The Wireless Constructor

6D MONTHLY

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

Vol. II OCTOBER, 1926 No. 12

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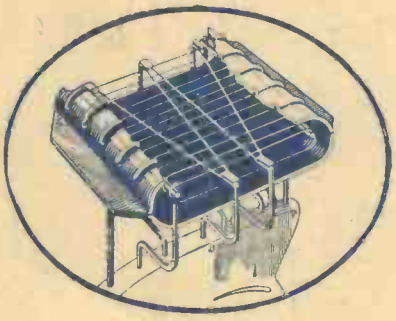

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Find out all about the P.M. Filament before you select your valves for the coming winter.

Ask your Dealer for the Valves with the Wonderful P.M. Filament.

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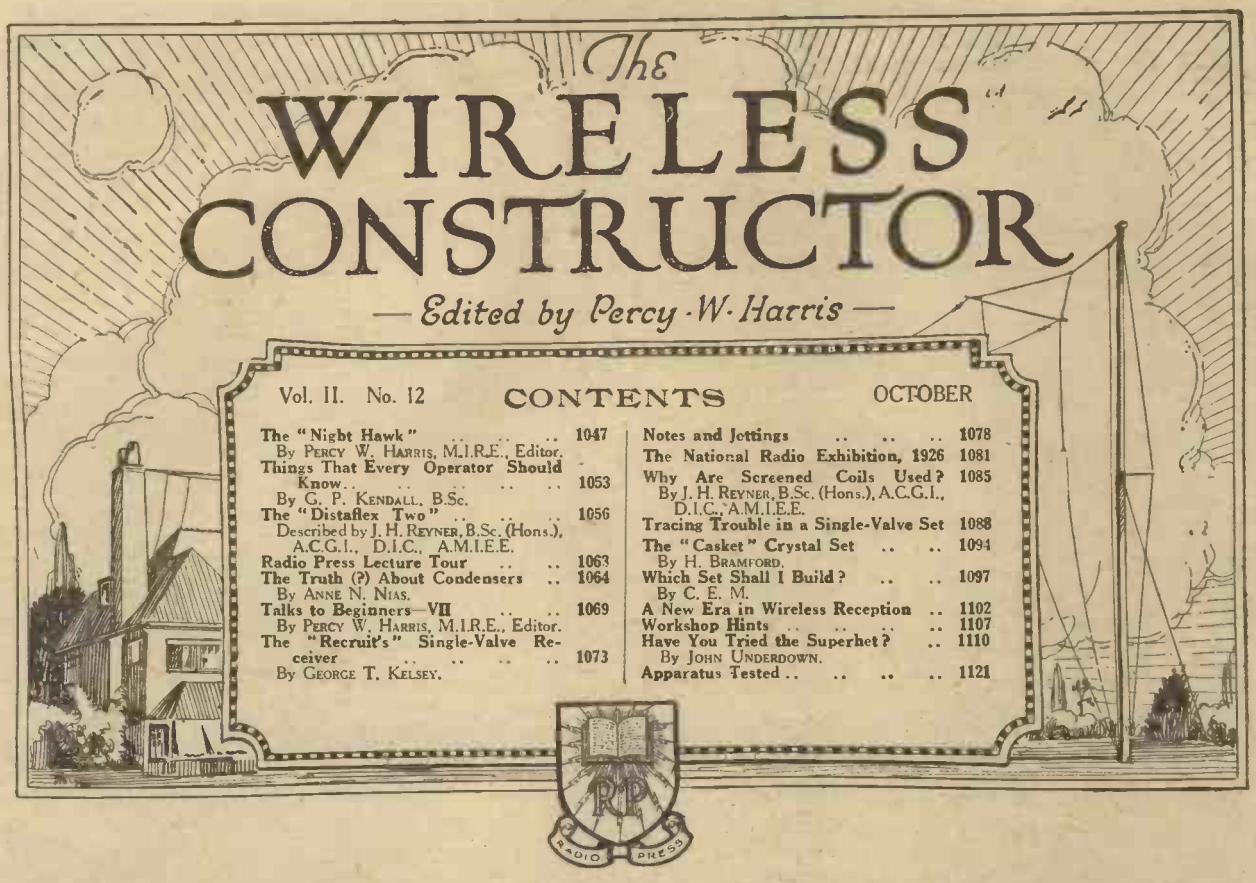

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THE MUSIC OF EUROPE IN YOUR HOME

Long Distance Reception for Everyone

Full Description of the "Night Hawk"
A Radio Press Star Set

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

LAST year, after returning from a tour of the leading American radio centres, I wrote: "Just as Great Britain was the first to realise and put into practical operation the advantages of unified control of broadcasting, so America has been the first country to realise that the technical future of broadcasting is inseparably tied up with the development of tuned high-frequency amplification." The technique of audio frequency amplification and valve detection has been well understood in this country for a long time, and certainly we have nothing to learn from other countries in this respect. But when you come to consider that sensitivity and selectivity—two immensely important factors in the development of receiver design—are inseparably bound up with the development of tuned radio-frequency amplification, you will readily understand why Radio Press, Limited, in their Research Laboratories at Elstree, and the individual writers in their own research work, have devoted so much time in the last twelve months to the subject.

Simplicity

The "Night Hawk," which, I venture to hope, will in the future be a willing searcher of the ether for WIRELESS CONSTRUCTOR readers, is my own interpretation of the technique which has been so steadily developing in the improvement of radio receivers. Its appearance, as you will notice, is plain almost to the point of severity. The old-fashioned array of multitudinous knobs and switches, once the delight of the real enthusiast, has given way to the simple panel with three tuning dials, an "on and off" switch and a small condenser knob for that final touch of reaction amplification which is so valuable. Indeed, there are fewer knobs than on many of the most popular American receivers.

The appearance of the "Night Hawk" is plain almost to the point of severity.

Compact Layout

If you lift the lid of the cabinet you will find inside five valves symmetrically disposed, not in one straight line, but in such a manner that the radio-frequency and detector valves come near to their tuning controls, while the audio-frequency valves, which are not concerned in the tuning, are disposed at the back.

By adopting this arrangement it is possible to obtain a good layout for the essential parts, while avoiding lengthy and expensive panels. Actually the panel used is of the standard 16 in. × 8 in. size, which is well known in conjunction with other receivers, such as the "All Concert De Luxe."

The "Night Hawk"

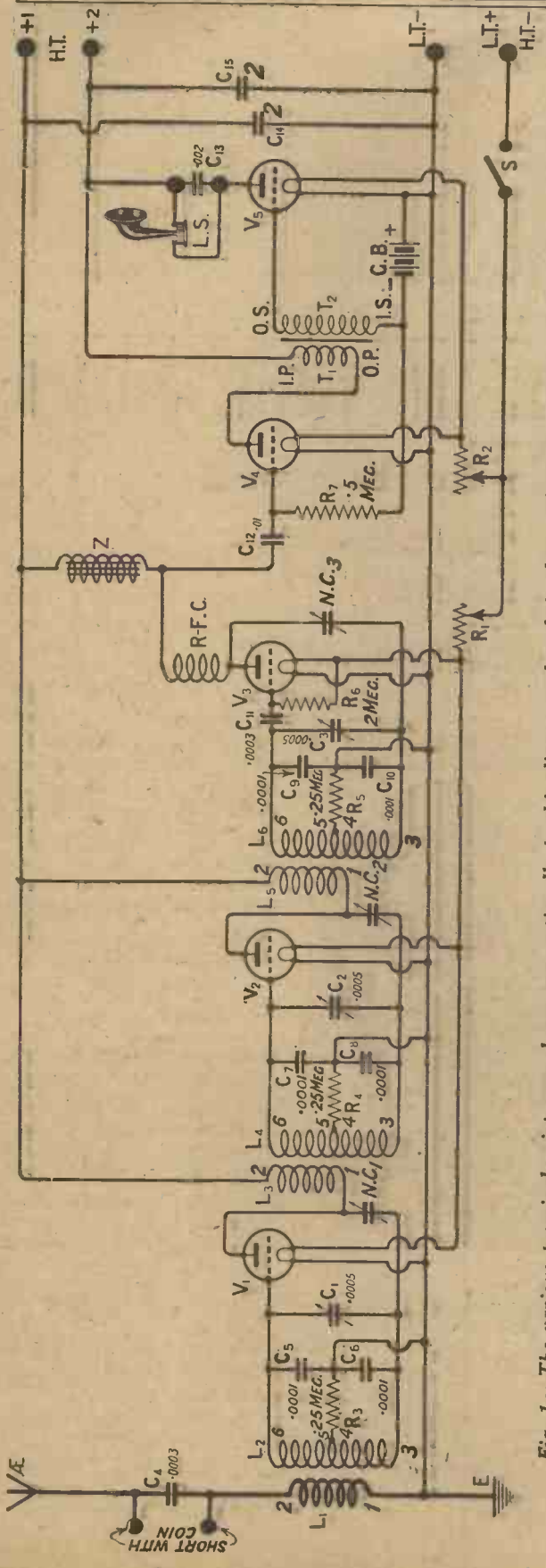


Fig. 1.—The various terminal points are shown conventionally in this diagram, though in the receiver no separate terminals are provided.

Points in the Design

Before proceeding to a description of the constructional details, let me tell you a little about the design itself and its distinctive features. I have long felt that for good all-round reception of near and distant stations a five-valve receiver is excellent in many ways. Nowadays everybody wants loud-speaker reproduction, particularly since loud-speakers have reached such a high state of perfection. This means that for adequate volume on average aerials two stages of note-magnification must follow the detector. At the same time to get long-distance reception without distortion I feel that two stages of efficient radio-frequency amplification are required to give you "something in hand." At the same time the high selectivity demanded by modern conditions is difficult to obtain without the use of two stages of radio-frequency magnification.

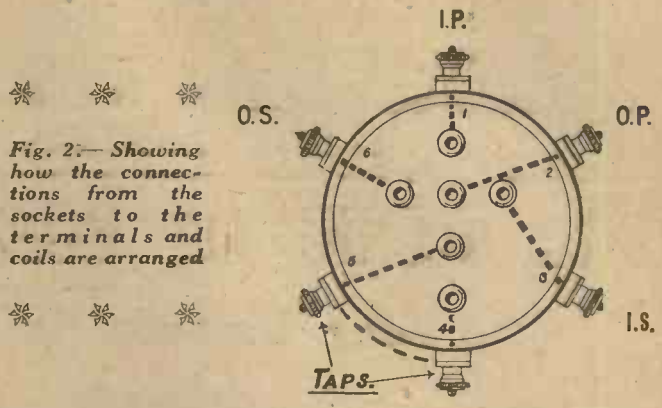


Fig. 2.—Showing how the connections from the sockets to the terminals and coils are arranged

OFFICIAL TEST REPORT

The following stations were received on the loud-speaker at Elstree, using an aerial 60 ft. long and 20 ft. high; head telephones were not used at all during this test.

Station.	Dial Reading.	Station.	Dial Reading.
Elberfeld	22	Bournemouth	108
Malmo	34	Hamburg	111
Bremen	39	Dublin	116
Hanover	55	Newcastle	118
Stoke-on-Trent	59	Muenster	120
Bradford	65	Bilbao	121
Leeds	70	Breslau	122
Barcelona	74	Glasgow	125
Nottingham	76	Rome	127
Petit Parisien	78	Radio Toulouse	128
Hull	80	Berne	130
San Sebastian	86	Belfast	132
Cardiff	90	Leipzig	135
London	98	Frankfurt	140
Manchester	104	Birmingham	143
Oslo	106		

Eliminating Direct Pick-up

Another problem we have to consider in the design of a modern set is the necessity of avoiding what is known as "pick-up" by the coils themselves, this enabling any interfering signals to get straight to the detector

A Radio Press Star Set which You should Build

without passing through the tuned circuits designed for them. No matter how sharply a receiver may tune the signals picked up on its associated aerial, this selectivity is completely discounted if, say, the coil next to the detector itself acts as a small aerial, which can quite easily happen. Indeed, one frequently hears the remark about a certain receiver, that it gives splendid signals from the local station at a distance of, say, 20 miles "without any aerial or earth whatever." This means, of course, that the instrument itself is picking up the energy, a most undesirable feature if high selectivity is required.

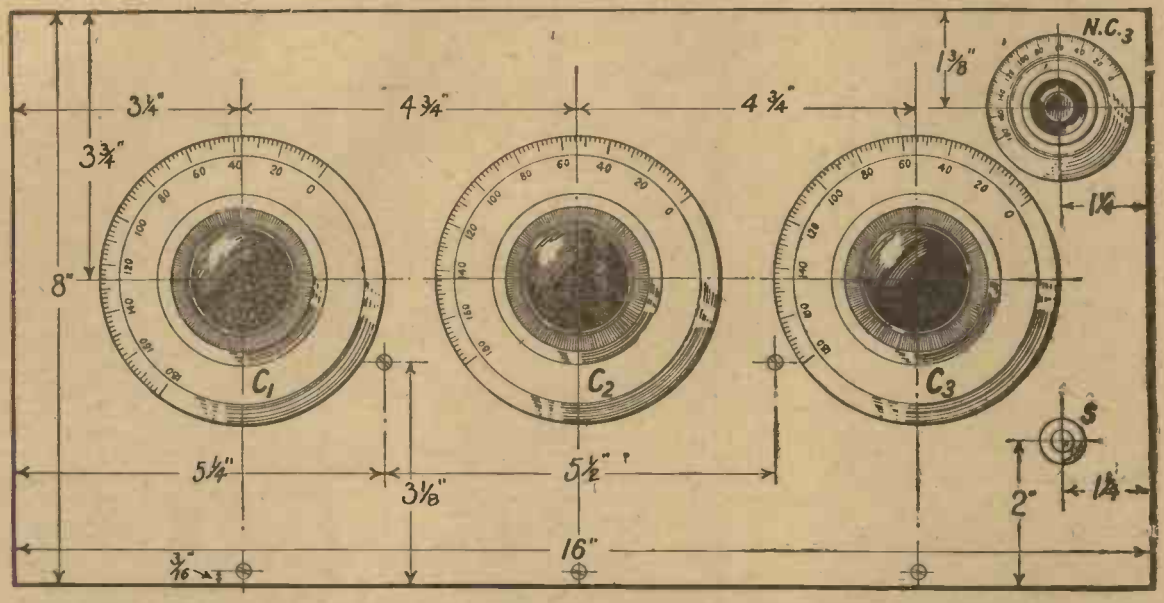
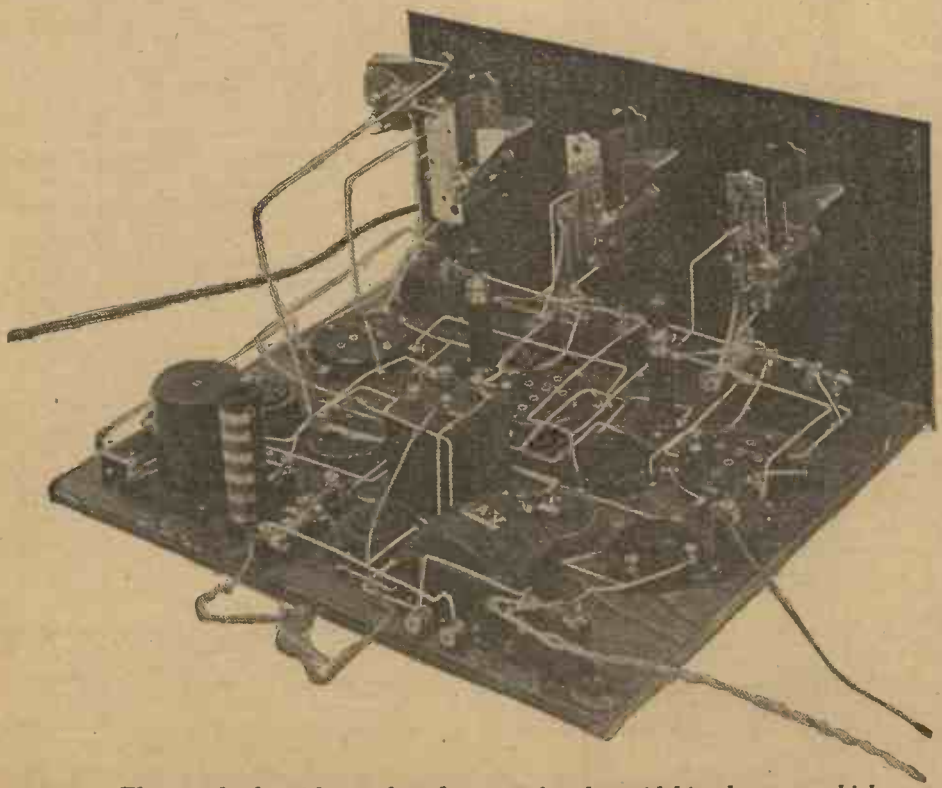


Fig. 3.—The simple layout of the panel makes for ease of construction. Blueprint No. C. 1062A is also obtainable.



The two leads with wander plugs are for the grid bias battery, which may be placed inside the cabinet.

BUILD THIS SET WITH—

One ebonite panel, 16 in. by 8 in by 3/16 in. or 1/4 in. (Any guaranteed Ebonite)

One special "All Concert" cabinet, with double depth baseboard (14 in.) to suit (Camco). An alternative cabinet is shown on page 1047 (Peto-Scott Co ,Ltd.)

Three "Eureka Ortho-cyclic" S.L.F. .0005 variable condensers (Portable Utilities Co.).

Three sets of fieldless plug-in coils with bases (Lissen). (Daventry coils may also be obtained if required.)

Five "Lotus" anti-phonic valve holders (Garnett, Whiteley & Co.).

Six fixed condensers .0001, one .0003 with clips, and one .002 (T.C.C.).

One fixed condenser .0003 type 600 with clips and 2 megohm leak, and one fixed condenser .01 type 610 (Dubilier).

Two Mansbridge condensers 2 mfds.

Four "Dumetohm" bases, three .25 megohm and one .5 megohm leaks (Dubilier).

One panel mounting neutralising condenser (Peto-Scott Co., Ltd.).

Two baseboard mounting neutralising condensers (L. McMichael, Ltd.).

One 6-ohm and one 35-ohm baseboard mounting filament rheostat (Lissen).

One H.F. choke (Varley Magnet Co.).

One "Success" L.F. choke (Beard and Fitch, Ltd.).

One all-purpose L.F. transformer (C. A. Vandervell & Co.).

One push-pull switch (Igranic).

Two small panel brackets (Burne Jones & Co.).

Glazite, and flex for leads.

Approximate cost, complete with valves, L.T. and H.T. batteries and loud-speaker, £20.

