards above the surface of the earth, normally at a potential of some 200,000 volts to earth. Possibly, however, a change in the atmospheric conditions might cause this potential to increase some three or four times, bringing it somewhere in the neighbourhood of 1,000,000 volts.

Now such changes are comparatively local, which means that the equilibrium over a very large area would be disturbed, and some discharge would take place between various points in order to maintain a more or less uniform potential of the atmosphere. These discharges need not necessarily be accomplished by actual visible light as in the case of lightning, yet they are capable of producing electrical impulses which in turn give rise to what are known as atmospherics.

"Grinders"

There are other types of atmospherics, in addition to those just described, which are known as "grinders." These take the form of a more or less long, grinding roar, somewhat similar to the noise produced by breakers on the seashore. As far as present evidence goes, it would appear that this type of atmospheric is produced in certain parts of the earth only.

Thus, some of the tropical regions North of the Equator turn out large quantities of "X's" every day and all day. Presumably these disturbances are due to electrical effects caused by the hot air rising from the land, and this theory has some support from the fact that deserts containing large areas of hot sand seem to produce atmospherics in great profusion.



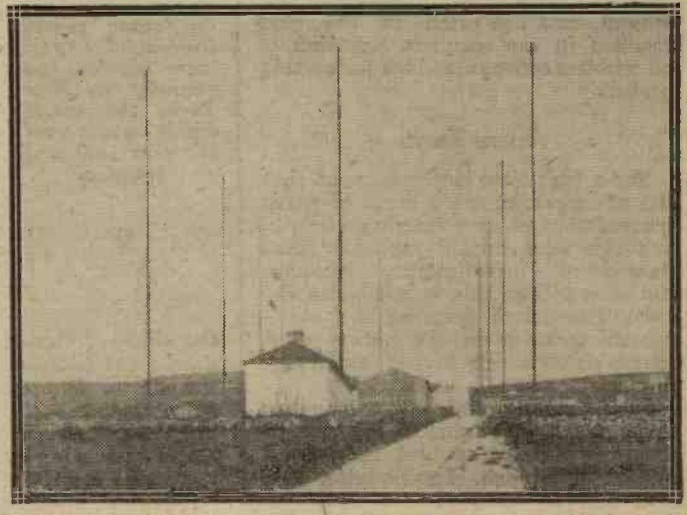
The devastating effect of a lightning discharge which actually struck an aerial when the receiver was in use is illustrated here.

Locating the Disturbances

Considerable evidence may be obtained by actually plotting the direction from which atmospherics appear to come. The "click" type of atmospherics is comparatively local, and comes from a more or less vertical direction. On the other hand, the grinder type of atmospheric appears to come more from a horizontal direction, which in many cases is fairly well defined. Such X's may be produced at a point hundreds of miles from the receiver.

It is by taking observations of this sort that we are able to obtain some indication of the source of grinders, and in nearly all cases the evidence

"X's" are liable to cause trouble in long-wave commercial stations by upsetting the tape records of high-speed automatic reception.



WHERE THE "X's" COME FROM—*continued.*

points to some very hot tropical area or desert. There is also a certain amount of evidence that high mountains produce atmospherics, possibly due again to a very unequal distribution of the electrical potential in the neighbourhood, which is constantly undergoing reorganisation in order to maintain a state of equilibrium. As long as this constant change goes on, electrical disturbances will result, and these will ultimately produce atmospherics.

The Wavelength of "X's"

The form of the atmospheric is of considerable interest. It has long been observed that the atmospheric interference was considerably more serious on long waves than on short, and in fact one of the joys of working on the very short wavelengths which are coming into favour is that the atmospheric disturbances are very often negligible. On the other hand, the atmospheric disturbances on long-wave reception of 10,000 metres and more is appalling at certain times and seasons, and has often in the past resulted in the complete cessation of all wireless communications for certain periods.

Wave Form

For a long time it was thought that the atmospheric was a form of spark transmission of very long wavelength, and this view existed for some time. Subsequent investigation, however, has shown that this is not quite the case. The actual form of the atmospheric is really in the nature of a sharp pulse which is not oscillatory in character at all.

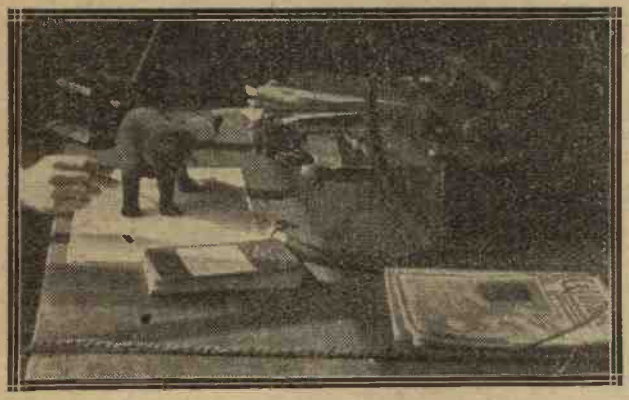
Such a shock would act on a wireless aerial in a very similar manner to dropping a heavy weight in a room containing a piano. In this latter case a large number of strings would be set in vibration by the shock produced by the falling weight. It would be found, however, that the lower notes would respond more readily than the higher ones.

In a similar manner it is the lower frequencies (higher wavelengths) which are most affected by the atmospheric pulses, so that the interference is greater on the longer wavelengths.

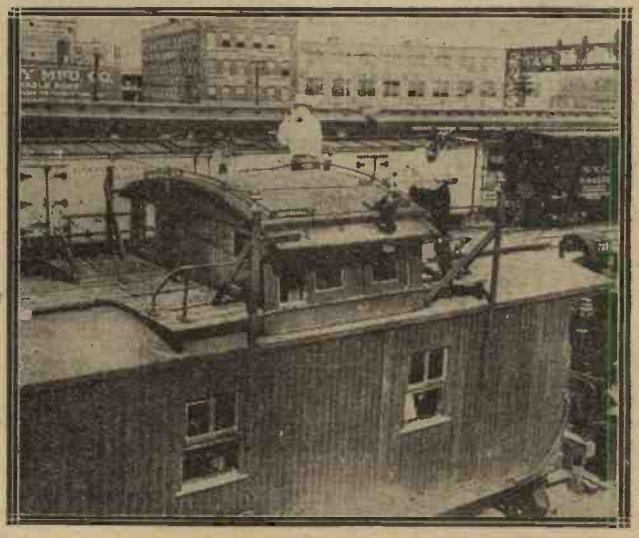
Can We Eliminate "X's"?

One point stands out from this, namely, that the effect of the atmospheric is to shock the aerial at the frequency to which it is tuned. In other words, tuning has no effect whatever in cutting out atmospherics.

Various methods have been devised from time to time in order to reduce the effect of these unpleasant disturbances, but little success has attended the efforts. Without the use of special apparatus, the best method of reducing the interference is to use a small aerial system and to make sure that the aerial is efficient and that it has as low a resistance as is possible. The interference produced on a low resistance aerial is definitely less than that observed on a poor and inefficient one.



A recent addition to the laboratory staff at Elstree is Mu, who is seen here busily engaged in dictating an article.



Signalling by wireless to and from moving trains has been the subject of continual experiment for some years. Successful tests were carried out recently in New York, the aerial being on the roof of one of the wagons.

The photograph which appears on the cover of this issue is reproduced by courtesy of Sir W. G. Armstrong Whitworth Aircraft, Ltd.

TWO NEW SHORT-WAVE ENTHUSIASTS

SIR,—I have constructed the short-wave receiver described by Mr. Percy W. Harris in the August issue of THE WIRELESS CONSTRUCTOR, and, although I have not yet received "Australia on Two Valves," I am more than pleased with the results I am already obtaining with this set. I have no knowledge of the Morse code, and yet find the shorter waves most fascinating. I was surprised by the ease of construction of this set, and also by the comparative ease of operation, compared with the average broadcast receiver employing H.F. amplification. I am now a confirmed "short-waver."—Yours faithfully,

F. R. ABBOT.

Lincoln.

SIR,—May I be allowed to thank Mr. Percy W. Harris, through the medium of THE WIRELESS CONSTRUCTOR, for the short-wave set described in last month's issue? It took me less than four evenings to construct this, and I had it working well on the fifth. I have already overcome my previous dread of short waves, and hope that Mr. Harris's article will be the means of introducing many other readers to this fascinating branch of radio.—Yours faithfully,

L. C. NEWLAND.

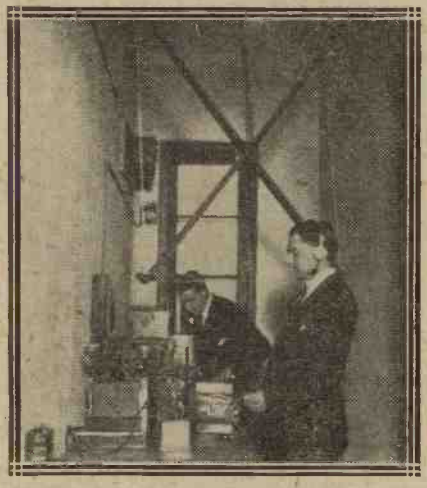
Bishopston, Bristol.

POINTS FOR THE SHORT-WAVE OPERATOR

By A. V. D. HORT, B.A.

Do you find difficulties in tuning your short-wave receiver? This article will explain to you why the tuning of a short-wave receiver is different from that of a broadcasting receiver, and will help you to get better results on the short waves.

IN last month's issue of THE WIRELESS CONSTRUCTOR the Editor described a receiver which he had designed for the reception of short waves. The title of the article in question, "Australia on Two Valves," apart from the further details given,



The B.B.C. on several occasions relayed the short-wave transmissions from KDKA, East Pittsburgh, via their Biggin Hill station, shown here. Have you tried to get KDKA direct?

showed some indication of the capabilities of this receiver. Now it is possible that some constructors have made up the receiver and have been successful in receiving a certain number of stations with it, but yet have discovered that there are in tuning such a receiver difficulties of a kind which are not encountered in the reception of broadcasting.

How Stations are Missed

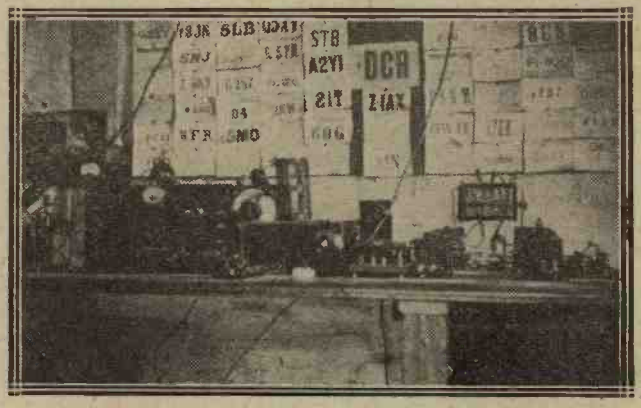
The purpose of the present article is to indicate some of the difficulties which may be expected by the newcomer to short waves, and to show how they may be successfully overcome in practice.

Supposing, first of all, that the operator of a short-wave receiver were to handle the dials of the tuning condensers exactly as though it was a broadcasting receiver, he would possibly find a certain number of stations, but he would be practically sure to miss a far greater number. The reason for this is that it is possible on the short waves to crowd stations much closer together in respect of wavelength without mutual interference, so that the number of possible stations which may be picked up during one rotation of the condenser dial will be much greater on the short waves than on the broadcasting band.

Frequency and Wavelength

To go a little more deeply into this, it is necessary for a moment to consider frequencies and their relationship to wavelengths. The frequency of the oscillations of the transmitted and received wave at a wavelength of 300 metres is 1,000,000 cycles per second, or, as it is more commonly expressed, 1,000 kilocycles. Again, the frequency at 400 metres is 750 kilocycles, so that in the band of wavelengths between 300 and 400 metres there is a frequency band of 250 kilocycles. During the discussions some weeks ago on the subject of the necessary separation between broadcasting stations, the fact became generally known that a frequency difference of 10 kilocycles is needed for the separation of telephony stations. Thus between 300 and 400 metres there will on this basis be room for 25 stations if there is to be no overlapping, and assuming, of course, that they are at such a distance apart and of such power that interference is likely to take place with a less degree of separation.

A well-known short-wave station in India is that owned by an amateur at Rawal Pindi, using the call-sign Y-DCR.



An Enlightening Comparison

Turning now to the short waves, the frequency at 50 metres is 6,000 kilocycles, and at 100 metres is 3,000 kilocycles. The difference is apparent at once. On the short-wave band, between 50 and 100 metres there is a frequency difference of 3,000 kilocycles. This band, only one-half of the previous band when measured in metres, allows room on the same separation basis of 10 kilocycles for 300 stations, twelve times as many. Further, this amount of frequency separation between stations is calculated as a fair allowance for telephony stations. Stations working with continuous wave transmitters, which are capable of much sharper tuning than is possible with telephony, will not really need to be separated so widely, so that the available "space" in the band will be increased still more.

Slow Motion Dials

It follows from this that in a short-wave receiver rotation of the tuning dial will change the frequency more rapidly than on the longer waves, and the stations will be more crowded together on the dial. It is therefore necessary to carry out the operation of tuning more slowly, in order to be certain that no stations are missed. It is, in fact, extraordinary how easily stations may be passed over on the short waves, if the dial is turned too quickly. It is worth trying the experiment, after locating one or two stations by careful tuning, of turning the dial at varying speeds backwards and forwards across the settings at which they can be heard. Unless the signals are exceptionally strong, it will be found that nothing will be heard of them at all, unless the dial is turned quite slowly.

This necessity for slow rotation of the tuning dial of a short-wave receiver accounts for the provision of

Points for the Short-Wave Operator—*continued*

slow-motion condensers on the receiver already quoted.

Trouble from the Hand

Another trouble which may present itself in the operation for a short-wave receiver is that of hand-capacity. Hand-capacity is sometimes noticeable in the operation of a broadcasting receiver, especially when the receiver is

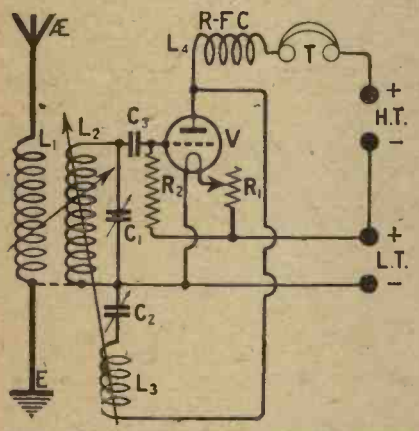


Fig. 1. — To reduce hand-capacity effects it is generally advisable to earth the L.T. battery, as shown by the dotted line.

worked in its sensitive condition close to the point of oscillation. On the short waves this effect is likely to be even more marked, making accurate tuning a troublesome matter.

It is often possible to get rid of hand-capacity effects altogether by seeing that the receiver batteries are earthed. Most commonly the type of circuit used for short-wave reception has an untuned aerial coil loosely coupled to a tuned secondary, as in Fig. 1. The necessary earthing of the batteries in this case is carried out by connecting a wire from the earthed side of the aerial coil to the filament end of the secondary or grid coil, thus connecting the filament negative to earth, as indicated by the dotted line in Fig. 1.

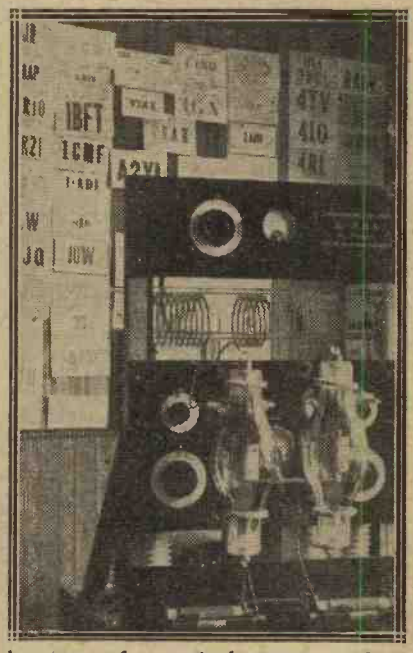
Try a Counterpoise

Sometimes it is necessary or desirable to use a counterpoise with the receiver instead of a direct earth connection. Under these circumstances it has been the experience of the writer that a good deal depends on the position of the operator relative to the counterpoise lead. In one case of this kind, where the counterpoise consisted of a number of wires radiating out fanwise from the receiver and placed on the floor under the carpet, it was found that so long as the operator kept his feet somewhere near the centre of the fan, hand-capacity was negligible. Any attempt to operate the receiver in any other position produced troublesome symptoms at once.

Screening of the condensers, or even of the whole panel of the receiver, is a measure which is drastic, but which is frequently helpful in difficult circumstances when other expedients fail. It is necessary in this case to earth the screen and to connect to it all points of the circuit which are at the potential of the filament negative.

Tuning Without Touching Dials

On the very short waves it is practically essential to provide long extension handles for the control knobs. On the ultra-short waves the receiver is sensitive to any movement on the part of the operator up to a surprising distance away. Fine tuning may often be carried out simply by movements of the body, without touching the tuning controls. This applies also to the tuning-in of weak telephony on wavelengths between about 30 and 100 metres; a slight movement of the hand near the receiver will be all that is necessary to tune-in the station accurately. This is not, of course, the recommended procedure if the station is to be listened to for any length of time, owing to the difficulty of keeping still enough to maintain the receiver in tune. In practice, allowance should be made for this hand-capacity effect, and the tuning dial should be set in such a position that the station is accurately tuned in when the hand has been removed, and not when it is still resting on the control.



A corner of a typical amateur short-wave transmitting station. This actual station is in Holland.

The question of the most suitable type of aerial to use with a short-wave receiver would provide material enough for a complete article dealing with that subject alone, but a few notes here may be helpful to the newcomer to this kind of reception.

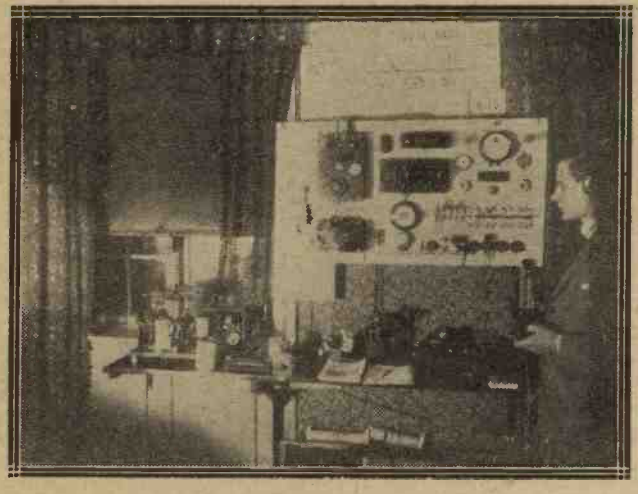
An Essential Point

If a short-wave receiver is to work satisfactorily in the reception of continuous wave signals, which in fact will form the bulk of the signals heard, the receiver must be capable of going smoothly into and out of oscillation over the whole tuning scale. When the reaction coupling or reaction condenser is increased in value past the critical point, the receiver should commence to oscillate quite quietly and without any "click." It should be possible to set the receiver so that it just is or just is not oscillating, and this cannot be done if oscillations start abruptly or if there is any sign of overlap in the reaction control.

Series Aerial Condenser

Assuming that such matters as the correct values of the high-tension and

(*Continued on page* 1021.)



There are many hundreds of short-wave stations similar to this one (7MT of Denmark), from which signals may be picked up.

According to Homer, Stentor was the name of a Greek herald in the Trojan War whose voice was as loud as that of 50 other men combined. As the name for a new Cossor Power Valve it is, therefore, peculiarly appropriate.

The new Stentor Two

described by "Popular Wireless" as a wonderful little power valve with a punch out of all proportion to its diminutive wattage.

FOR more than 20 years automobile engineers have been waging a ceaseless struggle in an effort to produce engines of more power with less weight. So successful have they been that to-day motor-car engines develop more than twice the horse-power of engines of equal weight constructed a decade or so ago.

And with the reduction in weight naturally follows a tremendous economy in upkeep. Less petrol, less oil, lighter moving parts with less wear. In fact cheaper motoring all round.

This lesson has been taken seriously to heart by wireless engineers. Everyone realises that to obtain really good loud speaker results a power valve is essential. The ordinary valve cannot give the volume necessary because it has little or no reserve of output. But in the past power valves have suffered from two main disadvantages: (*a*) they have been expensive to buy and (*b*) they have been costly to maintain both in filament and anode current.

Takes only ·15 of an ampere

At last, however, there is available a real power valve—entirely redesigned and utilising principles of construction never before found in any valve—which finally overcomes both of these serious disadvantages. It is the new Stentor Two—manufactured under a group of Cossor Patents.

Its superb fidelity of tone and unparalleled grandeur of reproduction has astonished even the most critical of radio technicians. They have readily admitted that never before has a 2-volt dull emitter consuming so little as ·15 of an ampere been able to produce such magnificent results.

Get acquainted with this wonderful new power Cossor Valve now—your dealer can supply from stock. Ask him also for our descriptive literature explaining the Cossor method of Co-axial Mounting and its far-reaching advantages.

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TIME AND THE RECEIVING SET

By JOHN UNDERDOWN

After giving good service for a long period, your receiver may fall off in performance, for no apparent reason. This article tells you where to look for the causes of this deterioration, and explains how you can restore the set to its original level of efficiency

THE devastating effect of time may not leave the receiving set unscathed. A gradual falling off in signal strength, unnoticed at first, begins to make itself felt after some time. This insidious attack passes unnoticed at first, and it may not be realised how poor reception is, compared with that obtained when the set was first new, until a comparison is made with some other similar receiver. In other cases crackling may result, which is first put down to atmospherics.

Crackling

Should reception become marred by crackling noises the first step to take is to remove aerial and earth leads, and to note whether these noises cease. If they do so, some external source, perhaps atmospherics, is responsible. Where an aerial and earth switch is fitted for safety, this should receive attention, since contacts become dirty and loose or corroded through exposure, and when the tension on the down lead is altered by the aerial swaying in a wind trouble may occur.

The H.T. Battery

The persistence of crackles when aerial and earth are disconnected is often indicative of the high-tension battery having reached the stage where it should be renewed. Another should be bought, therefore, or one should be borrowed which works silently upon another receiving set, when it will be evident whether this component is responsible. To purchase a new high-tension battery, however, merely for substitution purposes, when this accessory may not be at fault, is a somewhat expensive way of locating the fault. If, for example, an anode resistance of 100,000 ohms and of wire-wound type is available, and this is known to give silent working, you can connect it in series with a pair of telephones across the high-tension battery, when if you hear crackles on listening in the telephones, the battery should be renewed. Do not connect the telephones and anode resistance in series across the whole battery, but listen across a part first, e.g., 30 volts, then the next 30 volts, and so on until the whole battery is tested.

Failures in L.F. Transformers

Breakdowns in audio-frequency transformer windings, more especially the primaries, are not as rare as they should be, even with the more expensive types; with the very cheap ones they are all too frequent. Reception may become spasmodic, serious crackling being heard from time to time, with intermittent periods of normal working. Faults of this type are not difficult to locate, and for the sake of example, referring to Fig. 1, the procedure to adopt is as follows:—Here a 3-valve circuit of general purpose type is shown, the first valve being a neutralised tuned-anode stage of high-frequency, the second a detector, and the third a transformer-coupled note magnifier.

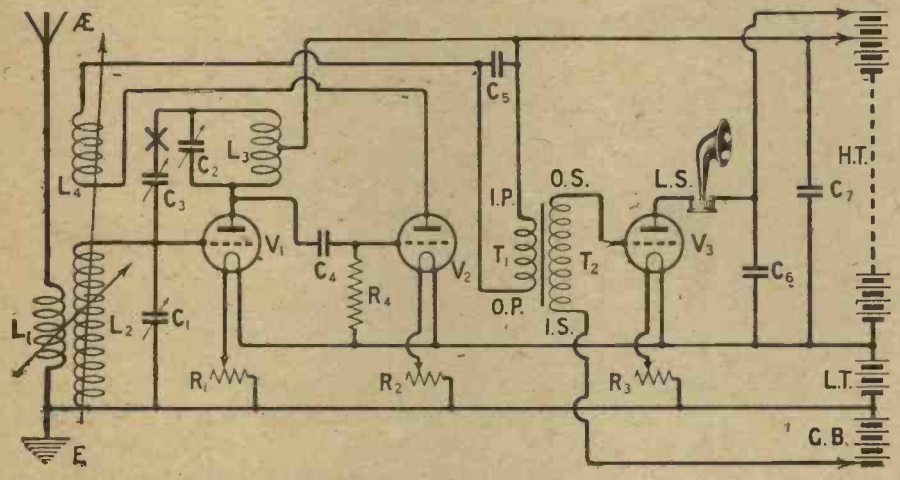


Fig. 1.—A fixed condenser connected in circuit at the point X will often cure noises due to trouble in the neutralising condenser C3.

Locating the Fault

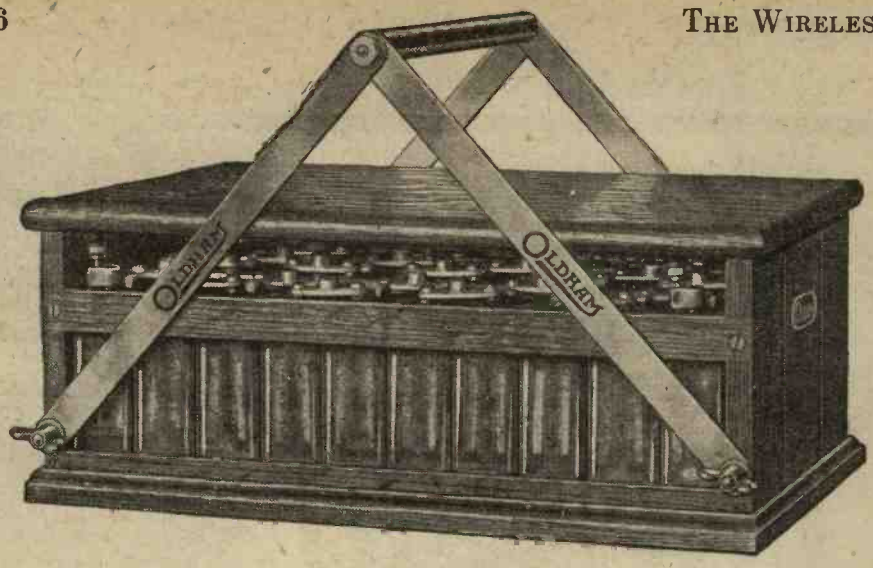
If it is suspected with an arrangement of this type that crackling is due to a breakdown in the L.F. transformer winding, the two leads to the primary should be disconnected, V3 should be extinguished upon its filament resistance, and the tags of a pair of telephones should be connected to the two wires which have been removed from IP and OP. Normal reception, with a quiet background, indicates that the primary winding T1 has in all probability broken down. Often the application of the well-known telephones and dry cell test, across the primary winding, will permit such a fault to be located. Normally a pair of telephones, in series with a small dry battery, will give very loud clicks when the free telephone tag is tapped on to one end of the winding, the free side of the battery, of course, being joined to the other end of the winding.

Intermittent Faults

If the break is complete, only feeble clicks will be heard, but unfortunately the test will not locate, in many cases, an intermittent break. The procedure to adopt then is either to substitute a transformer known to be working effectively, or alternatively to listen, in a quiet room, with the telephones connected in series with a small battery across the suspected winding. If slight crackles are heard, the transformer should be changed. Before carrying out this test, however, it should be ascertained that neither the telephones nor the battery are noisy, by listening for a short period with the 'phones directly connected across the battery. For such a test it is best to employ a 2- or 4-volt accumulator, since there is less tendency for a secondary battery to be noisy.

Leakage Across Condensers

If the receiver has a neutralised high-frequency stage, such as that in Fig. 1, or employs a variable condenser for reaction control, as in Fig. 2, and the L.F. side is proved not to be responsible for crackling by listening without these latter valves in circuit, leakage across the neutralising or reaction condenser should be suspected. Dust between plates is often responsible here, and if after cleaning the trouble is not overcome, the effect of placing a suitable fixed condenser in series with the variable condenser should be tried.



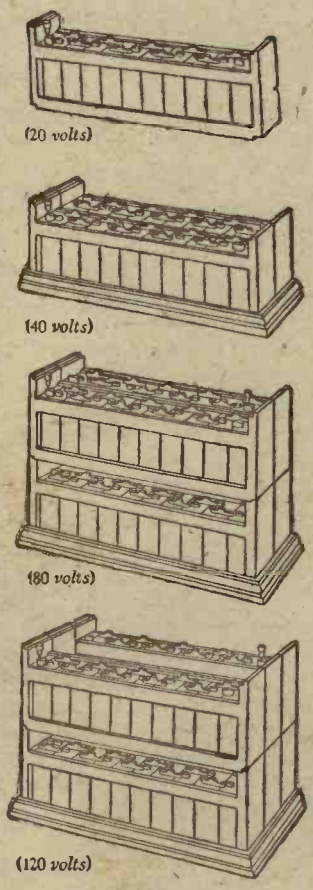
The Only High-Tension Accumulator

built in units like an expanding bookcase

THE H.T. Accumulator is now added to the ever-increasing list of commodities to which the expanding system has been successfully applied. Just as the unit principle revolutionised the bookcase, so, we predict, will the new Oldham H.T. Accumulator change the whole trend of battery design.

The principle underlying this new Oldham is just this : a single unit is made up of ten 2-volt cells complete in a wooden holder ; thus if a 60-volt Accumulator is wanted, three of these units are supplied clamped together, complete with carrying handle. Other units can be added at will (as illustrated on this page) to make up accumulators of 80, 100, or 120 volts.

The unit principle is, however, by no means the only advantage of this new accumulator. The fact that it bears the proven name of "Oldham" is sufficient to commend it to thousands of accumulator users whose experience tells them that the Special Activation Process, under which it is made, is responsible for a far greater efficiency,



immense resistance against all accumulator ills, and therefore a much longer life.

The Oldham H.T. Accumulator is not only more efficient, but is cheaper than the dry battery. Constant cost of renewals of H.T. Batteries has been a big deterrent against radio ; the initial cost of this accumulator is covered in the amount saved in renewals after a few months' use. An additional feature that must not be ignored is that, each cell being tapped, the accumulator can be used for grid bias.