You Can Make the "Night Hawk"

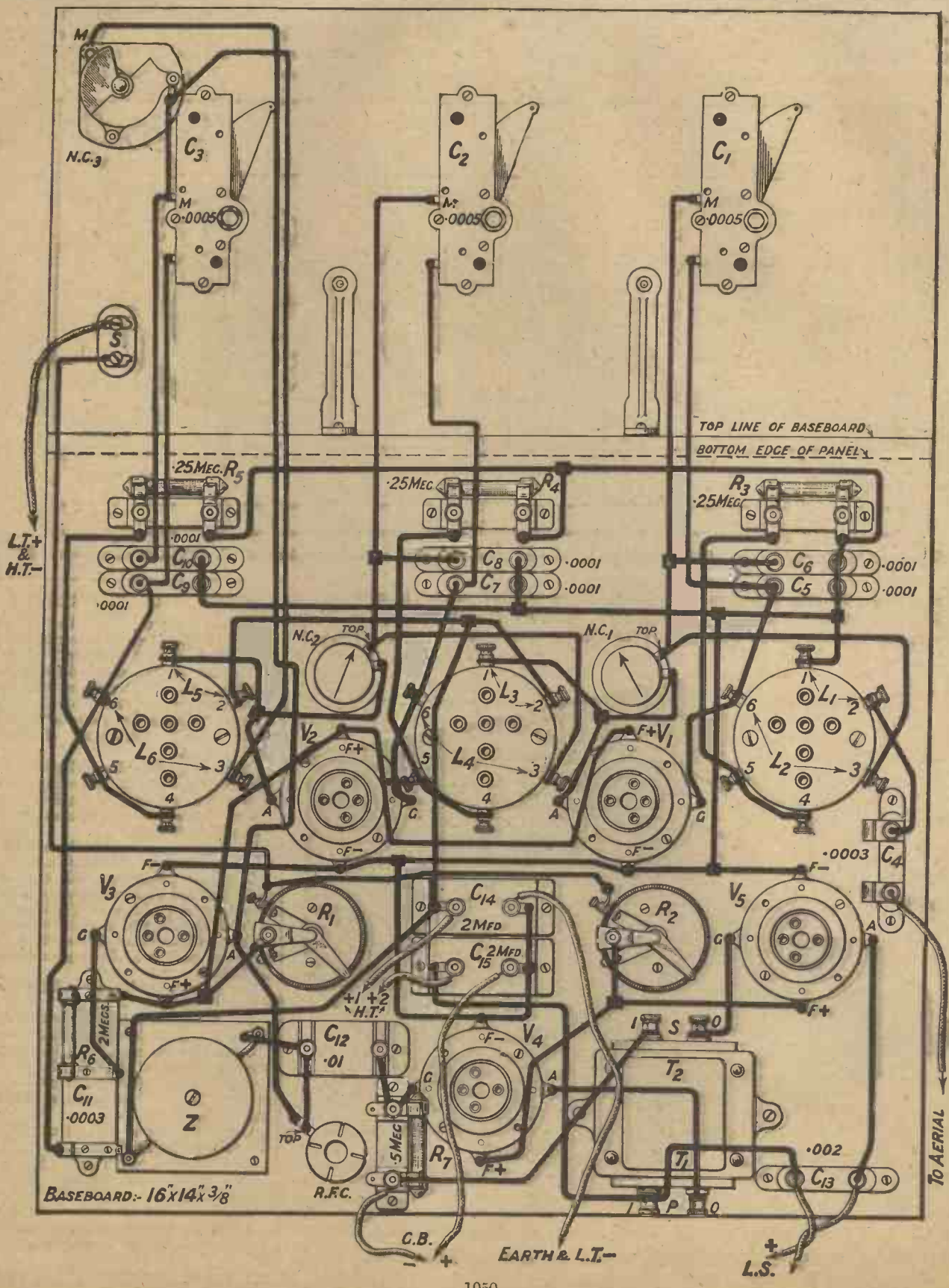


Fig. 4.—Flexible leads from appropriate points are used for making the necessary external connections to the set. Blueprint No. C. 1062B.

Complete with All Accessories for £20

Special Coils

Now there are two chief methods of avoiding pick-up in a receiver. One is to shield the instrument completely in a properly designed metal case which will be impervious to the waves which would otherwise set up currents in the coils and wires of the receiver. A very practical modification of this method is to shield the coils themselves which do most of the picking up. (This method has been developed so excellently by Mr. J. H. Reyner, and is described elsewhere in this issue.)

The other method is to use coils of such a design that they are not appreciably influenced by the waves which may impinge upon them. The coils used in the "Night Hawk" fall under this heading, being of a type which I described last year on my return from America. It will be noticed that they consist of two insulating tubes stood side by side, each tube carrying two windings, a small and a large. The two small windings joined together form the primary and the two larger windings joined together form the secondary of the high-frequency transformer. The direction of winding of the two pairs of coils is such that a train of waves from an interfering station falling upon one pair of coils would generate certain potentials across them, but at the same time would set up equal and opposite potentials across the other coils, the windings being so arranged that these two effects cancel out. The effect is practically the same as if the coil were shielded.

WIRING IN WORDS

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

Join a flex lead to one terminal of fixed condenser C4. *This lead is for the aerial connection and passes out through the side of the cabinet.*

Join other side of C4 to terminal 2 of right coil base.

Join terminal 1 of right coil base to right contacts of fixed condensers C5 and C6, thence to right contacts of leaks R3, R4, and R5, also to right contacts of fixed condensers C7, C8, C9, and C10, also to one filament contact of valve holders V1, V2, V3, V4 and V5, and to right terminals of fixed condensers C14 and C15.

Join together terminals 4 and 5 of right coil base, thence to left contact of R3.

Join together terminals 4 and 5 of centre coil base, thence to left contact of R4.

Join together terminals 4 and 5 of left coil base, thence to left contact of R5.

Join grid contact of valve holder V1 to terminal 6 of right coil base, thence to left contact of C5.

Join grid contact of valve holder V2 to terminal 6 of centre coil base, thence to left contact of C7.

Join grid contact of valve holder V3 to common contact of fixed condenser C11 and leak R6.

Join other contact of C11 to terminal 6 of left coil base, thence to left contact of C9.

Join remaining contact of R6 to remaining filament contact of V3, thence to one terminal of rheostat R1, also to remaining filament contacts of V2 and V1.

Join remaining filament contacts of V4 and V5 to one terminal of rheostat R2.

Join together remaining terminals of R2 and R1, thence to lower contact of switch S.

Join a flex lead to top contact of switch S. *This lead is for connection to L.T. + and H.T.−.*

Join terminal 3 of right coil base to top contact of N.C.1.

Join bottom contact of N.C.1 to terminal 1 of centre coil base, and to anode contact of V1.

Join terminal 3 of centre coil base to top contact of N.C.2.

Join bottom contact of N.C.2 to terminal 1 of left coil base, and to anode contact of V2.

Join terminal 2 of centre coil base to terminal 2 of left coil base, also to left terminal of C14 and one terminal of choke Z.

Join remaining terminal of Z to one contact of C12, also to top contact of R.F. Choke.

Join bottom contact of R.F. Choke to anode contact of V3.

Join remaining contact of C1 to one contact of leak R7, and to grid contact of V4.

Join remaining contact of R7 to IS terminal of L.F. transformer T1, T2.

Join OS terminal of T1, T2 to grid contact of V5.

Join anode contact of V4 to OP terminal of T1, T2.

Join IP terminal of T1, T2 to left terminal of C15 and to one terminal of C13.

Join remaining terminal of C13 to anode contact of V5.

Join spindle of variable condenser C1 to top contact of N.C.1 and left contact of C6.

Join fixed vanes of C1 to left contact of C5.

Join spindle of variable condenser C2 to top contact of N.C.2 and left contact of C8.

Join fixed vanes of C2 to left contact of C7.

Join spindle of variable condenser C3 to fixed vanes of N.C.3, also to left contact of C10 and terminal 3 of left coil base.

Join fixed vanes of C3 to left contact of C9.

Join moving vanes of N.C.3 to anode contact of V3.

Join a flex lead to left terminal of C14, *for connection to H.T. + 1.*

Join a flex lead to left terminal of C15, *for connection to H.T. + 2.*

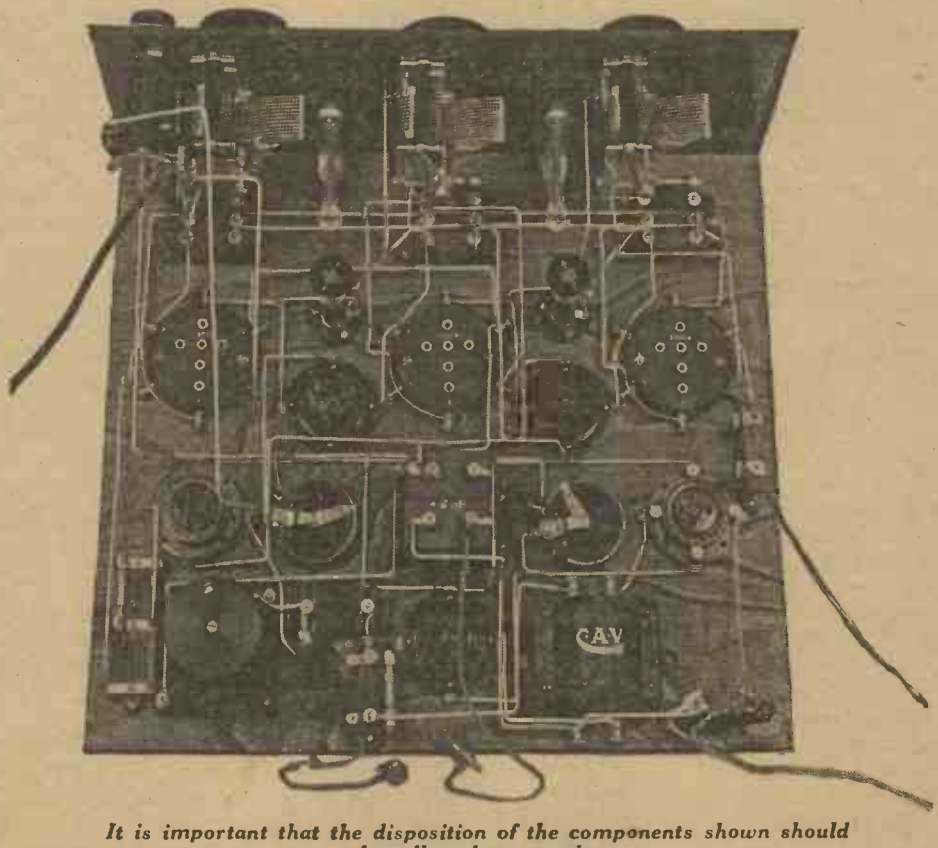
Join a flex lead to right contact of C14, *for connection to Earth and L.T. −.*

Join a flex lead to right contact of C15, *for connection to grid bias +.*

Join a flex lead to contact of R7 to which T1, T2 is connected, *for connection to grid bias −.*

Join flex lead to left contact of C13, *for loud-speaker +.*

Join flex lead to right contact of C13, *for loud-speaker −.*



It is important that the disposition of the components shown should be adhered to exactly.

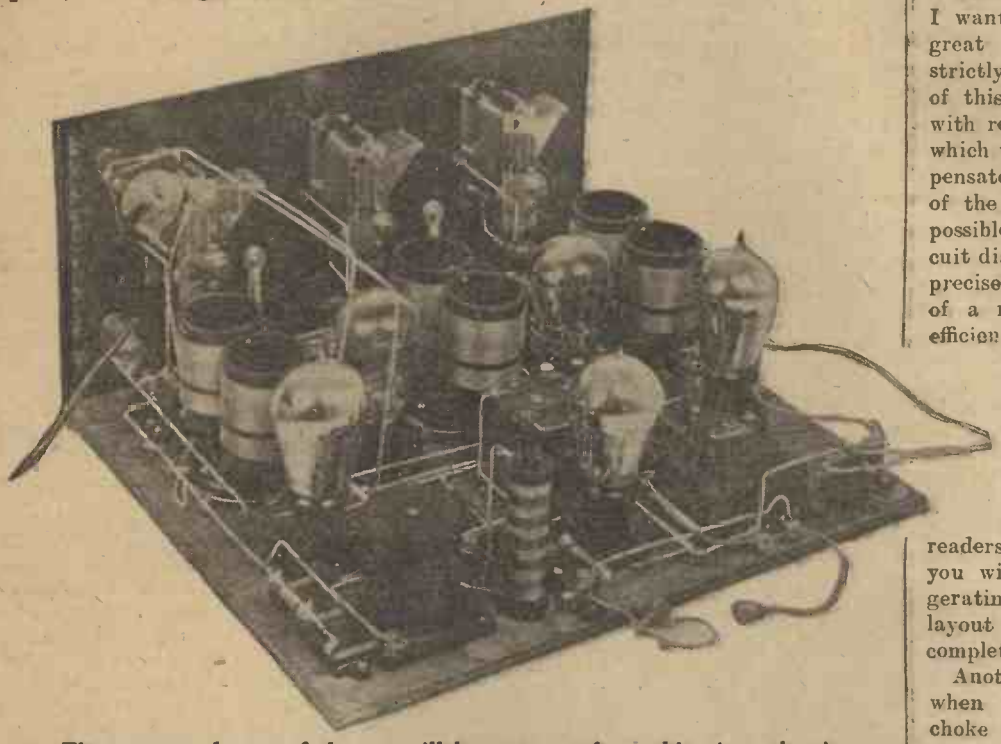
Coil Interaction

Another important point to consider both in shielded coils and in coils of this "Fieldless" type is that interaction between adjacent coils is reduced to a minimum. This has a very important bearing upon the layout of a receiver and enables a far more compact arrangement to be adopted than would otherwise be the case. This accounts for the compactness of the "Night Hawk."

The "Night Hawk"—*continued*

The Circuit

The theoretical circuit illustrated in Fig. 1 is a modification of the now well-known "Elstree Six" circuit, but whereas in the latter double condensers are used with a tapping at the middle point, in the Night Hawk a similar



The compact layout of the set will be apparent from this view, showing the valves and coils in position.

effect is obtained by using single variable condensers with two small fixed condensers shunted across them, the tapping being taken at the point of contact between the two condensers. Again, in place of the 100,000-ohm resistances, ¼-megohm gridleaks are used. Following the detector valve, we have one stage of choke amplification and one stage of transformer-coupled amplification, the combination of the two methods giving particularly good reproduction with a variety of makes of low-frequency transformer.

Controls

We are now in a position to examine the set more in detail. The front panel carries, as you will see, three dials and a small knob. The first dial tunes the first grid circuit, the second dial the second grid circuit, and the third dial the detector valve grid circuit, as might be imagined. The small knob in the top right-hand corner affords a very delicate reaction control, and although in very many cases this will not be used, as the set will give ample strength without, there are times when on distant stations it will be found most valuable, and in any case it will increase selectivity when razor-sharp tuning is needed.

No Special Terminals

You will look in vain for the terminal strip, for there is no such component in the whole set. The abandonment of the conventional terminal strip may be looked upon by many readers as a revolutionary step, but in thinking out the design I realised that by careful layout, not only could the wiring be simplified but expense could be reduced in abandoning the conventional arrangement. Instead of all the leads being brought across the set to one point, thus adding to the complication of wiring, the various components have been so arranged with terminals upon them that leads can be taken straight from vital parts to the outside. The points to which these leads should be attached will be found in the special wiring instructions. The cabinet is provided with drilled holes at the back through which the flexible leads can be taken. It will thus be seen that no leads of any kind disfigure the front of the panel, while the aerial lead, which for appearance may be made of silk-covered flexible wire, is the only one which is not concealed by the cabinet itself, this passing out through a hole in the side.

Follow the Instructions

Before starting constructional work, I want to emphasise once again the great importance of following very strictly the exact layout of the wiring of this instrument. In the old days with relatively insensitive receivers in which various losses were crudely compensated for by a further tightening of the reaction setting, it was often possible to interpret a theoretical circuit diagram in a variety of ways with precisely the same results. In the case of a modern sensitive receiver with efficient high-frequency stages, the disposition of the wiring may make or mar the success of a receiver, and when I tell you that the functioning, sensitivity and selectivity of the present set were completely changed by what might appear to many readers to be simple changes of wiring, you will realise that I am not exaggerating when I say that to follow the layout exactly is essential to obtain complete success.

Another interesting point is that when the present radio-frequency choke was substituted for a less efficient type the size of the reaction condenser had to be completely changed. With a less efficient choke, a small variable with several plates had to be used, and its maximum was scarcely enough at the top of the condenser scale to give oscillation control. When the change for a more efficient type was made, the *minimum* of the reaction condenser was found to be too high, and as a consequence it had to be changed for a type with much smaller maximum and minimum capacities.

Condensers

The set of fixed condensers of .0001 should be ordered matched, and the T.C.C. condensers can be obtained guaranteed with an accuracy of 2 per cent., at a very small increase over the normal cost. Straight-line-frequency condensers are used as the variables, but it must not be taken as any condemnation of the straight-line-wavelength type. Electrically both will be found equally efficient, but the disposition of wavelength on the S.L.F. is somewhat different from

(*Continued on page* 1125.)

THINGS THAT EVERY OPERATOR SHOULD KNOW

By G. P. KENDALL, B.Sc.

There are numerous useful hints which the experienced operator can give to those who are new to the art. Mr. Kendall shows in this first article on operation how skilful operating may assist in improving the results obtained from a receiver.

DO you know how to allow for hand capacity in a set which is troubled therewith? Can you decide quickly what is the matter with a set which is afflicted with what is known as "overlap"? Do you know the most certain method of picking up a distant station upon a receiver which has two or three separately tuned circuits? If you do not feel able to answer all these questions with an unhesitating affirmative, perhaps some of the following notes will be of use to you:—

Hand Capacity

Let us take first the question of hand capacity, by which I mean the question of what to do when operating a set which suffers from this trouble. I do not propose to go into the various methods of removing hand capacity by using the correct connections to variable condensers, employing screens and so on, because these matters have already been dealt with at various times, and it may be assumed that the reader is familiar with them. Nevertheless, it does sometimes happen that one is presented with the problem of operating a set in which hand capacity effects are bad, and in which there is no time to make alterations.

What it is

Let us make quite sure that we understand exactly what is meant by "hand capacity." Strictly speaking, these are effects taking the form of alteration of tuning when the hands are placed upon certain of the operating controls, usually the dials of the variable condensers. This alteration is the natural result of the fact that the hands of the operator possess a certain capacity to the various parts in the set, so that they upset the tuning when placed in close proximity to those parts. For example, when you place your hand upon a variable condenser you add a certain small amount to the capacity of that condenser, and so alter the tuning of the circuit in which the component is situated.

The Usual Effect

In most cases, then, we may take it that the effect of placing one's hand upon one of the operating controls is to *add* capacity to the circuit, and therefore to *increase* the wavelength to which it is tuned. With this fact in mind, it becomes easy to see how we may allow for these objectionable effects in tuning, and so adjust our sets that when the hands are removed, they will be found to be correctly tuned to the desired station.