Finally, you should note that every Oldham Accumulator is soundly constructed to give several years' service. Each cell is a real miniature accumulator, using real plates and contained within a stout glass box, sealed at the top against evaporation. There are no cheap flimsy test tubes to break—no thin plates to buckle—no connections to corrode and cause trouble. Ask you Dealer to show you one—you'll be amazed at the moderate price of such a beautifully constructed accumulator.

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Time and the Receiving Set—*continued*

Neutralising Condensers

Where a neutralising condenser, such as C3 in Fig. 1, is suspected, a small fixed condenser of .0003 to .001 connected in the position X, should be used. This condenser will prevent leakage through C3, and being very large in capacity as compared with C3, will not materially affect the capacity of the latter. With Reinartz type reaction the fixed condenser should be of the order of .001 to .002, if the capacity of the reaction condenser is not materially to be reduced.

Flex Leads

Before leaving the subject of crackling which mars reception, some mention of the effect of intermittent breaks in flexible leads should be made. If when wearing telephones it is noticed that crackling is particularly pronounced when a movement is made, the fault will often be located in the telephone leads, which should be replaced. Where the trouble is most evident when adjusting the reaction coil, the flex leads to the moving coil holder should be renewed.

Shunting Condensers

Shunting condensers across the various tappings of the high-tension battery are very desirable, more especially when the end of the useful life of the battery is being approached, but occasionally these components become leaky, thus imposing a continuous load on the high-tension battery, which runs down in a much shorter time than it should. A milliammeter, placed in the lead to a shunting condenser, will give a useful indication here.

Dust and Flux

The presence of dust between the vanes of the condensers, on fixed condensers and valve holders, or the presence of flux on the panel may also give rise to noisy reception. The receiver should be carefully dusted from time to time and any traces of flux on the panel should be removed by scraping or by washing with methylated spirit. It is rather interesting to note that certain fluxes on the market, when tested with a megger between two pins inserted into the flux, will give a practically infinite resistance reading. If, however, the flux is heated, as must necessarily happen when soldering is carried out, the reading on the megger will be considerably lowered, and traces of such flux on the panel provide serious leakage paths, more especially if dust gathers.

Resistance Coupling Troubles

So far we have dealt mainly with troubles which develop after some time in transformer-coupled receivers. From this it should not be assumed that resistance amplifiers are left unscathed by the passing of time. It often happens, especially with anode resistances which are not of the wire-wound type, that reception tends to become somewhat noisy, hissing being audible during the silent portions of the programmes. This is almost invariably due to the anode resistances having passed their useful life, and having reached the condition where their resistance fluctuates, instead of remaining constant in value.

Defective Coupling Condensers

Coupling condensers, for example, C3, C4 and C5 of the Fig. 2 circuit, may tend to become leaky after pro-

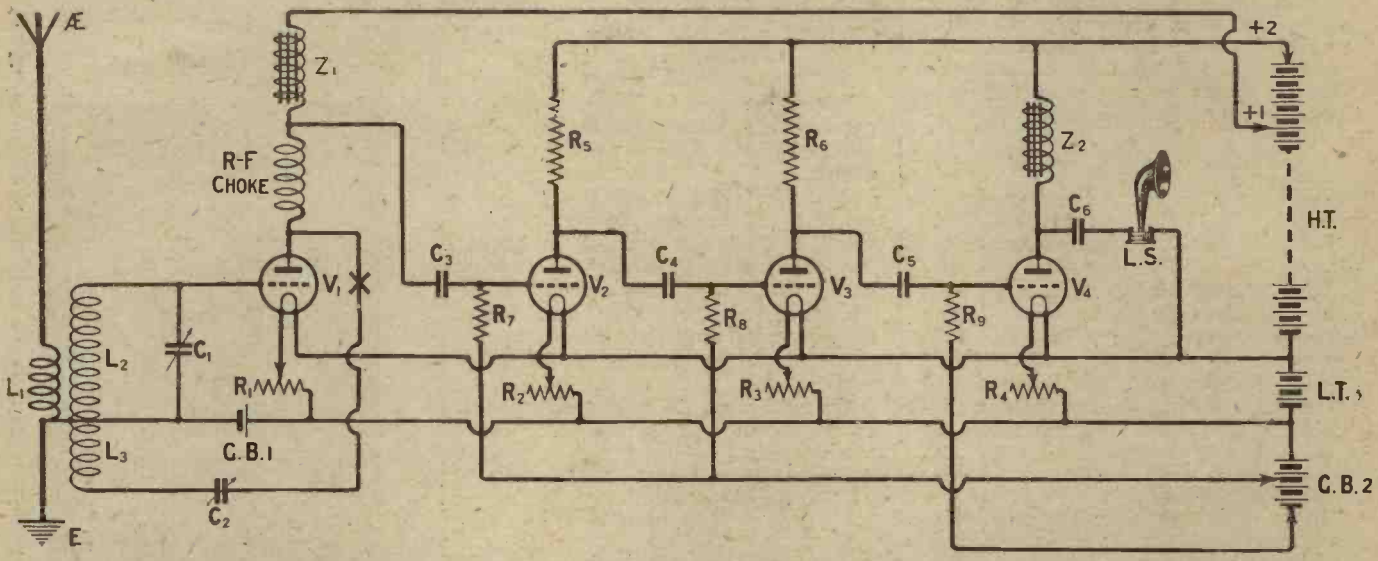
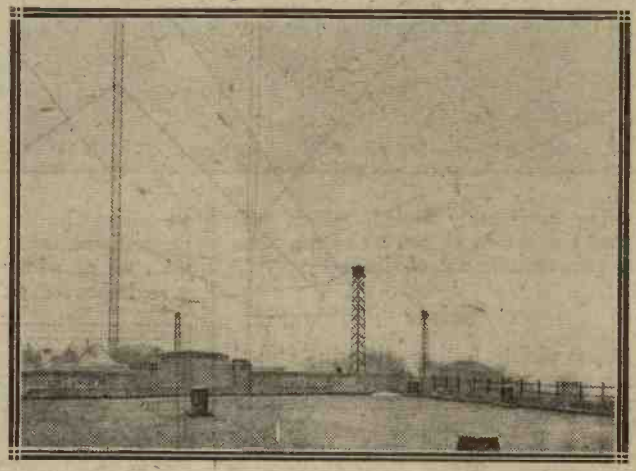


Fig. 2.—In a receiver employing a circuit of this type, poor performance may be due to faults in the anode resistances or grid leaks.



The aerial system of the high-power Rosenhugel Broadcasting Station, Vienna, which is often heard in this country.

TIME AND THE RECEIVING SET—*continued*

tracted use, and when this happens the grids of the valves concerned receive a positive bias from the high-tension battery, with the result that they do not work upon the part of the characteristic curve which gives pure reproduction. A heavier load is placed on the high-tension battery when the grids are made positive, grid current tends to flow, and reproduction will become poor in quality. Substitution is the only effective test which most constructors can apply here.

Fading

With resistance-coupled amplifiers it occasionally happens that signals are heard at good strength when the set is first switched on, but they gradually "fade," and can only be brought back to full strength again by switching the set off for a minute or two. Such a symptom is indicative of the grid leaks, for example, R7, R8 or R9 of the Fig. 2 arrangement having developed extremely high resistances, or having completely failed, which will cause the set to choke. The remedies for this trouble are obvious.

Valves

A gradual falling off in signal strength may be due to valves gradually losing their emission, either through the normal effect of use or through being run with too high a filament voltage. Dull-emitters of the thoriated filament type, which have been ill-treated in this latter manner, may have their emission restored in many cases by running them at a slightly higher temperature than normal with the high-tension supply disconnected. If no improvement results from this treatment, the valves may be "flashed." This is effected by running the filament for a second or two at three to three and a-half times the normal voltage, the high-tension, of course, being disconnected. Such drastic treatment may result in burning out the filament, but if successful it will restore the emission by causing a fresh coating of thorium to form on the surface of the filament.

The Panel

With constant exposure ebonite panels may tend to become discoloured and surface leakage may result. Where this greenish discolouration is noticed, it is worth while to take all the components off the panel, and to rub the latter down with fine emery cloth, rubbing with a circular motion of the emery cloth moistened with ordinary lubricating oil. By so doing the panel may be rendered fit for further satisfactory service.

When the set is taken down for attention to the panel it is worth while to adjust the bearings of variable condensers, contacts of rheostat brushes, etc., all of which repairs will tend to give improved working.

The control room at the London station may be described as the hub of the programme distribution system.

A READER'S APPRECIATION.

AN UNUSUAL "MIDGET" SET.

SIR,—Being a regular reader, I have been greatly interested in watching the notes, etc., on the "Midget One-Valve" set of May, 1925, designed by Mr. A. S. Clark.

I have enclosed the photograph of the "Midget" I made in an old Avro "prop." I might say that I am more than satisfied, and many congratulations for the set; everybody says it is the finest one-valve set they have heard for its simplicity.

The coils of Mr. Frank Hall's "Midget" set may be seen above the boss of the propeller.

The stations I can get on it with an aerial 24 ft. high and 50 ft. long are Nottingham, Sheffield, Manchester, Birmingham, Stoke-on-Trent, Newcastle, Daventry, Hamburg, Münster, and several others.

Wishing THE WIRELESS CONSTRUCTOR every success,

Yours faithfully,

FRANK HALL.

Mansfield.

A SCREENED-COIL SINGLE-VALVE SET

By W. H. FULLER

Are you troubled with direct pick-up, so that the local station cannot be cut out? Do you want to receive distant stations without local interference? Here is a set to help you, a set which is easy to construct and economical to use.

ONE of the principal difficulties encountered in attempting distant reception in towns is the direct pick-up from the local station. Even when using a tolerably selective circuit, it is found that a certain amount of direct action remains which renders fine tuning difficult, if not impossible.

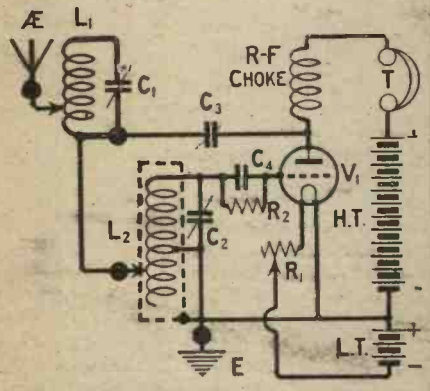


Fig. 1.—The earthed screen of the tuning coil is shown by the dotted line in this diagram.

The use of an efficient wave trap goes a long way towards reducing the interference which enters the receiver via the aerial itself. In this way the overwhelming signal received from the local station may be reduced to a value comparable with that from the distant station, so that a normal low-loss tuning circuit can be employed with some measure of success.

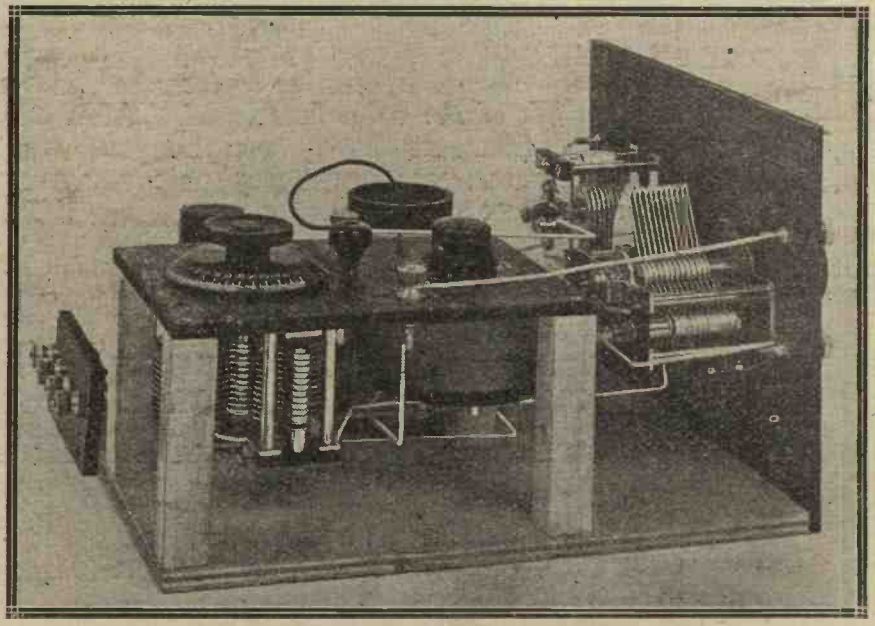
Direct Action

The direct pick-up on the coil of the tuning circuit itself, however, still remains, and for this reason the selectivity of any single circuit receiver is somewhat limited. In the set described in this article, an attempt has been made to overcome the direct pick-up by the use of a screened coil for the actual tuning circuit. A self-contained wave trap has also been included, with the result that some really selective results are possible with this receiver.

The circuit of the instrument is shown in Fig. 1. It will be seen that a Reinartz arrangement is adopted for the receiver itself, the only special point being that the tuning and reaction coils, both of which are wound on the same former, are enclosed inside a screening case.

A Wave Trap

The aerial circuit contains a simple auto-coupled series-rejector wave trap. This consists of a simple tuned circuit, of which a portion is included in the lead between the aerial and the set. When this is tuned to the interfering station, the signals received may be either reduced to zero or considerably decreased in volume, with the result that distant stations operating quite close in wavelength can be received satisfactorily.



A separate panel, supported on four wooden legs, carries the trap circuit tapped coil and variable condenser.

Components Required

The components you will require for this receiver are as follows:—

One panel 10 in. × 7 in. × ¼ in. (Clayton Rubber Co.).

The mahogany finish has been used in this instance, although the ordinary type may be used if desired.

One sub-panel 7 in. × 5 in. × ¼ in. (Clayton Rubber Co.).

One cabinet to suit main panel, with baseboard 11 in. deep (Camco).

Allowance should be made for a terminal strip, 4 in. × 2 in. at the back of this cabinet, on the right-hand side looking from the front.

Two .0005 variable square-law condensers, slow motion type (Jackson Bros.).

One .0003 variable square-law condenser, ordinary type (Jackson Bros.).

One .0003 fixed condenser, type 600, with clips and a 1-megohm leak (Dubilier).

One screening case with base complete (Burne-Jones & Co.).

One Reinartz coil to suit (Burne-Jones & Co.).

One H.F. choke (Lissen, Ltd.).

One vibratory valve holder (Lotus).

One filament rheostat (Etherplus).

A Screened-Coil Single-Valve Set—*continued*

One tapped trap coil (Burne-Jones & Co.).

One terminal strip 4 in. × 2 in., carrying four terminals.

Four separate 4 B.A. terminals.

Four lengths of wooden rod ¾ in. square by 3½ in. long.

Quantity of Glazite wire for wiring up.

Short length of flex wire.

Packet of Radio Press panel transfers.

Construction

The constructional details will offer little difficulty. Attention may be drawn to the fact that the trap has been mounted on a special sub-panel behind the main panel. This is done because the adjustment of the trap tune only requires occasional alteration if the wavelength of the local station varies in any way. All the normal tuning is done on the main grid tuning condenser, so that the only two controls which need to be mounted on the panel are the grid and reaction condensers, and the filament rheostat, the remaining controls being placed out of the way.

The Main Panel

The first operation therefore is to obtain the main panel, 10 in. × 7 in., and to drill the holes for the two condensers, the filament rheostat and the four terminals in the positions shown. The components may then be mounted up and this panel put on one side for the time being.

The next job is the mounting of the components at the back of the panel. While this is being carried on, it is as well to place the 7 in. × 5 in. panel for the wave trap in the position which it will ultimately occupy, so that it can be ensured that none of the base-board components foul the trap in any way. The layout is perfectly simple, the only components to be mounted up consisting of the screened coil, the H.F. choke, the valve holder, and the terminal strip.

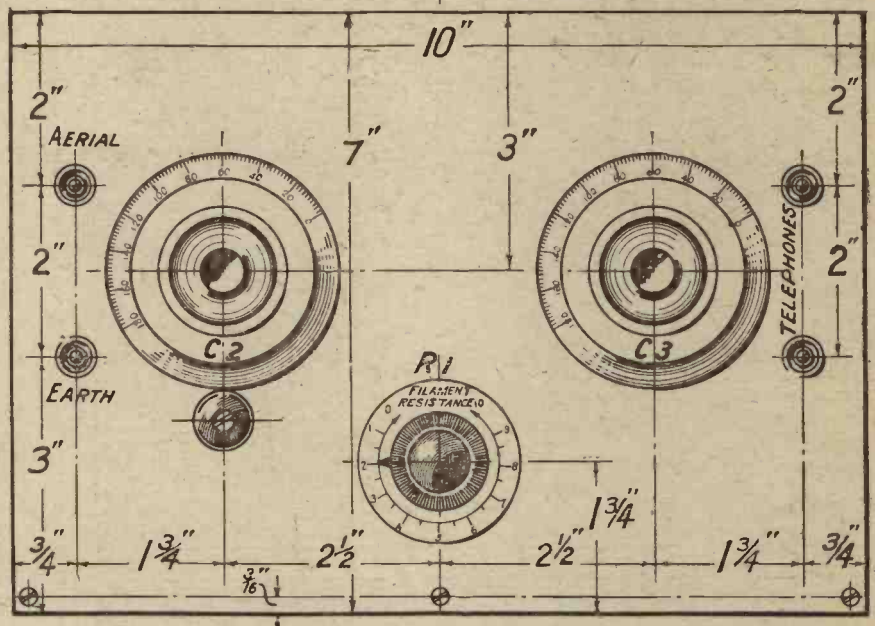
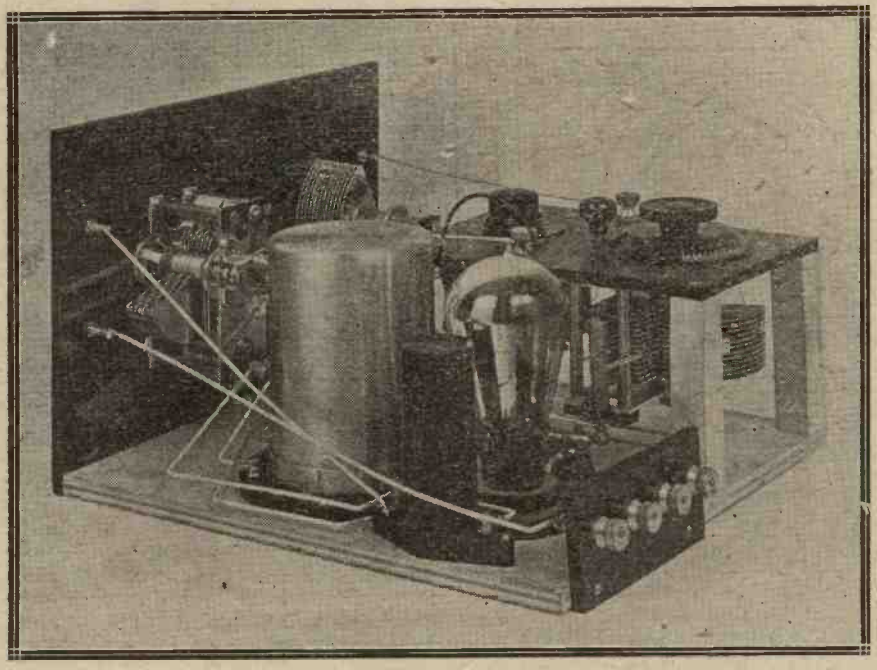


Fig. 2.—The condenser on the left tunes the grid circuit, while that on the right is for reaction. Drilling dimensions may be taken from this diagram, and blueprint No. C1060A is also available.



Care should be taken in placing the screened coil and choke coil to allow ample room for vibration of the valve.

Back of Panel Layout

These components should be mounted in the positions shown in the wiring diagram accompanying this article. When laying out the components, the main panel should be placed temporarily in position to ensure that there is ample clearance between the reaction condenser and the screened coil. A valve should also be inserted in the valve holder to ensure that there is clearance between the valve itself and the high-frequency choke which is mounted beside it.

The Wave Trap

Attention may now be turned to the wave-trap itself. Take the 7 in. × 5 in. panel and drill this in accordance with the diagram given. The required dimensions for this panel will be found on the back of panel wiring diagram. The second .0005 slow-motion condenser may then be mounted as shown, and the trap coil mounted beside it.

This latter unit is made up as a single-hole fixing component by Messrs. Burne-Jones & Co. Those readers who prefer to make their own, however, may easily do so, and this component need not necessarily be made as a complete unit.

Winding Details

If desired, a small switch with five studs may be mounted on the sub-panel, and the trap coil itself can be

A Screened-Coil Single-Valve Set—*continued*

wound separately and mounted in any convenient manner. The details of the coil are given below, so that no difficulty will be experienced in this direction, but those who prefer to do so can purchase the article ready made.

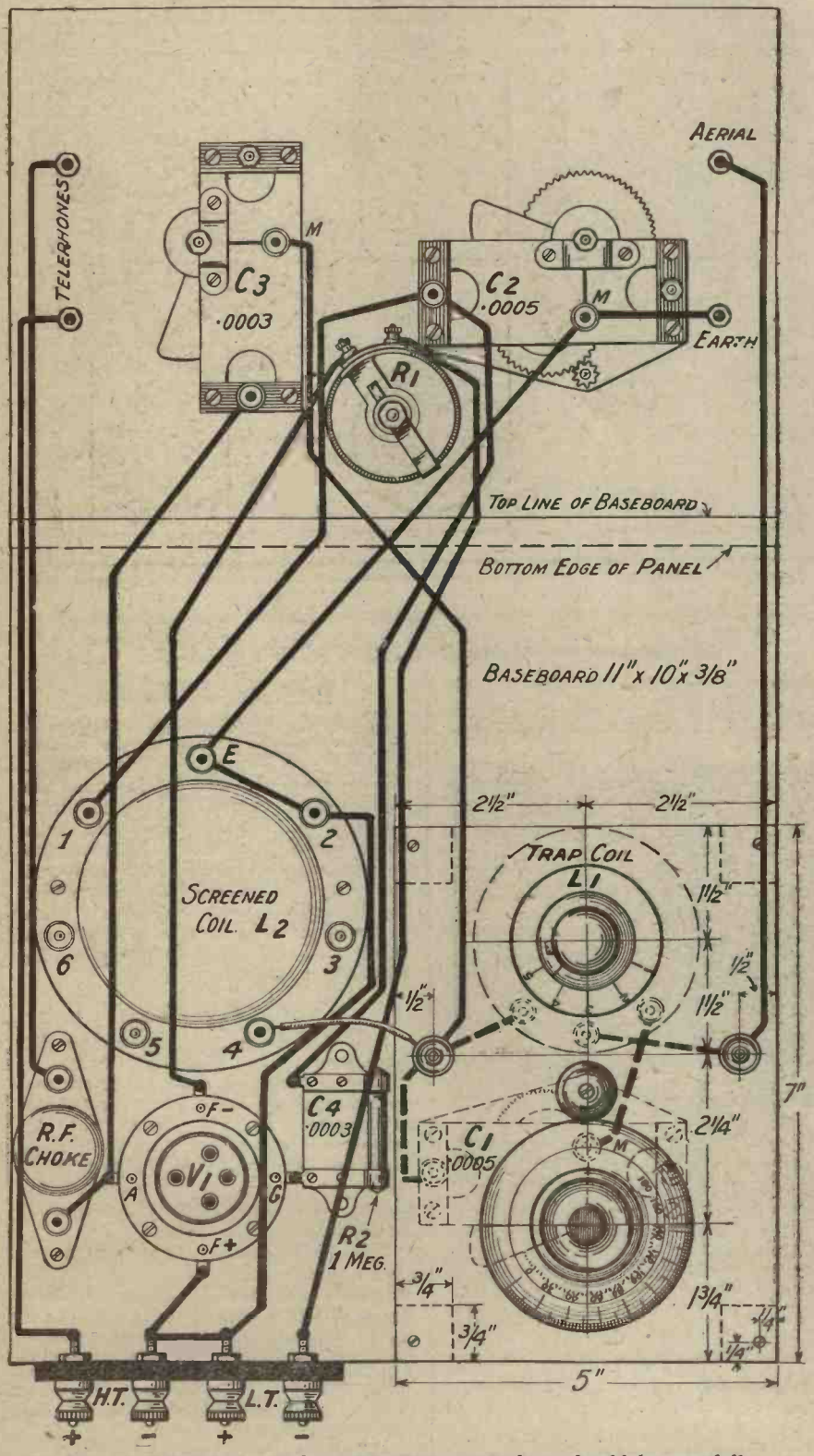


Fig. 3.—The layout of the components given here should be carefully followed in assembling the set. Blueprint No. C1060B is also obtainable with the aid of the Coupon in this issue.

The coil consists of 55 turns of 30 d.s.c. wire wound on a 3-in. former. These turns should be spaced at 40 to the inch. This may be done either by grooving the former or by adopting some of the methods which were described in an article in the last issue of this journal. If spacing is not resorted to, the trap will still function, although not so efficiently.

Tappings should be taken at 10, 15, 20 and 25 turns, so that the extent to which the trap is coupled to the aerial circuit can be varied.

Wiring the Trap

The trap may now be wired up in accordance with the wiring diagram supplied. The tuning condenser is connected across the whole of the coil. The terminal on the left-hand side of the panel viewed from the front is connected to the tapping switch. The other terminal on the right-hand side is connected to the bottom end of the coil, i.e., the end from which the tappings are taken.

The wiring of the tappings to the switch stud is straightforward. The first stud is connected to the bottom end of the coil itself, so that the trap may be cut completely out of circuit if desired. The other four studs in rotation are connected to the tappings on the coil at 10, 15, 20, and 25 turns. If the ready-made article is purchased it is simply necessary to connect up the wires as shown on the wiring diagram, the connections to the switch arm and the two ends of the coil being already made internally and brought out to the three terminals A 1, A 2, A 3.

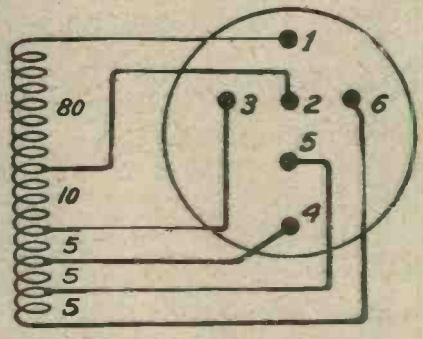


Fig. 4.—Details of the tuning coil and the connections on its base are shown here for the benefit of those who wish to wind their own coil.

The four lengths of ¾-in. square wood should now be screwed to the four corners, in order to form legs, as can be seen in the photographs. The trap may be then fixed in position by means of wood screws coming through the baseboard into the bottom of these legs.

Completing the Wiring

This completes the assembly of the receiver, and the main wiring may

Selectivity and Economy

now be undertaken. Little difficulty will be experienced in this direction, as the wiring is straightforward and simple. The aerial terminal is connected to the left-hand terminal on the trap, looking from the front, while the right-hand terminal thereon is connected by means of a flexible lead to a suitable tapping on the Reinartz coil itself. The remainder of the wiring requires no comment.

WIRING IN WORDS

All directions are given as viewing the set from the back.

Join AERIAL terminal to right hand terminal on trap panel, and continue to centre terminal of trap coil.

Join EARTH terminal to spindle of variable condenser C2, thence to E and terminal 2 of screened coil base, thence to L.T. + terminal, H.T. – terminal and one filament tag of valve holder.

Join fixed vanes of C2 to terminal 1 on screened coil base, and also to one side of C4 and R2.

Join other side of C4 and R2 to grid tag of valve holder.

Join L.T. – to one side of filament rheostat R1.

Join other side of R1 to remaining filament tag of valve holder.

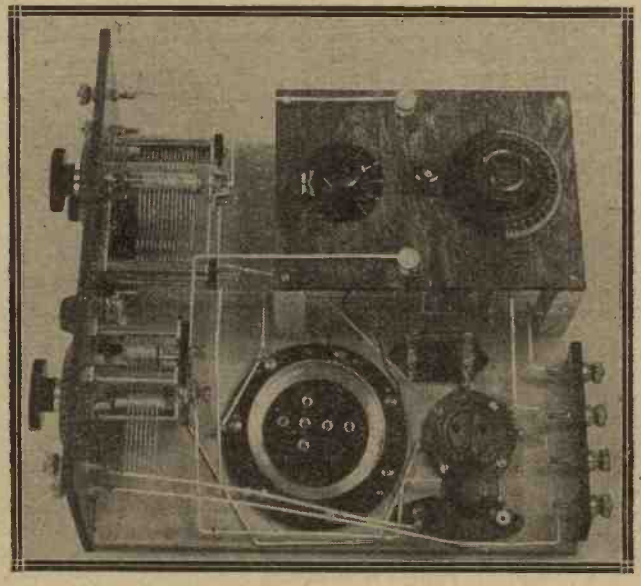
Join spindle of variable condenser C3 to left hand terminal on trap panel, thence to left-hand terminal on trap coil L1, fixed vanes of trap condenser C1, and (flexible lead) terminal 3, 4, 5 or 6, on screened coil base.

Join right-hand terminal of trap coil L1 to spindle of trap condenser C1.

Join fixed vanes of condenser C3 to anode of valve holder, thence to one side of R.F. choke coil.

Join other side of R.F. choke coil to upper telephone terminal.

Join lower telephone terminal to H.T. + terminal.



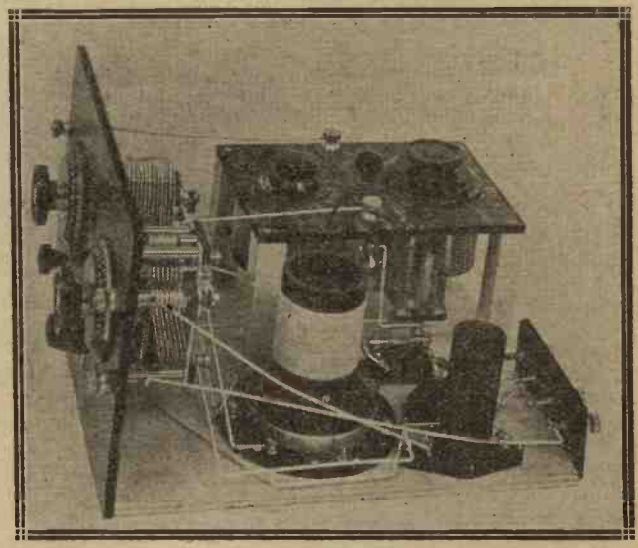
The details of the wiring and layout seen here should be studied in conjunction with the wiring diagram, Fig. 3.