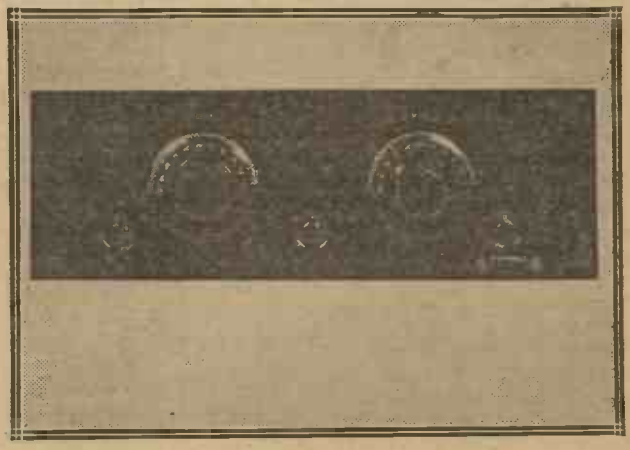
The First Step

The first thing to be done is obviously to discover how much capacity is added to the circuit when one places one's hand upon a variable condenser, and this is fairly easily done. With one of the receivers of the latest non-radiating variety—that is to say, one in which it is possible to make one of the circuits oscillate without danger of causing interference—the procedure is as follows:—Tune in a distant station and throw the non-radiating part of the set into oscillation. Now, with the hand upon the tuning condenser of the circuit which is oscillating, proceed to tune in to the silent point of a carrier-wave. Next, lift the hand off the condenser and note to what pitch the squeal rises as a result of the alteration of tuning produced by taking the hand away. Place the hand upon the condenser once more and *increase* its reading until you hear a squeal of the same pitch as you previously heard. Now remove the hand once more, and the squeal should die down again to the silent point if you have correctly estimated the note.

You will soon discover how much to increase the condenser, in order that the carrier-wave may be heard at its silent point when the hand is removed, and this difference of reading should be noted, being found to be perhaps 1½ degrees. Then simply regard this figure as a sort of correction factor to be used when operating that particular dial, and whenever you find a station, simply add on the correction to the apparent reading, and when you remove your hand you should find that the station will be heard properly.

Another Method

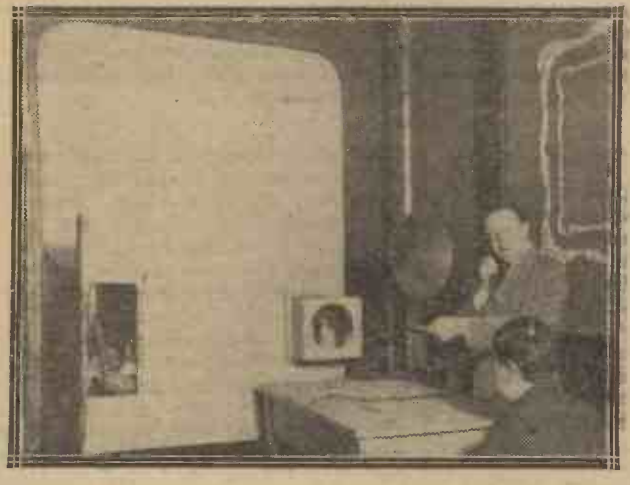
Having discovered the correction factor for the dial of the condenser tuning the circuit in the set which it is permissible to set into oscillation, it is necessary to discover the correction for the other dial, which will probably be that of the condenser tuning the aerial or secondary circuit. It



"In tuning a two-dial set, the procedure is to set one dial at zero and revolve the other slowly and carefully throughout its scale."

THINGS EVERY OPERATOR SHOULD KNOW—*continued*

is not possible to adopt the same scheme here without causing interference, so a little trial and error is needed, increasing the reading of the condenser a fraction of a degree at a time, removing the hand each time, and noting whether the signals come in properly when the hand has been taken away. A setting will soon be discovered at which signals are heard correctly, and disappear again when the hand is replaced; the difference between this reading and that given when the hand is placed upon the condenser and the adjustment of the condenser altered to bring in the signals once more should be duly noted, for this is our correction factor.



Is "looking-in" to become a widespread pastime? Here is a television receiving station, which is now in operation on Mr. J. L. Baird's system.

Simplified Operating

When you have obtained the appropriate correction figure for each of the dials in your set, tuning-in the distant stations becomes quite a simple matter, even when hand capacity effects are relatively bad, for you simply tune-in with your hands upon the dials, add the appropriate amount to the readings, remove your hands, and there is the station. In the case of sets which it is not permissible to use in the oscillating condition for the determination of the correction factor, of course, you can employ the other method described for the first circuit of a non-radiating type of set, and you will soon obtain the desired information.

Searching

Now, what about methods of searching? There are two principal methods of searching, one which can be used when you are thoroughly familiar with the set, and the other, one which most of us have to employ at times when using sets with which we are not well acquainted. The first is the method of rotating the various dials simultaneously in sympathy with each other in such a way that the several tuned circuits are maintained in resonance with each other as searching proceeds, a gradual sweep over the various wavelengths of search being made.

For example, in a set with two tuned circuits, the procedure is to set the two dials at such readings that the two circuits are in tune with each other, and then to proceed to vary them simultaneously, keeping them in tune with each other as this is done. To do this one must become acquainted with the sound heard when the two circuits are in resonance, and this again is not, as a rule, a difficult matter to discover. Generally, there will be a faint sound of "liveliness," as it were, made up of a slight crackle of atmospherics, stray Morse signals, and so on, and it is possible to follow this sound round upon the dials with just a little practice.

An Alternative

This is a method which is familiar to most people, and can be learned by anyone with a little practice, but it may perhaps be useful to explain the other method, which can be used without any practice, even upon a new and unfamiliar receiver. The scheme is simply to adopt a method of varying the readings of the dials progressively in such a way that all the possible combinations are tested in turn until the correct one for the desired station is found.

In a two-dial set, for example, the procedure is to set one dial at zero and revolve the other slowly and carefully throughout its scale. If nothing is heard, advance the first dial a couple of degrees, and try again, proceeding in this way until all possible combinations of settings have been tried. (In a very sharply-tuned receiver, of course, it may be necessary to advance one of the dials in steps of one degree at a time instead of two, lest a station be missed.)

AN IMPROVEMENT WORTH TRYING.

WHEN it becomes necessary to mount a two- or three-way coil holder on the outside of a wireless cabinet, leads from the coil connections are generally taken through holes in the cabinet side to their correct positions in the receiver. If the receiving set is designed with the upright panel and baseboard, each time the set is taken from its case the leads under the screw heads in the coil blocks must be released and pulled through the holes in the cabinet before attempting to slide out the panel and baseboard.

To avoid this, it will be found quite useful to mount a pair of terminals on ebonite strip, as indicated in Fig. 2. The nuts holding the terminals fit into holes recessed in the ebonite, while the terminal shanks pass through holes with a reasonable clearance in the side of the cabinet. Two terminals should be mounted inside the cabinet for each coil block, and then short, flexible leads from the coil screws can be taken and soldered on to the terminal shanks. The leads inside the receiver can now be taken to the terminals, and are easily loosened when withdrawal of the set from the cabinet is desired.

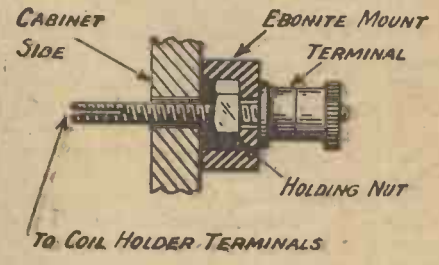
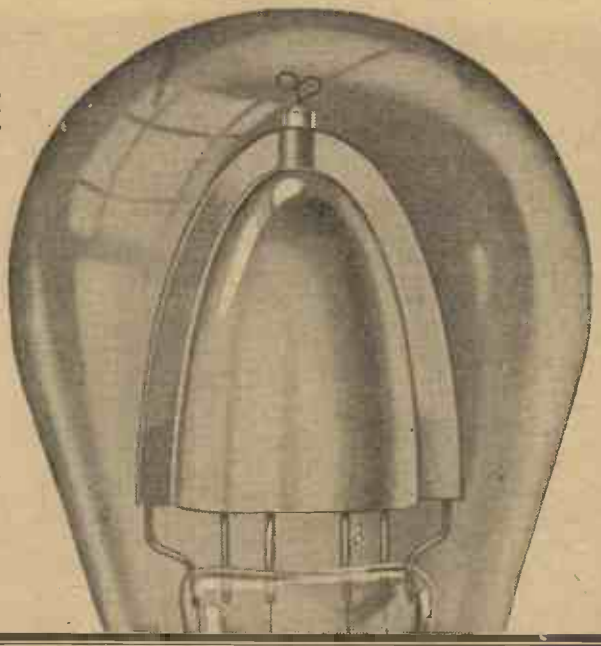


Fig. 1.—The ebonite strip carrying the terminals is screwed to the outside of the cabinet.

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.



Already a sensational success

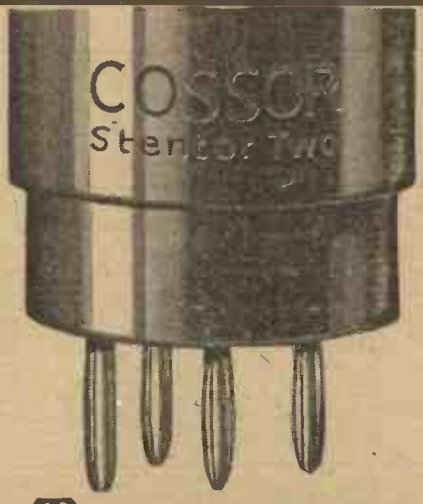
ALREADY technical experts and radio journalists are enthusing over the new series of Cossor "Point One" Valves. "The best Valves Cossor has ever made," said one, whose name is a household word among home constructors. "These new Cossor Point One valves have quite converted me to the 2-volt idea," writes another prominent radio journalist. "Your new Valves prove that this country has nothing to learn from other nations in valve design," is an extract from a letter recently received from a third expert.

We could quote numerous other letters in similar strain, and it is significant that many of those who have taken the trouble to write to us during the past two or three weeks are men who have grown up in the wireless industry.

Men whose seasoned judgment in radio technique is invaluable—men who are not easily roused to enthusiasm by the introduction of a new valve.

They are the men who are the pace-makers of the whole Radio industry—their opinions are the straws which show which way the wind is blowing. And there is unmistakable evidence that the new Cossor Point One has been given warmth of welcome accorded to no other valve. Wireless enthusiasts have been quick to realise the importance of the wonderful new system of Coaxial Mounting, which ensures perfect uniformity of characteristic between all valves of the same class. An exclusive Cossor feature. The broadcast listener, tired of frequent replacements, has appreciated the tremendous advantage of a shock-proof filament system which ensures an incredibly long life. While its exceptional economy in current consumption (the new Cossor Point One consumes only .1 of an ampere at 1.8 volts) proves that there is now available a valve capable of giving superb results from ordinary dry batteries.

When your present valves become useless, choose the new Cossor Point One Series—the only valves in the world to utilise Coaxial Mounting. We can promise you a new pleasure in Radio—greater volume—improved stability—a fidelity of reproduction that will astound you—an increased sensitiveness that will add miles and miles to the range of your Set. And remember, finally, the prestige enjoyed by Cossor—the good name that stands squarely at the back of every Cossor Point One and Stentor Two.



The wonderful new Cossor "Point One" Dull Emitters

Plain Top: For Detector or L.F. (Consumption .1 amp.)	14/-
Red Top: For H.F. use (Consumption .1 amp.)	14/-
Stentor Two For Power use (Consumption .15 amp.)	18/6

All operate at a voltage of from 1.2 volts to 2 volts.

Cossor Point One

Issued by A. C. Cossor, Ltd., Highbury Grove, London, N5. *Gilbert Ad. 5638*

A TRIUMPH FOR ELSTREE

2 VALVES GIVE 20 STATIONS ON THE LOUD-SPEAKER

Full Instructions for You to Build

The "DISTAFLEX TWO"—An Elstree Star Set

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

QUITE early in the history of broadcasting the possibility of utilising one valve to perform the double purpose of amplifying both at high frequency and low occurred to the designers of receiving sets, and for some time there were many varieties of dual amplification or reflex circuits. The outstanding example of this class of receiver was the S.T.100, designed by Mr. John Scott-Taggart, which achieved considerable popularity, and indeed is still treated by many as the standard two-valve set.

Modern Requirements

Since the early days, however, considerable development has been made in the art of high-frequency amplification. The increasing number of stations working in Europe generally has resulted in the possibility of a large number of different programmes being received as well as that from the local station. Before such stations can be satisfactorily received, however, two essentials have to be fulfilled.

In the first place the receiver must be able to eliminate the local station within a few degrees on the dial, and so receive the distant stations without excessive jamming. In order to obtain really good selectivity, and to enable practically every other station to be tuned in without any interference from the local station, a very efficient tuning system is required.

Moderate Selectivity

There are many people, however, who do not require the degree of selectivity which is necessary to receive stations working on wavelengths only a few metres different from the local station, and are quite satisfied with a reasonable degree of selectivity only, which will permit the reception of 15 to 20 stations on the loud-speaker free from interference. At the same time a certain amount of selectivity is necessary to separate the various distant stations which are working so close together that they will jam each other on an ordinary simple circuit.

The Demand for Economy

These conditions can be complied with in an ordinary five-valve receiver comprising two stages of high-frequency, a detector, and two stages of low-frequency amplification. For some people, however, a set of this description is not feasible. The cost of running demands a large accumulator and a high-tension battery of ample capacity, while of course the fact that five valves are required is also a point for consideration.

If it were possible to obtain results comparable with those from an ordinary five-valve receiver with a

The "Distaflex Two"—*continued*

smaller number of valves, utilising the reflex principle, then there is no doubt that the reception of these distant programmes would become a much more practical proposition to many people.

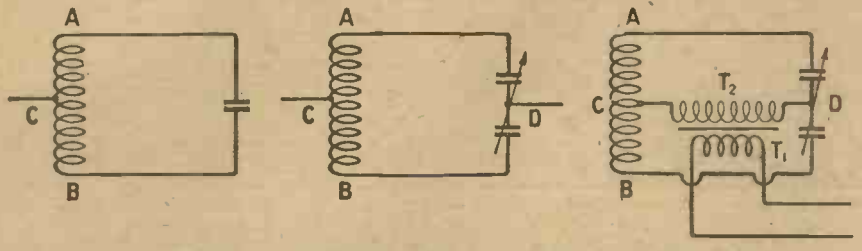


Fig. 1 (a, b and c).—Illustrating the new reflexing principle which is used in the receiver.

Two Valves for Five

With this end in view some extensive research work has been conducted at the Elstree Laboratories to produce a receiver comprising two high-frequency stages, a crystal detector, and two low-frequency stages, two valves only being utilised and made to perform the double function of high- and low-frequency amplification.

A New Principle

This has been rendered possible by the use of an entirely new principle of reflexing. It is necessary that the presence of the low-frequency transformers utilised in the receiver shall in no way affect the high-frequency tuning circuits, in order that the necessary selectivity and high-frequency amplification may be unimpaired. If we could connect the low-frequency transformers across two points in the circuit which were always at the same high-frequency potential, we should achieve this object, and this is the principle which has been adopted.

The Circuit

The development of the circuit is shown diagrammatically in Fig. 1. On the left-hand figure (a) we have a simple tuned circuit. The middle tapping of the coil is at a potential midway between the potentials of the two ends. There is obviously some similar point in the middle of the condenser somewhere, and these two points would therefore be at the same potential.

In order to obtain this centre tapping on the condenser, we utilise a dual condenser for tuning, when the two points, the centre-tap on the coil, and the middle point on the condenser are both at the same potential, and we can therefore connect our low-frequency transformer across these points as shown in Fig. 1 (b).

Separating H.F. and L.F.

Since both valves are carrying both high-frequency and low-frequency currents, it is necessary to obtain some method of separating these currents in the anode circuit. In order to achieve this, therefore, a choke feed has been obtained. The principle adopted is illustrated in Fig. 2. The high-frequency currents go through the small condenser C and the primary of the H.F. transformer on to the next valve, while the low-frequency currents pass through the high-frequency choke and the primary of the L.F. transformer.

Alternative Circuits

These are the essential principles in the receiver, the complete circuit being as shown in Fig. 3. The three tuned circuits are each tuned with a dual condenser, a crystal detector being connected across the last tuned circuit. In order to minimise damping as far as possible, the detector circuit is only connected across one-half of the coil instead of the complete coil. A jack is inserted in series with the detector, so that telephones may be plugged in at this point with the receiver working as a simple two H.F. and detector circuit. On withdrawing the telephones, the primary of the first transformer is connected in circuit, and the receiver operates as a reflex.

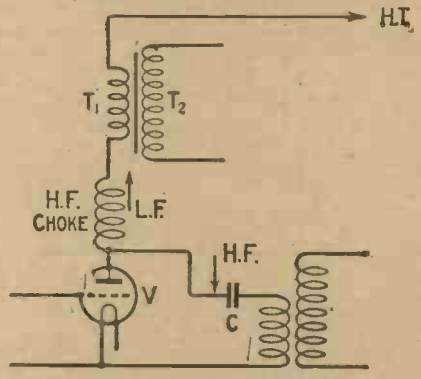


Fig. 2.—The separation of the H.F. and L.F. currents is achieved, an H.F. choke being used in the anode circuit.

Neutralised H.F. Stages

The secondary of the first transformer is connected in the grid circuit of the first valve, after which the low-frequency currents pass through the paths allotted to them and are taken off from the anode of the second valve. In this latter circuit an alternative jack or telephone connection is provided, so that tuning-in may be carried out on the telephones if desired, when a removal of the plug will place the station on the loud-speaker.

TWENTY STATIONS ON THE LOUD-SPEAKER.

The following stations were received on a simple 60ft. aerial, 20ft. high, the strength in all cases being sufficient to operate a loud-speaker.

The dials read approximately together, although a slight difference of 1 or 2 degrees may be observed at certain points of the scale.

Station.	Dial Reading.
Liege	54
Hanover	59
Dundee	66
Nottingham	70
Hull	72
San Sebastian	78
London	82
Manchester (slight interference by London)	88
Oslo	90
Bournemouth	91.5
Dublin	94
Newcastle	98
Muenster	99
Glasgow	101
Radio Toulouse	103
Belfast	106
Leipzig	112
Frankfort	115
Birmingham	117
Aberdeen	122.5

The "Distaflex Two"

Both the high-frequency circuits are neutralised, the second neutralising condenser being mounted on the panel in order to provide a reaction control.

In marking out the panel, of course, all scriber lines should be made on the back of the panel, so that the positions of the components will be

minals in the middle for the L.T. and H.T. batteries. In order to simplify matters, only one high-tension battery tapping has been used.