The Reinartz Coil

There may be some readers who prefer to obtain just the coil blank to fit the screened coil, and to put their own winding on it. For the benefit of these readers details of the actual windings are given herewith. The tuned winding consists of a single layer coil wound with 80 turns of 28 d.s.c. wire on a 2-in. former.

The reaction coil consists of 25 turns of the same wire, wound as a continuation of the tuned winding tapped at 10, 15 and 20 turns.

The connections to this coil are as shown in the diagram, Fig. 4, which gives a view of the underside of the coil. The top end of the coil goes to pin No. 1. The end of the tuned coil is connected to pin No. 2, and the other tappings to pins Nos. 3, 4, 5 and 6 respectively.



This photograph, showing the coil with its screening cover removed, will be of assistance in wiring the set.

Testing Out

The receiver is now ready for testing out. Connect up the batteries, telephones, aerial and earth, and insert a suitable valve in the holder. The flex lead from the trap to the screened coil should be connected to tapping No. 6.

Set the reaction condenser at zero, and place the trap switch at No. 1 tapping, in which position the trap is out of circuit. Now, on rotating the tuning condenser on the main panel, signals from the local station may be heard.

Adjusting the Tap

Try the effect of increasing the reaction condenser, which should produce a steady increase of strength up to the point at which the set commences to oscillate. It should not be allowed actually to oscillate during broadcasting hours, but the tendency to oscillate may easily be gauged, to see if everything is satisfactory.

Selectivity

The effect of decreasing the tappings on the aerial winding may then be tried. The smaller the tapping the more selective the set, but if the tapping is made too small the receiver cannot be brought up to the oscillation point. The best position will readily be found by trial on the particular aerial with which the set is to be used.

The Wave Trap

It is now advisable to introduce the wave trap. Tune the set to the local station and place the trap switch at 2 or 3. Tune the trap condenser until signals are a minimum.

It will be found that at a certain point the signals suddenly decrease in

(*Concluded on p.* 994.)

FOR some little time past Mr. Gumplethorpe has been firmly in the grip of a fit of economy. By making his own components he has effected a saving so remarkable that you would never believe the total if I told it you, any more than I believed him when he told me. It has all been rather a surprise to me, for Mr. Gumplethorpe is not naturally of the saving nature. I rather think that the seeds were sown when he read one day in an advertisement: "Fit a Topnotch Valve and Save Half Your Filament Current." Mr. Gumplethorpe at once fitted two, in a laudable desire to save it all. Anyhow, it was not long after that that he lifted up his voice to me against the folly of those who waste their money by buying every gadget, jim and doohickie ready made.

"Take yourself, for instance," he cried. "If you wanted a variable gridleak, you would not make it; you would go out and buy one for several good shillings."

"Nothing of the sort," said I.

"Oh?"

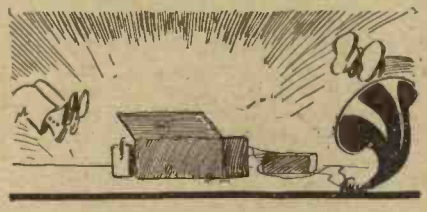
"I'd go to the little shop round the corner and buy a genuine 2-megohm leak for fourpence halfpenny. *They* are variable if you like."

The Expanding Gridleak

Mr. Gumplethorpe, however, was not to be unseated in this way from his

. . . *A highly effective home-made black eye* . . .

hobby-horse. He proceeded without further ado to unfold to me his own original idea for the construction of variable gridleaks at trifling cost in the home workshop. All that one need do, he explained, is to draw a stout pencil line on a strip cut from an old inner tube. This is fixed between two terminals, so arranged that the distance between them can be varied at will. Increase it, and the rubber stretches, making the line longer and thinner. The resistance thus rises to a higher and higher figure. He insisted upon taking me round at once to his house for a practical demonstration of his invention. By means of the rack and pinion movement borrowed from his best camera he was able to move the terminals with great exactitude. He was showing me the enormous resistance that could be obtained when



. . . *Blue flames everywhere* . . .

the rubber strip decided to call it a day. One flying end gave Mr. Gumplethorpe a highly effective home-made black eye, whilst the other did in a power valve in the most economical manner in the world.

True Neutralising

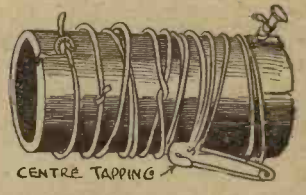
Always up to date, Mr. Gumplethorpe has long been interested in neutralised circuits. He soon became an ardent supporter of the principle, but one thing stuck firmly in his gizzard. This was the cost of the silly little variable condensers needed to do the job. He decided immediately to strike a blow against the manufacturers and in defence of his own bank account by making them for himself. Sardine tins seemed to him to furnish the ideal material for the plates. He therefore caused a dozen to be ordered, and the family lived entirely upon these tasty little fish for several days. Having thus acquired his supply of raw material, Mr. Gumplethorpe waited until his wife was out, when he borrowed her cutting-out scissors. Within an hour his workshop bore a distinct resemblance to a battlefield; Mr. Gumplethorpe, streaming with gore, was obliged to telephone for the doctor to stick together such portions of his hands as were left. Mrs. Gumplethorpe on her return home gave one glance at her scissors and then went straight out again to order a new guinea pair, which she put down to her husband's account.

Patience Ill Rewarded

Battered by the blows of fate, but still undaunted, Mr. Gumplethorpe returned to the job with such devotion that in less than a month two neutralising condensers stood side by side upon his wireless table ready to begin their life's work. It was some days before he could bring himself to mount them in a receiving set; he liked to take them up, to look at them with a loving eye, to twiddle their knobs, to show them to his friends. Then one evening I begged him to try them out. He consented, after much persuasion, to wire up one of them. "I just turn the handle," he said. . . . "Clonk! Glup! Plonk!" remarked the loud-speaker. "Of course, they are not quite *finished* yet," explained Mr. Gumplethorpe, still turning. Next moment there was one of the prettiest electrical effects that I ever remember seeing. There seemed to be blue flames everywhere. Mr. Gumplethorpe's condenser had lived up to its name; it had neutralised both high- and low-tension batteries.

Economy in Coils

Experiments with a diversity of neutralised circuits cannot be conducted unless the investigator of their little ways is the happy possessor of a set of centre-tapped inductances. In the making of these Mr. Gumplethorpe really excels, and I trust that the shining example that he has set may lead the feet of thousands of other constructors into the paths of economy.



A home-made inductance of high efficiency.

These things, as Mr. Gumplethorpe has proved conclusively, are perfectly simple to make at home at not much more than double the cost of ready-made articles. I begged him to let me have a photograph of one of his efficient centre-tapped solenoids, so that all readers of THE WIRELESS CONSTRUCTOR might be able to admire its perfections. Unfortunately the rack and pinion movement of his camera was still in use as a gridleak-stretcher, but the artist has made such a faithful picture of one of these remarkable

Mr. GUMPLETHORPE "SAVES" MONEY—*continued*

coils that you, dear reader, will have no difficulty in following all the details of its construction. The windings are made with No. 18 d.c.c. copper wire upon a former consisting of an ebonite tube three inches in diameter and six inches in length.

Remarkable Economy

Owing to the liability of the latter (by which, of course, I mean the

Mr. Gumblethorpe's finest piece of work.

former) to split when the staple and nail anchorages for the ends of the windings are driven in, it is advisable to order half-a-dozen or so for each coil which it is intended to wind. The wire, too, has an unpleasant way of flying off and getting all tangled up if you take your thumb off it for a moment during the winding process. A good deal of wire is therefore needed for the job. To show the vast economy that may be effected by making centre-tapped coils at home, I give a list of the parts required for one inductance, together with their cost.

	£	s.	d.
6 formers		18	0
3 lbs. wire		7	6
Staple, nail and safety-pin			¼
	£1	5	6¼

It remains for you, reader, to sail in and do likewise.

And Condensers

But perhaps Mr. Gumplethorpe's finest piece of work is his entirely-all-home-made variable condenser, whose counterfeit presentment appears upon this page. This condenser is remarkable for the fact that its minimum capacity is .0000000 microfarads, and still more remarkable in that its maximum capacity is the same. Further points of distinction are that the fixed plates all move, whilst the moving plates are tightly fixed. Since the dial rotates eccentrically and quite independently on the spindle, it is a component that will be welcomed by those who have become bored by manipulating tuning controls of the commonplace type. It is so designed that it may be placed with equal ease upon the panel, upon the baseboard, or in the dustbin.

The Last Feat

When I saw Mr. Gumplethorpe the other night I found him busily engaged in make a low-frequency transformer of the most modern type. He was getting on quite well with the primary, for having wound on five hundred turns, he had only nineteen thousand five hundred to go. He calculates that the component will be ready for use by this time next year if his luck holds good. So far he is not averaging more than one break for every three turns, but I rather fancy that his figures will not be so good, for he is becoming a little fatigued towards the end of his task. The work is really progressing very satisfactorily, and I do not fancy that the transformer when finished will cost him all told a penny more than ten or twelve pounds; this, of course, includes the cost of two or three professional transformers that he has pulled to pieces in order to learn how the job is done by experts.

A Real Pioneer

Mr. Gumplethorpe, by the way, was one of the first to use fixed resistances in the filament leads of his valves. They began life as home-made rheostats, but owing to some small defect in the design the contact arm soon became immovably fixed. Many a great discovery has been made by chance in such a way as this. Mr. Gumplethorpe has many other home-made components in view, and I have no doubt that they will all of them be as successful as those which he has already constructed. My only fear is that he may find himself unable to stay the economy course, for already his business shows signs of approaching dissolution, since he prefers to save money in his workshop rather than make it in his office. Meantime, however, he is perfectly happy, and that, after all, is the great thing.

A competition held by the Sheffield Wireless Society to locate a hidden transmitter was recognised locally as a most interesting event.

A SCREENED-COIL SINGLE-VALVE SET

(*Concluded from page 991*)

strength and the trap should be adjusted to this point.

The trapping action extends to some extent on each side of the minimum point; a station working on a wavelength near to that of the local station may also be reduced in volume. This effect is controlled by the tappings on the trap coil.

Choosing the Best Tapping

The larger the tapping the greater is the reduction in the strength of the local station, but also the effect on stations working on neighbouring wavelengths is more serious. Conversely, if the trap tapping is too small, the distant station may not be affected, but the local station may still cause interference.

A little trial, therefore, will show the best tapping in the particular circumstances.

It should be noted that the trap requires retuning every time the tapping is altered.

Test Report

The apparatus was tested 12 miles north of London, and gave very good results. It was easy to handle and selective in operation. 2LO was received at good loud-speaker strength, while Birmingham could just be heard on the loud-speaker.

NEWS FROM OUR READERS

CURIOUS EFFECTS OF LIGHTNING

SIR, — A few points recently observed by me during a thunderstorm will, I hope, interest some of the readers of THE WIRELESS CONSTRUCTOR.

I was listening on a two-valve set to 2LO with a large indoor aerial, and a direct earth. A thunderstorm was approaching, but considering the fact that no outdoor aerial was in use I did not switch off the set. Suddenly there was a particularly vivid flash outside, and 2LO suddenly stopped. Finding nothing wrong with the set, I took out the valve (which was still alight) and substituted another. All went well, and I afterwards discovered that the first valve (a two-volt dull-emitter) had lost its emission.

On another occasion a grid-leak was "burnt-out," the set suddenly bursting into a howl.

Yours faithfully,
J. R. FODELL.

Brockley, S.E.

A TIMELY WARNING— FOR OTHERS

SIR,—In view of a recent unhappy experience of mine, I feel that I should warn your readers against making a similar mistake. I was experimenting with a receiver employing one .06 amp. valve, and with about 4 microfarads of condensers across the H.T. battery. Upon disconnecting the latter from the positive H.T. terminal the lead accidentally touched the negative L.T. terminal, and the charge held by the condensers (at 90 volts) was sufficient to burn out the filament.

Probably no other valve than one of the .06 amp. type would have been affected.

Yours faithfully,
R. K. BROWNLEY.

Bolton.

TROUBLE WITH LONG LOUD-SPEAKER LEADS

SIR,—I have for some time been puzzled by a curious phenomenon which occurs when I attempt to use my loud-speaker in the garden. The set is one described by Mr. Percy W. Harris, M.I.R.E., in THE WIRELESS CONSTRUCTOR, and gives most extremely pleasing quality, *when the loud-speaker is indoors* and close to it. I have a double "land-line" of "electron wire" leading to the end of a long garden, and on placing the loud-speaker at the end of this the results are extremely hollow and muffled. I have repeatedly made slight alterations in the placing of the line, but cannot get rid of the trouble. Have any of your readers had a similar experience?

Yours truly,
R. L. BARNELL.

Portslade, Sussex.

[Our correspondent's trouble is most probably due to the fact that his long extension line is acting as a large capacity in parallel with the loud-speaker. The trouble may possibly be cured by separating the two leads, or by connecting an L.F. choke across the output terminals of the receiver, one side of the loud-speaker being connected, through a large condenser, to the terminal which goes to the anode, and the other side through a short wire to earth. In this case it is essential to make sure that one side of the low-tension battery is earthed, as otherwise the loud-speaker circuit will be incomplete.—ED.]

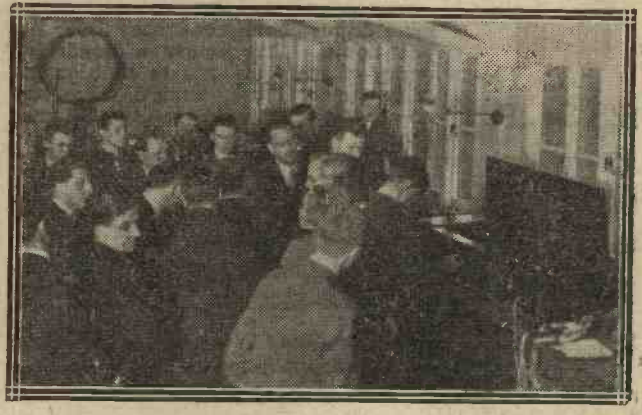
"REPAIRING" A FAULTY TRANSFORMER

SIR,—I should like to know whether any of your readers have had experiences similar to mine in connection with faulty transformer windings. It is well known that when the primary winding of a L.F. transformer first "goes west," the trouble may show itself, not by complete failure of the set, but in the form of troublesome crackling noises.

I have a transformer of high reputation and price which does this fairly often, but I can always cure it simply by short-circuiting the primary for a moment with a piece of wire. After this it will work perfectly again for several days. I am wondering whether there is any means of righting this trouble before it gets worse.

Yours faithfully,
"AMPLIFIER."

Goodmayes, Essex.



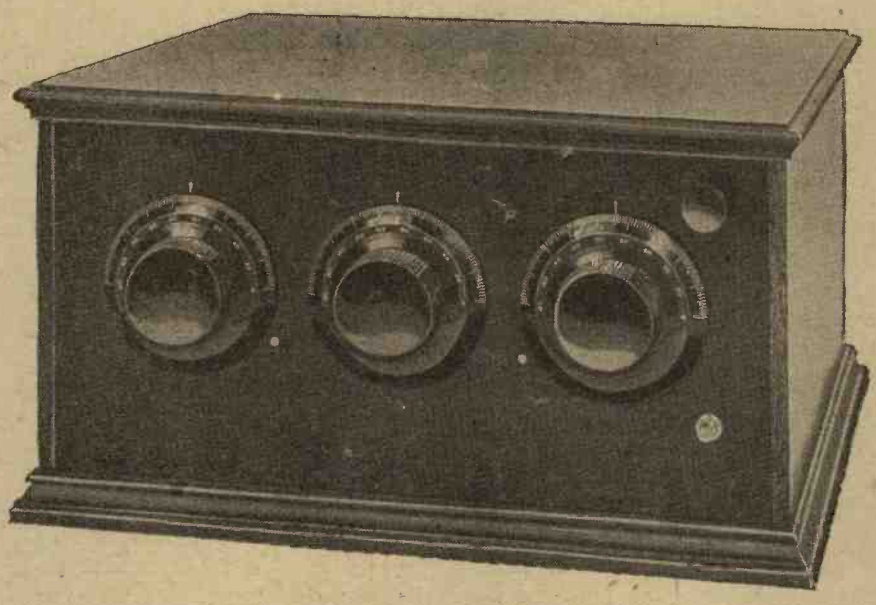
Are you in this photograph? The famous "Elstree Six" receiver attracted large crowds to the Radio Press Laboratories for demonstrations of its capabilities.

SPLENDID NEWS FOR THE HOME CONSTRUCTOR

TWO REMARKABLE NEW RECEIVERS

Advance Particulars of "The Night Hawk"

SENSITIVITY, compactness and a pleasing appearance—all these features will be found in "The Night Hawk" Receiver, Mr. Harris' latest set to be described in the next issue of THE WIRELESS CONSTRUCTOR. The story of the evolution of "The Night Hawk" begins over a year ago, when in visiting many wireless laboratories in America Mr. Harris was examining the best that could be offered in the way of selective long-distance receivers. Many were good, some were poor, but all had features of interest, yet, searching among them, not one seemed to possess the features which make the strongest appeal to the home constructor. Furthermore, without exception the receivers which were most interesting were actually built from products developed in research laboratories and only made practical by the utilisation of a skilled staff, machine tools and all the conveniences of a well-equipped factory.



The result of a year's work to produce a set to beat America—"The Night Hawk." Full particulars of how to build this five-valve set will be published next month.

You Must Build It

Would it not be possible to design for the home constructor a set possessing all of the virtues of those to be seen in America, yet so simple and inexpensive as to tempt the veriest tyro to try his hand? At the time the difficulties seemed almost insuperable, but after more than a year of work Mr. Harris has succeeded in evolving the receiver illustrated on this page, for which the very apt title "The Night Hawk" has been chosen. With this receiver the coming winter evenings will be made still more fascinating for the wireless enthusiast. Station after station can be brought in by simple adjustment of the three dials, and when, as is sometimes the case, the very limit of sensitiveness is required to pick up some distant station, full recourse can be had to reaction amplification right up to the oscillation point without any chance of radiation from the aerial. This feature, by the way, means at least a 50 per cent. increase in signal strength over most neutralised receivers and enables conscientious listeners who in the past have refrained from availing themselves of reaction amplification, to use it without any fear of disturbing their neighbours.

Attractive Features

"The Night Hawk" is not a large instrument—its panel is of a standard size and measures but 16 in. × 8 in. By utilising a new form of layout, considerable economies in space have been effected, the wiring is made extremely short and straightforward and the constructional work reduced to the simplest form. To give but one example, there are but five holes on the panel for mounting components. Three are for one-hole-fixing condensers, one for an on-and-off switch and one for the small knob of the reaction control. All other components screw on to the baseboard, and indeed practically the whole of the receiver can be wired up before the front panel is attached. This greatly simplifies the home-constructors task.

High Selectivity

There are two stages of neutralised high-frequency, a detector and two really efficient note magnifying stages. The selectivity is such that even when one is close to a broadcasting station there is no difficulty in tuning out the local signals and obtaining those from weak distant stations.

Last, but not least, the cost is exceedingly low. It is possible to build this instrument exactly as described by the author, provide it with five valves, accumulator, high-tension and a first-class loud-speaker for not more than £20, an astonishingly low figure for such a wonderful set.

A New Reflex from Elstree

"The Night Hawk" is not the only remarkable instrument to be described in the next issue of THE WIRELESS CONSTRUCTOR. The Elstree Laboratories have succeeded in developing a really astonishing reflex instrument, using but two valves and a crystal, possessing many qualities which have not previously been associated with reflex circuits, giving remarkable volume on the local station. At the same time it is possible to cut this out at a distance of a few miles and receive other stations of the B.B.C., many of them on the loud-speaker. It will thus be realised how revolutionary is the progress being made in the development of wireless receivers.

A CRYSTAL SET FOR THE DOUBLE PROGRAMMES

By A. S. CLARK

The experiences of those who listened to the B.B.C. double programme tests from two London stations have shown that to separate the two transmissions at a distance of a few miles with a crystal set needs a circuit to give good selectivity. The set described here fulfils this requirement and will be found useful under any circumstances when selectivity is desirable.

AS a rule crystal receivers are not very selective, the reason probably being that since only the local station is to be listened to, selectivity is not required. There are, however, some cases where selectivity is necessary, for instance, when the crystal set is used near the coast; here selectivity is required to cut out ship and coast station interference. Again, there is the new development of having two programmes from

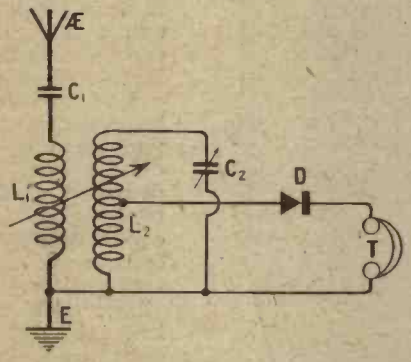


Fig. 1.—An untuned primary and centre-tapped secondary are used to give the requisite degree of selectivity.

neighbouring stations on somewhat different wavelengths, as was recently tried at 2LO. In the near future this may become quite a regular practice.

The set, of which constructional details are given in this article, has been designed to be selective without becoming difficult to tune. Only two variable controls are used, apart from the crystal detector, and one of these can be set approximately once and for all.

The Circuit Used

Fig. 1 shows the circuit of this crystal set in its theoretical form. The aerial coil L_1 is aperiodic, and is variably coupled to the tuned coil L_2. The condenser C_1 in series with the aerial coil is to sharpen tuning by reducing the effect of the aerial damping. Its value may be varied in steps of .0001 from .0001 to .0015, and when the value is .0001 the condenser acts as a C.A.T. condenser.

Centre-Tapped Coil

The coil L_2, which is tuned by the condenser C_2, is centre-tapped, the centre tap being connected to the crystal detector. This, again, is to reduce damping, and so sharpen the tuning of the circuit L_2 C_2. The telephones are connected in the usual manner between the detector and earth. In order to avoid any hand-capacity effects when operating the tuning condenser, the lower end of the coil L_2 is earthed.

Simple Construction

The construction of the set is quite simple, and very little wiring has to be done. The coil holder is fixed to the top of the cabinet, and connections are made to it with flexible wire. There are four telephone terminals. These are so arranged that when one pair of telephones is to be used, they are connected across the top two terminals. If, however, it is desired to use two pairs of telephones their tags are connected to the two pairs of terminals on the left and right, the telephones being thus placed in series.

Components

The components required are given in the list below, and the makers of those used in the actual receiver are indicated. Of course other components of good quality may be substituted if desired, providing they are suitable.

One panel 7 in. x 5 in. x ¼ in. (Trolite).

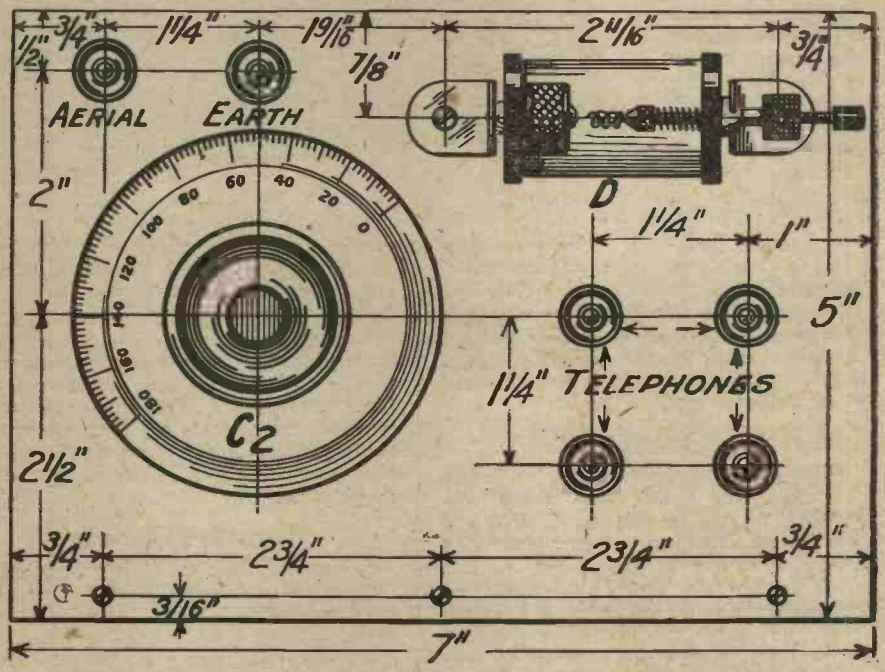


Fig. 2.—Those who use the components recommended will be able to take the necessary drilling dimensions from this diagram. Blueprint No. C1061A.

One cabinet to suit same, with baseboard 7 in. × 4⅝ in. × ⅜ in. (Pickett).

One .0005 variable condenser (Jackson Bros.; ebonite end plates).

A Crystal Set for the Double Programmes—*continued*

One crystal detector and crystal (E. J. Lever).

One multiple fixed condenser .0001-.0015 range (C.A.V.).

Six terminals.

One two-coil holder (Polar cam-vernier).

Packet of Radio Press panel transfers.

Glazite, flex wire, etc.

Drilling and Assembling

Commence the constructional work of the set by marking out the panel in accordance with the drilling diagram of Fig. 2. All points at which holes are to be drilled should then be centre-punched, after which the holes may be made. The next step is to mount the variable condenser and terminals on the panel and then attach the latter to the baseboard with three screws. Then mount the fixed condenser on this baseboard, and the set is ready for wiring.

Wiring

All points to which wires are to be attached should be first of all tinned, if there are no terminals to screw the wires down. Make the Glazite wire connections first. This will be quite easy if the wiring instructions are followed in conjunction with the wiring diagram of Fig. 3. The five flex connections are put on last; they are marked to indicate the points on the coil holder and coil to which they have to be attached. The fixed block of the coil holder, which as already indicated is screwed to the top of the cabinet, should carry the aerial coil.

The appearance of the set is greatly enhanced by the addition of panel transfers. These should be affixed in accordance with the lettering given on the drilling diagram.

WIRING IN WORDS.

Join AERIAL terminal to 000 terminal on fixed condenser C1.

Join EARTH terminal to moving vanes of C2, and also to one upper telephone terminal.

Join other upper telephone terminal to one side of Detector.

Join together the two lower telephone terminals.

The above connections are made with stiff wire. The remainder are flexible leads.

Join No. 1 (or other suitable) terminal on fixed condenser C1, to one side of fixed block of coil holder.

Join EARTH terminal to the other side of the fixed block.

Join EARTH terminal to one side of moving block of coil holder.

Join fixed vanes of variable condenser C2 to the other side of the moving block.

Join the free side of the Detector to the centre-tapping terminal on coil L2 (in moving block of coil holder).

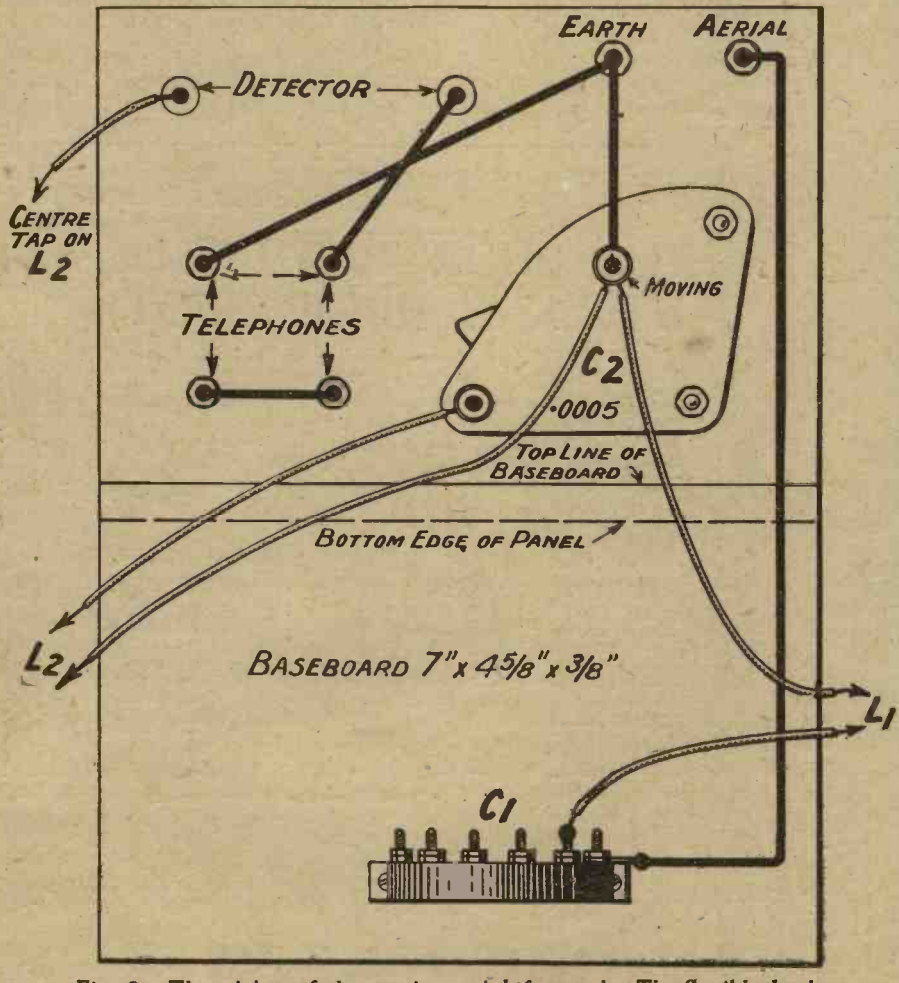
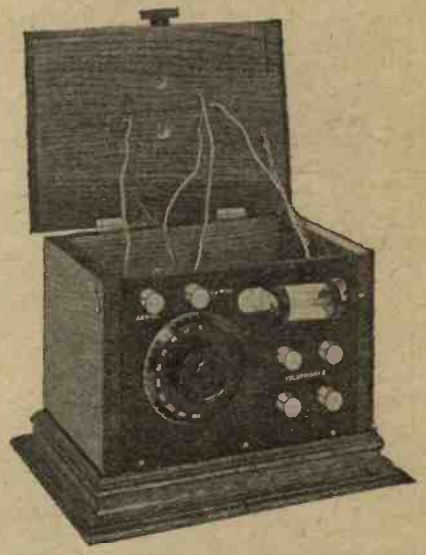


Fig. 3.—The wiring of the set is straightforward. The flexible leads are attached to the coil holder when the set has been fixed in the cabinet. Blueprint No. 1061B.