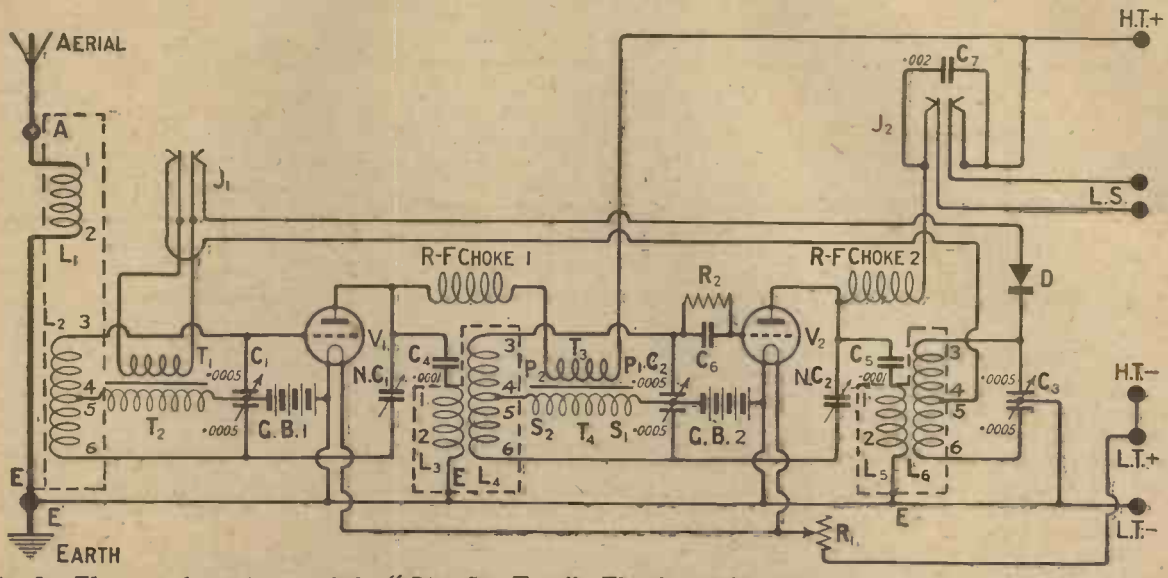


Fig. 3.—The complete circuit of the "Distaflex Two." The dotted lines represent the screens of the screened coils, the windings being numbered to correspond with the numbered terminals on the coil bases.

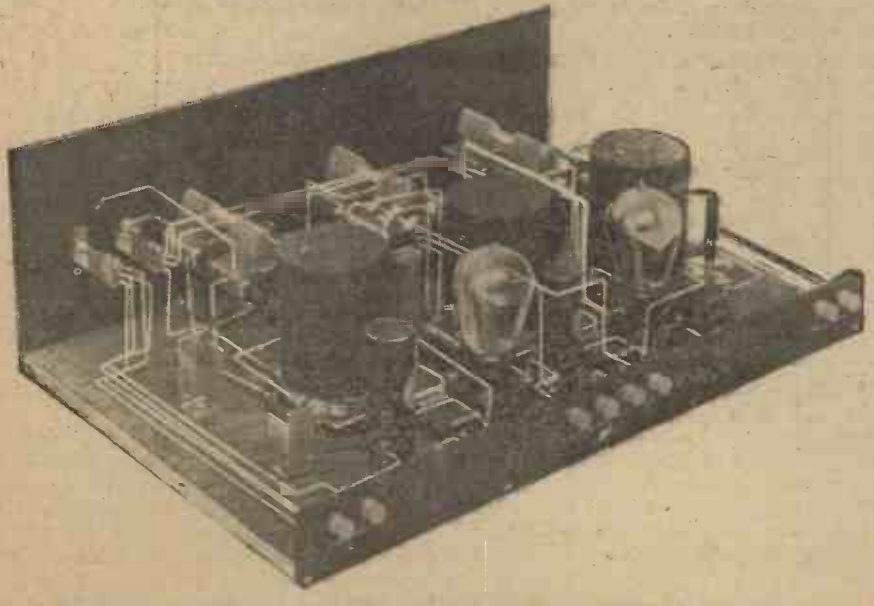
Constructional Details

The first procedure is the mounting of the three dual condensers, the filament rheostat, the panel-mounting neutralising condenser, the two double circuit jacks, and the crystal detector upon the main panel. The positions of these components will be seen clearly from the panel diagram supplied, which gives the positions of the holes looking from the front of the panel.

reversed, and this should be borne in mind when this operation is carried out.

Terminals

The next operation is the drilling of the terminal strip which runs along the whole length of the back of the set. Holes should be drilled for the eight terminals necessary in the positions shown. The right-hand pair are for the aerial and earth, the left-hand the loud-speaker, and the four terminals in the middle for the L.T. and H.T. batteries. In order to simplify matters, only one high-tension battery tapping has been used.



The terminals are carried on a strip of ebonite which runs for the full length of the baseboard.

The panel may now be screwed into position on the baseboard, and the baseboard components laid out in their appropriate positions. The three coil screens are mounted behind the respective condensers, the distance apart being a little greater than that between the condensers, as shown. The two L.F. transformers are mounted in the space between the variable condensers, as will be seen from the layout provided. The remainder of the components can be fitted in the positions shown without any difficulty, and when all the components have been suitably spaced they may be screwed into position.

Wiring

The receiver is now ready for wiring up, and little difficulty will be experienced as every component is readily accessible. It is advisable to remove the covers from the screened coils and also the coils themselves during the wiring-up process, as this enables one to obtain easier access to the terminals on the base. In some cases it has been found that in transit the terminals on the base of the screens become slightly loose, and as this would give rise to a fault when the receiver is completed, each unit should be examined carefully to ensure that this has not happened. It is better to make sure of this point when commencing to wire up the set rather than to discover it later on, and have to dismantle a portion of the receiver in order to put the matter right.

The filament circuit may be wired first, after which the connections to

A Star Set of Universal Appeal

the screened coils may be made. The high-frequency side of the circuit may be wired almost completely without troubling about the low-frequency side, which is to all intents and purposes a separate circuit.

After the high-frequency wiring has been completed, the necessary connections to the low-frequency transformers and jacks may be made, and this will complete the wiring of the receiver.

When the receiver has been completely wired, it may be placed on test and the necessary preliminary adjustments made. The first thing to do is to place the three H.F. transformers in position in the screening coils, and to place the shields over the coils. Care must be taken that the shields make a good tight fit with the cases. In some instances it is found that all the screens are not exactly interchangeable, so that when a screen is removed from its base it should be returned to its correct position and not placed on any other base.

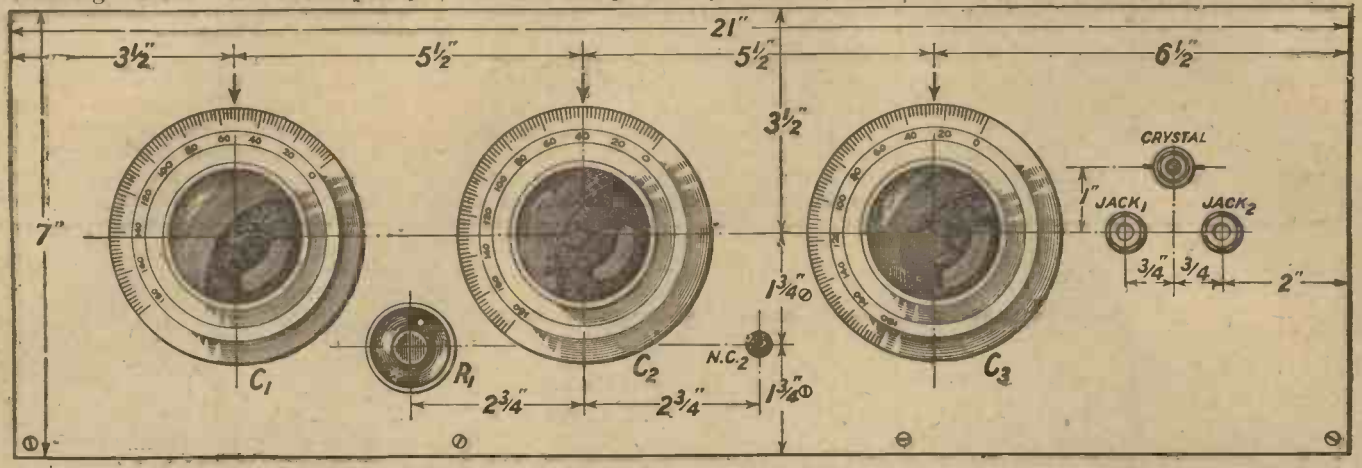


Fig. 4.—The drilling layout of the panel is simple, only one filament rheostat being employed. Blueprint No. C.1063A.

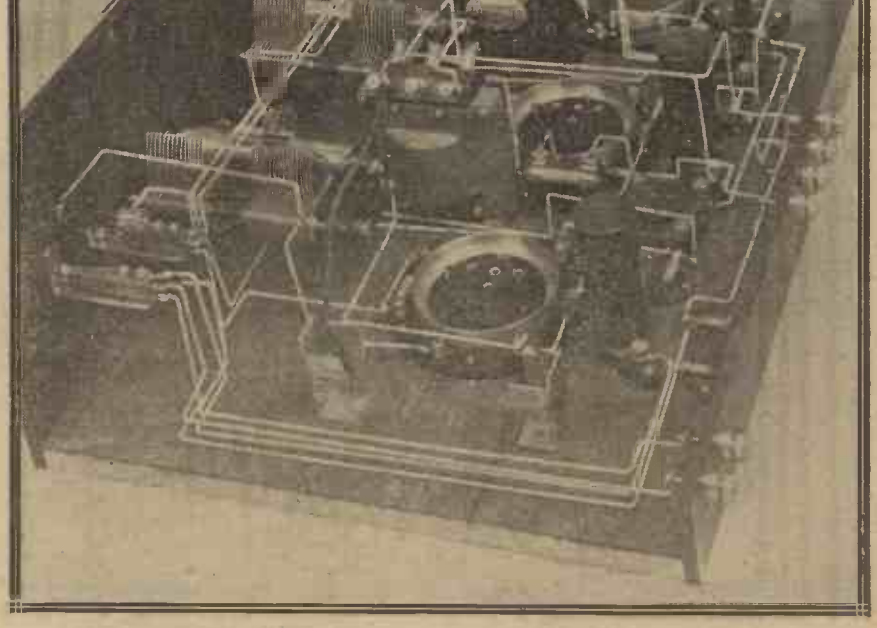
BUILD THIS SET WITH—

One ebonite panel, 21 in. by 7 in. by ¼ in. (Clayton.)
One cabinet to suit with baseboard 13½ in. deep. (A cabinet with two glass panelled doors, which makes a very attractive finish, is supplied by Messrs. Caxton Wood Turnery Co., Ltd.) That shown on page 1056 is of different make.
Three .0005 dual condensers (Collinson) with 4 in. dials.
Three split-secondary transformers, 250 to 550 metres. (Daventry coils may be obtained if desired.)
Three coil screens and bases. (Burne-Jones & Co.)
Two vibratory valve holders. (Benjamin.)
Two H.F. chokes. (Lissen, Ltd.)
One baseboard-mounting neutralising condenser. (Bowyer-Lowe Co.)
One panel-mounting neutralising condenser. (Bowyer-Lowe Co.)
One all-purpose L.F. transformer. (Ferranti.)
One 2nd stage L.F. transformer. (In this case an R.I. multi-ratio has been adopted, so that the most suitable ratio can be chosen.)
One filament rheostat. (C.A.V.)
Two double circuit jacks. (Bowyer-Lowe Co.)
One panel mounting crystal detector. (R. I., Ltd.)
Two .0001 fixed condensers. (Dubilier Co.)
One .002 fixed condenser. (Dubilier Co.)
Two pairs grid bias battery clips. (A. F. Bulgin.)
One .0003 fixed condenser with 2 megohm leak. (T. C. C.)
One ebonite strip, 21 in. by 2 in.
Eight terminals.
A quantity of Glazite and a short length of flex.
Radio Press panel transfers.
Approximate cost, £7 6s.

Valves to Use

The principal difficulty with this receiver had been that of rendering it capable of handling the large volume from the local station. With an efficient high-frequency amplifier such as we have here, the signal strength applied to the detector is considerable, and the two dual valves therefore have to handle a very large H.F. current and a still larger L.F. current superimposed.

It is thus essential to utilise a valve having a very long characteristic. A low-impedance type of power valve is essential, therefore, and in fact if the receiver is to be used close to a local station, it is desirable to use a valve having an even lower impedance than usual.



This photograph shows clearly the arrangement of the wiring to the jacks and terminals.

The "Distaflex Two"

With Other Valves

This is not absolutely necessary, however, unless exceptional volume is required from the local station. With an ordinary low-impedance valve there will be a tendency to blast when receiving very loud signals, owing to the fact that the valve cannot handle the volume, and this may be cured either by dimming the filament slightly by means of the filament rheostat provided or by mistuning the aerial circuit.

A Limiting Device

The grid condenser and leak, which is provided in the grid lead of the second valve, is to some extent a preventive of this blasting. The position of this component may have occasioned some surprise, since the rectification in the receiver is provided by a crystal.

The function of the condenser and leak in this case is not to provide any rectification, and in fact it does not do so, because the return circuit of this grid is connected to a considerably negative potential. It acts rather as a limiting device on very strong signals, tending automatically to increase the grid bias potential and to minimise the blasting.

Grid Bias and High-Tension

The grid bias which is provided on each of the valves should be considerable, the actual value depending upon the valve in use and the high-tension voltage. Owing to the large volume

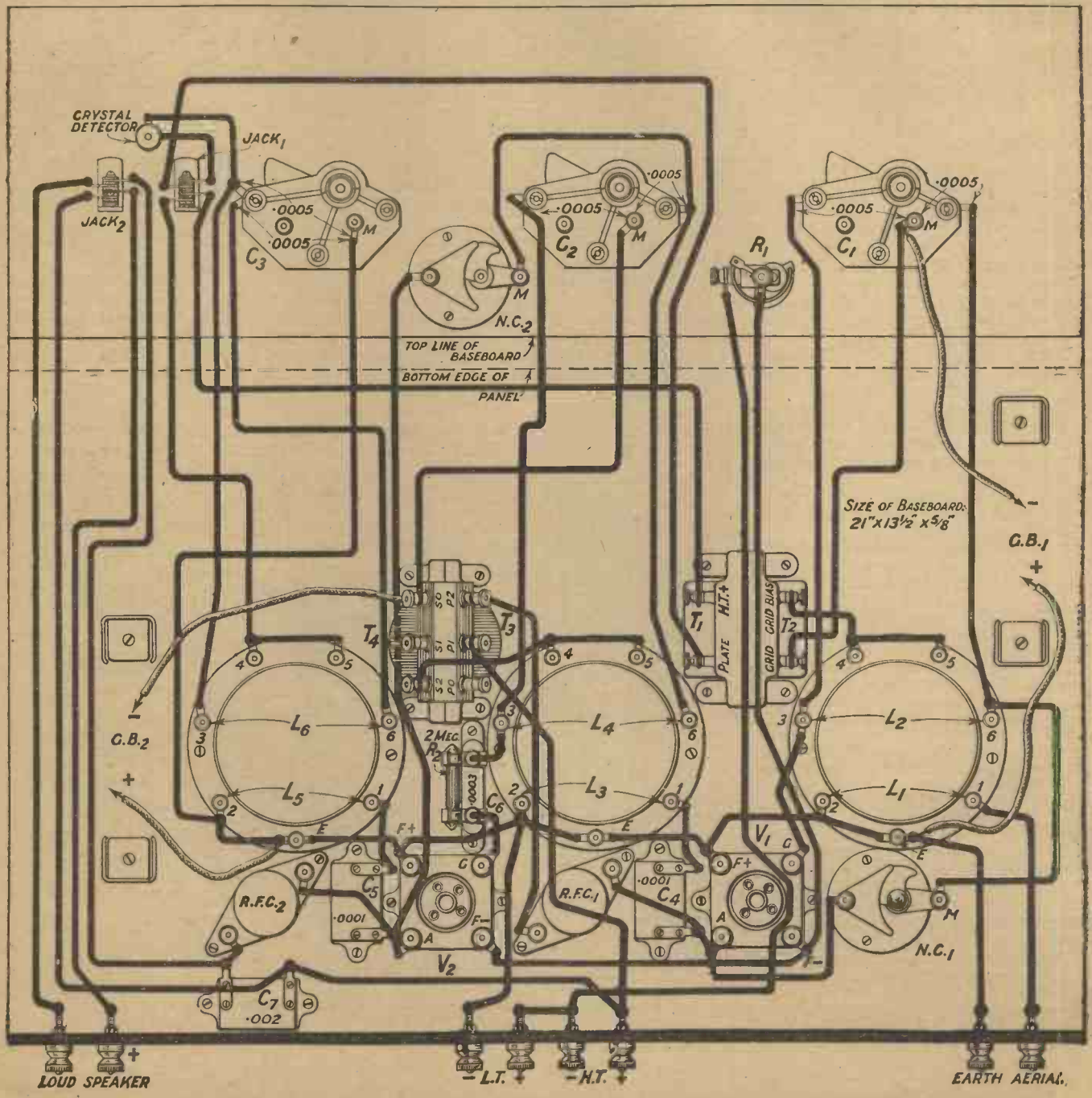


Fig. 5.—A useful check may be kept on the wiring by crossing out each connection in the instructions on the opposite page as it is completed. Blueprint No. C.1063B of this diagram may also be obtained.

Begin and Build It Now

which these valves have to handle, it is advisable to use as large a high-tension voltage as practicable, about 100 or 120 volts being satisfactory for ordinary purposes. With such voltages from 6 to 9 volts negative at least is required on each valve grid in order to avoid blasting, and also to avoid rectification by the valves themselves.

low-frequency oscillation. When this receiver is correctly adjusted it will be found that all signals cease when the crystal is removed. There may be a very faint background of signals when receiving the local station, but on other stations no signals whatever will be heard.

Having chosen the valves and batteries, therefore, the telephones should be inserted in the No. 1 jack. This connects up the receiver as a straightforward 2 H.F. and crystal circuit.

Place both of the neutralising condensers about one-third of the way round, and then tune in to the local station. No sign of oscillation should be observed, but if the set tends to oscillate at any point, one or other of the neutralising condensers should be adjusted slightly until no such oscillation is produced.

WIRING IN WORDS

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

Join Aerial terminal to terminal 1 of right-hand coil base.

Join Earth terminal to terminal E of right-hand coil base, thence to terminal 2, to one filament contact of V1 valve holder, to terminal E and terminal 2 of centre coil base, to one filament contact of V2 valve holder, to terminal E and terminal 2 of left-hand coil base, and to spindle of variable condenser C3.

Join H.T. positive terminal to P1 terminal of L.F. transformer T3 T4, also to one side of fixed condenser C7 and thence to bottom contact of Jack 2.

Join H.T. negative terminal to L.T. positive terminal and to one terminal of filament rheostat R1.

Join L.T. negative terminal to terminal 2 of centre coil base.

Join right-hand loud-speaker terminal to lower right-hand contact of Jack 2.

Join left-hand loud-speaker terminal to upper left hand contact of Jack 2.

Join top contact of Jack 2 to one side of R.F. choke 2 and to remaining side of fixed condenser C7.

Join inner (nearest panel) fixed vanes of variable condenser C1 to terminal 6 of right-hand coil base, and thence to moving vanes of condenser N.C.1.

Join moving vanes of C1 to Grid terminal of L.F. transformer T1 T2.

Join Grid bias terminal of T1 T2 to terminals 4 and 5 of right-hand coil base.

Join outer fixed vanes of C1 to terminal 3 of right-hand coil base, and thence to grid contact of V1 valve holder.

Join remaining terminal of filament rheostat R1 to remaining filament contacts of V1 and V2 valve holders.

Join inner fixed vanes of variable condenser C2 to terminal 6 of centre coil base, and also to moving vanes of condenser N.C.2.

Join spindle of C2 to SO terminal of L.F. transformer T3 T4.

Join outer fixed vanes of C2 to terminal 3 of centre coil base, and thence to one side of fixed condenser C6.

Join other side of C6 to grid contact of valve holder V2.

Join terminal 1 of centre coil base to one side of fixed condenser C4.