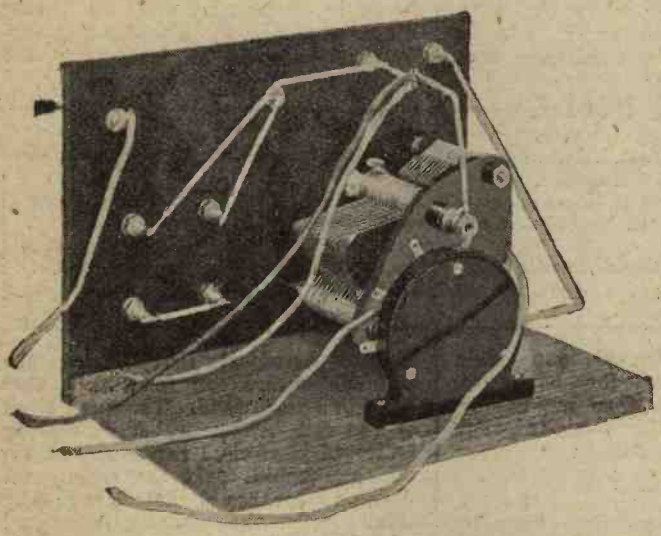
Holes are drilled in the lid of the cabinet to pass the leads to the coil holder.

Testing the Set

Connect the aerial and earth and also the telephones to their respective terminals. For the lower range of broadcast waves the aerial coil should be a No. 25 or a No. 35 coil, and the other coil a centre-tapped No. 60 or No. 75. Other sizes may be tried for the aerial circuit since the value of this depends to a large extent on the particular aerial in use. The fixed condenser has been shown connected up as a .0001, but other values should be tried to find the one which suits the aerial best.

For the long wave a No. 75 or No. 100 coil can be used in the aerial circuit, and a No. 200 or No. 250

A Crystal Set for the Double Programmes—*continued*



This photograph shows clearly the arrangement of the wiring. The flexible leads from the earth terminal are soldered to the wire between this point and the variable condenser spindle.

centre-tapped coil in the secondary circuit.

As the two coils are brought further apart, the selectivity will increase, but beyond a certain point selectivity will increase at the expense of strength.

Results Obtained

In actual practice the tuning of the local station, 8 miles away, was extremely sharp for a crystal set, and this with the coils only a very little way apart. The signal strength was also up to that of any standard crystal receiver not specially designed for selectivity. And the set should prove quite suitable for the purpose for which it was designed, as indicated in the opening paragraph of this article.

THE "POWERFUL THREE"

SIR,—Having noticed from time to time in various issues of THE WIRELESS CONSTRUCTOR words of praise for the "Powerful Three" which appeared in the issue of April, 1925, I am sending my results.

I made the set exactly as Mr. Harris described, but using cheaper components. Some of my friends who saw the set during construction advised me to scrap it and make a set using a H.F. valve; I did not, however, scrap it, and I am very pleased with the set and its results, which are as follows:—Daventry, Bournemouth, Cardiff, Radio-Paris, all on the loud-speaker, and the stations which can be received on the telephones are too numerous to state here.

Yours faithfully,
G. N. CARTER.

Torquay.

ANOTHER NEW FIELD TO EXPLORE

There is much of interest going on above the normal broadcast wavelengths, as well as on the short waves to which our readers were introduced by the Editor last month. Some of the most important longer wave transmissions are described in this article.

The excellent aerial system used at the Eiffel Tower in Paris is probably responsible for the enormous range of this station.

ALTHOUGH there is no doubt whatever that it is far more easy in these days of short-wave communication to receive stations at great distances than it has ever been before, the writer cannot help wondering whether there is such an amount of interest and fascination, purely from the receiving experimenter's point of view, as there used to be in the "pre-broadcasting" days.

In those "good old days" valve receivers were very few and far between, and those that existed were generally very imposing affairs, with complicated switchboards and enormous quantities of apparatus that really served no useful function other than that of duly impressing visitors, who, by the way, were by no means few in number.

Thrills from Croydon's Telephony

The writer's first valve receiver (employing one valve only) was of this description, with switching arrangements covering ranges from 300-900 metres (with a small loose-coupler), 900-3,000 metres (with a bigger affair, wound on a sieve!), and 3,000-25,000 metres, the last step being accomplished by means of "slab" coils.

Probably the greatest excitement in those days was derived from decoding weather reports and listening to time signals from the Eiffel Tower, with a real thrill now and then when Croydon used telephony. The latter item would attract quite a crowd!

Yet there was certainly as much interest in the whole business in those days as there is at present, however easy it now is to receive Australia and New Zealand with one valve. Probably the old maxim, "Familiarity breeds contempt," explains most of it.

Try Long Waves

This short article was written as the outcome of the writer's recent attempts to recapture some of the fascination of the pre-broadcast days by listening on the longer waves almost exclusively. Incidentally, this experiment met with quite a fair measure of success, and a long-wave receiver is kept permanently at hand as a result of it.

Reading Morse Signals

It is assumed that the reader has at least sufficient knowledge of the Morse code to pick out the call-sign of the station he listens to, and to follow such signals as the Eiffel Tower time signals, etc. If he is already as far advanced as this, half-an-hour's practice on weather reports or similar transmissions each night will enable him to reach quite a respectable speed without much trouble. For those who do not know the code at all, the writer's advice is: Learn the letters *thoroughly* first of all, and then practice *regularly* on a transmission that is too fast for you to follow, just picking out a few letters here and there, until ultimately you find that you are getting practically the whole of the transmission. It is not such a wearisome business as many imagine.

Details of Transmissions

The following is a specimen list of some of the high-power stations that are within easy range of a single-valve set in this country, together with the times of working in the mornings and the wavelength:—

Time (GMT)	Station	Wavelength	Type of Transmission
0835	FL Eiffel Tower	4,700 m. C.W.	Weather Report
0840	GFA Air Ministry	4,100 m. C.W.	Weather Report
0900	GFA Air Ministry	4,100 m. C.W.	Weather Report
0922	OPO Brussels	1,680 m. C.W.	Weather Report
0923	FL Eiffel Tower	2,600 m. Spk.	Time Signals
0955	SUC Cairo	11,000 m. C.W.	Weather
1034	FL Eiffel Tower	2,600 m. Spk.	Calibration
1044	FL Eiffel Tower	2,600 m. Spk.	Time Signals
1115	SAJ Karlsborg, Sweden	2,500 m. C.W.	Weather
1200	NIDK Atlantic Ice Patrol	1,420 m. C.W.	Special Warnings
1244	GKU Devizes	2,100 m. C.W.	Calibration

The midday transmission by the Atlantic Ice Patrol Vessel (NIDK) is of special interest, but rather difficult to receive, as this boat is usually in the neighbourhood of Newfoundland. The writer has, however, heard these signals more than once with a detector followed by one stage of L.F. amplification.

A Useful Transmission

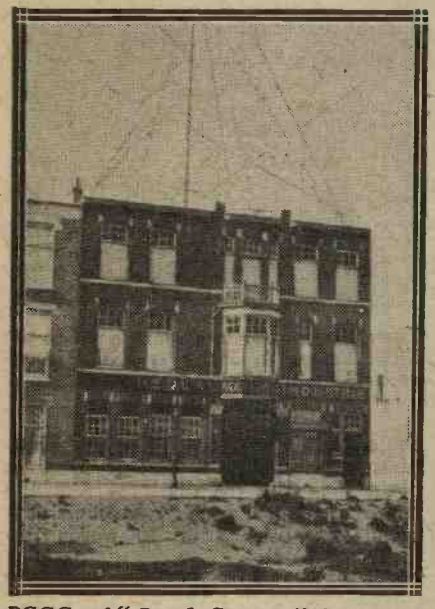
For those desirous of learning Morse more thoroughly the 0900 transmission by the Air Ministry (GFA) on 4,100 metres is particularly useful, as after the conclusion of the "Weather Shipping" bulletin a special forecast in plain language (as distinct from the usual "numeral code") is given at a speed of about 8 or 10 words per minute. This type of transmission is also carried out at 2000 GMT. If the receiver to be used will not normally tune as high as 4,100 metres there will be no need to wind special coils, as GFA has various strong harmonics that can be heard in most parts of England. The writer often used to take this report down from one of these on approximately 460 metres.

Time from the Eiffel Tower

With regard to the time signals from FL, there are three separate types of these, but only two of them are likely

ANOTHER NEW FIELD TO EXPLORE—*continued*

to be of any use to the receiving experimenter. Those sent out at 0923 (*not* repeated in the evening) take the following form:—After the preliminary call, a series of X's (— . . —) is sent, followed by three long dashes, the last of which ends at exactly 0928 GMT. After this five N's (— .), with about ten seconds interval between them, are sent, also followed by three dashes, the last ending at exactly 0929 GMT. The third series consists of G's (— — .), followed by another three dashes, the last of which ends at 0930. This is the international form of time



PCGG, of "Dutch Concert" fame, will soon be heard again by listeners on the longer waves.

signal, and is standard for all stations with the exception of the first line of X's, which is varied by certain other stations, and is intended for a "call-up" only.

The International Method

The "semi-automatic" time signals at 1044 (also repeated at 2244) are transmitted as follows:—

Starting at 1044 exactly, a series of T's (—) is transmitted, lasting until 55 seconds after 1044. There is then a pause of five seconds, and at exactly 1045 one short dot is sent. This procedure is followed from 1046 till 1047, D's (— . .) taking the place of the T's. The final dot is at exactly 1047. The third and last series, of 6's, (— . . . . .) concludes with a dot on 1049 GMT, after which the station "signs off."

The first form (international) is also transmitted by Nauen (POZ) at 1155 and 2355 GMT, simultaneously on 3,100 metres spark and 18,075 metres C.W.

In the case of the semi-automatic time signals, the preparatory signals (T's, D's and 6's) are sent by hand, and the time signal proper by landline from Paris observatory.

"Rhythmic" Signals from FL

Eiffel Tower (FL) also transmits scientific or "rhythmic" signals at 1000 and 2200 G.M.T., but these, although of very great importance to ships at sea, are of little interest to the average experimenter. They are sent on the "vernier" principle, fifty dots being transmitted in 49 seconds.

Another transmission that is of great assistance to the novice in the Morse code is that of GGB (the Aldershot Army station), who transmits special "practice" signals on weekday evenings at 2000 G.M.T. The method of procedure is as follows:—Mondays, Wednesdays and Fridays, 2000-2020, six words per minute; 2020-2040, 10 w.p.m.; 2040-2100, 14 w.p.m. Tuesdays and Thursdays, 2000-2020, 8 w.p.m.; 2020-2040, 12 w.p.m.; 2040-2100, 16 w.p.m. These transmissions take place on 1,900 metres, and form an excellent "progressive" system of practice for the beginner.

Long-Wave Telephony

For those who prefer telephony, there is quite a wide field open for exploration. FL works at various times of the day on 2,650 metres with a power of 5 kw., and gives a concert on Sundays and Wednesdays at 8.30 p.m. on 2,200 metres. Radio-Paris (SFR) works at all times on 1,750 metres with 6 kw., and, on Sundays, Berlin gives a concert from 11.30 a.m. to 12.50 p.m. on 1,300 metres, using 10 kw. All these stations may be *well* received with two valves in this country. Then there is Hilversum on 1,050 metres, and PCGG will soon be starting up again on about the same wavelength, so that there will certainly be no lack of telephony on the longer wavelengths.

Croydon and the aeroplanes were, of course, the star turn previous to the commencement of the "Dutch Concert," and, of course, there is even more work being carried out on the 900-metre wavelength now than there was before. Croydon, Lympne, Pulham, Le Bourget, and sometimes Cologne, as well as innumerable aeroplanes, can always be heard on this wave; the wavelengths used by all these stations vary over such an exceedingly small range that several tuned stages of H.F. amplification can be used without any trouble—this is, in fact, the method employed by the stations themselves!

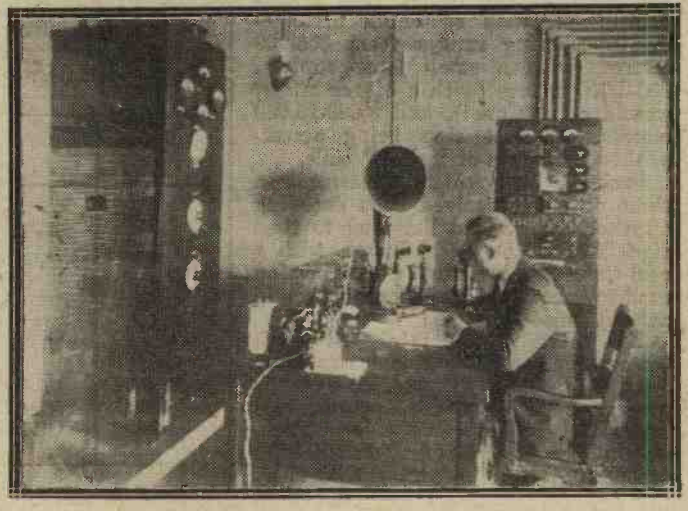
DX Work!

Using three tuned-anode stages for this work, the writer has succeeded in picking up the transmission on 940 metres from the Leningrad station, which transmits a concert and news on weekdays between 3 and 5.30 p.m. These signals are rather weak, however, the power employed being only 2 kw.

The babel of spark stations on 600 metres makes quite an interesting field for the Morse enthusiast, but unless he is capable of reading the code at a fairly good speed, it is apt to be rather bewildering. Quite good "DX" can, however, be accomplished upon this wavelength when there are not too many stations working. It is necessary, however, when "tracking" ships, to be able to understand the meaning of the bearings given by the D.F. stations, and the receiving operator must keep all his wits about him. This work can, of course, also be carried out on 2,100 metres, on which wavelength Devizes (GKU) may be heard working with the larger ships, notably the Atlantic liners.

Taken as a whole, the longer waves are, in the writer's opinion, quite as interesting as any of the wave-bands below the normal broadcast band, from the receiving amateur's point of view only, as, of course, low-power transmission would not be very successful above about 500 metres, even if it were permitted.—W. L. S.

The more ambitious listener should experience little difficulty in picking up the American long-wave stations. Our photo shows the control table at New Brunswick.

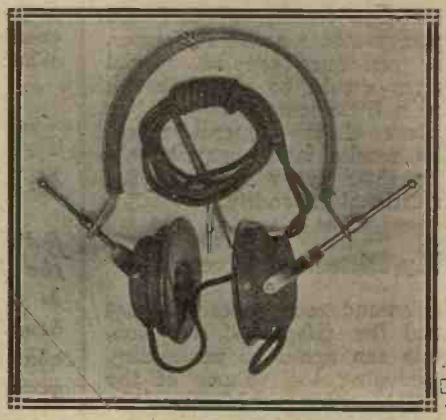


LOUD-SPEAKER or TELEPHONES?

By

STANLEY G. RATTEE,

M.I.R.E.



" Telephones are so much better than a loud-speaker for quality of reproduction," is a remark one often hears. Is this really true? The discussion in this article may provide you with some enlightening information on the possible cause of poor results.

FOR some reason or other there appears to exist in the minds of many listeners a distinct distrust of the loud-speaker. These listeners have formed the opinion that whereas the telephones give a reproduction both pure and clear, the loud-speaker can only give results which are distorted.

Inquiry into the circumstances which led the listener to this conclusion usually elicits the information that the opinion was formed after hearing the results from a friend's loud-speaker, or else the " demonstrations " given by his local dealer have forced him to this conclusion.

Where the Fault Lies

The reason for this distrust of loud-speakers is perfectly understandable, since, strange as it may seem, quite a large percentage of loud-speaker users are obtaining results which cannot be compared with those obtained with telephones.

As bad workmen blame their tools, so, many listeners blame the loud-speakers for their indifferent reproduction. When it is pointed out to them that the loud-speaker can only reproduce what is put into it, and that the chances are that the distortion is occurring before the signals actually reach the loud-speaker, such a possibility is regarded as absurd.

Necessary Amplification

It will be understood that when a loud-speaker is used, either one or two stages of low-frequency amplification are employed, and when it is desired to use telephones either these stages are cut out of circuit or else the receiver is detuned in order to reduce the volume. Here is where the average listener goes wrong in his comparison test between 'phones and loud-speaker when using a given set.

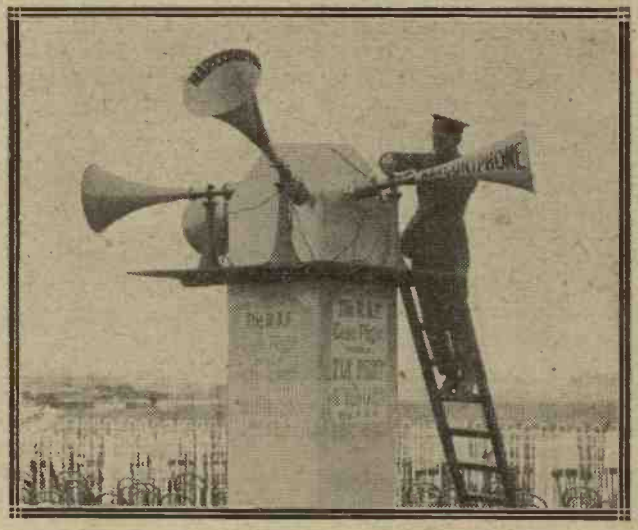
Is This Your Experience?

Let us assume that we have a four-valve receiver, consisting of an H.F. valve, a detector, and two low-frequency stages, and that the loud-speaker results from this set when tuned to the local station are far from pleasant to hear. If with the four valves signals from the local station are at loud-speaker strength, it is obvious that the telephones cannot be used for receiving that station without either cutting out the two low-frequency stages or else detuning the set so that the volume is reduced to one which is less deafening.

In the first place the comparison with the former results can be decidedly misleading, for though the telephone results may be perfect, the two (or one) L.F. stages may be distorting these signals before they reach the loud-speaker, thus giving the impression that the loud-speaker is responsible for the difference in reproduction.

How to Correct Distortion

In many cases this possibility is overlooked, and where loud-speakers appear to give distortion a point should be made of carefully examining the amplifying stage immediately preceding the loud-speaker. It may be that the valves are unsuitable or they may not be operated correctly. By the latter remark it is meant that care should be exercised in seeing that the correct H.T. voltage is used, in conjunction with a suitable value of grid bias. Experiments should be conducted with a view to improving results by using as high a value of grid bias as possible, though too high a value will reduce signal strength, or may even bring about distortion.



An elaborate system of power loud-speakers was used at the R.A.F. display at Hendon earlier this summer.

Loud-Speaker or Telephones?—*continued*

Use the Right Valves

For the best results, whether the low-frequency stages are transformer, choke or resistance coupled, special L.F. valves should be used; though these are a little more costly to buy than valves of the general-purpose type, the results which may be obtained by their use will justify the slight additional expenditure.

Why Distortion Occurs

In the second case, where the set is detuned for telephone reception, the results can again be misleading, for by reducing the volume of the signals to the extent which would be required for comfortable telephone work, the cause of the distortion may at the same time be eliminated. This circumstance may be brought about by using too much or too little grid bias, so that when full loud-speaker volume is being obtained the voltage swing instead of remaining on the straight part of the characteristic of the valve passes over one or the other of the bends.

Detuning the set for telephone use reduces the length of this voltage swing by virtue of the weaker signals, and so may avoid the bends in the characteristic, even though the H.T. and grid-bias values remain the same. In such cases as this experiment in the values of H.T. or grid-bias voltages or both will usually have the desired effect of curing the distortion.

Excessive Reaction

Another cause of poor loud-speaker reproduction is often due to the over-use of reaction. Suppose, for example, that we are using a two-valve receiver, consisting of a detector and note magnifier, for the reception of the local station on the loud-speaker.

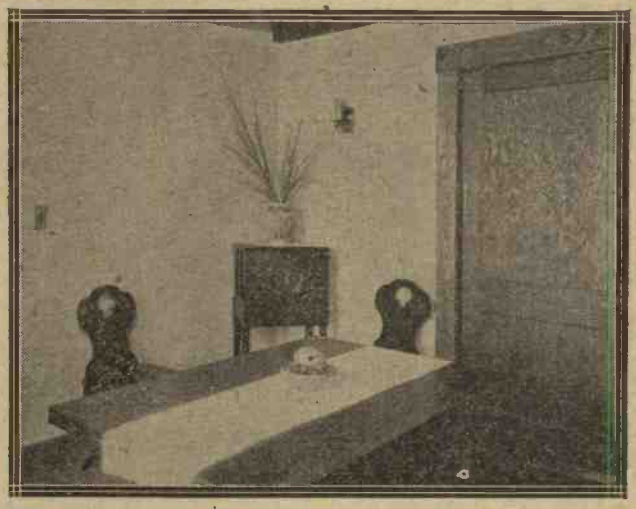
The chances are that when the reaction coupling is slackened off, that is to say when the reaction effect is small, the signals may not be loud enough to suit our requirements. When the fullest possible reaction effect is used, however, the volume is increased to satisfy our needs, but in this case when receiving really loud signals, such as those given by a full orchestra, the loud-speaker appears to distort.

Telephones are to be preferred when listening to Morse signals, the volume of signals being not usually so great as those of telephony.

Uneven Results

This position of things is by no means infrequently met with, and one usually finds that the receiver has been adjusted so that the fullest possible reaction effect is used. For the reception of speech and more or less quiet music, the results are worth listening to, but when a full orchestra is playing the signals are so loud that they have the effect of throwing the set in and out of a state of self-oscillation, thus producing a most displeasing effect upon the ear of the listener.

When using telephones on this same set, the reaction adjustment is, of course, not so critical, and whereas with the loud-speaker the distortion was due to the forcing of reaction, with the telephones the distortion is absent, due to the use of less reaction.



Suitable placing of the loud-speaker in a room may have a considerable effect on the quality of reproduction.

Conclusions

For the best loud-speaker work as little use of reaction as possible, careful attention to valves and voltages, the use of a good make of loud-speaker and intelligent operation of the set are requirements of primary importance, while the provision of a set of sufficient sensitiveness is another point which should not be overlooked. For safety not less than three valves should be used in circuits of the ordinary type, though when the local station is near two valves may sometimes be sufficient.

Disadvantages of Telephones

In so far as the lovers of telephones are concerned, though willingly admitting for the sake of argument that they have certain advantages over loud-speaker users, these instruments have nevertheless many disadvantages.

Perhaps one of the biggest is the fact that when more than one person desires to listen to a particular item in the programme, it is necessary to provide each person with a pair of telephones all to himself. It is true that the 'phones may be "split up," that is, each earpiece may be taken from the headband and each would-be listener given one 'phone, but this is, after all, hardly satisfactory, even to the most enthusiastic listener.

Tied to the Receiver

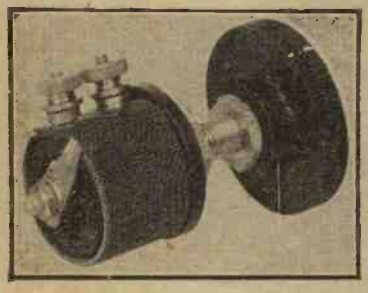
Another disadvantage is that of limited freedom. Indeed, to listen to a whole evening's programme when wearing telephones is like unto being chained to the set. Another point is the difficulty of conducting conversation, for even the most accustomed user

(*Continued on page* 1029.)

WHERE RESISTANCE HELPS AND HINDERS

By C. P. ALLINSON, A.M.I.R.E.

Resistance may be both the "servant" and the "master" in your receiver. For efficiency the harmful resistances must be kept as low as possible, and this article tells you where resistance is useful and where it is to be avoided.



A filament rheostat is an example of resistance concentrated and capable of continuous variation.

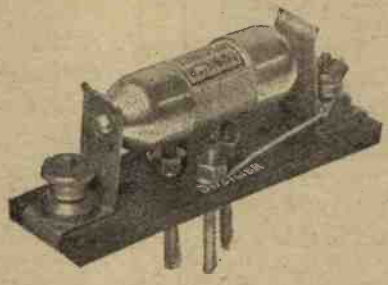
"LOOK here," said Merrick to me the other evening, "since high resistance 'phones are more sensitive than low resistance ones, why don't they wind them with resistance wire?"

"Well," I replied, "the point about 'phones is not that their resistance, as such, should be high, but rather that there should be sufficient turns of wire in the windings to give as great a degree of sound from the amount of signal energy as possible. Actually 'phones don't need to have a high resistance if a special output transformer is employed. The sound you hear in a pair of headphones is due to the actual energy from the signal, and if this fluctuating signal current is small, a large number of turns in the 'phone windings is required to obtain the greatest volume from it. If, however, you use a step-down transformer, this increases the signal current, though, of course, at the same time it decreases the signal voltage and thus low resistance 'phones can be used."

Needless to say, much was left unexplained, since Merrick was only a beginner at wireless, and a more detailed explanation would have puzzled him.

A Convenient Description

The technical expression for the requirements of a good pair of 'phones is that they should have a large number of ampere-turns or a high impedance, but since this is a very difficult factor to determine with windings of this description, an easier method of classifying these instruments is by their resistance. If resistance wire were used, a large amount of the available signal energy would be lost in overcoming this resistance.



High resistances are conveniently made up into small sealed cartridges, constancy of value being a matter of importance.

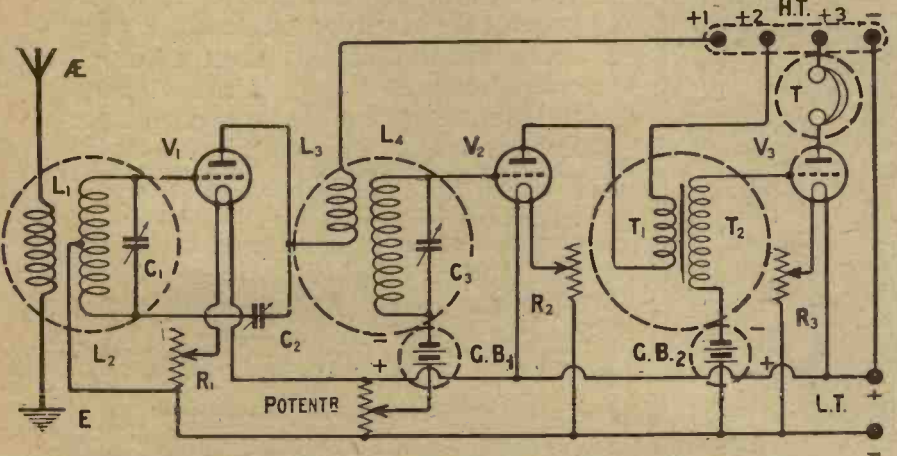
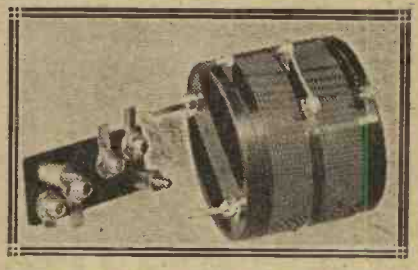


Fig. 1.—Excessive resistance is especially undesirable in the parts of this circuit enclosed within the dotted circles.



In low-loss coils every effort is made to keep the resistance of the windings small.

L.F. Transformer Windings

In the same way a good L.F. transformer requires the primary winding to have a sufficient number of ampere-turns, according to its position in the receiver, and an indication of this factor is given by the resistance of the winding. Similarly the resistance of the secondary gives some indication of the number of turns on it, and, if the windings are wound with the same gauge of wire, the ratio of transformation can also be estimated.

Where Resistance is Not Wanted

It is interesting to examine a wireless receiver and to see where resistance is required and where it is harmful. Its effects are most detrimental in tuning circuits, for there its presence produces a loss in signal strength and a decrease in selectivity. A tuning coil may actually only have a resistance of half an ohm to direct current, but to high-frequency currents it may have a resistance as high as 15 or 20 ohms, a decidedly high value.

Especially is this harmful in coils which are connected to the grids of valves, for the output of the receiver depends on the voltage which is applied to the grids, and any resistance in such coils will reduce this voltage and so reduce the signal strength of the station being received.

How Reaction Helps

The use of reaction greatly reduces the effects of such resistance, but it has been shown that its bad effects cannot entirely be counteracted by the use of reaction. Thus, if resistance is added to a low-loss circuit in

Where Resistance Helps and Hinders—*continued*

which reaction is being used, though more reaction will be required, the signal strength will not be quite so great as it was before the resistance was added.

These questions of high-frequency resistance, however, have been dealt with in other articles, and it is proposed to consider more particularly the effect of simple D.C. resistance.

Harmful Resistance

Another point at which resistance is likely to produce harmful effects is in the H.T. battery. Where a number of valves are being used with various H.T. voltages, the presence of resistance in this battery will cause coupling to be introduced between the valves, with the result that high- or low-frequency oscillation may occur. It is well known that a run-down H.T. battery, which has therefore developed a high internal resistance, will produce howling in an L.F. amplifier, but it is not so generally known that it may also cause instability in an H.F. amplifier. I have come across receivers which, though perfectly stable when used with a new H.T. battery or a H.T. accumulator, would be exceedingly difficult to control with an old H.T. battery.

A Different Case

Once, however, I had a set that was perfectly easy to handle with an old H.T. battery, but which oscillated violently when used with an accumulator, even though the same nominal voltage was applied. I found out later that the voltage on the old H.T. battery, when the set had been running for a few minutes, was actually only 23 volts, while the 45-volt, or to be accurate the 44-volt tap, on the accumulator really *was* 44 volts.

A high resistance in a grid battery which is common to two L.F. circuits may also produce coupling effects, and

Low internal resistance is necessary in a high-tension battery to ensure satisfactory operation of the receiver.

I have known a case of L.F. oscillation which was largely due to the use of a common grid-bias battery, and the use of two separate batteries helped to eliminate the trouble.

Curing L.F. Oscillation

While on the subject of L.F. oscillation, I might mention a cure which makes use of resistance, and that is the shunting of one or both of two transformer secondaries with a high resistance, between the values of 100,000 ohms and 2 megohms. In many cases this will stop any howling that occurs without appreciably reducing signal strength. It is best to use as high a value as possible, so that any reduction in volume which may result shall be as small as possible.

A Question of Degree

The point whether a resistance is high or low is determined by the function of the resistance and its normal value. Thus a value of 1,000 ohms, though exceedingly high for filament resistances, is extremely low for an anode resistance in a resistance-capacity coupled L.F. amplifier, the usual value for which is generally in the region of 100,000 ohms. This value again is low when a grid-leak is needed, of which the value, as generally used, is 2 megohms (*i.e.*, two million ohms). So we see that it is somewhat difficult to determine what constitutes a high resistance and what a low.

Volume Control

A variable resistance with a fairly high maximum value, say 10,000 ohms, is extremely useful in a large powerful set for use as a volume control. It may be shunted across the primary of an L.F. transformer and it will enable the exact volume of signal to be obtained that is desired.

If a loud-speaker is used with a number of different sets and you wish to have volume control with all of them, using only one variable resistance, it can be connected across the loud-speaker itself and too strong signals can then be cut down as wanted.

Filament Regulation

For the control of valves as regards their filament temperature, resistance is of course required. A number of the valves now available are not suitable for use with a battery without any resistance in series with the filament, so that any attempt to run the valve without such a resistance would shorten its life as well as result in reduced efficiency.

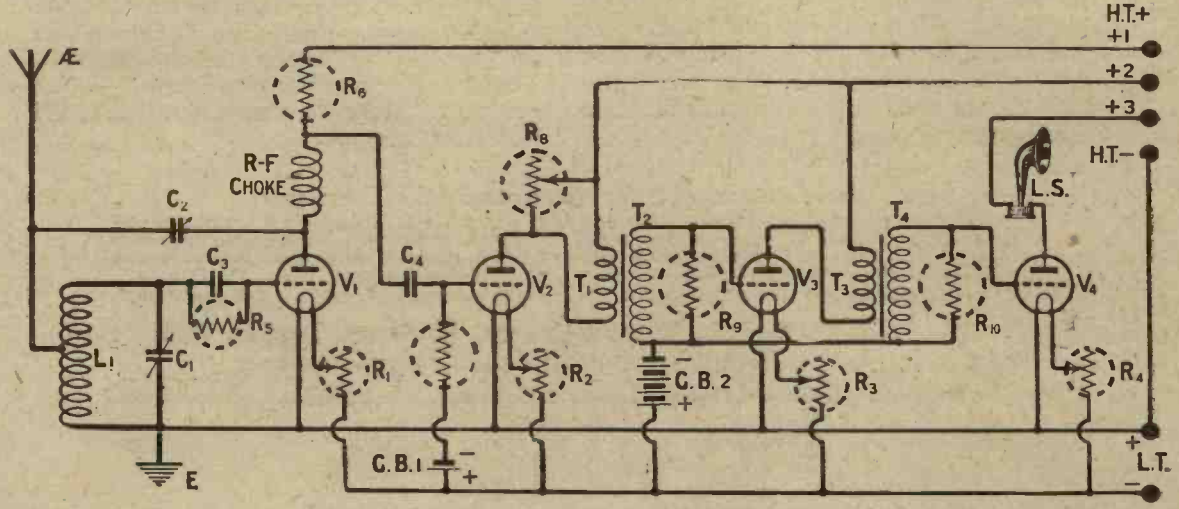


Fig. 2.—Here the dotted circles enclose those parts of the circuit where resistance is made to serve a useful purpose. This may be compared with Fig. 1.

Where Resistance Helps and Hinders—*continued*

Valves which are designed to work exactly on 2, 4, and 6 volts have till recently been the exception rather than the rule, while a popular .06-ampere type of dull emitter needs 3 volts for the filament. If only one or two of these last are being used they can, of course, be run off a dry battery, but more than this number impose a rather heavy load, and under these circumstances an accumulator is desirable.

Concentration of Resistance

This is one of the few cases where resistance is desirable. Even so, it should strictly be confined to the resistance element itself. Some filament rheostats when tested have shown as much as ½ ohm between the soldering tag and the tip of the moving contact which moves over the resistance winding. Although this may not seem a great deal, it is nevertheless troublesome in many cases. Seeing that this resistance is probably largely due to a poor contact between the spindle and its bush, it is ten to one that its value will vary. The result will be that the temperature of the valve will alter with it and scratching noises will be heard in the 'phones. It is important, then, that even where resistance is required it should remain constant.

Potentiometers

Another instrument employing the property of resistance is the potentiometer. The chief uses of this instrument in wireless receivers are, either for stabilising the H.F. side of a set, though the use of neutralised circuits has practically entirely superseded it, or else for anode bend rectification or circuits such as the Prince Trigger circuit. Since a potentiometer is connected directly across the L.T.

Very high resistance in insulating materials is specially important when the insulators are of small size.

battery, it should have a high resistance, so that too much current shall not be taken from the L.T. source. A satisfactory value is in the region of 300 ohms, though a higher value will, of course, be an advantage.

Causes of Noise

Constancy is particularly important at two other points, namely, the grid leak and the anode resistance. Grid leaks, if not constant in value, can give rise to most unpleasant noises in a set, especially if one of them is used with the detector valve, for any noise that may result from its variation will be amplified. An examination of a large batch of grid leaks some time ago showed that only about one in nine was really silent. Since then, however, metallic and other improved forms of grid leak have been produced, and a noisy leak is now rather the exception than the rule.

Improved anode resistances, too, have been evolved, and a number of reliable components of this description are now available, in particular the wire-wound type. I recently examined some anode resistances that I had had for a couple of years, and out of four that were supposed to be 100,000 ohms each, only one was anywhere near that value.

Insulators

A high value of resistance is required in all insulating materials, for none of them, strictly speaking, are absolute insulators. They merely have an extremely high resistance, and when this is over a certain value they are usually spoken of as having an infinite resistance.

Notes & Jottings

A page of information of interest to all constructors.

A VARIABLE CONDENSER DIAL which is not securely fixed on its spindle is a source of great annoyance to the operator, because the readings noted from it cannot be relied upon. The dial is often locked in position with a small grub screw, and a trouble sometimes encountered by the constructor is that he has no screwdriver with a narrow enough blade to enter the hole in the knob and drive the screw well home. The use of too large a screwdriver under these circumstances will damage the knob, and may even split it if it is of the moulded type.

* * *

It is quite worth while to keep as part of the wireless workshop equipment one of the small screwdrivers which are used by watchmakers. These are made entirely of metal, with a hollow handle to hold blades of various sizes. The cap at the end of the handle is free to turn independently of the rest of the tool, so that the blade can be pressed firmly into the slot of the screw and turned with the fingers, while the cap stays still and so does not cut into the palm of the hand.

BROADCAST listeners sometimes complain that there is a sort of hissing or "buzzing" noise continuously audible from their loud-speaker when a programme is coming through. This is distinct from the harsh sound due to overloading of the loud-speaker, which can be readily detected owing to its greater prominence when the volume of sound transmitted is increased. The hissing noise, on the other hand, remains practically constant whatever is coming through from the broadcasting station. A cure may be effected by the provision of a shunting condenser across the terminals of the loud-speaker.

* * *

For general use this condenser may have a value of .002 microfarads. Those who are critical of quality and who like to hear every transmission at its best will be well advised to use different values of shunting capacity for different items in the programmes. For example, the value quoted above will usually suit for speech, but for a full orchestra a larger condenser, even up to a value of about .02, will usually help to give clearer reproduction and to enable the various instruments to be distinguished. Too large a condenser is to be avoided, or the higher notes will be partially lost, and the general effect spoiled.

HIGH-TENSION batteries of the "wet Léclanché" type are becoming increasingly popular nowadays, especially in localities where the recharging of high-tension accumulators is a difficult matter, and where the demands of the receiver are too great to be supplied by the ordinary battery of dry cells without heavy expense in replacements. The convenience of the wet cells under such circumstances is that they can easily be recharged when they run down, by the renewal of the solution, and possibly also of the zincs. In default of special instructions given by the battery manufacturer, the renewal of the solution will simply consist in filling up the cells with water to replace that lost by evaporation, and adding a small amount of sal ammoniac.

* * *

When this latter is bought at the chemists, it is usually supplied in the form of coarse crystals. It is worth while to ask for these in powder form, or alternatively to crush the crystals to a fine powder before putting them in the cells. The amount to put in can then be gauged with greater accuracy. About half a teaspoonful should be ample for each cell, assuming that the cells are two or three inches deep and an inch or so in diameter. Too strong a solution will cause trouble, owing to the increased likelihood of "creeping" taking place, with consequent damage to the inter-cell connections.

THERE is much to be said for the use of a frame aerial in a situation close to a broadcasting station, owing to its portability and the small space it occupies in comparison with even an indoor aerial. It is a mistake to suppose, however, that a frame may be connected across the aerial and earth terminals of a receiver designed for use on an aerial and earth, without any alteration to the receiver. The effect of doing this would be to put the frame winding in parallel with the first tuning coil of the receiver, as shown in Fig. 1, thus reducing the amount of inductance in the circuit, probably below that required for tuning in the desired transmission. The correct way of connecting the frame is shown in Fig. 2, this arrangement being suitable when the frame is too small to act as the tuning coil by itself. A frame with enough turns to act as the tuning coil may be connected to the aerial and earth terminals, the coil being removed.

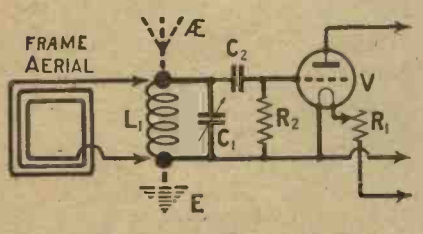


Fig. 1.—This method of connecting a frame aerial to the aerial and earth terminals of an existing receiver would not be satisfactory, as the coil and frame would be in parallel.

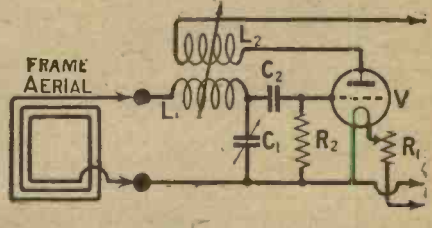


Fig. 2.—By slightly altering the receiver wiring the frame may be connected as shown here, the coil being used for obtaining reaction coupling. This diagram may be compared with that of Fig. 1.

"TPS" CIRCUITS FOR THE EXPERIMENTER

By J. H. REYNER, B.Sc. (Hons.),
A.C.G.I, D.I.C., A.M.I.E.E.

Are you keen on trying out new circuit arrangements? Here are some interesting circuits providing material for experiment on methods of transformer coupling for high-frequency amplifying valves, and requiring but little apparatus to construct them in practical form.

THE development of high-frequency amplification has led to the increasing use of transformer-coupled circuits, and in fact a great deal of the development which has taken place in recent times has been in the direction of finding out the necessary proportions of the various windings in order to fulfil the combined claims of sensitivity and selectivity.

Experimental Layout

Some time ago in these columns I gave several circuits with which the transformer - coupled arrangements could be tried out, with the aid of two- or three-way coil holders and ordinary plug-in coils. Such an arrangement enables a variety of different combinations to be tried out at will, and gives a good indication of what to expect if it is desired to make up a transformer unit at a later stage.

A New Arrangement

I propose in this article to give some circuits embodying a modification of the usual transformer arrangement, by means of which some rather interesting results can be obtained. This modification consists in tuning both the primary and secondary windings of the transformer with a single condenser, and for this reason I have called them "T P S" circuits, implying that they are provided with both tuned primary and tuned secondary.

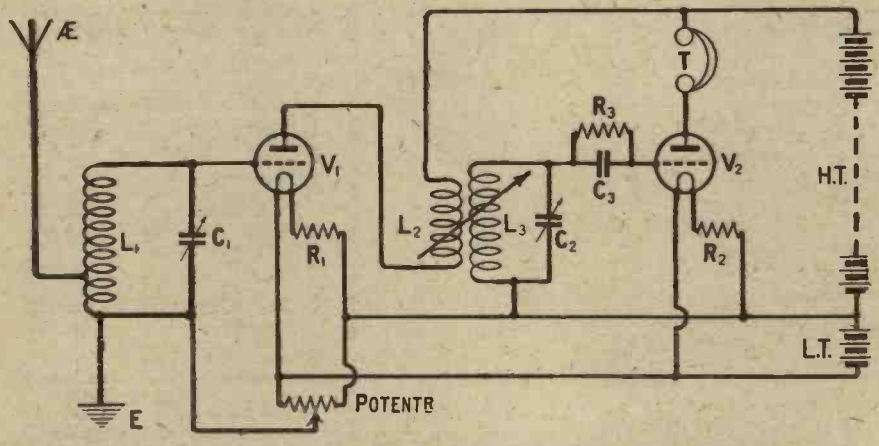


Fig. 1.—With this circuit varying degrees of selectivity may be obtained by altering the coupling between L2 and L3.

Transformer Coupling

The circuit shown in Fig. 1 is a straightforward transformer arrangement, having a tuned secondary with an untuned primary. Such a circuit may be either tightly or loosely coupled, as desired. The relative merits of the two types have already been discussed in a previous article.

Such an arrangement constitutes a sort of cross between the transformer intervalve connection and the tuned-anode circuit, and partakes of the advantages of both. This point will be discussed a little later, but for the present it will be advisable to trace the development of the circuit from a simple transformer-coupled circuit

Briefly, the coupling should be tight enough for the secondary tune to be reflected into the primary to some extent, so that the impedance of the primary coil becomes comparable with that of the valve. Unless this is done, the amplification obtained from the valve is only comparatively small.

Selectivity

Provided that this condition is complied with, then the weaker the coupling is made the greater will be the resulting selectivity. By using a simple two-way coil holder, this effect may actually be observed in practice, and indeed forms an interesting experiment in itself.

No neutralising arrangement has been shown in this circuit, in order that simplicity may be retained as far as possible. To check any tendency to self-oscillation, therefore, a potentiometer control is provided on the grid of the first valve and this will enable the circuit to be maintained in a stable condition. This does not mean that better results cannot be obtained with a neutralised circuit, but any extra adjustments may serve to mask the true action of the transformer coupling.

A Development

Let us now consider the circuit given in Fig. 2. Here the anode circuit contains the coil L_2 as before, and this coil is coupled to the coil L_3, which is connected across the grid and filament of the second valve as before.

The tuning condenser C_2, however,

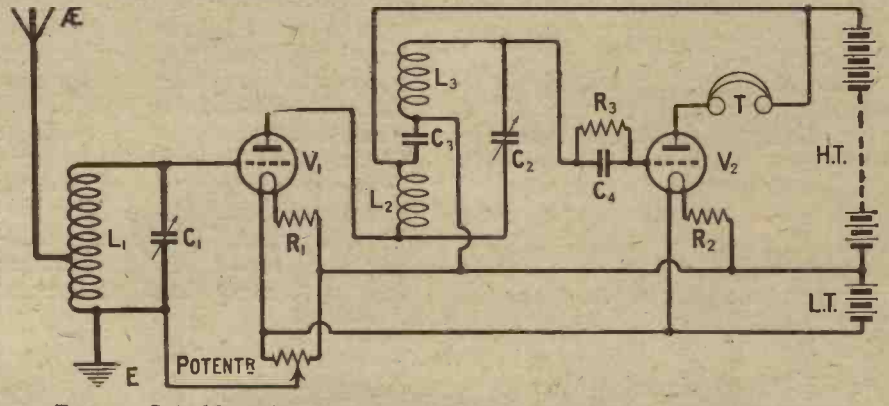
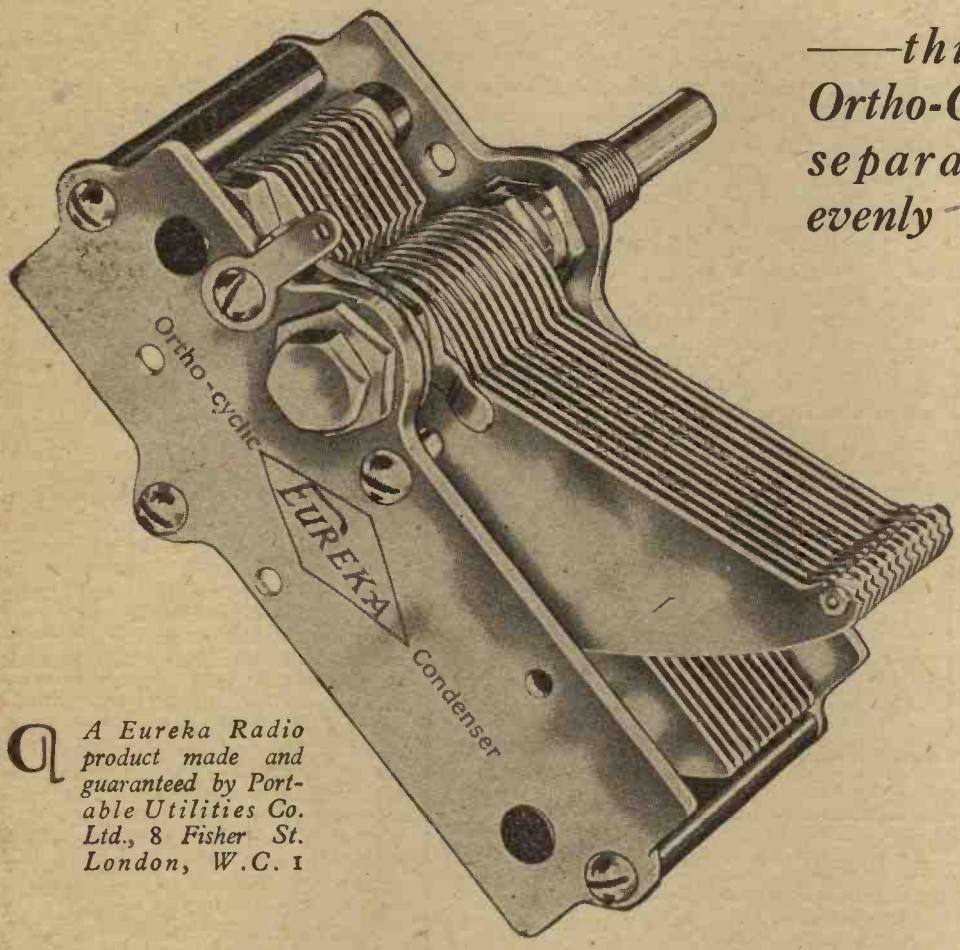


Fig. 2.—Suitable values for the components in this circuit are indicated in the article. A shunting condenser may be included between earth and L.T. negative across the potentiometer winding.

Don't get lost in the Maze!



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FOR three years wireless enthusiasts have been struggling to obtain selectivity. Sets have been made more and more sensitive—long distance reception is simplicity itself. But the trouble has always been to receive stations *one at a time* without interference.

With Jazz Bands inextricably intermingled with Italian Opera, it is little wonder that long-distance Broadcasting has—to the average man—lost much of its earlier fascination.

But now, at last, there comes the dawn of a new era—the promise of razor sharp tuning. The new Eureka Ortho-cyclic sets a higher standard in Condenser design—by its aid a measure of selectivity is obtained which but a year ago would have been unbelievable.

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"T P S" CIRCUITS FOR THE EXPERIMENTER—*continued.*

is connected across both the coils L_2 and L_3, which thus form one complete tuned circuit.

An Isolating Condenser

The high-tension connection is taken to the other end of the coil L_2, but in order to prevent the high voltage from being applied to the grid of the valve V_2 through the coil L_3, a large condenser C_3 is connected between the two coils as shown. This effectively isolates the grid from the high voltage, and provided that it is large in size compared with C_2 it will have little effect on the tuning.

If, for example, we make the condenser C_2 the usual value of .0003 or .0005, then the value of C_3 should be not less than .005. A .01 condenser is a very convenient size for this component.

Potentiometer Control

As in the previous circuit, a potentiometer control has been provided on the first valve in order to check any tendency to self-oscillation, and with the circuit as shown some very interesting results may be obtained. The coil L_1 may be of the usual size, a No. 50, 60 or 75, and in order to obtain good selectivity it should be of the tapped type, enabling a tight-coupled aerial to be employed, as shown in the diagram.

The Transformer Coils

The coils L_2 and L_3 have to be chosen with two factors in mind. First there is the question of the step-up required from the primary to the secondary, and secondly there is the question of the tuning of the whole arrangement.

For a first test it is very useful to make the two coils equal, and of such a value that when connected in series they tune to the wavelength range required.

Suitable Values

Allowance must be made for the coupling between the coils themselves. If the coils are connected in the same direction, then the total inductance will be greater by a small amount than the sum of the two coils individually.

If the coils are connected in the reverse direction, the total inductance will be less than the sum of the coils alone. Two No. 25 or No. 30 coils will usually be found to be satisfactory.

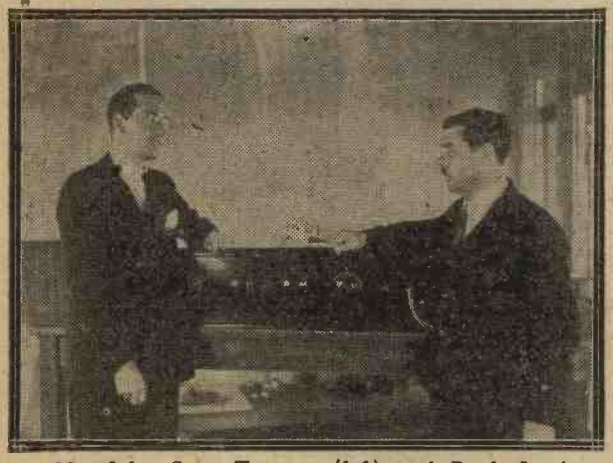
Direction of Windings

The relative directions of the windings of the coils is also of interest. Generally speaking, the best results will be obtained with the coils both wound in the same direction, as shown in the diagram, but quite interesting results can be obtained if the coils are reversed. A little experiment in this

(*Continued on page* 1040.)

"EQUAL TO THE BEST I HAVE HEARD IN AMERICA"

Famous Inventor's Opinion of the "Elstree Six"



Mr. John Scott-Taggart (left) and Prof. L. A. Hazeltine discuss the "Elstree Six" receiver.

Professor L. A. Hazeltine, the well-known American inventor, paid a visit to the Radio Press Laboratories at Elstree as soon as he arrived in England in July. He had nothing but praise for the "Elstree Six," and his impressions of this receiver are given below.

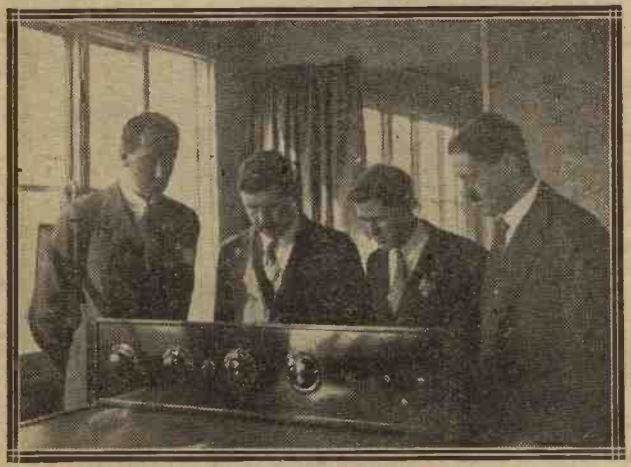
PROFESSOR L. A. HAZELTINE availed himself of the opportunity of visiting the Radio Press Laboratories at Elstree within a few hours of landing in England. He was received by Mr. John Scott-Taggart, Mr. J. H. Reyner, and Mr. Percy W. Harris. Professor Hazeltine was first shown some of the latest Radio Press receiver designs, after which interest was centred on the famous "Elstree Six" receiver.

Praise for the "Elstree Six"

A number of stations were tuned in on this receiver, and Professor Hazeltine expressed his great appreciation of its sensitivity. After handling the instrument himself he pronounced his opinion: "This is certainly equal to the best I have heard in America! I should imagine the selectivity is as great as it is possible to get without cutting off side bands and introducing distortion."

Professor Hazeltine was much impressed by the performance of the receiver in clearly separating London and Cardiff, and remarked that the problem of separating them was greater than the similar problem in New York. His opinion on the quality of reproduction from the "Elstree Six" was summed up in the one word, "Excellent!"

Outside the Radio Press Laboratories at Elstree (left to right) Mr. Percy W. Harris, Mr. John Scott-Taggart, Prof. L. A. Hazeltine and Mr. J. H. Reyner.



The "Elstree Six" was the centre of attraction (left to right) Mr. Scott-Taggart, Prof. Hazeltine, Mr. Reyner and Mr. Harris.

What America is Doing

A number of questions put to Professor Hazeltine elicited the information that listeners in America at the present time are making an increasing demand for multi-valve receivers, five- and six-valve sets being in common use. More attention than in the past is also being paid to the quality of the reproduction obtained, the craze for mere distance in reception, irrespective of the quality of the results, being on the wane.

Battery Eliminators

It is not infrequently supposed in this country that American listeners are now able to dispense with batteries for their receivers almost entirely owing to the large number of satisfactory "battery eliminators" which are available over there. Professor Hazeltine, on the other hand, after testing a large number of these devices, still prefers to use batteries for high-tension supply. In general, the results with the battery eliminators are good, and progress is being made so that, in his opinion, the electric light mains will be used almost exclusively in the future.

A Word for Radio Press

Before leaving the Laboratories, Professor Hazeltine complimented Radio Press, Ltd., on the whole equipment and on the work which is being carried out there. In his own words, "The Laboratories are very well equipped for the work they have to do, and both listeners and the trade should be very grateful to Radio Press for the work they are doing in serving the art."

Professor Hazeltine Honoured by "The Wireless Dealer"

ON July 15 Professor Hazeltine was the guest of honour at a luncheon given at the Savoy Hotel by the proprietors of *The Wireless Dealer*. Nearly a hundred guests were present, including Mr. Willis H. Taylor (of the Hazeltine Corporation), Sir Edward Marshall Hall, K.C., Captain Ian Fraser, M.P., Captain P. P. Eckersley, Capt. H. J. Round, Lieut.-Commander Kenworthy, Lieut.-Colonel Eric Ball, the Press, and a large number of representative members of the industry.

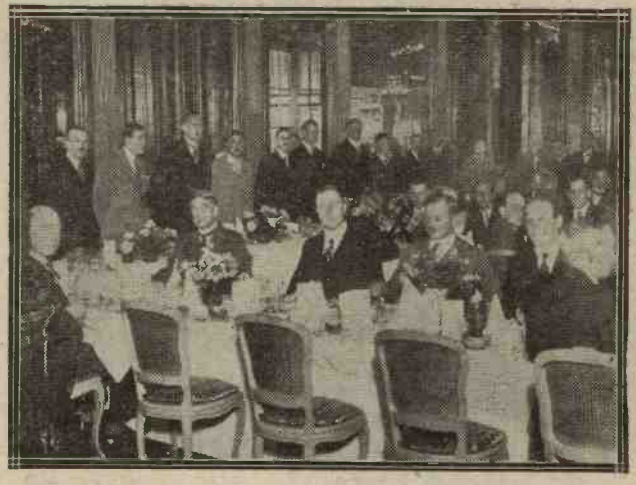
Mr. Percy W. Harris, who was in the chair, welcomed Professor Hazeltine, who replied in an important speech reviewing the steps which have led to modern wireless.

A Review of Radio

After dealing with such important developments as tuning, rectification and the three-electrode valve, with due homage to the pioneers, Sir Oliver Lodge, Dr. Pupin, Professor Fessenden, Professor Fleming, Dr. de Forest, and many others, Professor Hazeltine passed on to the effect on radio design and practice of the neutralisation of capacity coupling in valve circuits.

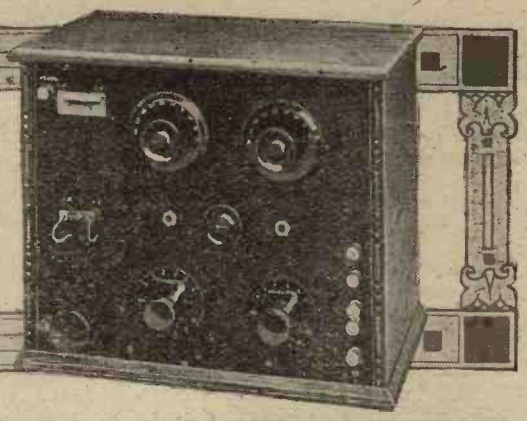
Who Invented the Neutrodyne?

"For the last step in the neutralisation of capacity coupling in valve circuits," said Professor Hazeltine, "we shall have to straddle the Atlantic, for Scott-Taggart in England and the speaker in America almost simultaneously developed a stable tuned high-frequency amplifier, a type which has made a profound impression on the wireless art and which no less an authority than Captain Round has strongly endorsed. I feel that while we in America call the receiver the Hazeltine Neutrodyne we should in England call it the Scott-Taggart Neutrodyne."



Prof. Hazeltine was the guest of honour at a luncheon given by "The Wireless Dealer."

WHY DOES RECEPTION VARY?



Why does the receiver give excellent results one night and appear noticeably poorer within twenty-four hours? Is the receiver to blame, or what is the cause? Some of the probable reasons are discussed here, and cures for the trouble are suggested where these are possible.

ONE evening last week I was round at a friend's place listening to the new four-valve receiver he had just completed. My friend is the kind of man who is rather unduly fussy over details, and is possessed of an unusual degree of skill as regards constructional work. He has a keen ear for music, and has gone to great pains in this his latest pet to obtain the most perfect reproduction. Special resistances, special valves and everything special in fact have been called in to assist him in his search for fidelity of tone.

He lives near Kings Langley, and at this distance finds that, with the circuit he uses, four valves give him just that degree of loud-speaking that he requires.