Join other side of C4 to anode contact of valve holder V1, thence to fixed vanes of condenser N.C.1, and to one side of R.F. choke 1.

Join other side of R.F. choke 1 to P2 terminal of L.F. transformer T3 T4.

Join terminal S2 of T3 T4 to terminals 4 and 5 of centre coil base.

Join fixed vanes of condenser N.C.2 to anode contact of valve holder V2, also to one side of fixed condenser C5 and to remaining side of R.F. choke 2.

Join remaining side of C5 to terminal 1 of left-hand coil base.

Join inner fixed vanes of variable condenser C3 to terminal 6 of left-hand coil base.

Join outer fixed vanes of C3 to one side of crystal detector, and also to terminal 3 of left-hand coil base.

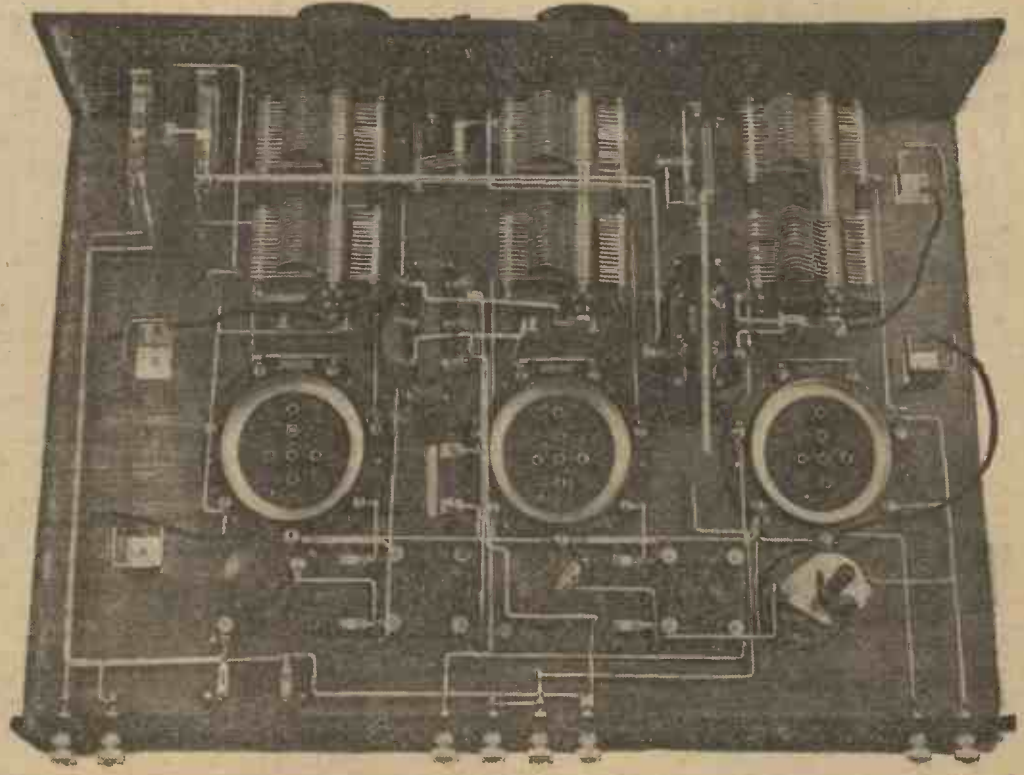
Join other side of crystal detector to top contact of Jack 1.

Join bottom contact of Jack 1 to terminals 4 and 5 of left-hand coil base.

Join upper left contact of Jack 1 to Plate terminal of L.F. transformer T1 T2.

Join H.T. + terminal of T1 T2 to lower right contact of Jack 1.

Attach flex leads with battery wander-plugs to the following points: spindle of variable condenser C1; terminal E of right-hand coil base; S O terminal of L.F. transformer T3 T4; terminal E of left-hand coil base.



The correct lay-out of the components and wiring is of great importance, and this view should furnish useful supplementary information to Fig. 5.

Final Adjustments

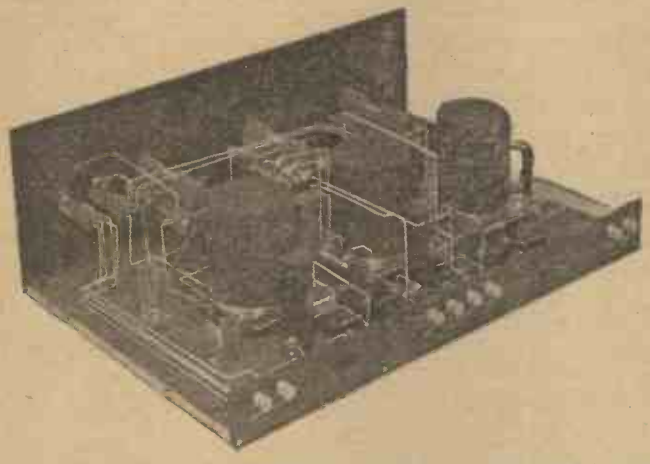
As with all reflex circuits, the dual valves must not be allowed to rectify, as otherwise there is a tendency to

Neutralising

Then move the dials in unison, that is to say, keeping the dials approximately the same from top to bottom

THE DISTAFLEX TWO—*continued*

of the scale, swinging the aerial condenser over 5 or 10 degrees on either side of the actual tuning point, and noting whether any tendency to oscillate is observed. If the receiver bursts into oscillation, this should be checked by a slight movement of the neutralising condensers one way or the other, and by this means a position will readily be found in which the receiver is stable over the whole range. The baseboard-mounted condenser is then left fixed, while the panel-mounted condenser is utilised to apply deliberate reaction.



The neutralising condenser mounted on the baseboard is set when the receiver is first tested, and then left, the panel neutralising condenser being used for reaction control.

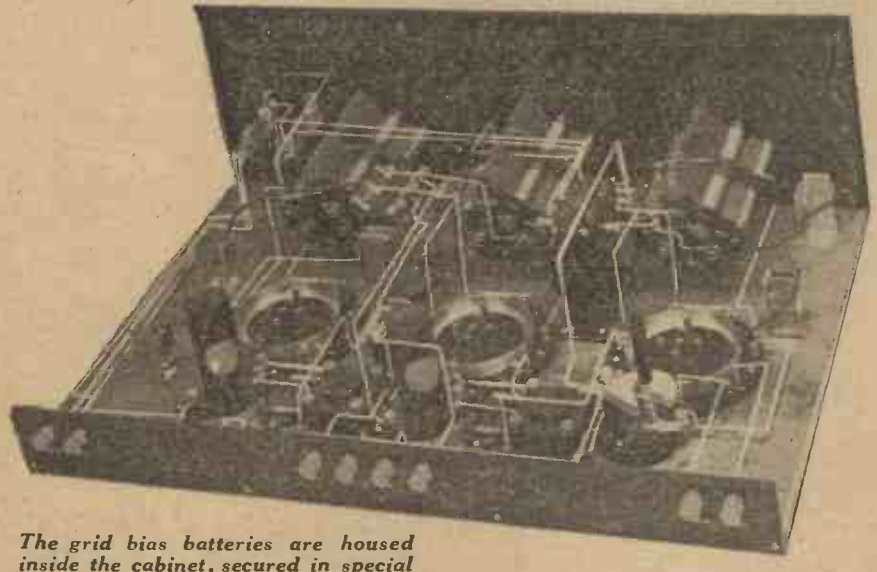
The L.F. Stages

The telephones may then be removed from jack No. 1 and inserted in jack No. 2, when the reflex portion of the circuit will come into operation, and the signals will be considerably increased in volume. The tuning will be found to be practically the same as when using the receiver as 2 H.F. and a crystal, the only difference being that two note-magnifying valves have been added. It is a good plan, therefore, to search for the various stations required with the telephones in jack No. 1 until some skill in the use of the three dials is acquired.

As long as the three dials are rotated exactly together little difficulty will be experienced in finding the stations. The aerial dial will be found to be slightly different from the other two owing to the effect of the aerial capacity, but this is usually only a matter of two or three degrees, and the correct tuning positions will readily be found.

Stations Heard

The approximate positions of the various stations will be shown from the accompanying test report, which gives a list of some 20 stations which were all received on the loud-speaker. The aerial employed for the tests was quite a simple 60-ft. aerial about 20 ft. high, so that conditions were equal to those obtaining under average circumstances.



The grid bias batteries are housed inside the cabinet, secured in special clips at each end of the basebcard.

By placing the dials approximately in the positions shown, and swinging them one after the other one or two degrees on either side, the stations may be picked up with comparative ease. After practice has been acquired in this manner, the telephones may be inserted in jack No. 2 and the full capabilities of the receiver may then be judged. It will be found, as a matter of fact, that in many cases the stations can be tuned in direct on the loud-speaker when the settings have become known and a little experience in tuning has been acquired.

(*Concluded on page* 1118.)

NEWS IN ADVERTISEMENTS

Messrs. Falk, Stadelmann & Co., Ltd., request readers to write for their catalogue, in which appear full descriptions of their products—including the Variform low-frequency transformers.

Readers are invited to send for illustrated leaflets dealing with the comprehensive range of Benjamin Products. It is interesting to note that this Company announce in their advertisement the marketing of the Benjamin Radio Valve.

The advertisement of the Varley Magnet Co. gives particulars of the new Varley Multi-Cellular high-frequency choke.

Messrs. Hart Accumulator Co., Ltd., request readers to write their department W.C.R. for full particulars of Hart batteries.

Messrs. Pettigrew & Merriman (1925), Ltd., advertise their willingness to send the Newey Catalogue of Radio Components to any reader.

An announcement of the "Brandeset" receivers is made in this issue by the manufacturers of the well-known "Brandola" and "Table-Talker" loud-speakers.

No. J.105 is a very interesting pamphlet on the Igranic Superheterodyne, which Messrs. Igranic Electric Co., Ltd., will send to readers on receipt of a postcard.

In their advertisement, Messrs Bowyer-Lowe Co., Ltd., give particulars of their Gang-control condenser, especially designed for the Elstree "Solodyne." Full particulars of this and other products of this Company can be obtained by writing for the latest number of the Bowyer-Lowe Radio News.

DEMONSTRATIONS OF RADIO PRESS STAR SETS

The New Elstree Developments Explained

RADIO PRESS LECTURERS TO TOUR THE COUNTRY

WE are pleased to be able to announce to our readers that Radio Press, Limited, the proprietors of this journal, and also of *Modern Wireless* and *Wireless*, are proposing to arrange to tour the country and give lectures on and demonstrations of the new developments which have resulted from the research work in their Elstree Laboratories.

Radio Press Designs

The Radio Press designers have in the past enjoyed a considerable reputation by reason of the receivers which they have produced, and Radio Press sets have been extremely popular in the past. In the catalogues issued by the principal firms catering for constructors, more than 90 per cent. of the designs are those published in Radio Press journals. Now every Radio Press designer realises how revolutionary are the new developments which have come from Elstree. It is therefore the intention of Radio Press, Limited, to endeavour to create a great revival of interest in radio by demonstrating the new receivers and showing how much superior they are to the older designs.

The Elstree "Solodyne"

In the September issue of *Modern Wireless*, which was published on September 1, are given the details of a Radio Press Star set, the Elstree "Solodyne." With this remarkable receiver it is possible, by adjusting a single dial, to bring in numerous stations at full loud-speaker strength. This receiver is to be demonstrated by Radio Press, Limited, in different parts of the country.

It is obviously out of the question to make arrangements for every one of our readers to see and operate the "Solodyne," but wireless enthusiasts who attend the lectures and demonstrations will be able to spread the news of the success of the receiver and to encourage others to build it and see for themselves.

The Elstree "Solodyne," described in the September issue of "Modern Wireless," is one of the sets which it is proposed to demonstrate.

It will only be possible to visit the principal towns. The lectures will deal with the research work which is done at Elstree, and the "Solodyne" and possibly also other sets will be demonstrated.

Dates of the Lectures

It is impossible to give the dates of the lectures in THE WIRELESS CONSTRUCTOR, since it is only a monthly publication. You are therefore requested to send a postcard addressed "Lecture Tour," Radio Press, Limited, Bush House, Strand, London, W.C.2, giving your name and address, and stating the maximum distance which you are prepared to go to hear the lecture.

When a lecture is arranged, the first people to be invited will be those whose cards we have received, and we shall communicate with them before the lecture is given.

Reserved Accommodation

Details of the Lecture Tours will also be published in *Wireless*, although we advise readers to send us a card, as in that case accommodation will be specially reserved for them. It may occasionally be necessary to give the same lecture several times over in a big town.

The Secretaries of Radio Societies in or near big towns who are prepared to assist in the organisation of the lecture and demonstration locally are also asked to communicate with us.

This new move will, we feel, inspire the greatest confidence in those who read our journals, and will show that we are anxious to do everything possible to encourage our readers to proceed at once with the construction of the Radio Press Star sets.

THE TRUTH (?) ABOUT CONDENSERS

IT is time, I think, that a really authoritative article was written on the subject of condensers fixed and variable, and since no one else seems to be tackling the job, I suppose that I had better take it on myself. There are scores of makes of variable condenser on the market, each of which is a very great deal better than any other; this must be true because the makers always say so, and surely to goodness *they* ought to know what they are talking about.

Those Mystic Signs

The symbol used by you, by me, and by others of the common herd for the variable condenser, when we make what we are pleased to call diagrams, is

Only the Very Great are permitted to employ the symbol

The difference between a

and a

is precisely the same as that which exists between a souldering iron and a soddering iron. Personally I employ a slight variation of the first symbol for many variable condensers, drawing it thus:

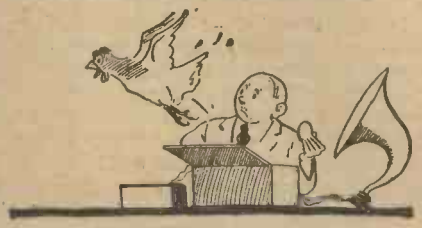
The reason is that if, when sitting at my table, I draw it like this:

the arrow points exactly in the direction of the dustbin.

There are three main classes of variable condenser: the straight-line-capacity, known professionally as SLC, the straight-line-wavelength (SLW), and the straight-line-frequency (SLF); there is also a fourth sub-class known as KLA, or kinky-line-anything.

Theory and Practice

The principle of the straight-line-capacity condenser will be readily understood from inspection of Fig. 1, which shows the calibration curve of one of these instruments. It will be observed that, barring accidents, such as will happen, a steady increase in



. . . birds' nests in the condenser . . .

the capacity takes place as the knob is rotated in a clockwise direction by the supple wrist of the user. The almost infinitesimal deviations from the straight line, which will be found if the diagram is inspected closely, are due to slight defects in the contact between the spindle of the moving plates and the bush. These are often caused by the presence of birds' nests in a condenser that has been in use for some time; precautions should, therefore, be taken to exclude our little feathered friends from the cabinet of the wireless set. Even a new condenser, however, may show distinct signs of wonkiness, for many manufacturers have so concentrated on the SLW, SLC or SLF ideas that they have no time to think about SLS, or straight-line-spindle.

Straight Curvature

Turning now to the straight-line-wavelength principle, I present to

. . . probably a pair of broken ear-drums . . .

your notice Fig. 2, which shows exactly how condensers designed on these lines carry out their duty. It will be seen that from 0 to 30 degrees or thereabouts the straight line forms a graceful curve; but if we refer, as we frequently do in wireless, to straight lines as curves, then why, I ask you, should we not call a curve a straight line once in a way? From this point progress is upwards on true Excelsior lines until the 60-degree mark is reached, where a slipping knob gives us a breathing space for a spell. Then we have another slopilinear bit, followed—are we not talking about *variable* condensers?—by a fall and a rise (and probably a pair of broken ear-drums) due to touching plates. With the exception of the initial slight curve, however, all the lines are straight, so that the condenser has lived up to its name.

For the Mathematician

A straight-line-frequency, or, as I prefer to call it, straight-line-frequently condenser, is exceedingly useful for those who like to spend their

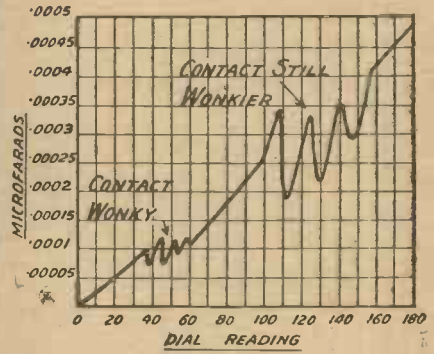


Fig. 1.—The curve of a straight-line-capacity condenser. Careful inspection of the bushes may lead to the discovery of the birds' nests which often cause the deviations shown.

evenings in working out the formula $\lambda = \frac{300{,}000{,}000}{F}$ or conversely $F = \frac{300{,}000{,}000.}{\lambda}$ Actually this formula is not quite correct, since the speed of light is not exactly 300,000,000 metres a second; but this does not very greatly matter, since the answers produced by most enthusiasts would be incorrect in any case. I do not give a typical curve of the SLF condenser since I am not good at kilocycling, but it follows the same general lines as those seen in Fig. 1 and Fig. 2.

Refinements

We come next to refinements in condenser design, such as the integral vernier and the slow-motion dial. Both of these devices were designed

The Truth (?) About Condensers—*continued*

to facilitate fine tuning, and they do so in a remarkably effective way. The word "vernier" is almost as blessed as Mesopotamia; like charity it covers a multitude of sins. Originally the word "vernier" was applied to delicate apparatus which enabled you to obtain a reading in tenths,

. . . without spoiling the temper of their families . . .

hundredths or thousandths of a coarse main scale; in wireless it is used to describe a method which prevents you from obtaining any reading at all.

Constant Entertainment

The variable condenser of the baser sort, with a still baser integral vernier, can be relied upon to ensure that the enthusiast has never a dull moment. It consists as a rule of a main spindle, carrying the moving plates, through which has been drilled a slightly eccentric hole. Through this passes a secondary spindle carrying a single plate which meshes with a lone fixed plate at the far end of the instrument. Since the vernier spindle does not like to be left out of it when the main spindle is moved, it travels to and fro whilst the coarse adjustments are made.

Fine work is accomplished by means of the knob attached to the vernier spindle. When this is moved it carries the main spindle with it, thus making it the easiest thing in the world to make a fine movement of fifteen or twenty degrees in either direction. Many a Londoner who has never previously heard Manchester has been able to pick up 2ZY through the help of the integral vernier condenser, the Northern station having been brought in by a sudden and fortuitous upward leap of its plates.

More Entertainment

The slow-motion dial is designed somewhat on the lines of the gear-box on a motor-car. The idea is that since most of those who have made a hobby of wireless for any length of time are afflicted with Knob-Wangler's Twitch, it is impossible for them to make a small increase or decrease in their dial settings without some arrangement containing cogs, pinions, and other bits and pieces to help them. Some slow-motion dials are exceedingly useful for strengthening the wrists. If, for example, you choose one with a reduction of 300 to 1, you will have to give its knob about a hundred complete turns in a clockwise direction when you wish to ascend from London to Birmingham, and an equal number in an anti-clockwise direction when you desire to reverse the process. Some of the handiest slow-motion dials are those which free-wheel for about ten degrees when you change the direction. These can be strongly recommended to confirmed knob twiddlers, who can sit happily waggling their dials of an evening without spoiling the temper of their families by constantly altering the tuning.