Not Satisfied

On this particular evening a most enjoyable programme from 2LO was being broadcast, and the pure volume of sound issuing from the loud-speaker was nearly as good as it could be. My friend, however, was ill at ease. He kept getting up to make small adjustments to the set, he would alter the tuning a trifle, then reduce reaction a bit, then try slightly different values of grid bias on the L.F. side and so on.

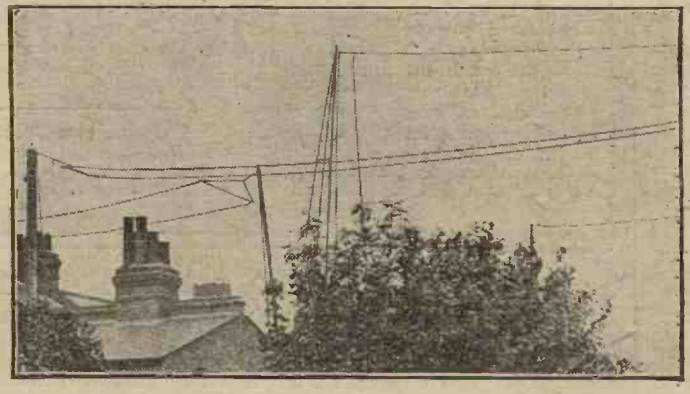
"What's up, old man?" I finally asked, somewhat irritated by the constant interruptions of the programme that resulted from his continuous fiddling.

"Well," he said, "that is just what I am trying to find out. Last night when I was listening to 2LO the quality was ever so much better than it is to-night, and I can't make out what it is due to."

Is the Receiver to Blame?

This led to a chat on the variations in conditions as affecting reception, and I was surprised to find that, beyond a vague comprehension of the fact that winter conditions were better than summer ones, my friend was totally unaware of many other circumstances that have their influence on wireless.

Many listeners probably do not realise that the B.B.C. are continually experimenting in methods by which their transmissions may be improved. Various types of microphone have been used from time to time, adjustments are made to the transmitter, etc., with the object of giving the best possible quality. Sometimes it happens that instead of quality being improved by a certain alteration, the reverse is the case, and the average listener promptly blames his receiver. There are other reasons, of course, within the set itself why quality may deteriorate, but these will be dealt with further on.



Variations in reception may easily be caused by the tuning of other receivers in the vicinity.

Fading

Another symptom noticed is that signals do not appear to be so loud as usual, and this may, of course, be due to a slight drop in the power used by the local station. There is another form of variation, however, which is due to totally extraneous causes, and one of these is short distance fading.

All experimenters are familiar with long distance fading, but it is not generally known that fading at short distances can take place. Experiments have been carried out which have ascertained the fact that without any alteration to the transmitter being made, the signal strength at quite short distances from it may vary quite appreciably; indeed, such variations have been observed at a distance of only three miles from the broadcasting station. In most cases this is probably insufficient to be observed aurally, although on occasions it may be fairly well marked.

Special Kinds of Fading

Another aspect of the fading question that has recently been investigated is what is known as "frequency fading," and definite indications of selective fading have been observed. This means that different frequencies which are actually within a narrow band fade in a different manner.

A simple example of three frequencies transmitted together is that of carrier waves modulated by an audio-frequency tone, say, of 250 cycles, thus producing three distinct frequencies which will be (1) the carrier frequency, (2) the carrier minus the tone frequency, and (3) the carrier plus the tone frequency. In the investigations carried out these three frequencies were separated at the receiving end, and after being amplified were fed to three oscillographs by means of which visible records were made.

These records showed that the carrier and side band signals did not fade together as a unit. At any given instant it might be found that the carrier was at a minimum, while both side bands were at different

Why Does Reception Vary?—*continued*

values, and it was also observed that the side bands and carrier would fade in various orders.

Distortion Due to Fading

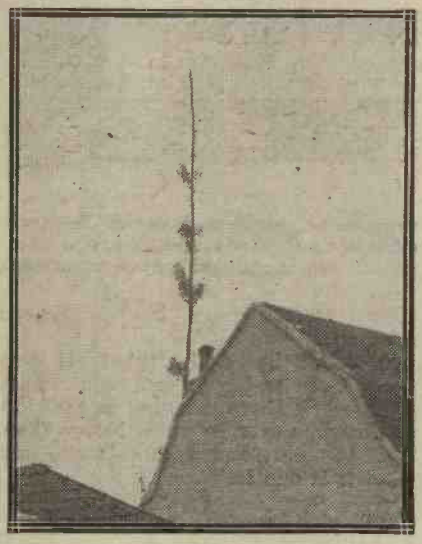
It is clear from the above that selective fading of this description may readily cause distortion, especially when weak or distant transmissions are being received. To this may be added distortion caused by the use of excessive reaction, and it is by no means difficult to understand why the quality of reproduction on distant stations is frequently poor.

Seasonal Variations

Earlier in this article I mentioned the fact that long distance reception is better in winter than in summer; similarly night time conditions are more favourable than day time conditions.

The two chief theories which have been put forward to explain these facts are, first, that since sunlight is propagated by ether waves the ether is not so free to carry wireless waves during daylight, that is the ether becomes too crowded, and secondly, that light causes ionisation of the atmosphere so that it becomes slightly conducting. This results in part of the energy of the wireless waves being conducted to earth and so lost.

The latter theory is that which is most generally accepted, though other considerations enter into it, with which it is not proposed to deal here.



This curious looking aerial mast decided to go on growing in spite of its new occupation.

Effects of Weather

Much work has also been done in trying to determine to what extent the state of the weather affects wireless reception. Most experimenters agree that wet, muggy weather seems to be the most favourable for long distance work. It is also claimed that reception is worse when the moon is full, while the other day I met an experimenter who had been studying the effect of the planets on reception.

It has been observed that reception during the day preceding a thunderstorm is poor, quite apart from whether atmospherics are present or no, while when the thundery conditions have ceased conditions are considerably better.

Sun Spots

About two years ago it was by no means a difficult matter to pick up three or four American transmissions in the early hours of the morning on quite a small set; WGY at Schenectady for instance could be received on a loud-speaker with only four valves. More recently, however, it has been exceedingly difficult to receive any of the American stations even with a super-heterodyne receiver. Basing the explanation of this on the presence of a cycle of sun spots, it is stated that conditions for picking up American broadcast stations will not improve again for three years.

(*Continued on page* 1020).

Why Does Reception Vary?—*continued*

(*Continued from page* 1018.)

A cause of poor reception, which is so far unexplained, is that known as "visitor's depression." I do not think this expression needs amplification, for I expect every amateur is familiar with the extraordinary deadness that comes over one's set when someone drops in to hear it.

Faults in the Receiver

There are other causes which result in poor reception taking the place of what but a few days ago was good. These lie either within the set itself or in the aerial-earth system.

A source of much trouble is the high-tension battery, especially when this is of the dry battery type. Perhaps a three or four valve set, with two stages of L.F. amplification is in use, and if the cells of the battery are small the current taken by the receiver may constitute a heavy drain, so that its voltage drops rapidly after a few weeks use. This results in distortion occurring on the L.F. side of the receiver owing to the plate voltage being too low, and even though the grid bias be reduced to a suitable value, it is still present because the second valve is overloaded on strong signals. Volume, too, is lost with a run-down H.T. battery, and it is important, therefore, to see that the H.T. battery is suited to the work it has to do.

An Easily Made Error

A mistake that everyone will no doubt label as childish is one that I made myself the other day. Its results were very marked, however, signal strength on stations like Bournemouth and Birmingham, which usually come in extremely well, was very poor, while the selectivity of the set was certainly not up to normal. After having tried a number of remedies, I happened to look at the low-tension accumulator and found that it had been connected the wrong way round. The accumulator leads were correctly connected as regards their polarity at the battery end, but had been reversed on the set.

Faults Outside the Receiver

If the performance of a receiver has deteriorated and everything is in order both as regards the set and its accessories, there are three other points where the trouble may be found, these are the loud-speaker, the aerial or the earth.

To test the loud-speaker, the set should be switched on and one of the loud-speaker leads alternately disconnected and connected. Good loud plonks should be heard every time this is done. If these do not occur either the loud-speaker winding has broken down or else the magnets may have become demagnetised. The continuity of the winding may be tested with a pair of 'phones and a dry cell, while if the magnets are in order they should be able to suspend the diaphragm placed edgewise against them with the base turned upside down.

Inspect the Aerial System

If the aerial is suspected, it should be carefully examined to see whether any joints in it have become corroded, and the insulators should be carefully cleaned. As slight a thing as a spider web has been known to result in a serious reduction in signal strength, and one case I came across recently was due to the virginia creeper on the house having twisted a tendril round the supporting wire and so on to the aerial close to the lead-in.

In cases where a buried earth is used, it should be kept moist, for in very dry weather its efficiency may seriously diminish, while if an earth connection to a water pipe is used, the wire lead should be examined for a break. The earth clip may also be removed, and the pipe around which it is fixed may be cleaned up with some emery paper, so as to ensure that the contact at this point is satisfactory.

C. P. A.

POINTS FOR THE SHORT-WAVE OPERATOR

(*Concluded from page* 980.)

low-tension supplies and of the grid leak have been dealt with satisfactorily, it may still be found that at certain settings of the tuning condenser the set either refuses to oscillate altogether—this being the most common state of affairs—or else that it oscillates much more violently on some settings than on others. A cure for this trouble is often to be found in fitting a series fixed condenser in the aerial lead, in order to change the natural wavelength of the aerial. If this does not altogether put matters right, the effect of a variable condenser should be tried, though in this case care should be taken that the condenser is never set to a lower value than about .0001, or else signal strength will suffer.

Indoor Aerials

An alternative is to try the effect of a counterpoise instead of a direct earth connection. A few feet of insulated wire laid across the room under the carpet will usually suffice, though, if space permits, it will be as well to experiment with a wire of greater length erected a few feet above the ground under the aerial. It may be mentioned here that for reception below about 100 metres an indoor aerial will often be found quite efficient, the comparative freedom from atmospheric disturbances resulting from its use, especially in the summer, amply compensating for the decrease in signal strength experienced.

Conclusion

Generally speaking, in short-wave reception, as compared with broadcast reception, a great deal more care and attention to detail is required to get really good results. This applies specially to the operation of the receiver, but at the same time it should be remembered that it is not enough to construct a receiver that will oscillate and which can be controlled to a certain extent. It is essential, in view of the finer tuning involved, that the controls work smoothly and accurately, not only in a mechanical but also in an electrical sense.

HAVE YOU SEEN
THE
ANNOUNCEMENT
On PAGE 997
IN THIS ISSUE?

PRACTICAL WORKSHOP HINTS FOR THE HOME CONSTRUCTOR

A Neat Tool—Cutting Aluminium—Opinions Differ—Notching Low-loss Formers—Re-conditioning Old Tools—Curing Intermittent Contacts.

A NEAT TOOL

I AM not, as a rule, fond of combination tools, which have a way of performing a multiplicity of duties rather badly and none of them very well. Particularly do I loathe pliers intended to do a dozen different jobs, and the kind of "tool pad" that can be converted in a second or two from a corkscrew to a gimlet or a gouge. But the other day I bought one of the neatest little combination screwdrivers that I have ever seen. This tool, which is seen in Fig. 1, is only 4½ in. in length when the blades are detached and stowed away in the opening with a most ingenious trap-door covering which is provided in the handle. It can, therefore, be carried in one's pocket or kept in a drawer of the wireless table for use when it is wanted.

Blades For All Purposes

The blades, which are made of excellent steel, are double ended, and one has thus a set of four screwdrivers with widths of ⅛ in., 5/32 in., 3/16 in., and ¼ in. As they are ground to various degrees of fineness, one can deal with every screw that is used in wireless construction from the smallest to the largest. To fix a blade in position the milled collar is given

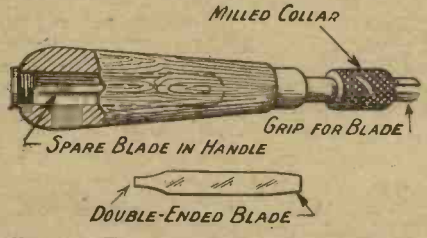


Fig. 1.—This neat type of screwdriver with blades of different sizes should prove valuable in any workshop.

half a turn in an unscrewing direction. The blade is then thrust into the grip and the collar is given a half turn with a screwing-in motion. This makes the blade absolutely rigid. With the blade mounted the tool is 6¼ in. in length, an extremely handy size for the wireless man. I can recommend these little tools as thoroughly well made and as most convenient for wireless work.

CUTTING ALUMINIUM

I HAVE met several constructors lately who, after essaying the job of making their own neutralising condensers, have come to the conclusion that aluminium is by no means such an easy material to work as might be thought at first sight. The business of cutting out the little vanes, fixed and moving, from old standard condenser plates is, however, not really a difficult one if you tackle it in the proper way and use suitable tools for

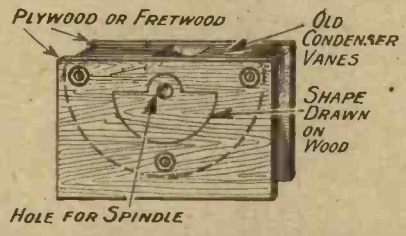


Fig. 2.—This method of cutting out the vanes for small condensers ensures that the finished vanes are flat.

the purpose. The best way of proceeding is as follows:—Begin by clamping as many plates as you require between two pieces of plywood or fretwood, as shown in Fig. 2.

Drilling for the Spindle

Draw the shape of the small vane to be cut on one of the pieces of wood and drill a hole for the spindle before starting to cut. If the plates are clamped up really tightly little or no burring will result when the drill is passed through. Care must be taken to see that the drill does not clog, for aluminium is such soft stuff that it is very liable to fill up the flutes with a solid mass of metal quite close to the point of the drill. Having made this hole, place the clamped-up plates in the vice and cut round the lines that you have drawn to indicate the shape required, using a fretsaw for the purpose. A strong blade of the kind intended for use upon hard wood should be used, or, better still, a blade made for cutting thin metal. If you go carefully you will have very little difficulty in shaping your plates quite accurately.

Finishing the Vanes

They may now be unclamped and finished up. First of all scrape the edges of each with an old knife to remove any roughness; then lay a sheet of fine emery cloth on the bench and rub each plate upon it, pressing it down firmly with the fingers of the right hand. Next clamp the plates together again by passing a bolt through the spindle hole, fix tightly in the vice, using lead protectors over the jaws, and file the edges true, using an *old* file for the purpose. The work must be arranged so that only a small portion protrudes above the jaws of the vice, and filing must be done very gently or the outer plates will be bent. A final smooth up with emery completes the job.

A Warning

On no account should a good file be used for any kind of work upon aluminium, for this soft metal will rapidly clog it up, forming little "blobs" all over its surface which defy the efforts of the stiffest file card to remove them. If a good file has been used inadvertently and has become clogged up in this way, the only method of clearing it is the rather laborious one of picking out the lumps of metal with the point of a scriber or some similar tool.

OPINIONS DIFFER

IN a recent issue of the *Wireless Constructor* a colleague published a most interesting and most informative article on the subject of working ebonite. I was, however, rather surprised to notice that he stated that he himself regarded the tapping of ebonite as an awkward job owing to the liability of the material to heat up and soften in the process. Personally I am a confirmed "tapper," using screwed holes in preference to those of the clearance variety whenever it is a question of fixing anything that is required to "stay put."

Practical Workshop Hints—*continued*

Making Terminals Secure

Take the case of terminals; if you fix one into a clearance hole by means of a nut on the underside of the panel and then solder a lead to its shank, it is more than likely, however skilful you are with the soldering iron, that the terminal will loosen. You can tighten it up again by means of its nut, but if you exert a certain amount of force in attaching or detaching leads later on, or if the process is frequently repeated, a time will come sooner or later when the terminal becomes loose. But fix your terminals in screwed holes, locking them with a nut below, and you can rely upon them to stay tight indefinitely, even if connections are frequently made and unmade, and if the milled nut is turned really hard down every time.

The whole secret of tapping ebonite successfully lies in observing two rules. The first of these is to use best quality second-cut taps and the second is to employ, as suggested recently in these notes, a drill slightly larger than the standard tapping size. If these points are observed, the tap may be placed in the chuck of the hand-drill, and, in the case of ebonite up to ¼ in. in thickness, run quickly in and out without the slightest trouble.

NOTCHING LOW-LOSS FORMERS

THE only satisfactory method of air-spacing the windings of coils made upon low-loss formers is to provide some kind of notches in which the turns can lie. If this is not done they are certain to become displaced when the coil has been in use for a little time, to the detriment both of its appearance and of its efficiency. If the former is of the skeleton type made up of strips set edgewise in circular endpieces as seen in Fig. 3, the notches may be cut with a hacksaw, so long as the spacing is fairly

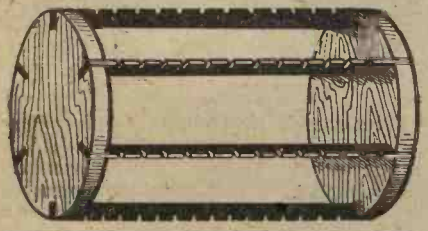


Fig. 3.—The notches in a former of this kind may be made with a hacksaw if the spacing is fairly wide.

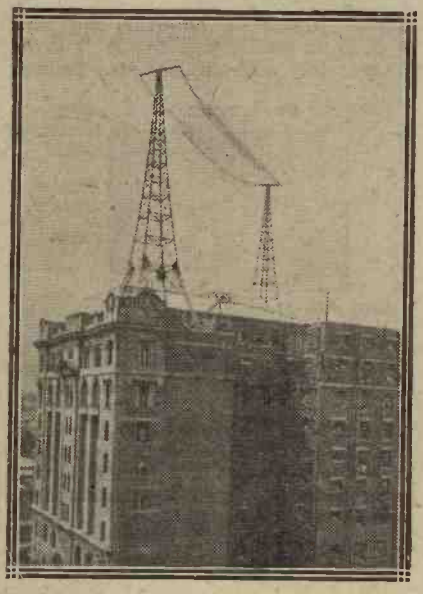
wide. To do this the strips must be clamped together in the vice, and the positions of the notches carefully marked. All can then be cut together with the hacksaw. Matters become more difficult when fine wire is used. No. 30 d.c.c., for example, makes forty-four turns to the inch when closely wound, and if we wished to make the spacing equal to the diameter of the wire we should have to make twenty-two hacksaw cuts to the inch, which would be, to say the least of it, a somewhat tedious business. Even with a very fine-bladed hacksaw it would be almost impossible to make a good job, since the thin webs between the cuts would be apt to break away.

For Fine Wire Coils

Luckily there is no need to notch deeply, for mere scratches will serve

Fig. 4.—An outside thread-chaser will be found useful for notching a former when the turns are to be close.

to hold fine wire in position. The job may actually be done quite easily in the following way. Having clamped the strips tightly in the vice with their edges uppermost, file them until a level surface is produced. Now take



This finely situated aerial is owned by the station 4QG, in Brisbane.

an outside thread chaser (Fig. 4) designed for making the appropriate number of threads to the inch, lay a set square across the strips and use the chaser as if it were a scriber. Continue in this way for the whole length of the strips and you will find that the scratches produced will serve to keep the windings in place. Chasers can be purchased for about a shilling apiece. Moulded tubular low-loss formers with fins can be notched very easily with a chaser. If a lathe is available the former should be mounted in it, when the job can be done quickly. A substitute for the chaser may be found in a rather coarse ¾-in. flat file, which if held against the fins as they rotate will notch them quite satisfactorily. Where a lathe is not available it is usually not difficult to get the work done by a friend who has one, or at a cycle repair shop.

RE-CONDITIONING OLD TOOLS

EVERY workshop contains a number of old tools which have been discarded because they have become damaged or worn. Many of them may be reconditioned quite easily, so as to be capable of giving useful service again. A broken screwdriver, for example, can be filed up into shape without much trouble, and if the work is done carefully it is often better than it was when it was new, since the blades of screwdrivers are not always of the ideal shape when they are purchased. When you are filing up a screwdriver let your first care be to make the edge straight. Next place it in the notch of a 4 B.A. screw and hold the two up to the light. The perfect screwdriver should exactly fit the notch, going right down to the bottom of it and having the same slope upon the faces of its blade. If the driver is shaped in this way it will never slip. Broken scribers, again, can be re-pointed with the file, though if they are very hard it may be necessary to let them down and to re-temper them afterwards.

Keep Your Tools Sharp

A tool which is often in a bad condition in the constructor's workshop is the centre-punch. After repeated use with even such soft material as ebonite the point becomes blunt and accurate punching is almost a matter of impossibility. File up your centre punch every now and then, placing it in the vice and working round the tool, turning it after every few strokes. Centre bits and auger bits which have lost their original keenness may be sharpened readily with a fine file. It is particularly important with these to keep the vertical cutting edges sharp, since if they become blunt the wood is apt to be torn as the bit goes in, and a ragged edge results.

CURING INTERMITTENT CONTACTS

IN variable condensers and in other components with moving parts a bad contact frequently develops after a varying period of use, owing to the wearing of the spindle or of the bush through which it passes. A faulty

PRACTICAL WORKSHOP HINTS—*continued*

contact of this kind may be cured very easily in the way seen in Fig. 5 by placing a thin spiral spring over the spindle and fixing it with a nut and locknut so that it is slightly compressed between these and the bush. Some constructors use a spring washer

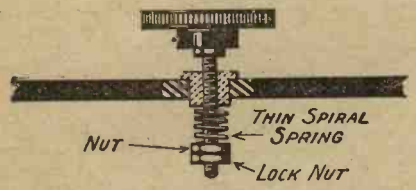


Fig. 5.—Showing how an intermittent spindle contact may be put right.

for the purpose, but this is not to be recommended, since such washers have a way of making the movement of the spindle rather harsh at certain points in its travel. What is wanted is quite a thin spring, and if this is used the easy movement of the spindle will be in no way impaired. The spring can be fitted in any suitable position; it may, for example, be placed between the knob and the upper flange of the bush, or, in the case of a variable condenser, it may be set to press against the bush in the lower end plate.

STRAIGHTENING WARPED EBONITE

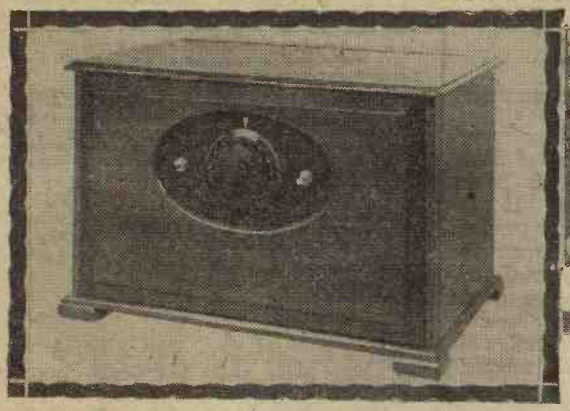
EBONITE that has been in one's workshop stock for some time, particularly if it has not been properly protected from the effects of heat and cold, may be found to have warped rather badly when it is brought out for use. Certain grades of ebonite are much more prone to warping than others; material of really fine quality will stand a good deal of ill-treatment without becoming badly affected, but poor stuff will sometimes become very much warped for no apparent reason. A warped panel may often be brought back to the true by a little careful treatment. A method that I have frequently found successful is as follows:—Immerse the panel in hot water for a short time, then place it upon a perfectly flat surface. Cover it with a sheet of glass, and on top of this lay a number of fairly heavy weights. When the ebonite is cool an improvement will generally be found to have resulted, though it may be necessary to repeat the process before it becomes perfectly flat again.

Should the surface of a panel assume a horrible sickly greenish hue as the result of this treatment or of exposure to light, its own good colour may be brought back again quite easily. Rub off the surface with an oily rag dipped in knife powder, taking care to work in straight lines and not with a circular motion; then wash over with a little turpentine, and give a final polish with an old piece of silk.

The problems of television are engaging the attention of scientists all over the world, and this Japanese inventor is said to have devised apparatus for sending moving pictures by wireless.

BOTCHING WITH THREADED ROD

MOST of us have lying about in our workshops a number of old ebonite panels of various sizes from complete sets or from smaller pieces of apparatus which have been dismantled. These contain holes of various sizes, and either remain disused or are cut up somewhat wastefully when small pieces of insulating material are required. By the use of threaded ebonite rod an ebonite panel can be "botched" so neatly that when the job is finished it looks almost as good as new. To stop a 4 B.A. clearance hole, for example, a piece of 3-16 in. threaded ebonite rod may be used. The hole is tapped 3-16 in. and a little piece of rod previously smeared with Chattertons compound, is screwed in. The rod is cut off flush, and when the panel has been well rubbed down with knife-powder and oil there is hardly a sign to be seen. Even large holes may be dealt with in the same way. A $\frac{3}{8}$-in. hole can be stopped with 7-16-in. rod, a 2 B.A. hole with $\frac{1}{4}$-in. rod and so on.



CONSTRUCTING A RECEIVER
SOME USEFUL HINTS

By D. J. S. HARTT, B.Sc.

Practical experience is the best guide to set construction. If you are an old hand, you will appreciate the practical worth of the information given here, while those who are new to the art will find much valuable assistance.

THERE are a number of points in set construction with which it is not always possible to deal in any detail in an ordinary descriptive article; so for the benefit of the beginner interested in set-making it is proposed to devote this article to a consideration of the most important of these.

Tendencies in Design

At one time practically all our sets were made up on a horizontal panel

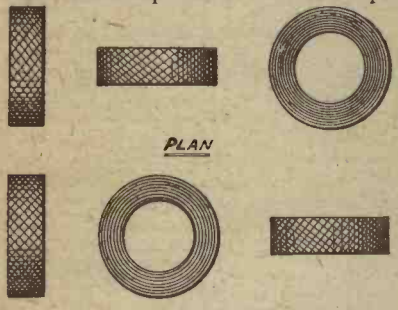


Fig. 1.—Undesirable coupling effects between coils may be minimised by placing them in the positions shown here.

which fitted into a "tray-type" box. This method had certain disadvantages, chief amongst which was the fact that the valves were completely exposed and consequently liable to injury through accidental knocking, etc. The rapid accumulation of dust on the surface of the panel and the components mounted thereon was another factor which led set designers to look for some more satisfactory method of assembling a receiver.

A vertical panel was less likely to harbour unwanted dust, and it was obviously a distinct advantage to protect the valves and other components by enclosing them in a cabinet, so that the American layout, comprising a vertical panel and sliding baseboard fitted into a cabinet, came into being. This method has now been generally adopted in this country, a further improvement being the provision of hinged doors or a drop front to the cabinet, so that the whole could be completely enclosed, thus still further protecting the panel from the bad effects of light and the accumulation of dust.

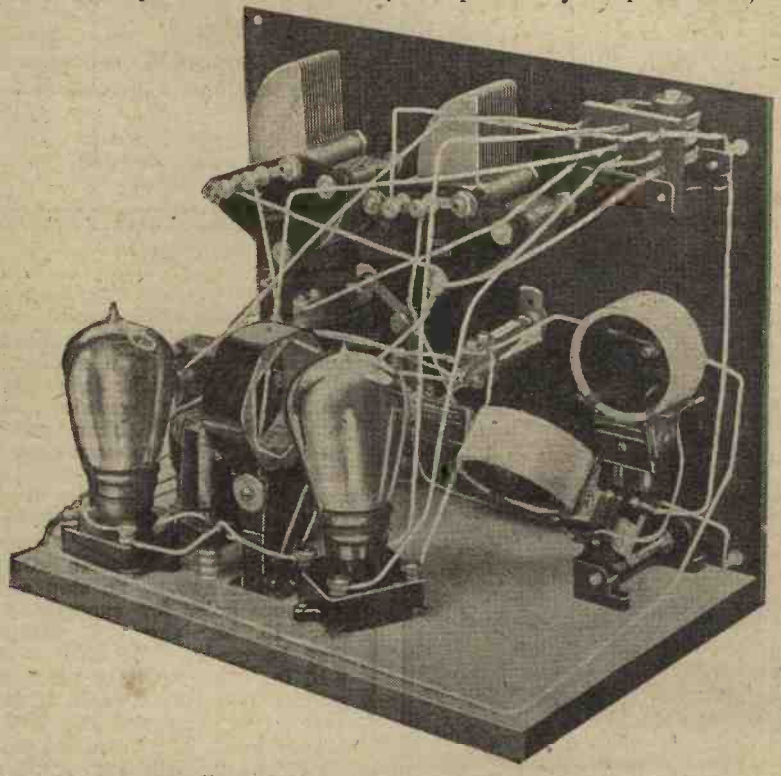
Positions for Components

Granted, then, that this represents about the best method for amateur construction, there has consequently been a large increase in the number of components suitable for mounting on the baseboard. The panel is, as a rule, used only to mount the variable controls, such as tuning and reaction condensers, filament resistances and jacks.

For small sets, having panels not more than 8 ins. by 6 ins., it will therefore usually be sufficient to secure the panel to the front edge of the baseboard with three or more wood screws, preferably countersunk flush with the surface of the panel. When the panel is larger or has to support heavier components, two angle brackets should be used, one at each end.

Fixing the Panel

First of all, then, place the panel against the front edge of the baseboard on a flat surface, and with a steel scriber scribe a line on the back of the panel to represent the level of the top surface of the baseboard. Then place the angle brackets in their correct positions against this line and mark the position for the drilling centres of the holes for the fixing screws. It is customary to drill and countersink these holes and to use flat-headed 4 B.A. screws, but those who object to the appearance of a number of screwheads on the front of the panel may adopt the alternative though more difficult method of drilling blind holes and tapping them.



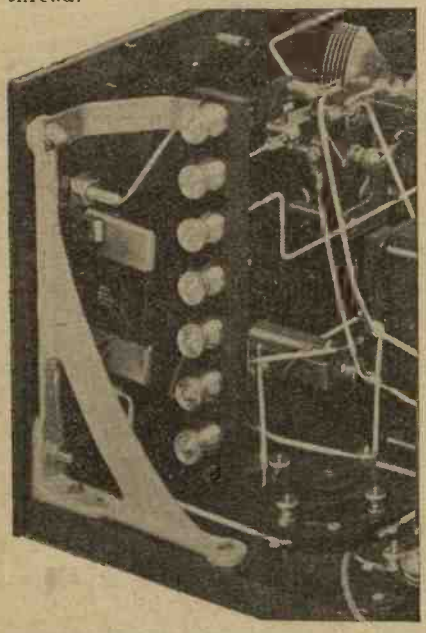
In laying out a set, "make sure there is adequate clearance between the valve and other parts of the set to allow of vibration."

"Blind" Holes

These holes should be drilled with

Constructing a Receiver—*continued*

great care so as to penetrate about three-quarters of the thickness of the panel from the back, and then carefully tapped. The ordinary type of tapered tap is not of much use here, except for starting, and a special tap which is about the same thickness throughout its length should be used. Short screws are necessary, of course, and these will probably have to be cut with a hacksaw and carefully finished with a file so as not to damage the thread.



This method of arranging the terminals only involves the drilling of one hole for the leads instead of cutting a wide slot in the cabinet.

Wood screws are used to fix the brackets to the baseboard.

When you have completed this job, see that the panel and baseboard slide easily into the cabinet. It is always a wise plan to order the baseboard one-eighth of an inch shorter than the panel, though most cabinet manufacturers now allow this margin. The width of the baseboard should be equal to the total depth of the cabinet from the front of the panel minus the panel thickness, one-eighth of an inch being deducted from this to allow for easy fitting. In general, the width of the baseboard will be approximately equal to the panel height, *i.e.*, about 6 to 8 ins. in most cases. This will usually give adequate room for the components on the baseboard.

Smaller Panels

As I mentioned previously, it is usual to mount only a few components on the panel, and there is often an unnecessarily large waste of ebonite. To save the expense of an unduly large panel and enhance the appearance of the set, a polished wood front panel containing an opening may be provided, behind which is screwed a rectangular panel sufficiently large to allow of an attractive and symmetrical layout of the controls. An example of this method of construction is shown in the photograph on the preceding page.

Filing Ebonite

Often you will find that the panel and the baseboard, when screwed together, do not quite fit into the cabinet. Ascertain carefully which of the edges of panel or baseboard is preventing an easy fit, and then use a fairly coarse file on the baseboard and a smoothed file on the panel. Filing the edge of an ebonite panel is rather a tedious business, and if you have to remove much ebonite I would recommend you to try scraping the edge with a penknife blade, holding the blade firmly so that it is perpendicular to the edge. The ebonite can be removed much more rapidly and cleanly by this means. This tip will be useful if you do not buy your panel ready cut to size and have to square it up and finish it yourself. To give a dark finish to ebonite which has been treated in this way, just rub it over with a rag dipped in methylated spirits and smeared with a trace of vaseline.

Mounting Components

If you follow a published design, you will have no difficulty in assembling and mounting the components on the panel and the baseboard. Every set designer aims at a reasonable compactness, combined with adequate spacing and easy wiring facilities, and in the case of Radio Press designs you cannot do better than follow the layout exactly.

In other cases arrange your components in such positions that the wiring is fairly direct and yet not unduly cramped. Designing the layout of a set is rather like putting together a jigsaw puzzle, and when an apparently satisfactory arrangement is arrived at, it must be tried experimentally to see that it is quite satisfactory.

All coils, H.F. transformers, L.F. transformers, L.F. chokes, etc., must be placed in such positions that the risk of interaction is minimised. Also do not place any large metal parts, such as variable condensers or transformers, in positions where the field of a coil is strongest. Single-layer and most multi-layer coils have their strongest fields at the ends of the axis passing through the centre perpendicular to the plane of the winding.

Additional Precautions

If you are using one of the many types of anti-shock valve holders, as you probably will, make sure there is adequate clearance between the bulb of each valve and other parts of the set to allow a reasonable amount of vibration without the risk of knocking the bulb, since the glass may easily be broken in this way.

The line you have previously scribed on the back of the panel to indicate

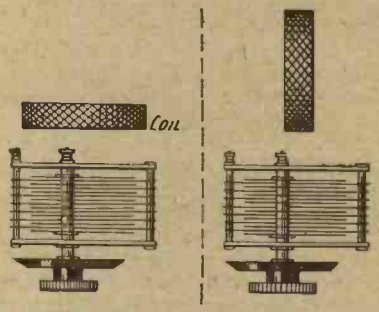


Fig. 2.—A coil should not be fixed so that it has in its field a large mass of metal. The position shown on the right is more satisfactory.

the level of the top surface of the baseboard will serve as a guide in mounting the panel components. Make quite sure that no part of any component overlaps below the line before drilling the panel.

Terminal Strips

It is customary nowadays not to have any terminals on the panel, but to mount them on ebonite strips attached to the back edge of the baseboard. Corresponding holes are cut in the back of the cabinet to make room for these strips when the panel and baseboard are pushed in. This method certainly obviates the use of untidy leads to the front of the set, but makes the cabinet rather unsightly. A scheme to be preferred, and one which was used in the "Riverside Four," described by the present writer in the July issue of *Modern Wireless*, is to mount the terminal strip vertically on the baseboard inside the set with the aid of suitable brass brackets. The various battery leads can then be bunched together and brought out through a *small* hole in the cabinet at some convenient point. With such an arrangement you will find the combined battery and loudspeaker leads sold by many makers very useful.

Hints on Soldering

You will meet with very little success in the construction of a modern receiver until you acquire a certain amount of skill in the use of the soldering iron. Many components are fitted only with soldering tags, so that connections must be soldered. Other components have terminals and some are equipped with both. The terminals are exceedingly useful for rough experimental and "hook-up" work, but the more permanent soldered

CONSTRUCTING A RECEIVER—*continued*

connections are best for a finished instrument.

There is nothing difficult about soldering, provided that a few elementary principles are mastered and that you follow instructions carefully.

Equipment You Will Need

First purchase a good soldering bit from a reputable tinsmith. I have a bit in my possession with which good soldering is impossible. I have often tried to master the idiosyncrasies of this bit and "tame" it, but without success. I can only conclude that the copper is of very poor quality, otherwise it would be an easy matter to tin it and use it successfully

Obtain also a tin of "Fluxite" or other good soldering paste, some fine emery cloth, an old, fairly smooth file, and a stick of good solder. Purchase the solder from a plumber and prefer the solid sticks to the thin, hollow ones of fancy material, for which you will have to pay about ten times too much.

Keep Everything Clean

You are now in possession of all the material equipment you require; the possession of a normal amount of common sense completes the outfit. You cannot imagine two metal surfaces fusing in a solid, mechanically strong and electrically sound contact if each is covered with a coating of dirt and grease, so do not try to coerce them into doing so with the aid of a soldering iron covered with dirty scale and copper oxide, aided and abetted by an eightpenny tin of "Fluxite." This is an excellent material and helps a lot, but if you plaster it on it will not help you to achieve what is practically impossible.

Tinning the Iron

Thus the first essential of good soldering is *cleanliness*. *Clean* soldering bit, *clean* surfaces, *clean* flux, and *clean* solder; it is easy if you use a file and a piece of emery cloth. First, then, heat the bit, preferably in a non-luminous gas or spirit flame, which does not deposit soot. Allow it to remain until the edges of the flame become tinged with green. Then remove it and rapidly brighten and smooth the surfaces with the file. Replace it for about ten seconds in the flame and then dip the end momentarily into the flux and immediately apply it to a piece of solder placed in a clean tin lid. If you have followed these instructions you will find the solder runs all over the tip of the bit, covering it for about half-an-inch. After removing the bit from the solder, rub it rapidly with the emery cloth. The whole tinned surface will then become as bright and clean as new silver, and the "iron" is ready for use.

Wiring a Receiver

Next proceed to clean with emery cloth the surfaces to be soldered, and apply with a clean matchstick just a small trace of flux, just sufficient merely to smear the surfaces. Then place the iron back in the flame so that the flame does not touch the tinned portion, until the green tinge appears again; dip the bit momentarily into the flux and apply to the solder.

The universal appeal of broadcasting is shown by the satisfied expression of these listeners on a Thames barge.

A globule or "blob" of molten solder will adhere to the end of the bit. Apply the bit to the surfaces to be soldered, and if the instructions given here have been exactly followed, they will each become coated with a film of clean solder. Another partial heating of the iron and the momentary application of a "blob" of solder will then result in a good soldered joint.

After removing the bit from the flame, it should take only a few seconds to complete the remaining operations, and thus many previously prepared surfaces may be soldered with one heating.

An occasional rub over with the emery cloth while the bit is hot will keep it quite clean; but as soon as the solder or flux becomes dirty, discard it for some clean material.

A CONVENIENT AERIAL TO EARTH ARRANGEMENT

THE aerial and earth leads are often provided with spade terminals which in turn connect to the receiver, and with this arrangement an aerial-earth switch is usually employed.

A very convenient indoor arrangement for effecting the aerial to earth connection when the receiver is not in use and also for making the necessary connections when signals are to be received is shown below, plugs and sockets being used in lieu of terminals.

The Arrangement

First remove the existing terminals upon the receiver which are intended

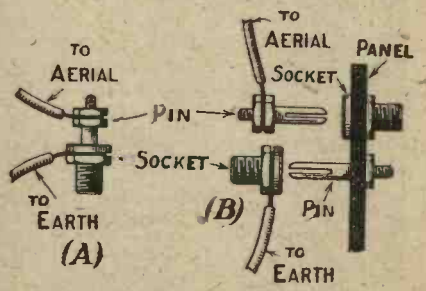


Fig. 1.—With this device it is impossible to connect aerial and earth the wrong way round.

for the aerial and earth connections, and in the place of the aerial terminal assemble a standard socket, while in the place of the earth terminal fix a standard plug or pin. Now equip the aerial down lead with a standard plug or pin and the earth lead with a standard socket, as shown at B in the diagram. By this arrangement it is thus impossible to connect hurriedly the aerial where the earth should go upon the receiver, or vice-versa.

The method of joining aerial to earth is shown in the diagram at A, the aerial down lead plug merely being inserted into the earth lead socket.

H. B.

LOUD-SPEAKER OR TELEPHONES?

(*Concluded from page 1004*).

of telephones usually raises his voice when speaking while "dressed" in telephones. So long as everybody in the room is similarly dressed, maybe the raising of a speaker's voice is not too irritating, but should there be also someone in the room who is not listening, then the added volume to the natural voice becomes most unpleasant.

We All Know This

Still a further disadvantage when wearing telephones is that should someone in the room be rustling a newspaper in the ordinary manner of turning over the pages, the noise experienced in the telephones is often enough to disturb one's hearing to such an extent as to obliterate a word or two in, say, an announcement. Particularly is this so if the signals are not too strong, as, for instance, in crystal reception.

An Important Advantage

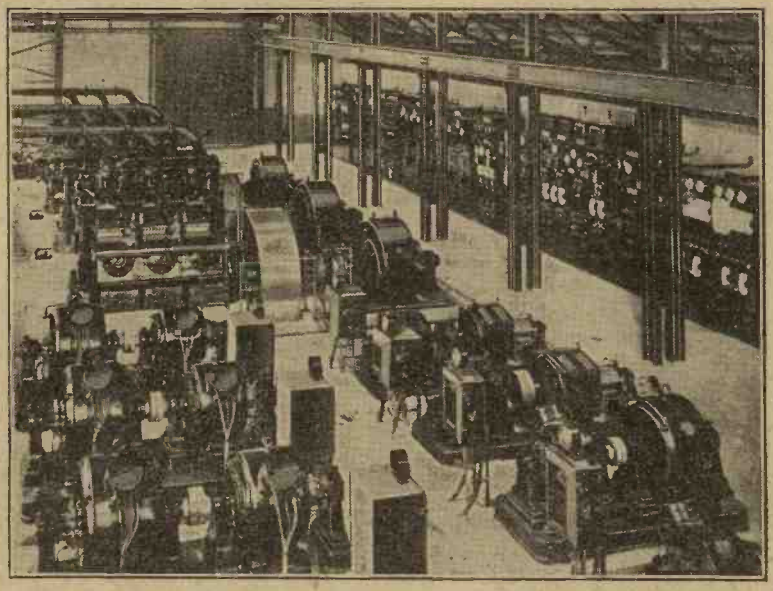
Of the advantages in using telephones there is that of confining the programme merely to those who wish to hear. That is to say, whereas with the loud-speaker everybody in the room is compelled at least to hear the programme, whether they wish to listen or not, with telephone reception the programme may be enjoyed only by those who wish to hear it, without in any way interfering with the occupation of others who may be present.

Economy with Telephones

On the question of economy in filament current, the use of telephones has much to commend it, for in these circumstances fewer valves need be used, and those that are used need not be run to their full limit. The matter of H.T. voltage also effects an economy, since nothing like the same amount of available voltage is called for, and similarly the valves themselves may be of the "general-purpose" type, thus further economising by reducing the initial cost and possible replacement bill.

Unsociability

Notwithstanding these latter points, the general feeling among listeners who use loud-speakers, and, let it be said, among many who do not, is that the telephones are in no way comparable with the loud-speaker, for the simple reason that much of the sociability of listening to a good radio programme is lost. Visiting friends become mute and stolid when wearing telephones, whereas opinions on the items may be expressed and discussed in the presence of a loud-speaker with perfect freedom and comfort.



A view in the generator room in the "beam" station at Bodmin, Cornwall, which forms part of the Imperial Wireless system of stations in process of erection in various parts of the country.

THE "DAVLOW THREE"

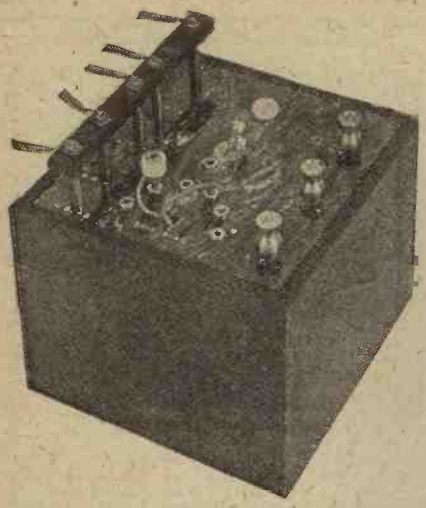
IN the article on the "Davlow Three" receiver, which appeared in the August issue of THE WIRELESS CONSTRUCTOR, the reference numbers for the blueprints of the front-of-panel and wiring diagrams were inadvertently omitted.

These are as follows:—Front-of-panel diagram (Fig. 3, on page 882), blueprint No. C 1054 A; wiring diagram (Fig. 4, on page 883), blueprint No. C 1054 B.

DO YOU USE GRID BIAS?

By GEORGE T. KELSEY

Here is a handy unit to attach to your set, suitable for applying separate values of grid bias to two valves. A high-tension fuse to protect the valves and a filament on-and-off switch still further increase its usefulness.



The grid battery is housed in the box, the leads on the left being for connection to the receiver.

THE unit, about which a description is to follow, might almost be termed triple-purpose, for although it is essentially a grid-bias unit, two other devices have been incorporated. The first of these two is a switch enabling the L.T. battery to be cut out of circuit when the receiver is not required for use, and the second a lamp in series with the H.T. negative lead, which serves the useful purpose of a fuse.

Why Use Grid-Bias?

Perhaps a few words at this juncture upon the need for grid-bias may be helpful.

To obtain fidelity of reproduction from a low-frequency amplifier, whether it consists of one or two or more stages, it is nearly always essential that grid-bias should be employed. Further, it follows that good volume is required if L.F. stages are being employed, so that the drain upon the H.T. supply may be heavy. The use of grid-bias in such an instance will bring about a reduced consumption of H.T. current, so that the effective life of the H.T. battery will be longer than would otherwise be the case.

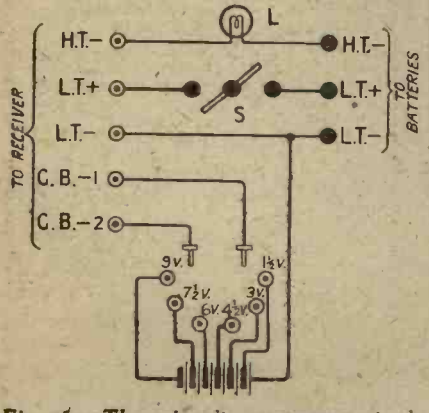


Fig. 1.—The circuit arrangement is simple and straightforward.

A Plug-In Connector

To facilitate the connection of the unit to the terminals of the receiver a plug-in arrangement has been incorporated. A length of ebonite equipped with five valve pins, spaced to avoid incorrect connection, forms the "plug," and to the left-hand side of the unit panel are fitted the necessary sockets.

The Circuit Arrangement

The circuit arrangement is shown in detail in Fig. 1. On the left of this drawing may be seen five sockets (marked "To Receiver") and the appropriate terminals to which they have to be connected. This drawing will be helpful in determining the points to which the sockets have to be connected under the panel. It will be seen that the grid-bias battery positive is joined direct to L.T. negative on the unit, and if the receiver is provided with a terminal for G.B. positive, no connection need be made to it.

Why Not Build It?

From the foregoing the usefulness of the unit will be obvious, and those who intend to construct such an instrument will require the following components:—

One Ebonart panel, 6 in. × 6 in. × ¼ in. (Redfern's Rubber Works, Ltd.).

One containing box for above panel.

Six Clix sockets and two Clix plugs (Autoveyors, Ltd.).

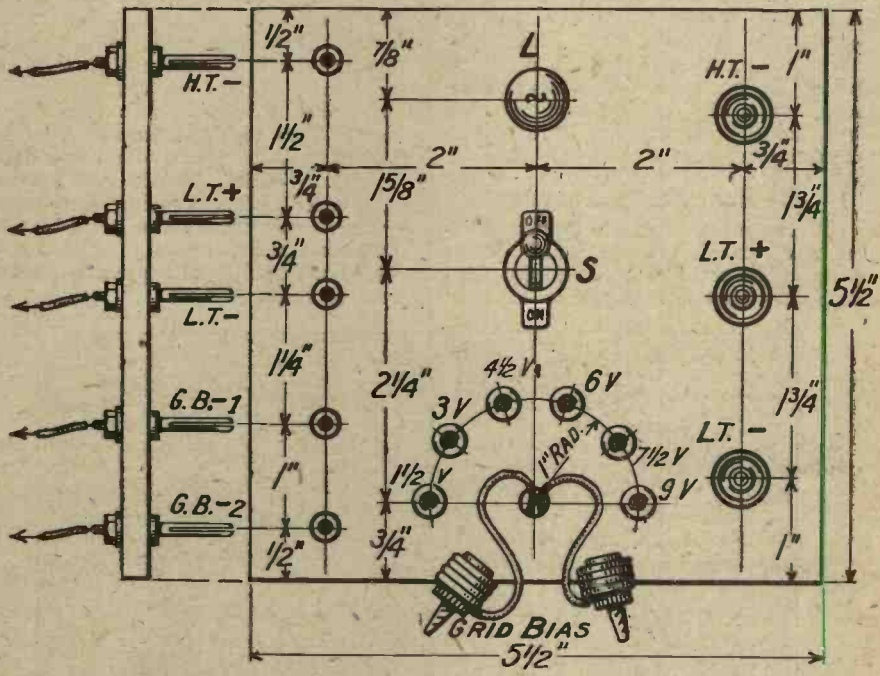


Fig. 2.—From the dimensions given here the panel may be marked out for drilling.

One "Trix" on-and-off switch (E. J. Lever).

One flashlamp bulb.

Three terminals, type W.O.

Five valve pins and five sockets.

Two flashlamp batteries.

Glazite and flex for wiring.

Radio Press panel transfers.

The panel, which is of standard size, should be cut down to 5½ in × 5½ in., one of the ½-in. scrap pieces forming the base of the "plug."

Construction

For the convenience of readers the front-of-panel drawing shown in Fig. 2 is fully dimensioned. If you mark your panel on the underside, remember that this drawing should be reversed. The drilling of the panel, and subsequently the mounting of the components, can now be started.

The lamp-holder of a disused flashlamp was used for mounting the bulb

Do You Use Grid Bias?—*continued*

on the panel, and the method of procedure is shown in detail in Fig. 4 As an additional refinement, and to dispense with soldering on to the end

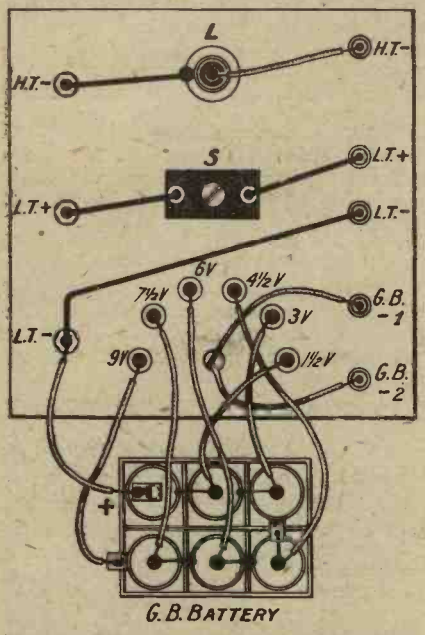


Fig. 3.—This diagram should be carefully followed when the cell connections are being attached.

contact of the bulb, it is quite a simple matter to arrange a spring contact. This, however, is left to the discretion of the reader.

Home Assembled Batteries

The 9-volt grid-bias battery (which should be tapped at every 1½ volts) can be purchased complete, or, as in the unit described, can be assembled from two 4½-volt pocket flashlamp batteries.

If two flashlamp batteries are chosen, proceed to strip off the outside cardboard covering, and remove sufficient of the pitch to enable soldered connections to be made to the contacts. If care has been exercised in stripping off the cardboard and pitch, the connections between adjacent cells will have remained intact; consequently it will only be necessary to join the negative pole of one of the outside cells on one battery to the positive of one of the outside cells on the remaining battery.

Connections

Now find a suitable cardboard box to hold the six cells, and place them in position with a dry cardboard partition in between each pair. The battery at this stage is shown in the lower half of Fig. 3.

The positive contact of this 9-volt battery should be connected direct to L.T. negative by means of flex wire, while the six Clix sockets are connected by flex to the six negative tapping points, that is, one to each cell, as shown in Fig. 3. It is a good plan, when the necessary soldering to contacts on the battery has been done, to melt some candle wax and to pour this all round and over the tops of the cells.

The few remaining connections required to complete the unit call for no special comment, since they are clearly shown in the wiring diagram. When the wiring is finished, apply the panel transfers and the unit will be complete.

Using the Unit

The complete unit is now ready for use, and should be stood next to the receiver with which it is to be employed. Connect the five pins on the "plug-in" strip to the correct terminals on the receiver proper, that is, H.T. negative to H.T. negative, and so on. It will be noticed that provision has been made for two G.B. negative tappings, but if three L.F. stages are to be used, slight modifications in the constructional work will be necessary.

A Safety Measure

The lamp placed in series with the H.T. negative lead is intended to act as a fuse, should the H.T. be accidentally placed across the filaments of the valves. Despite this precaution, and owing to the extreme fineness of some of the modern dull-emitter filaments, it cannot be guaranteed that the lamp will always burn out first. It is, however, certainly worth while incorporating such a device. The H.T. positive leads are taken direct to the H.T. battery.

WIRING IN WORDS

Join H.T.—terminal to lamp socket.
Join tip of lamp base to H.T.—socket.
Join L.T. + terminal to one side of switch.
Join other side of switch to L.T.+ socket.
Join L.T.—terminal to L.T.– socket.
All the above are stiff wire connections. The remainder are flexible leads.
Join L.T.—terminal to positive (carbon rod) of first cell of battery.
Join negative of first cell to 1½ v. stud of switch.
Join negative of second cell to 3v. stud.
Join negative of third cell to 4½v. stud.
Join negative of fourth cell to 6v. stud.
Join negative of fifth cell to 7½v. stud.
Join negative of last cell to 9v. stud.
Attach flex leads, each carrying a Clix plug, to sockets G.B.—1 and G.B.—2.

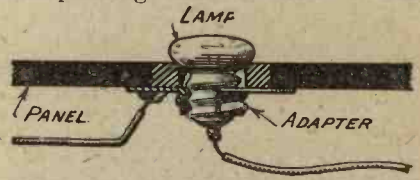
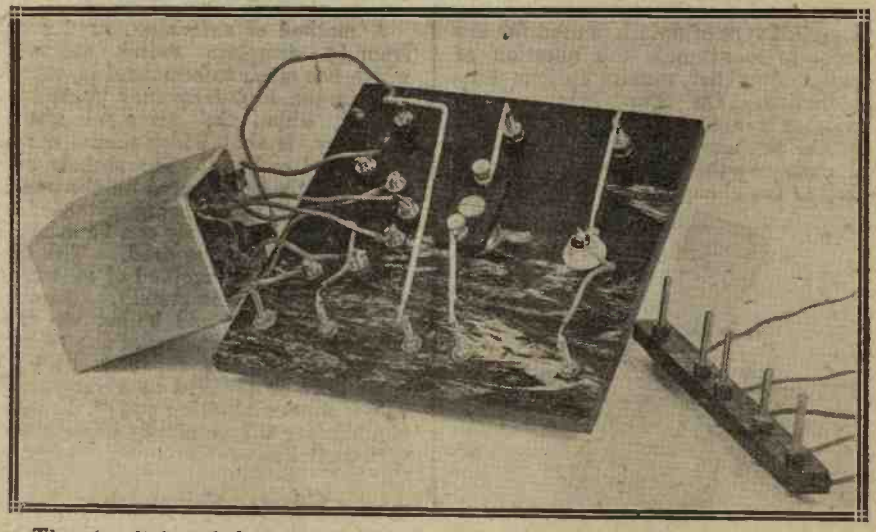


Fig. 4.—The lead on the right in this diagram may be soldered direct to the lamp as shown, or alternatively a spring contact may be devised.



The simplicity of the constructional work required will be apparent from this photograph. Sufficient lengths of flex should be attached to allow the battery to rest on the bottom of the containing box.

Conclusion

Perhaps a fitting conclusion will be to quote a rule-of-thumb method of determining approximately the correct grid-bias to employ. Find out from the side of the valve box, or from particulars contained therein, the *amplification factor* of the valve. Divide *twice* this number into the H.T. voltage in use, and the answer will be approximately correct.

SWITCHES AND SWITCHING METHODS

By H. DYSON

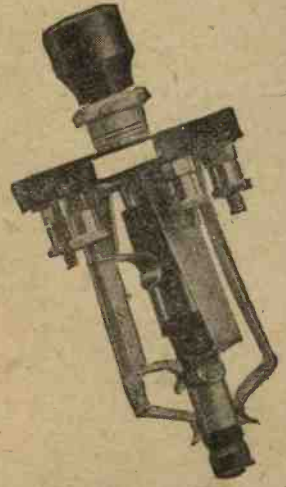
Switches are obtainable in a variety of forms which may tend to confuse the constructor who wants a switch to suit his needs. Some of the principal types of switches and the main features in their design are discussed in this article.

This type of change-over switch finds numerous applications in wireless circuits.

THE beginner in wireless constructional work is often advised to avoid the use of switches as far as possible. In general this may be taken to be good advice, since the inclusion of switches in wireless circuits usually involves a certain amount of complication in the wiring, and this is not desirable The incorporation in a receiver of one or two switches, such as those used for switching on and off the low- and high-tension supplies, need not as a matter of fact introduce any very serious wiring complications, provided that the switches are carefully placed relative to the other components in the receiver.

Uses of Switches

So long as a sound mechanical and electrical type of switch is used for the purposes mentioned, the question of design does not require serious consideration. On the other hand, switches for inclusion in the circuit for the purpose of providing a means of changing the number of valves in use, or for changing parts of the circuit in a similar way, must be chosen with more care, attention being paid to the suitability of the switch for the work which it is to perform.



A typical multi-contact push-pull switch. Only the knob and securing nut appear on the front of the panel.

This applies particularly to switches which are to be used in the high-frequency portions of a circuit, that is to say, in the parts of the circuit which carry high-frequency currents. The wrong type of switch in this latter case may lead to losses in the circuit, rendering the performance of the receiver poor, or perhaps even preventing it from functioning properly at all.

What is Wanted

Efficiency, then, is the first matter needing attention in the choice of suitable switches. Convenience is also necessarily of importance, the main purpose of the installation of switches at all being to avoid the necessity for the spending of time in making or changing connections. There are numerous types of switches available to the constructor, and a discussion and comparison of some of these may be of assistance to those who are designing or building receivers.

An Efficient Method

A method of switching, as distinct from a complete switch assembly, which has much to commend it, especially in the high-frequency parts of a circuit, when the principal aim is efficiency, is that which makes use of plugs and sockets. The sockets may conveniently be mounted on the panel, the plug or plugs being attached to flex leads, so that they can be inserted into the sockets required. The disadvantage of this method of switching is that it is rather clumsy. Against this, however, should be set the fact that by suitable spacing of the sockets on the panel the capacity between them may be reduced to a very small value, thus minimising one of the most troublesome effects usually experienced with switches.

Greater Convenience

This method of switching is represented in a mechanically improved form by the change-over switch with a hinged blade making contact with springy metal clips. This type of switch, which is illustrated in one of the photographs, is well known and is capable of wide application. In its simplest form it consists of the hinged blade and a single clip, this constituting a switch suitable for opening or closing any part of a circuit. The addition of extra blades, with clips on each side of the hinges, and with a bar of insulating material to link the blades together so that they may all be moved at once, develops the original simple device into a switch which makes it possible to change a number of independent parts of the circuit with one movement.

Inherent Defects

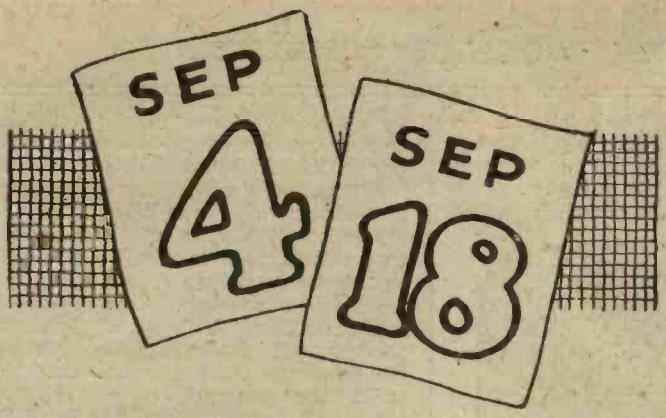
In a switch of the type just described, however, quite considerable stray capacities may exist between the blades, so that it is generally advisable not to wire up even a double-pole change-over switch of this kind in such a way that the two halves of the switch are utilised for making changes in parts of the circuit which carry high-frequency currents at widely differing potentials.