A Fascinating Sport

Another most interesting type is that in which progress upwards or downwards is accomplished by means of a series of jumps; with these in use one's wireless evenings are simply packed with delightful surprises. You have got, let us say, Rome and you think of proceeding upwards to Toulouse. Placing your fingers upon the knob you essay to make a small clockwise movement. The knob appears to have stuck. You increase the pressure. It leaps forward and in comes Porsgrund, which you have never heard before and will probably never hear again.

Even more delightful is the little game of Catch-the-station which may be played, a game quite as exciting as Hunt-the-slipper or Catching-the-greased-pig. You are after, let us say, Dublin. You know that you are

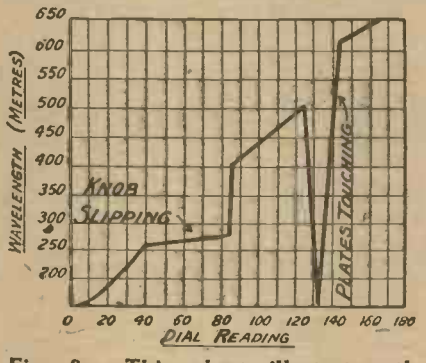


Fig. 2.—This chart illustrates the straight-line-wavelength principle as exhibited by a (very) variable condenser.

nearly there and every fibre is a-quiver. A tiny forward motion, a leap of the dial, during which you hear one wail from the Irish pipes, and you have gone too far. You turn back. Another jump, another wail. And so filled with growing excitement you repeat the process again and again, until there comes a sudden mighty jump which lands you bang in the middle of Frankfort.

A Warning to Twiddlers

Should variable condensers have ball bearings? This is a most important question to which every wireless enthusiast should pay the closest

. . . the instrument has burst into flames . . .

attention. Personally I contend that for confirmed ether-rakers, ball-bearing spindles are absolutely essential, for I have known many cases in which the friction of plain bearings during a prolonged search for an elusive station has generated such heat that the instrument has burst into flames, doing serious damage to the receiving set and severely scorching the fingers of the operator.

If ball bearings are not employed, the condenser should certainly be provided with some means of keeping its bearings cool. It is an excellent tip to arrange a small tap immediately over the receiving set, so placed that a thin stream of water is directed upon the end bearing of the spindle. Immediately under the condenser is placed a neat tank to which is connected a pipe running to that portion of the geranium bed beneath which the earth plate is buried. Thus not only is the condenser kept cool but the earth is also automatically soaked, thus eliminating the damping due to resistance by means of the damping due to wetness.

LOOK TO YOUR EARTHING SWITCH

MANY constructors show a partiality towards the type of aerial-earth switch which earths the aerial outside the house when the receiver is not in use. There is much to be said in favour of this principle, but the contacts which are exposed to the inclemency of the weather must be cleaned periodically, or some device made to cover them and prevent corrosion. The ingenuity of the constructor will not be taxed unduly in making a covering to fulfil this purpose.

Many of the switches one sees at the present time incorporate some form of patent lightning device, thus giving a measure of safety under all conditions.

H. J. B. C.

TALKS TO BEGINNERS

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

VII.—DEVELOPMENTS IN RANGE AND SELECTIVITY.

THE reader who has carefully read through my previous articles will by now be able to look at a wireless receiver, whether factory built or home constructed, with a greater interest than formerly. He will be able to take in at a glance the general features of a set, and will be able to some extent to appraise its value, and if, as is probably the case, he has been working a receiver for some time, he will be in a better position to appreciate features which make his set distinctive and to judge for himself whether or not it is really up to date.

This leads me to give this month a short talk on some of the more recent developments in sensitivity and selectivity, and to try and show how the ideal in these matters is not easily achieved, since both man and nature place certain difficulties in our way.

"Range" of a Crystal Set

Let us deal first of all with sensitivity. If you erect a simple aerial and crystal set connected to an efficient circuit you will be able to hear your local broadcasting station, a few Morse stations and ships, and very little else. The reason is, as explained previously, that you have to deal with the energy received at your aerial without amplification. By adding amplifiers to your crystal set you will greatly increase the volume of sound given out, and, indeed, the sounds from the local broadcasting station can easily be made so overwhelming as to be a nuisance to yourself and your neighbours, but you will probably listen in vain for the slightest sound from more distant stations, which somehow or other remain beyond your reach. Although low-frequency or "note" magnifiers do add to some extent to the range of a set, in order that distant stations may be brought in well, or even at all in some cases, it is necessary to introduce high-frequency magnification or magnification of the minute radio-frequency currents before they are passed to the detector.

High-Frequency Stages

In such a modern receiver as the Night Hawk, efficient high-frequency amplification is provided before the detector stage, and after this, further efficient magnification is used to bring up the volume. Those of us who have been connected with radio from its early days know that in a very large number of cases the home constructor who has successfully built a crystal or a single-valve set embarks light-heartedly upon the construction—often to his own design!—of an elaborate multi-valve set, expecting to get miraculous results without the slightest difficulty.

There's Many a Slip . . .

"Surely," he says to himself, "if each valve gives a certain amount of magnification, all I have to do is to make a set with as many valves as I can afford, and I shall bring in America without the slightest difficulty. After all," he continues, "I can easily work out the circuit. I shall connect my tuner to the first high-frequency valve, transformer couple this to the next, and so on for four or five stages. Connect it to the detector (I have one already made), and then add three or four stages of low-frequency. I am sure no one in my neighbourhood will have such a wonderful set!"

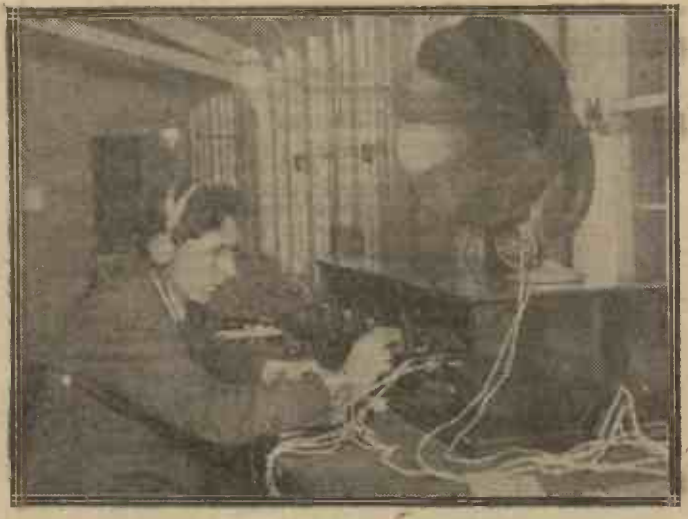
More than likely he will take a popular design such as the "Elstree Six," modify it to suit the cabinet he has, remove all kinds of arrangements which appear to him unnecessary, and then—well, we had better draw a veil over the conclusion of the story!

Is H.F. Efficient?

Two or three years ago a large number of experienced amateurs held the view that it was impossible to get any real magnification by high-frequency stages, and challenges were bandied about by owners of single-valve and reaction sets, who claimed that by critically adjusting reaction they were able to get as strong signals as their rivals were obtaining with two stages of high-frequency preceding their detector. Strange as it may seem to the beginner, they were often able to prove their case, and I have been present at more than one demonstration where the owner of a multi-valve set has had to retire much humbled from a contest with another amateur with only a detector followed by a couple of stages of note magnification.

The Cause of the Trouble

Framed in a few words, the reasons were as follows:—The grid circuit of the first high-frequency valve was tuned in the conventional way and the anode circuit was joined to a transformer, in which the primary and secondary were very tightly coupled. Either the primary or the secondary (it did not greatly matter which) was tuned, and as soon as the grid circuit



The remarkable performance of the famous "Elstree Six" is largely due to the use of very efficient high-frequency transformers.

Talks to Beginners—*continued*

and the anode circuit were brought into tune, the stray fields from the coils and the tiny condenser formed between the grid and the anode itself of the valve were together sufficient to hand back more than enough energy to maintain a continuous state of oscillation.

Stability—at a Price

To check this oscillation, all kinds of devices were tried, the most effective being to connect the wire, which normally would go from the condenser to the filament of the valve, to the slider of the potentiometer, by varying which it was possible to impress upon the grid of the valve a varying degree of positive potential. By adjusting this potentiometer slider a point was reached when oscillation just ceased, and the set was then stable. It was not generally realised that this stability was obtained by introducing losses into the circuit equivalent to introducing high resistance; thus stability was gained by sacrificing efficiency.

Some Good Results

Now if the parts were carefully chosen and carefully arranged so as to give a minimum of interaction between transformers and coils and also between wiring—for interaction between wiring is an important matter in wireless receivers—it was possible to obtain a fair degree of amplification, even after the losses had been introduced. I did a good deal of work myself in this direction, and succeeded in bringing out several sets having very distinct amplification for each stage, and a number of these sets, known as the "Transatlantic" series, have remained popular to the present day.

Careful Design Needed

Before these designs were produced, however, all kinds of difficulties had to be overcome, for it was quite a simple matter to make a set which was quite stable, but in which the losses in order to make it stable were so great as to cut out all amplification obtained by the valve. Thus, as in the cases above mentioned, it was possible to have a couple of stages of high-frequency magnification doing nothing more than hand on the signals un-amplified.

The Neutrodyne System

About this time Mr. Scott-Taggart in England and Professor Hazeltine in America were working on the problem of obtaining stability in high-frequency stages without sacrificing efficiency. Ultimately they were able to produce a system known as the "Neutrodyne" method which, instead of "killing" the oscillation by resistance and therefore by losses, brought it about that the tendency to feed back energy through the valve itself, by means of the small capacity between the filament and the anode, was balanced by an equal and opposite effect produced by certain coils and condensers. The energy which otherwise would have been wasted in heating the resistance was thus retained for use, thus increasing enormously the efficiency of high-frequency magnification.

An Early Neutrodyne Receiver

I have indicated above that when the anode circuit and the grid circuit were brought into resonance with one another a certain amount of loss had to be introduced by the old method in order to obtain stability. With every additional stage of high-frequency magnification the "feed-back" increased, so that it was found impracticable to get any efficient amplification by means of the older method after two stages had been used. With the Neutrodyne method, however, it was possible to proceed still further, and in a very early number of THE WIRELESS CONSTRUCTOR (January,

(*Concluded on page* 1100.)

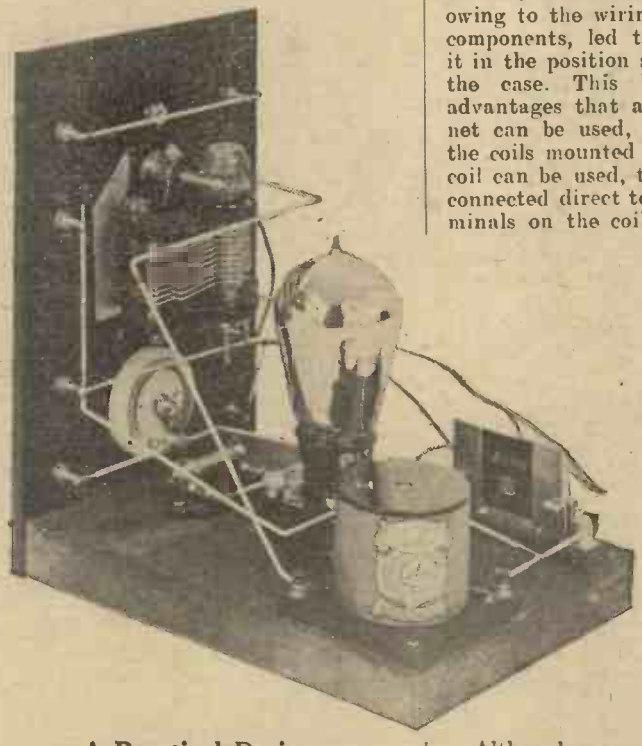
THE "RECRUIT'S" SINGLE-VALVE RECEIVER

By GEORGE T. KELSEY.

An easily constructed and inexpensive receiver, which may be relied upon to give good results in the hands of a "recruit" to radio. Varying degrees of selectivity may be obtained to suit individual requirements.

THIS period of the year can usually be regarded as the time when a large number of people become interested for the first time in radio. The reason for this probably lies in the fact that the dark evenings which are most suitable for the reception of wireless signals are those upon which tennis and similar outdoor pastimes cannot be followed. The construction of wireless receivers temporarily fills the time during the winter months.

The requirements of a recruit to radio whose intention it is to construct a valve receiver, usually amount to simplicity of operation and a low initial outlay, and, bearing these two points in mind, there is much to be said in favour of a receiver employing only one valve.



The wiring should be carefully arranged to allow of free vibration of the valve in its holder.

A Practical Design

A receiver which has been designed to meet the needs of the beginner and which calls for the use of only one valve may be seen in the photographs accompanying this article. A dull-emitter valve may be employed in the set, in which case the running expenses will be very low.

What You Will Need

In another part of this article the components used in the original receiver are listed together with the makers' names or trade marks. From this it should not be imagined that these are the only suitable makes, and reference to advertised goods elsewhere in this issue will reveal many of different manufacture. If substitutions are made, however, it is important that they should be capable of adaptation to the particular layout of the set.

The Coil Holder

The inaccessibility of the coil holder when it is mounted inside the cabinet, owing to the wiring and neighbouring components, led the writer to mount it in the position shown on the side of the case. This has the additional advantages that a much smaller cabinet can be used, and that by having the coils mounted externally an "X" coil can be used, the aerial lead being connected direct to one of the two terminals on the coil.

Although an aerial terminal is provided on the panel, this is only for use when it is desired to use direct aerial coupling.

Concerning Construction

The drilling layout is shown in Fig. 2, and this can be followed out on your own panel. Of course, the substitution of different components for those recommended may call for slight modifications when laying out the panel, but care should be taken to see that any alterations made are only slight.

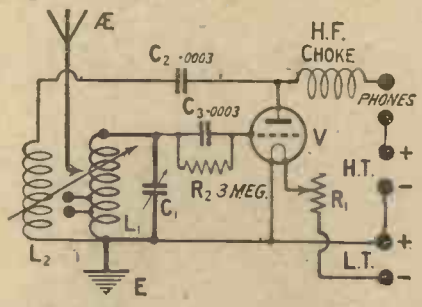


Fig. 1.—The aerial may be tapped on at any one of three points to obtain the required degree of selectivity.

Fixing the Panel

It was not found necessary to employ brackets to support the panel, so that when this latter has been drilled it may be attached to the baseboard by means of three ¾-in. wood screws. The terminals are best mounted in position before the variable condenser and the rheostat. Eight terminals in all are required—one for aerial and one for earth, two for the H.T. and two for the L.T. battery, the remaining two being those to which telephones are connected. When mounting the variable condenser the metal shield should be connected to the earth terminal.

Baseboard Components

The valve-holder, H.F. choke, clip-in condenser, and the grid-leak and condenser are mounted on the baseboard. The wiring diagram will show how the available space is utilised, and the reader is recommended to adhere to this arrangement. Incidentally, employment of the particular layout of components shown in the original set will simplify the wiring to a considerable extent.

To the left-hand side of the cabinet the two-coil holder should be secured in such a position that the knob of the control handle comes in the same plane as the knobs upon the panel. Three holes should be drilled in the

The "Recruit's" Single-Valve Receiver—*continued*

side of the cabinet, one above and two below the coil holder, to pass the leads through to the inside.

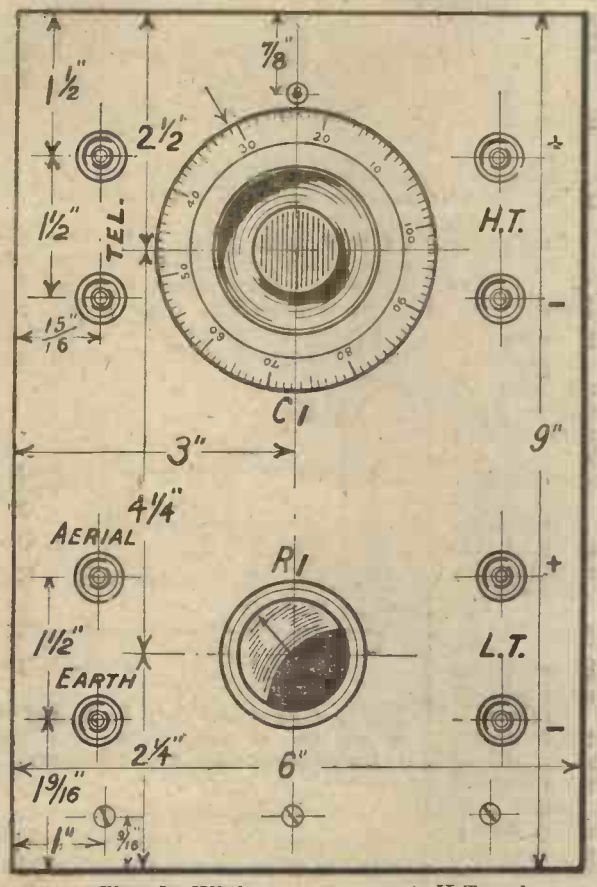


Fig. 2.—This diagram will provide drilling dimensions for the panel. Also obtainable as a blueprint, No. C.1064A.

Simple Wiring

In view of the printed wiring instructions and the back of panel drawing shown in Fig. 3, further detailed explanations of the procedure to be adopted in wiring are deemed unnecessary; regarding the connections to the coil holder, however, a few words may be helpful. These are carried out with flex wire. The aerial and earth terminals should be connected to the two screws on the fixed coil block connecting the earth to the pin side. The flex leads for these two connections pass through the two lower holes in the cabinet. A flex extension of the wire to the earth side of the aerial (fixed) coil mount should be secured to one side of the moving socket, the remaining connection on this latter being connected to one side of the condenser C2. After the application of suitable panel transfers, the receiver is ready for testing.

Filament Wiring

Connect up the L.T. battery to the appropriate terminals and insert a valve in the holder. Slowly turn on the filament resistance and notice if the valve gradually lights up. This is, of course, assuming it to be a valve from which a glow is visible. Leaving the resistance on, transfer the L.T. battery to the terminals on the panel marked H.T., when no degree of illumination whatever should be visible from the valve. Should the filament light up under these conditions turn off the rheostat and carefully check the wiring until the error is found. For the test just described, the coils should be mounted in the holder.

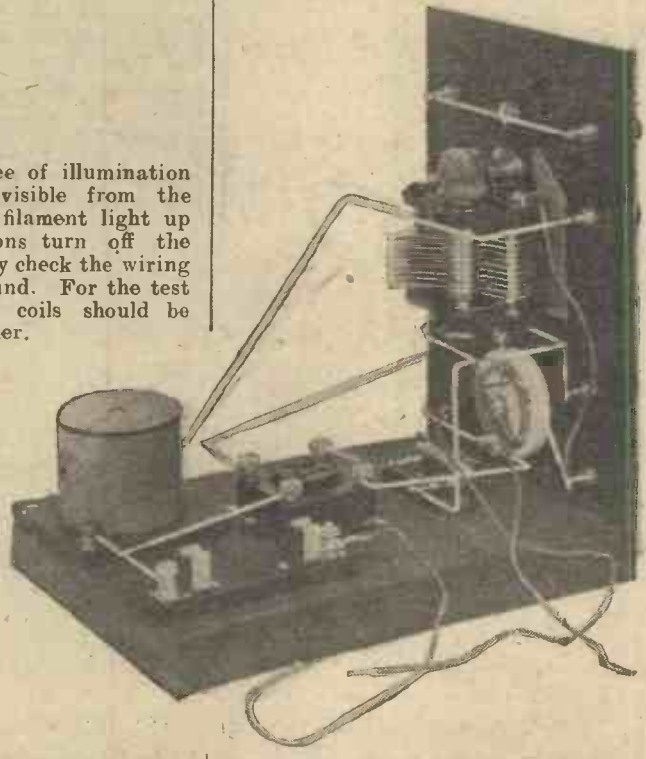
Here the fixed condenser C2 has been removed from its clips to show clearly the wiring to the valve holder.

With the filament wiring in order, connect up the batteries, using between 30 and 45 volts high tension. Place an "X" coil in the fixed coil socket and connect the aerial lead to one of the terminals on its side. The aerial coil should be a No. 50 or 60, and for reaction the smallest coil possible to obtain a reaction effect should be used. When using direct aerial coupling it is likely that a No. 35 or 40 coil will be large enough for L_1 wavelengths up to about 400 metres. The telephones and earth are the only other external connections to be made before the tests on broadcasting are made.

BUILD THIS SET WITH

One cabinet to take panel 9 in. by 6 in. and baseboard 8⅝ in. deep (Carrington Manufacturing Co., Ltd.).
One Becol panel 9 in. by 6 in. by ¼ in. (British Ebonite Co., Ltd.).
One "Colvern" selector low loss condenser .0003 (Collinson Precision Screw Co., Ltd.).
One "Competa" arrow line rheostat, 35 ohms (A. F. Bulgin & Co.).
One H.F. choke (Beard & Fitch, Ltd.).
One Benjamin non-microphonic valve-holder (Benjamin Electric, Ltd.).
One clip-in condenser .0003 with baseboard mount (L. McMichael, Ltd.).
One grid condenser and leak .0003 and 3 megs. respectively (Dubilier Condenser Co., Ltd.).
One two-way coil-holder (Penton).
Eight type W.O. terminals.
Glazite and flex for wiring and a quantity of wood screws.
Radio Press panel transfers.

Approximate cost, £4.



How to Test

Place the two coils at right angles and turn on the filament resistance.

The "Recruit's" Single-Valve Receiver—*continued*

Tune with C_1 until signals are heard from the local station. The reaction coil may now be brought slowly towards the aerial coil, when the strength of signals should increase. Be very careful at this stage, however, for at a certain position a slight "rushing" sound will be heard in the telephones, and on no account should the reaction coil be taken past this position, otherwise you will be liable to cause your neighbours considerable interference.

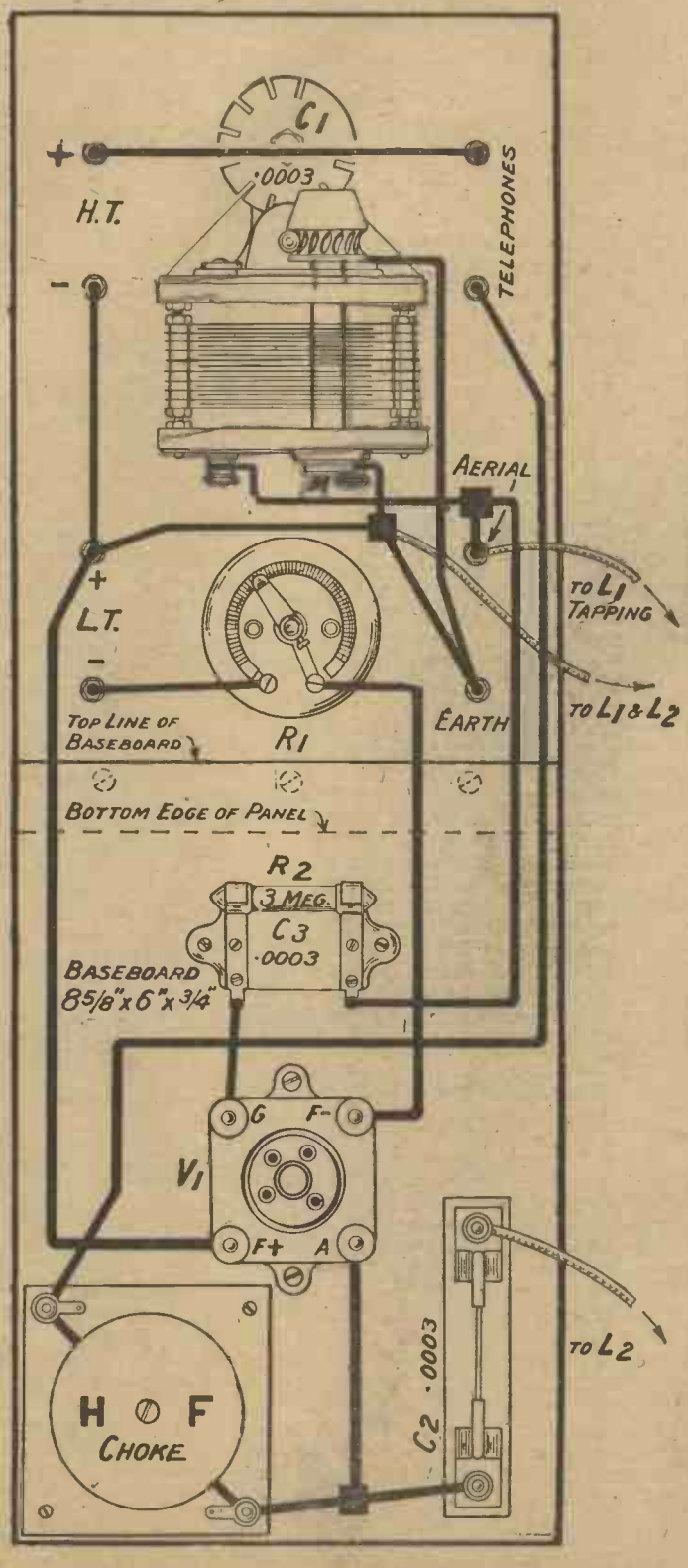


Fig. 3.—The flex leads are attached to the coil holder after the set has been placed in the cabinet. Blueprint No. C.1064B.

Smooth Reaction Control

For the reception of distant stations it is essential that the reaction control be very smooth, and if the set tends to start oscillating suddenly with an audible "plop" in the telephones try adjusting the values of high- and low-tensions.

After a short experience of handling the instrument the reception of distant stations under favourable conditions will become moderately easy. For such reception the receiver should be worked in its most sensitive condition, which is just below the oscillation point.

Just one further note regarding reaction. Should an increase in coupling between the two coils bring about *no increase* in signal strength then try reversing the leads to the moving coil block.

Author's Results

The original instrument has been well tried out in a locality about ten miles west of the London station. Bournemouth, Birmingham, Manchester, and, on one occasion late at night, Belfast, are among the British stations which have been received. Many Continentals, including Toulouse, Oslo and Hanover, have also been heard. The above results were obtained in darkness and under fair conditions, although there is little doubt that anyone under favourable conditions and capable of handling the receiver correctly could repeat the performance.

WIRING IN WORDS

Join AERIAL terminal to fixed vanes of variable condenser C1, also to one side of fixed condenser C3, and attach a flexible lead to the terminal.

Join EARTH terminal to moving vanes of variable condenser C1, also to the screen of C1, also to L.T. positive terminal. Also attach a flexible lead to the EARTH terminal.

Join L.T. positive terminal to H.T. negative terminal and to one filament contact on valve holder.

Join L.T. negative terminal to one terminal of the filament rheostat R1.

Join other terminal of R1 to remaining filament contact on valve holder.

Join remaining side of fixed condenser C3 to grid contact on valve holder.

Join H.T. positive terminal to the upper TELEPHONE terminal.

Join the lower TELEPHONE terminal to one side of H.F. CHOKE.

Join other side of H.F. CHOKE to anode contact on valve holder, also to one side of fixed condenser C2.

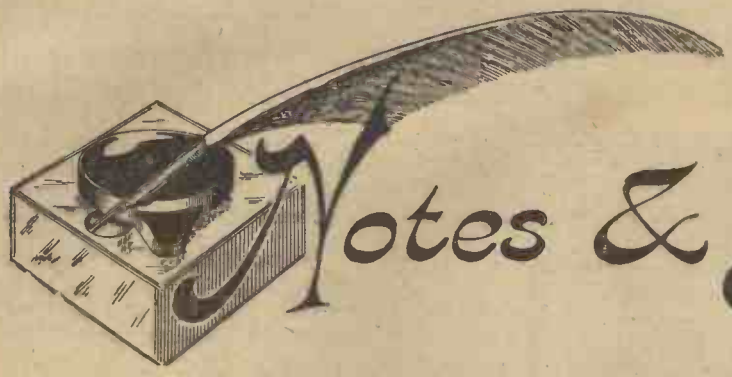
Attach a flexible lead to other side of fixed condenser C2.

After inserting the set in the cabinet, join up the flexible leads to the coil holder as follows:—

Join leads from AERIAL and EARTH terminals to fixed coil block, the lead from EARTH going to the pin.

Join this pin also to socket of moving coil block.

Join lead from fixed condenser C2 to pin of moving coil block.



Notes & Jottings

A Page of Information of Interest to All Constructors.

IN spite of the large number of different types of coils which are now available ready made for the constructor, there must still be many who prefer to make as much as possible of their receivers with their own hands, and who therefore like to wind their own tuning and other coils. The winding of solenoid coils is quite straightforward until it comes to the making of tappings. The most commonly adopted procedure in making tappings on such coils is to twist the wire up into small loops at the tapping points and subsequently to strip the insulation from these loops and solder leads to them.

This method does not prove very satisfactory if the finished coil is to be handled much in trying it in various circuits. The loops are liable to untwist slightly, with the result that the winding becomes loose on the former; this tendency may be reduced by varnishing the winding, though even by this expedient not altogether eliminated. A method of taking tappings which will stand any amount of handling without damage is illustrated in Fig. 1. The wire is wound on until the required point is reached, when a

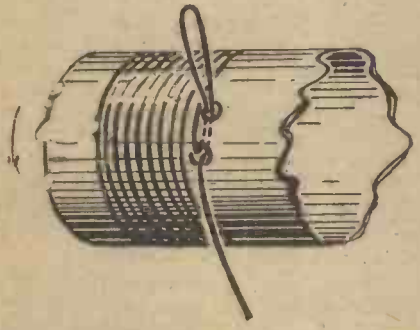


Fig. 1.—The holes in the former through which the loop is passed should in practice be as small as possible.

small hole is made in the former close up to the last turn. A loop of the wire about 2 in. long is passed through this, and then back again to the outside of the former through another hole, also close up to the last turn of wire and about ¼ in from the first hole in the reverse direction to the winding. A touch of shellac varnish on the two holes will make a thoroughly secure job of the tapping.

THE value of graphite as a lubricant is often overlooked, although, of course, it forms the base of a number of light lubricating oils, such, for example, as are used for the moving parts of small machinery. It sometimes happens that the bearings of a variable condenser become harsh, and if they are allowed to continue in constant use without attention, small particles of metal are likely to be rubbed from the bearings or the spindle, causing most annoying grating noises when the condenser is operated.

The application of oil or vaseline to the bearings is not a very satisfactory cure, as these substances tend to collect dust and so to produce a similar trouble in another way. A better method of applying the necessary lubrication is to dismantle the spindle from its bearings and to rub both spindle and bearings thoroughly with an ordinary drawing pencil, of HB or B grade. If it is not desired to take the condenser to pieces, a very little finely-powdered pencil "lead" may be introduced into the bearings from the outside, after which the spindle should be turned backwards and forwards to work in the lubricant.

THOSE who are sufficiently careful of their accumulators to check their condition periodically with a voltmeter sometimes fail to realise the fact that the accumulator should be checked only when it is "on load," that is to say, when current is being drawn from it. When an accumulator has been left standing for some hours it will often show a full reading on the voltmeter, even though it is discharged so far that it will not supply enough current to run the valves in the receiver. The voltmeter itself, if it is of a good make with a resistance high enough to prevent it passing more than a few milliamperes, will not impose sufficient load on the cells to cause any appreciable drop in voltage.

Actually the voltmeter should be applied to the cells when they are connected to the receiver with the valves alight. A more correct indication of their condition will then be obtained. To ascertain the actual voltage applied to any particular valve the voltmeter may be connected temporarily to the filament contacts of the required valve holder, the valve being left in position.

MOST constructors of home-made apparatus have probably at one time or another endeavoured to build a variable condenser, either from purchased parts or from the raw material in an unfinished state. Those who have made the attempt will no doubt have discovered that the job is by no means an easy one, unless an adequate tool kit is available. The small neutralising condensers which are in such common use nowadays with the advent of really satisfactory neutralised high-frequency amplification, are no exception to the rule, especially as they must be capable of accurate adjustment if the receiver is to function properly.

A substitute for this type of condenser can be readily made up in the home-constructed receiver. The method of providing the necessary

Fig. 2.—The ends of the leads which are to be tied together should be well straightened before being secured.

neutralising capacity is illustrated in Fig. 2. The ends of the two leads which would be taken to the terminals of the condenser are tied together side by side, and the amount of overlap is adjusted until the correct neutralising effect is obtained. Care must be taken that the two wires are well insulated, as otherwise a short circuit of the high-tension battery may result. If the existing insulation of the leads is distrusted, a short piece of insulating sleeving may be slipped over their ends before they are adjusted and fixed in position.

Here are the N.P.L. figures

—now you can judge for yourself!

TABLE 1			TABLE 2			
Coil	Inductance in microhenries	Self-capacity in micro-microfarads	Coil	Parallel capacity in micro-microfarads	Wave-lengths in metres	Effective resistance in ohms
35	61	15	35	300	264	2.8
40	90	15	40	„	318	2.9
50	150	9	50	„	406	3.3
60	200	13	60	„	472	4.4
75	295	12	75	„	573	5.3
100	540	11	100	„	774	6.6
150	1,410	12	150	„	1,250	15.8
200	2,220	17	200	„	1,580	19.7
250	3,070	17	250	„	1,860	24.9
300	4,800	14	300	„	2,320	28.2

IN the design of radio inductances it is a well-established fact that the smaller the R/L value for any circuit the greater is the selectivity and signal strength.

Because this fact predominated in the design of the LEWCOS Coil we can publish without fear the R/L values obtained in independent tests by the National Physical Laboratory.

Why the wave-length is given.

We would draw the attention of readers to the wave-length at which the measurements were made. This is a most important point which is often overlooked by amateurs and sometimes even by manufacturers when quoting the H.F. resistance figures for their coils. Resistance in high frequency varies with the frequency and to give a figure for H.F. resistance without the wave-length at which that resistance was measured is valueless.

Try this better coil yourself!

You will be delighted at the improvement in reception when you use Lewcos Coils. Besides being highly efficient they are strongly constructed and of good appearance. Try Lewcos Coils in your set—they make *all* the difference!

Your wireless dealer stocks or can obtain Lewcos Coils for you. Write for descriptive leaflet.

LEWCOS
Inductance Coil

No.	25	35	40	50	60	75	100	150	200	250	300
Price .	4/6	4/6	4/6	5/-	5/6	5/6	6/9	7/6	8/6	9/-	10/-

THE LONDON ELECTRIC WIRE COMPANY & SMITHS, LTD.

Playhouse Yard, Golden Lane, London, E.C.1

Phone: Clerkenwell 1388 *Telegrams: Electric, London*

The New Hall at Olympia, where the National Radio Exhibition is being held.

Have You Been to Olympia Yet?

THE NATIONAL RADIO EXHIBITION, 1926

Radio Press Star Receivers on Show

There are still a few days left in which to visit the National Radio Exhibition, which opened on September 4, in the New Hall at Olympia, and is to close on September 18. A few of the interesting exhibits are described and illustrated in the following pages, so that all can see the developments which are to make the coming season a notable one for every user of wireless apparatus.

THE National Radio Exhibition, 1926, opened on September 4 in the New Hall at Olympia, and closing on September 18, is this year an all-British Exhibition.

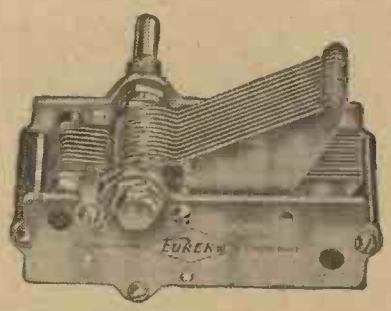
Those who are able to do so should make a special point of visiting the Exhibition this year, since the modern developments exemplified in the exhibits foreshadow an extremely interesting and successful season for every wireless enthusiast.

An H.F choke coil shown by the Varley Magnet Co.

Among many other interesting components, Messrs. Beard & Fitch are exhibiting on Stand 83 their "Success" "Super" variable condenser, a straight-line frequency instrument. The Bowyer-Lowe Co., Ltd., are to be found at Stand 126, prominent among their components being gang-control variable condensers for single-control receivers.

The "Clearertone" valve holder, shown by Benjamin Electric, Ltd., on Stand 105, is now available with a grid condenser and leak as a permanent attachment. A self-contained rheostat is another novel exhibit by this firm. It is claimed that the Brown disc loud-speaker, which is on show on Stands 128 and 129 by S. G. Brown, Ltd., is practically immune from damage due to accidental falls; the diaphragm is protected with metal on both sides.

The wide range of receivers manufactured by Burndept Wireless, Ltd., will be shown on Stands 140, 141, 144,



The Portable Utilities Co., Ltd., are exhibiting this new "Eureka Orthocyclic" variable condenser.

and 209, another feature of interest being the Auto Burndept System,

The National Radio Exhibition, 1926—*continued*

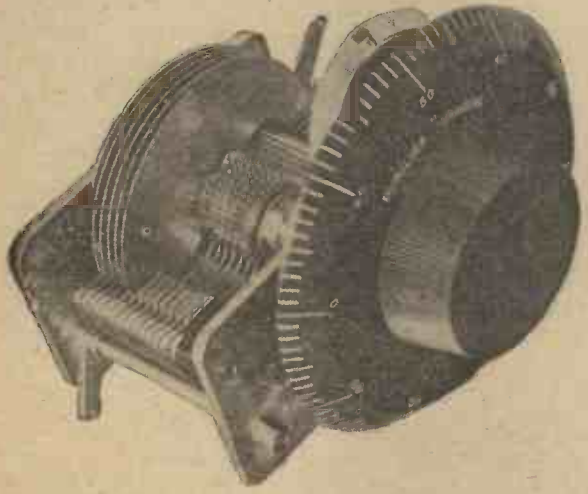
which allows of the set being switched on and off from any room in the house.

The "Magnum" All-Season portable receiver, shown by Burne-Jones & Co., Ltd., on Stand 111, is so designed that it may be withdrawn from its carrying case and used as an ordinary set in the home. On Stand 148 Climax Radio Electric, Ltd., are exhibiting their A.C. and D.C. H.T. battery eliminators, for which very low running costs are claimed.