A sound spindle bearing and a smooth-running contact arm are important in a stud switch.

Reducing Stray Capacity

Multi-pole change-over switches of types which are designed in such a way that the capacity between the various parts of the switch, and particularly between the adjacent contacts, shall be a minimum, are available in several forms. The aim of the designer of these switches is to keep as small as possible the area of the adjacent contacts, and usually these are placed in such a way that they are "edge-on" to one another.

The constructor, in order to secure the full advantage of this arrangement, should see that the wiring to the switch is disposed so as not to increase unduly the capacity between the contact points. The wires should therefore be arranged so that they do not run parallel as they lead away from the switch. It will often be necessary to lay out the receiver with the switch as the most important point of the design, and to place the remainder of the components in positions which will allow of a satisfactory scheme of wiring.



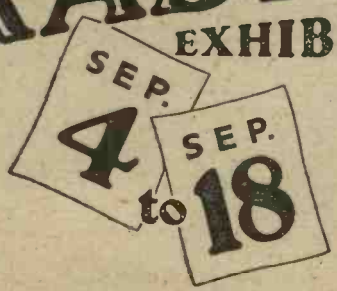
One of the most interesting features of the great Radio Exhibition, which opens at Olympia on September the 4th, will be, without doubt, the reproduction of the 2 LO Studio. During the run of the Exhibition, broadcasting will be done by the B.B.C, from this studio, so that you may actually see your favourite artists before the microphone.

For the first time in the history of British Radio it has been possible to arrange an exhibition that will be *complete*. No British manufacturer of standing but will be represented, so that within the New Hall, Olympia, will be found everything that is worth while in Radio.

All lovers of wireless should set aside at least one day for a visit. Each exhibit will have something of interest for them—something new, distinctive or novel. The great strike demonstrated the fact quite plainly that wireless—simplified as it is—is still the eighth wonder of the world. You cannot afford to be absent from its first really complete manifestation.

THE NATIONAL

RADIO EXHIBITION



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OLYMPIA

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ADMISSION INCLUSIVE 1/6

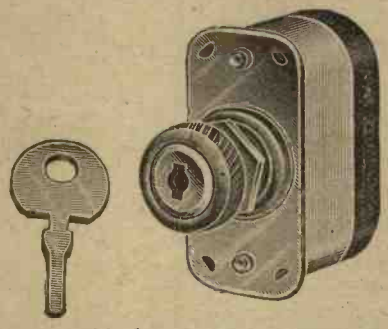
Switches and Switching Methods—*continued*

Barrel Switches

A type of switch which is compact and convenient to use, when a number of switching operations are to be combined in the one component, is the barrel switch. The barrel switch is capable of carrying a large number of contacts, the movable contacts being spaced round the outside of an insulating cylinder. These, on rotation of the barrel, make contact with fixed springy contacts suitably arranged. This type of switch is not in very common use in this country, at any rate not in its more complicated forms, though various forms of it are to be found employed as change-over switches in some of the small combined transmitters and receivers used by the Services.

Economy in Space

It is usual to mount the switches on the panel of a receiver, so that they may be as handy as possible in operation. At the same time, economy in the panel space taken up by a component is nearly always desirable. For this reason, among others, the "push-pull" type of switch has been evolved. The push-pull switch consists essentially of an insulating rod carrying one or more metal contacts, usually in the form of metal rings. Other individually insulated contacts projecting from the body of the switch is so placed that the contact between them and the rings is made or broken when the knob of the switch is pushed



A detachable key for the main on-and-off switch enables the owner to be in complete control of the operation of his receiver.

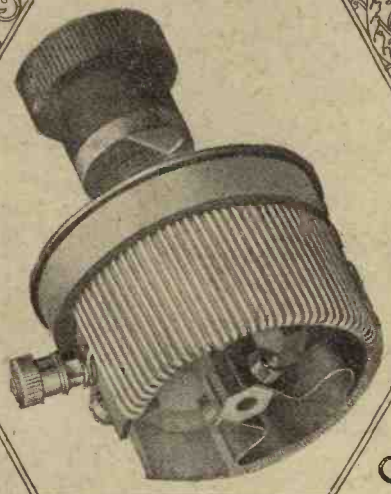
in or pulled out. By suitable arrangement and connection of the contacts, a number of operations may be performed by the one switch. These switches may readily be constructed to have low self-capacity values between the contacts.

Stud Switches

For coil tapping and similar uses the stud switch is a convenient type. The spindle and contact arm of a stud switch are illustrated in one of the photographs accompanying this article. The bearing of the spindle is an important part of the switch, since an easy running yet steady bearing will contribute largely to freedom from trouble in the switch. Care has to be taken, too, that the heads of the studs present a smooth and level surface for the passage of the contact arm. To avoid the presence of undesirable capacity between the studs it is advisable to use one nut only to secure each stud in the panel, and to solder the connections to the ends of the studs. An even better method is to tap holes in the panel and to screw the studs in position, so that there is the widest possible clearance between them.

A Safety Device

The simplest type of on-and-off switch, such as is used for switching on and off the filament current for the valves, lends itself to the addition of a simple device which is useful when it is desirable to keep meddling hands from interfering with the receiver. This takes the form of a detachable key, without which the switch cannot be operated; one of these switches is illustrated on this page.



COSMOS
RADIO
COMPONENTS

Smooth movement

The principal features of the "Cosmos" Filament Rheostat are its sturdy construction and reliable, smooth movement. The contact arm cannot easily be damaged, having its movement on the inner side of a porcelain bobbin, which carries the windings. Other pleasing features of this Precision Rheostat are the handsome knob and dial, ONE HOLE fixing, and the small space it occupies.

Made in four types, two of which are double wound for DULL or BRIGHT Valves and one a Potentiometer, the prices are as follows:—

Description	Ohms	Current	PRICE s.	d.
Single Wound	6·0	1·0 amp.	4	6
Double „	20	·4 „	5	0
Double „	34	·2 „	5	0
Potentiometer	300	—	6	0

"the best English fixed condenser in the Country"

Such is the opinion of a London Wireless firm after subjecting the "Cosmos" Permacon to a rigid test for insulation and capacity.

The "Cosmos" Permacon is an ideal fixed condenser, being light in weight, of guaranteed accurate capacity, and having the lowest possible losses.

The dielectric is mica and each condenser is tested at 500 volts during inspection. Nickel plated cases give them a particularly neat appearance. Prices are as follows:—

·0001 mfd.	1/6
·0002 „	1/6
·0005 „	1/6
·0003 „ (with clip for grid leak)	1/8
·001 „	1/8
·002 „	1/10
·005 „	2/8
·01 „	3/9

"COSMOS" GRID LEAKS are uniform and permanent
½, 1, 2 and 3 megohms .. .. .. each 1/6

Ask for copy of the "Cosmos" Components Leaflet.

METRO-VICK SUPPLIES, LTD.

(Proprietors: Metropolitan-Vickers Electrical Co., Ltd.),
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Cosmos
RADIO COMPONENTS

R
P44

The "Quality Five"

Pleasing music from distant stations by following this design

PURE musical reproduction is obtainable from many distant stations in addition to that from the local station by carefully following Mr. John W. Barber's instructions in the construction and operation of this receiver. Although incorporating many points in design favoured by the experimenter, the **"Quality Five"** makes a very suitable family receiver.

For the convenience of those who reside in close proximity to their local station the wavetrap is included as an integral part of the set. Three stages of resistance capacity couple the low-frequency amplifying valves—the H.F. valve being neutralised.

Mr. Percy W. Harris, M.I.R.E., writes in the August issue further hints upon the operation of the **"All-Europe" Superheterodyne,** the full and first description of which appeared in the previous number. Details are given in this second article concerning the use of various Superheterodyne Intermediate Transformers with but little alteration to the layout.

Further interesting notes appear upon the **"Elstree Six,"** containing helpful suggestions regarding such important components as suitable valves for the different stages.

As this list of principal contents shows, this issue of **MODERN WIRELESS** contains something of interest to everyone.

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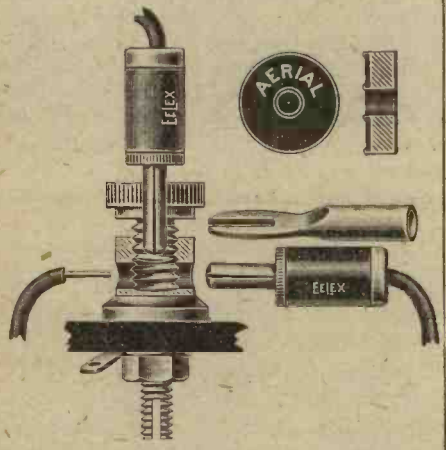
Read about the Phenomenal Success of the "ELSTREE SIX"

For "The Wireless Constructor" at our Elstree Laboratories.

Tags and Terminals

MESSRS. EASTICK & SONS have submitted to us for test and report a number of their spade pin tags, plugs, sockets and terminals.

The terminals are of a special type, enabling either pin type or spade tags to be utilised. They have a coloured indicating disc on the top, which not only shows the polarity but the function of the terminal. A 2 B.A. clearance hole is required for mounting



Messrs. Eastick & Sons' tags and terminals are available in several different forms.

these terminals, while the end of the shank is split, which enables wires to be fixed to the terminal without the necessity for soldering, a lock nut being all that is required.

The spade and pin tags are intended for finishing off flexible leads, these being soldered into hollow metal shanks. One of the spade tags is provided with a small spring chuck, by means of which leads may be gripped, and so obviating the necessity for actual soldering.

The plugs and sockets are provided with coloured insulating sleeves, and a special fitting is also supplied, consisting of two plugs linked together by means of a short strip of insulating material. The same method is employed to hold two sockets together, both pins and sockets being provided with coloured insulating bushes or sleeves of different colours, thus enabling the plugs to be inserted into the sockets having the correct polarity.

All these components are highly finished, and can be recommended as being of use to the amateur.

High-Tension Accumulator

MESSRS. THE TUNGSTONE ACCUMULATOR CO., LTD., have sent to us one of their standard 60-volt 3-ampere-hour high-tension batteries. This battery is contained in a polished teak box. Considering the capacity of this accumulator, it is not only reasonable in its dimensions, but also in its weight. The size of the container is 5 in. high, 9¼ in. wide and 12 in. long, while the weight of the complete battery with acid is just under 26 lb.

The battery is sent out with its first charge, but in a dry condition. On receipt the battery was filled with acid, and given a further charge, and then left to stand for two months, after which the voltage was found to be 63 volts. It was then put into use, and a heavy current taken from it, and it was also short-circuited on several occasions. It was then kept in use for about two months, current being taken from it at rates varying from 12 to 30 milliamps. At the end of this period it showed a voltage of 53 volts overall, and even then did not show any serious voltage drop when under load.

This battery is of robust construction and reliable in use, while a great convenience is afforded by the provision of inter-cell tappings, by means of which it can be tapped off every 2 volts. Further, a perforated insulating sheet which slides into two grooves above the cells is marked with the voltage of each tapping.

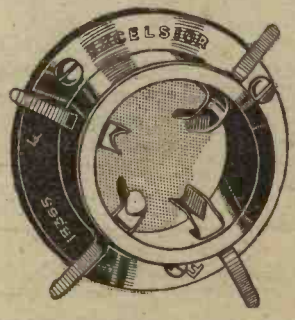
"Excelsior" Valve Holder

MESSRS. THE EXCELSIOR MOTOR CO. have sent us for test and report one of their Excelsior valve holders.

This instrument consists of an insulating shell having a flange by means of which the component may be mounted. The valve sockets are composed of bent strips of metal, which press tightly against the outside of the valve legs. The construction of the holder eliminates the presence of any solid dielectric between the valve legs, so that the capacity of the valve holder is reduced to an absolute minimum. The bent metal strips which form the valve sockets are continued through the moulded material of the holder so as to form long soldering tags.

Three nuts and bolts are provided for fixing this holder to the panel, but it may be mounted on the baseboard if desired.

It was found on test that the method of construction of this valve holder ensured a very easy fit for the valve, while at the same time the spring tension of the socket ensured a good electrical contact with each leg. In



Low self-capacity is a feature of the "Excelsior" valve holder.

soldering connections to the tags these are sufficiently long to render it almost impossible to do any damage to the moulded material through heating.

This valve holder appears to be particularly efficient from an electrical point of view. It is also quite satisfactory for general use, except that it would not appear to be advisable to use the valve holder vertically so that the valve is in a horizontal position, since it might then be possible for the valve to be shaken from its holder by vibration.

This valve holder can be recommended for general experimental and constructional work.

L.T. Accumulator

MESSRS. THE HART ACCUMULATOR CO., LTD., have sent us one of their "Enduro" accumulators for test and report. This accumulator is contained in a stout glass case, the glass top being sealed in by means of pitch. Two heavily insulated terminals are provided for making connections, the polarity of these being indicated.

This accumulator was given a thorough charge until gas was being freely evolved from both sets of plates, and on examination the colours of these plates were found to be exceed-

Apparatus Tested—*continued*

ingly satisfactory. The accumulator was then discharged at a rate of 1 ampere, and, though the capacity of this accumulator was only given as 10 actual ampere-hours, a total capacity in excess of this was obtained. At the end of 22 hours the rate of discharge had dropped to .25 amps.; the colour of the plates, however, showed the cell to be in good condition.

Ample space is provided below the plates for the reception of any sediment which may flake away from the plates, while the accumulator is exceedingly well constructed, though perhaps, in view of its capacity, it is a trifle on the bulky side. This accumulator can be thoroughly recommended where a robust battery of low capacity is required.

Cantophone Tuner

MESSRS. THE CANTOPHONE WIRELESS CO. have sent us for test and report one of their tuners. The design of this instrument is novel in that the tuner unit comprises a reaction control in each case, the whole being interchangeable so as to cover various ranges. Three ranges are supplied, which cover the wavelength bands between 70 and 2,000 metres,

The Cantophone Tuner No. 2 was found to tune from 220 to 750 metres approximately.

the one actually submitted for test being No. 2, which covers 220 to 780 metres. Further, a direct calibration scale is provided for use with a particular make of variable condenser. If a different make is used, of course, the calibration does not quite hold, although it is fairly approximate.

When placed on test in the aerial circuit it was found that the tuning range of this component was approximately from 220 to 750 metres, while the reaction control was found to be perfectly smooth when correct values of H.T. and L.T. were employed. The signal strength from distant stations was found to be normal, while a satisfactory degree of selectivity was obtained in view of the fact that no stage of H.F. was employed.

The instrument is well finished and robustly constructed. It is intended for mounting behind the panel, and it is only necessary to drill one hole for the reaction control. Connections are made to the tuner portion of the instrument by means of soldering tags, while two flexible leads finished with metal eyelets are provided for the connections to the reaction coil. This instrument can be recommended for use.

Apparatus Tested—*continued*

Combined Earthing Switch and Lead-In Tube

WE have received a combined earthing switch and lead-in tube which is manufactured by Messrs. J. Webb, of 35, Claremont Grove, Didsbury, Manchester.

The switch is operated from inside the house, a diagram showing the necessary connections being printed on the carton containing the combined

The switch of Messrs. J. Webb's earthing switch and lead-in tube is operated from inside the house, the tube being mounted in a hole in the window frame.

instrument. The accessory is fairly simple to fix, it being, of course, necessary to make a hole in the window frame to lead into the house.

The component submitted consists of a length of brass rod covered by insulating material. About a quarter of the way down the tube is a round flange of metal, by means of which this tube is screwed into position. One end carries a slate covering as a means of insulation, and under this the arrangement for earthing the aerial is provided for, so that when the knob is pulled outwards the outside aerial is connected direct to earth outside the house. This is done by means of a brass collar fitting into a brass socket, thus making a direct connection to earth, at the same time short-circuiting the brasswork carrying the aerial terminal to the set.

The component is well manufactured and can be strongly recommended.

Accumulator Reviver

MR. SKADDER has submitted to us for test at our Elstree Laboratories a sample of a liquid for reviving accumulators which have sulphated through over-loading or other causes.

Two distinct claims are made for the fluid submitted: (1) That it will revive spoilt accumulators so long as the plates are not badly buckled or shorted, and (2) that it will also serve partly to charge an accumulator in the sense that the charging current need be passed for a much shorter time if the liquid has been used in conjunction with complete replacement of the ordinary acid.

Two old 2-volt accumulators of 105-ampere-hour capacity were selected which through considerable overload on a motor starter had sulphated badly. After the addition of the liquid under test the voltage of these accumulators rose from almost zero to 0.8 volts and 1.4 volts respectively. After charging for 20 minutes at 6 amps. the voltage rose to 2.1 and 2.2 volts respectively.

On discharge at 6 amps. both accumulators went down in 20 minutes, so that there appeared to be no improvement brought about by the electrolyte.

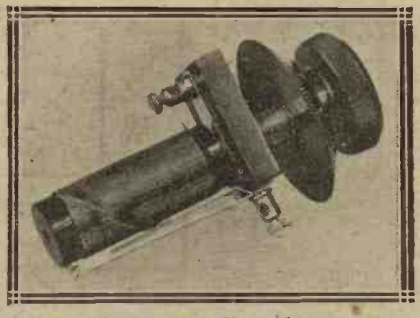
Both accumulators were then charged at 4 amps. for 7 hours. At the end of that time they were discharged at the rate of 3.8 amps. One accumulator was found to last 5½ hours and the other 6½ hours. Both accumulators were then given a full charge, and were found to behave as if fully restored. The reduction of the sulphating was also very evident.

Although the tests we have made do not indicate that the liquid gives a partial charge as claimed, yet it would appear to be very useful as a restorative for accumulators which have been given up as hopeless.

"Smoothac" Helical Contact Rheostat

A NEW type of rheostat has recently been placed on the market by Messrs. A. W. Stapleton, of Lorrimore Street, London, S.E.17.

This component consists of a piece of polished ebonite rod, cylindrical in shape, and wound round this rod is the resistance wire. A rather ingenious method of varying the resistance is incorporated in the component. A strip of No. 16 gauge wire is wound



In the "Smoothac" helical contact rheostat the contact arm is fixed, variation of resistance being carried out by rotating the bobbin.

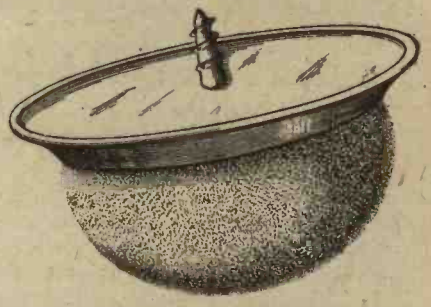
round the rod first, making one complete rotation in the whole length of the rod. The actual resistance wire is wound over this so that a small portion of every turn projects above the remainder. A springy piece of metal is provided for making contact as the bobbin is rotated, and thus the necessary variation in the resistance can be obtained. Two terminals are provided for making connection, and it is fitted with a well-manufactured knob and dial which are pleasing in appearance.

When tested at Elstree at full resistance it was found to measure 34 ohms, and we can recommend this component to our readers.

Shock Absorbers

WE have received a set of Absorbos from Messrs. Eddystone for test and report.

These accessories, which are intended to be fixed underneath a set so as to protect it from shock and vibration, are made in two sizes. A half-sphere of Sorbo rubber is carried in a small metal cap which may be fixed to the underside of the receiver by means of a wood screw. One of these absorbers is fixed to each corner, this operation



Absorbos may be fitted to the receiver by removing the hemisphere of Sorbo rubber.

being done without difficulty. Not only does the resilience of the rubber insulate the set from jars, but it also enables the receiver to be stood upon a polished surface without risk of scratching it. These absorbers are a novel and useful accessory and will, no doubt, commend themselves to many people.

Rheostat

MESSRS. THE ORMOND ENGINEERING CO. have submitted to us for test two samples of their No. 4 rheostat, one of 6 ohms for bright-emitter valves, and one of 30 ohms for dull-emitter valves.

The resistance elements of these rheostats are wound on fibre formers about 2½ in. in diameter. A contact arm which can be rotated by means of a moulded knob provides the coarse adjustment. A fine adjustment is also provided by a subsidiary contact arm which slides on a single turn of resistance wire wound on a small insulating former within the larger former.

Terminals and soldering tags are provided for this rheostat, together with a pointer.

It was found on tests that the resistances of these rheostats were of approximately the rated values—namely, 6 ohms and 30 ohms. On passing current through them, it was found that the dull-emitter rheostat of the larger resistance would pass .2 of an ampere without undue heating, but .8 of an ampere made the bright-emitter rheostat rather warm.

"T P S" CIRCUITS FOR THE EXPERIMENTER

(continued from page 1013)

direction can easily be carried out, and will throw considerable light on the action of the circuit.

Home-made Transformers

If it is not desired to use plug-in coils, the two coils L_2 and L_3 may be wound on a suitable ebonite tube. In such cases about 30 turns of a 3-in. former will be found satisfactory for each coil, for a first trial. When the circuit is functioning properly, the effect of reducing the value of the coil L_2 may be tried, and it will usually be found that the selectivity is improved by this alteration.

Reducing the Primary

As the value of L_2 is reduced, the number of turns on L_3 should be correspondingly increased, in order that the tuning of the circuit may remain approximately the same as it was before. It will usually be found that the value of L_2 may be reduced quite considerably before the signal strength begins to fall off, and the selectivity will, of course, increase continuously as this is done.

Good Signals

One of the advantages of this circuit lies in the fact that the coil L_2, which is effectively in the anode circuit of the valve V_1, can be reduced to quite a small value without reducing the impedance too much, so that the amplification of the first valve (and consequently the signal strength) is not sacrificed in obtaining the selectivity.

Valves

How far this can be done depends to a large extent on the valves in use. The valve V_2 should be any suitable detector valve, while that employed for the first stage may be of a special high-frequency type.

The higher the impedance of the first valve the greater will be the selectivity, when the correct value for L_2 has been found. It is very interesting to try the effect of different types of valves in the first stage, and to compare the signal strength in the various cases when the best conditions have been obtained. The relative values of L_2 and L_3 will require to be altered considerably to suit different valves.

A Further Step

The circuit shown in Fig. 3 is a development which may be built up after the best combination of coils and valves has been determined with the aid of the simpler Fig. 2 circuit.

Here, in order to obtain the full efficiency from the first valve, the inter-electrode capacity of this valve has been neutralised by connecting a small condenser between the grids of the first and second valves. To understand the action of this connection it is necessary to realise that the condenser C_3 is so large that it acts practically as a short circuit to the high-frequency currents.

Neutralisation

The circuit then becomes in effect a simple centre-tapped tuned-anode arrangement, with the grid lead to the second valve taken off from the opposite end to the usual. Obviously, therefore, the points A and B are at opposite high-frequency potentials, so that the feed back through the valve capacity is neutralised by that through the neutralising condenser, when this is properly adjusted.

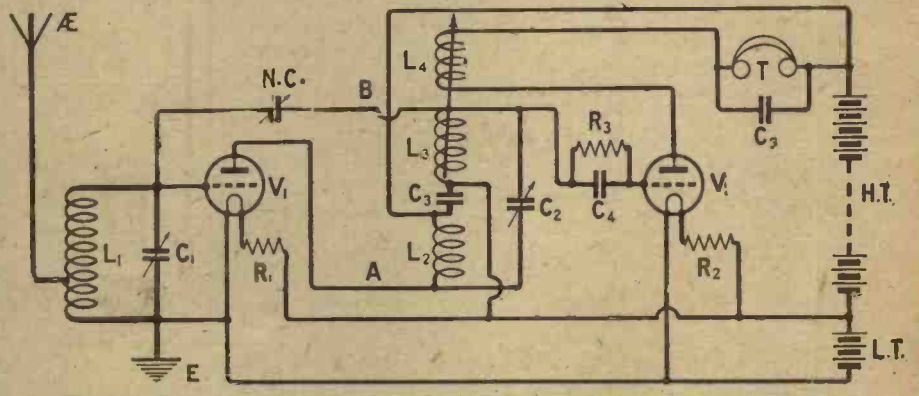


Fig. 3.—This circuit, a further development of that given in Fig. 2, incorporates a neutralised H.F. valve and a reaction coupling coil L4.

Reaction

This circuit is also provided with a reaction adjustment, by means of the coil L_4, which is coupled to L_3 in the usual manner. In order to provide a suitable path for the high-frequency currents in the anode circuit of the detector valve, it is desirable to shunt the telephones with a small condenser, shown in the diagram as C_5. The value of this should be about .0001.

As was mentioned previously, this type of circuit possesses several advantages and will provide interesting material for experiment. With the aid of plug-in coils and a three-way coil holder some very interesting and useful information may be obtained.

A PORTABLE SET FOR THE HOLIDAYS

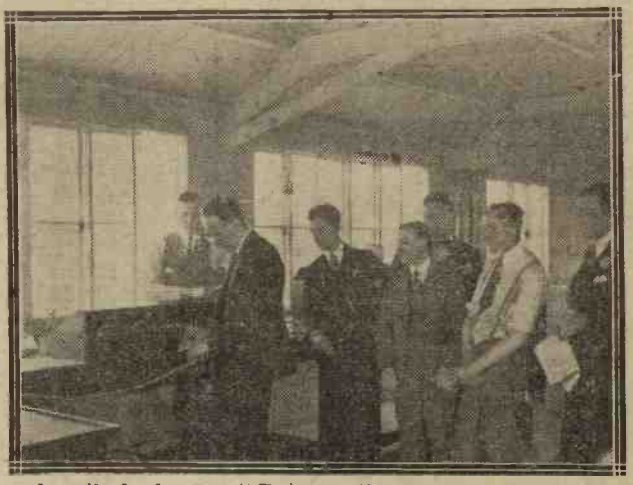
PORTABLE sets have always suffered rather cruel criticism by those who have said of them, "If that is a portable set, then my gramophone (or even piano) is also portable." There will always be a section of the radio public that considers wireless and weight to be inseparable, until they have seen and experimented with a set like "The Holiday Two," which is described by Mr. John Underdown in the August issue of *Modern Wireless*. This little set may be carried about with the greatest of ease, and is intended for use with telephones, one high-frequency stage and a detector being employed. The set may be used either with a frame or with a hastily-erected outdoor aerial, and, since it is not intended to give loud-speaker reproduction, it does not need the heavy batteries usually associated with power amplification.

Pure Reproduction

In the same issue of *Modern Wireless* Mr. John W. Barber describes the "Quality Five," a set which he has designed for pure reproduction. Three resistance-coupled stages are used, and, as there is one stage of H.F. as well as a wave-trap incorporated, selectivity and purity have really been combined in one set.

Mr. Percy W. Harris describes some slight alterations which may be made to his "All-Europe Superheterodyne" which was described last month, particularly the effects of changing the intermediate frequency transformers.

In the August 7 issue of *Wireless* a four-valve receiver is described by Mr. W. Q. Kay, already well known as the designer of the "Davlow Three" in last month's WIRELESS CONSTRUCTOR. This receiver incorporates some of the newest principles, and is particularly selective, a "Reinartz" detector following a stage of tuned-anode H.F. amplification. Two note-magnifiers are added, so that the receiver is excellent both for long-distance reception and as a loud-speaker set.



Visitors to the Elstree Laboratories for one of the many demonstrations of the "Elstree Six."

NEWS IN ADVERTISEMENTS

THE following short items are taken from advertisements appearing elsewhere in this issue:—

The Igranic Electric Co., Ltd., have recently published a new catalogue, and will be pleased to forward it, together with short leaflets on "Short-wave Reception," the "Multi-circuit Folder," and "Jack Switching Diagrams."

* * *

The newest Oldham H.T. accumulator costs 10d. per volt, and is built in units, "like an expanding bookcase."

* * *

The W. G. Pye variable condenser incorporates a slow-motion control with a ratio of 200:1.

* * *

The Collinson Precision Screw Co. are now supplying special Dual Condensers suitable for use in the "Elstree Six."

* * *

The new Efesca "Variform" L.F. transformer has a provision for variable magnetic coupling and an interchangeable primary winding.

THE "ANGLO-AMERICAN SIX"

SIR,—After having seen several reports of the "Anglo-American Six" receiver in your journal, I thought you would like to hear of the results I obtain from my receiver.

First, I would like to say that this receiver is by far the best I have constructed, both for quality and distance of reception.

The stations I have received are as follows:—All the B.B.C. main stations, Radio Toulouse, Berne, Hamburg, Munich, Munster, Rome, Madrid, Ecole Superieur, Prague and Vienna—these all at full strength on a Baby Sterling loud-speaker.

On the 'phones I have had Stockholm, Milan, and many other stations, including most of the B.B.C. relay stations, from several of which I have been unable to obtain the call signs.—Yours faithfully,

STANLEY PAPLETT.

Watford.

Professor L. A. Hazeltine

writes on "The Limits of Selectivity"

ON Tuesday, August 17th, a special number of **WIRELESS** will be published containing a striking article by the famous American Inventor, Professor L. A. Hazeltine.

Every wireless enthusiast should read this informative article; **it will mark one of the milestones in the history of the NEW WIRELESS.**

This Special Neutrodyne number will contain also two other valuable articles, "What is Neutralising?" by J. H. Reyner, B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E., and "Faults in Neutrodyne Receivers," by John Underdown.

Mr. A. Johnson-Randall will give full information for building "A Four Valve Ten-Guinea Neutrodyne," while G. P. Kendall, B.Sc., will describe under the title of "Build a Neutrodapter" how to make a novel Neutrodyne Unit to precede any standard Detector Valve Receiver.

The Neutrodyne will be the popular receiver for the future—get to know more by reading about it in the special issue of WIRELESS published on August 17th.

Be sure you buy your copy. It will help you to make wireless a greater pleasure

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COUPON

Questions and Answers

This Coupon must be accompanied with a 2/6 P.O. and Stamped Addressed Envelope.

"WIRELESS CONSTRUCTOR"

September, 1926.

FREE BLUEPRINT SERVICE

COUPON

Wireless Constructor. Vol. II. No. 11. Sept., 1926

This coupon entitles the reader to one back-of-panel blueprint of any set described in the above issue, and must accompany each postal application.