A comprehensive range of variable condensers and low-loss coils forms part of the exhibit by the Collinson Precision Screw Co., Ltd., on Stand 51. On Stands 86 and 87 are to be found the new "Point One" series of valves, manufactured by Messrs. A. C. Cossor, Ltd. Co-axial mounting of the electrodes is a special feature of these valves.

The "Duvarileak" is an interesting component shown by the Dubilier Condenser Co. (1925), Ltd., on Stand 154. This is a variable grid leak with a special type of resistance element, for which constancy of values is claimed.

In addition to their usual products, Messrs. J. J. Eastick & Sons are exhibiting, on Stands 54 and 231, the "Eelex" semi-automatic lightning arrester and lead-in-tube, which may be worked from inside the house.



The "Univane" variable condenser exhibited by the Dubilier Condenser Co. (1925), Ltd.

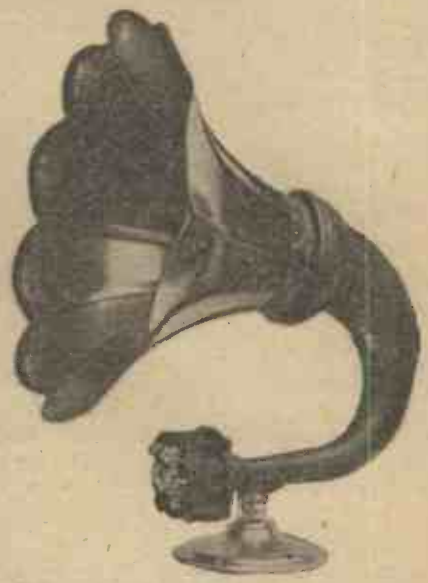
The "Indigraph" vernier dial is produced by the Igranic Electric Co., Ltd.

One of the pins of the "Ediswan" valves is sealed to prevent unauthorised use before purchase by the customer.

Those who use receivers which make heavy demands on the high-tension battery will be interested in Messrs. Ever Ready Co.'s exhibits on Stand 100, a special type of battery having been produced for this purpose.

The range of "Efesca" components, shown by Falk, Stadelmann & Co., Ltd., on Stand 114, has been augmented by new components inspired by the latest radio developments, particularly in the direction of methods of high-frequency coupling.

The "Formo" vernier dial, exhibited by The Formo Co., on Stand 78, is claimed to have a silent drive free from backlash, being entirely enclosed in a bakelite moulding, with a window for the scale.



The standard model "Dragon" Amplion loud-speaker, shown by Alfred Graham & Co.

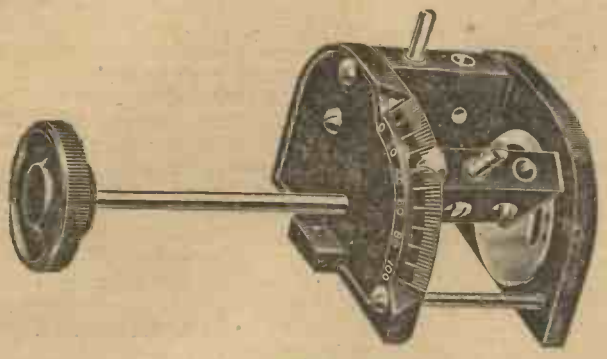
Messrs. Gambrell Bros., Ltd., are showing on Stand 90 a large range of new components, in addition to their well-known coils. The "Lotus" Buoyancy valve-holder is now fitted with terminals as well as soldering tags. This component will be on show on Stand 84 by Garnett, Whiteley & Co., Ltd., among other "Lotus" specialities

The "RAO" type of high-tension accumulator, shown by the Hart Accumulator Co., Ltd., on Stand 56, has all the plates covered with perforated ebonite to prevent any dislodging of the active material from the plates.

Messrs. C. A. Vandervell & Co., Ltd., are showing this new "Musicola" loud-speaker.

The National Radio Exhibition, 1926—*continued*

The superheterodyne outfit exhibited by the Igranic Electric Co., Ltd., on Stands 72 and 73, includes a short-wave unit, permitting of reception between 40 and 100 metres. A new coil-



Messrs. Radio Communication Co., Ltd., are showing a coil holder provided with a scale and pointer to indicate coupling positions.

holder produced by the London & Provincial Radio Co. (Stand 6) is fitted with an indicating dial to indicate the exact degree of coupling between two coils from 0 to 90 degrees.

A new form of balancing condenser is a feature of interest shown by L. McMichael, Ltd., on Stand 142. It is claimed that the range of P.M. valves, shown by the Mullard Wireless Service Co., Ltd., on Stands 136 and 138, covers every requirement of the broadcasting public, the distinctive features of the P.M. filament being retained in every valve.

The components shown by the Ormond Engineering Co., Ltd., on Stand 70, include an air dielectric fixed

A tapped resistance shown by Burne - Jones & Co., Ltd.

condenser with celluloid cover, and a special "Dual Indicator" dial. In addition to their usual ebonite products, the Paragon Rubber Manufacturing Co., Ltd., are exhibiting on Stand 7 a new ebonite battery container, the "Monobloc."

On Stands 161 and 259 will be found the comprehensive series of building kits and complete receivers manufactured by the Peto-Scott Co., Ltd. Specimens of screened coils and transformers, neutralising condensers, etc., also form part of the exhibits on these stands.

Messrs. Radio Instruments, Ltd., are showing on Stands 145 and 147, together with many other components and complete receivers, a new pair of push-pull transformers.

On Stand Radio Press Ltd., are exhibiting, in addition to a complete range of Radio Press publications, including books and envelopes, a number of Radio Press Star receivers.

The Sel-Ezi Wireless Supply Co., Ltd., are making a special show of the "Thermo" fixed condensers, in addition to many other exhibits, on Stand 88.

On Stands 116 and 43 will be found numerous types of receivers shown by A. J. Stevens & Co., Ltd. Among other features, the cabinet work of many of these instruments merits special attention. Battery charging

An S.L.F. condenser exhibited by the Formo Company.

apparatus forms the principal exhibit by the Tudoradio Co., Ltd., on Stand 10.

Ebonite panels, tubes and rods for all wireless purposes are to be found on Stand 31, where Trelleborgs Ebonite Works, Ltd., are exhibiting their products.

Recent productions by Wright & Weaire, shown on Stand 224, include a filament rheostat and a non-microphonic valve holder.

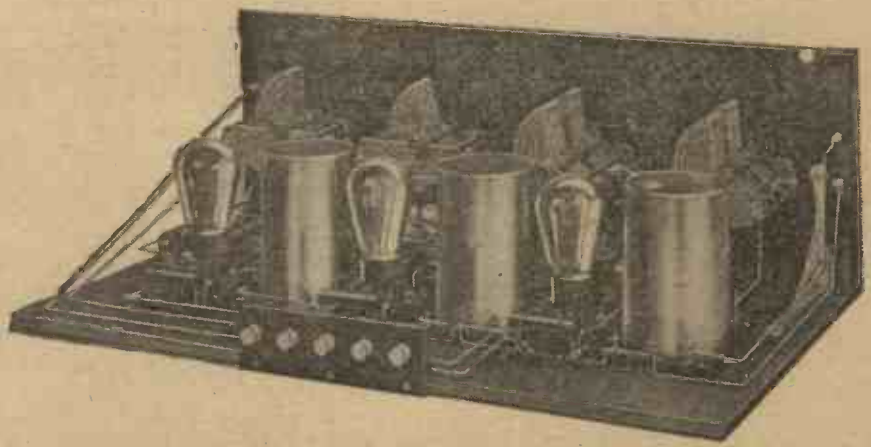
RADIO PRESS SETS AT THE EXHIBITION

The following Radio Press Star Sets, among others, will be exhibited on Stand

The "Elstree Six" (described in June *Modern Wireless*)

The "Elstree Solodyne" and The "Mewflex" (described in September *Modern Wireless*)

The "Night Hawk" and The "Distaflex Two" (described in this issue).



The "Mewflex" is one of the Radio Press Star Sets which will be on view at the Exhibition.

OUR READERS' VIEWS

HOWLING IN A SHORT-WAVE RECEIVER

SIR,—In answer to Mr. Benson's letter in the current WIRELESS CONSTRUCTOR on the subject of audio-frequency howling in a short-wave receiver, I think he will find one of the following alterations will remedy the fault he mentions:—

First, alter the value of the grid-leak; he may find that he has to use a very much higher value than he uses at present.

Secondly, alter the value of the choke coil. I use a coil holder into which I can plug different sizes of coils.

If neither of these remedy it he must change the type of valve he is using. I find that the best valve to use is one which will oscillate freely with a very small high-tension voltage. I have found that this howl will occur if either of these things are wrong.

Yours faithfully,
W. H. JORDAN.

Battersea.

SIR,—With regard to the letter from Mr. M. S. Benson, of Cheltenham, in last month's WIRELESS CONSTRUCTOR, I am glad to know that I am not alone in experiencing this somewhat puzzling trouble. For some time now my short-wave receiver (also to a WIRELESS CONSTRUCTOR design) has been rather apt to burst into a high-pitched whistle just before going out of oscillation, yet several of my friends with very similar receivers have had no trouble in this direction. The L.F. transformer seems to have something to do with it in my case, and possibly the L.F. choke in Mr. Benson's, since the trouble is not present when I listen on a detector only.

I should be very interested to know whether any of your readers has succeeded in curing this howl.

Thanking you for the splendid designs published in the WIRELESS CONSTRUCTOR,

I am,
Yours faithfully,
R. L. SPOONER.

Wandsworth Common.

Have You Seen the Announcement on Page 1063?

SHORT-WAVE AERIAL SYSTEMS

SIR,—Referring to the article in the August issue of THE WIRELESS CONSTRUCTOR, by Mr. G. T. Kelsey, entitled "For the Short-Wave Beginner," I feel that the author has omitted an important point. When the two aerials have been arranged as he suggests, and the lengths carefully matched off, *two* series condensers, one in each down lead, should be employed to tune the aerial circuit. It is plain that unless this is done the effects of the symmetrical aerial system are nullified, or at least hindered. If a parallel condenser were used, it would be a different matter, since the arrangement of aerial, counterpoise, and tuned circuit would then be symmetrical.

Yours faithfully,
D. M. BENTLEY.

Dublin.

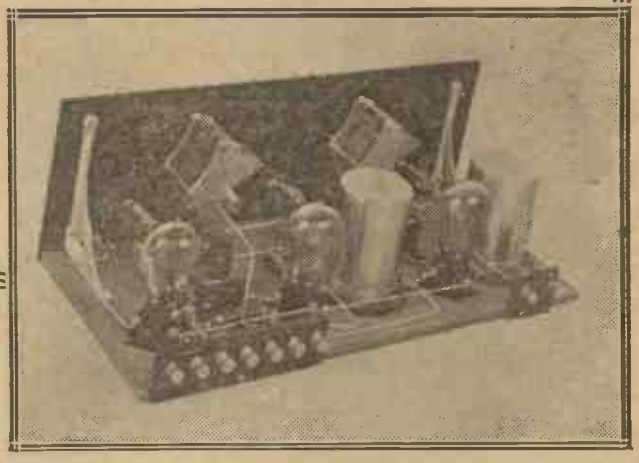
A NEW RADIO PRESS ENVELOPE

On page 1124 in this issue will be found details of Radio Press Envelope No. 14, which gives constructional details of an instrument of permanent value to every listener and experimenter.

WHY ARE SCREENED COILS USED?

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

Mr. Reyner has devoted a large amount of time to research work directed towards obtaining highly efficient tuned circuits in the high-frequency stages of receivers. He explains fully here why the screened coil has been developed, and the advantages gained by the use of this type of coil.



By incorporating screened coils in a receiver a compact layout can be secured without loss of efficiency.

THERE is an increasing tendency towards the use of screened coils in high-frequency amplifiers. Several of the sets which have been described recently have contained these new components, and a particular example is the "Distaflex Two," described in this issue, in which the high-frequency tuning circuits are all shielded.

Many readers will have wondered what the exact purpose of this screening is, what advantage is gained, and how the coils actually work.

Coil Interaction

The object of the screening is two-fold. First it is to prevent the magnetic field of the coil from producing any effect on neighbouring portions of the circuit. All my readers will know

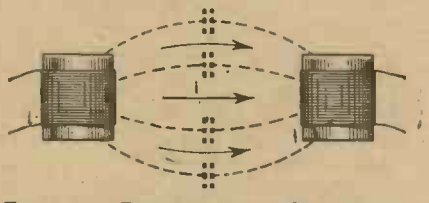


Fig. 1.—Representing the capacity coupling between two unscreened coils.

the trouble which can be caused by actual magnetic coupling between coils in different portions of a receiver. Not only does this often give rise to self-oscillation in the receiver, preventing it from being brought to its most sensitive condition, but it also destroys the selectivity of the arrangement.

If we have three tuned circuits, and we are attempting to receive a station operating on a wavelength very close to that of the local station, then if the circuits are efficient we can perhaps exercise such a filtering or selective action in the three tuned circuits that the local station is practically eliminated, and the station required is brought in at good strength.

A Cumulative Effect

The signals from the local station in such a case would be successively reduced in the three tuned circuits. In the first circuit they will probably be considerably stronger than those of the station which we wish to receive. In the second circuit we have a second filtering action, and this probably reduces the strength of the local station to something approximately of the same order as that of the required station. The third circuit completes the work, and reduces the local station still further until it is negligible as compared with the distant station to which we are tuning.

Stray Coupling and Selectivity

It will be obvious that if we permit any coupling from the front to the back of the receiver, *i.e.*, between the first and third circuits direct, we shall cut out altogether the eliminating effects of the middle circuit. Instead of obtaining the distant station considerably stronger than the local station therefore, we shall obtain both at equal strengths, as we should normally do with two circuits only. In other words our selectivity has been completely destroyed by this unwanted coupling between the circuits.

Obtaining Zero Coupling

Now this question of magnetic coupling has long been appreciated, and in order to avoid it, designers of circuits have placed their coils at such angles that the magnetic coupling between them was very nearly zero. There are several possible ways of arranging the coils in such a manner that the coupling between all of them is essentially zero.

Capacity Effects

This does not provide a complete solution of the case, however, because of a second effect which has to be considered, and this is the capacity coupling. An ordinary condenser has a capacity by virtue of the fact that the different plates are placed in proximity to each other, but are at different high-frequency potentials. Mr. Harris has already explained the effect of capacity in his Talks to Beginners. A little thought will show that any coils in a wireless receiver have different high-frequency potentials between them, and there will consequently be an appreciable capacity effect between the various circuits.

Practical Research

Recent developments have shown that this capacity coupling was of a much greater order than was previously thought to be the case. Some experiments which I carried out showed that at a distance of from 6 to 8 inches with an ordinary cylindrical coil about 3 inches in diameter, the capacity effect was greater than the magnetic coupling, and that in certain circumstances it was absolutely impossible to reduce the coupling between the coils to zero.

Relative Positions of Coils

Up to a certain distance we have the effects of the magnetic coupling and the capacity coupling acting together, and we can so place the coils that these two balance out, so that we

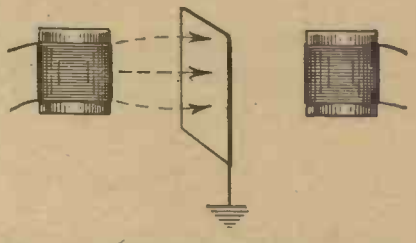


Fig. 2.—The introduction of an earthed screen provides an effective barrier to the capacitative coupling.

can obtain positions of zero coupling. It may be remarked in passing that these actual true zero couplings are by no means in the positions which one would expect them to be, and if we were dependent upon actual correct

Why are Screened Coils Used?—*continued*

spacing of the coils to obtain zero coupling between the various circuits, the design of sets suitable for construction by the average amateur from the details published in technical journals would be well nigh impossible.

To revert to the question of coupling, however, we find that outside a certain critical distance the effect of the capacity coupling absolutely swamps that of the magnetic coupling, and it is impossible to obtain a position where the coupling is zero. It is only because of the considerable developments which we have made in the art of high-frequency amplification generally that these points are now coming to light, and we have to find methods of overcoming the difficulties.

The "Five Fifteen" Receiver, described in the July issue of "The Wireless Constructor," utilised one screened and two unscreened coils.

How Screened Coils Help

In an efficient high-frequency amplifier we wish the signals received from the aerial to pass through the tuning circuits, and then through the appropriate valves in the correct sequence. If any energy is allowed to take alternative paths, we are going to suffer from a loss of efficiency. In addition to the direct leakage of energy from the front of the set right through on to the last tuned circuit which we have already considered, there are all manner of other possible stray paths for the energy, by which it can return and circulate in eddies as it were, and as long as this is permitted we cannot obtain the maximum efficiency. It is to avoid this filtering away of the energy in channels where we do not require it that the screened coils have been developed.

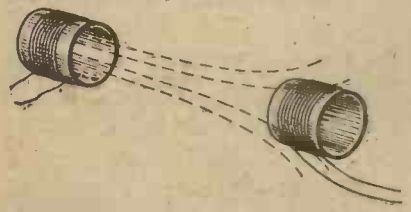


Fig. 3.—Showing how the magnetic field produced from one coil will affect another in the vicinity when no screens are used.

Eliminating Direct Pick-up

The second object of the screened coils is the prevention of direct pick-up. The coils of a receiver all act as very small aerials. Whatever the actual position of the coil itself, it will pick up a small quantity of energy either acting as a miniature frame aerial, or as a very small vertical aerial, and the result is that if the set is operated close to a transmitting station, these signals will be picked up directly, and will not be subjected to the filtering action of tuned circuits. This, again, will result in destroying the selectivity of the receiver. If the circuits are enclosed in screening cases, it is possible to prevent the waves from affecting the coils directly, as we shall see shortly.

The Function of Screens

The question to be considered now, therefore, is exactly how the screening produces the shielding effect that we require. We have seen that there are two effects to be considered. First that of the magnetic field, and secondly that of the capacity coupling between the coils.

Many people are under the impression that these new screened coils only eliminate the capacity coupling, and that in order to eliminate any magnetic coupling some form of magnetic metal, such as iron, must be used for the screening cases. This, as a matter of fact, is quite incorrect. The screens shield the effect of both the magnetic and the capacity coupling, and, indeed, if iron were used for the screens themselves the results would be so poor as to render the screens practically useless.

Capacity Coupling

Let us consider the effect of capacity coupling first of all. In Fig. 1 we have two coils at different potentials to each other, and there is consequently a capacity coupling between them. This will result in capacity current flowing between the two bodies, and consequently a certain amount of energy will be transferred between the two.

Inserting a Screen

We can prevent this transfer of energy by inserting between the two bodies a plate which is connected to earth. The earth is at the lowest potential in any circuit, and small variations take place about this fixed potential point. The surface of the earth plate thus prevents the voltage variations on the first body from producing any effect beyond the screen. What energy is lost is not transferred to the second body at all, but only to earth. Such an arrangement therefore effectively eliminates the capacity coupling between the circuits.

Magnetic Coupling

When we come to consider the magnetic coupling the position is a little more complicated. It is often thought that the insertion of a magnetic screen of some sort will actually prevent the magnetic field from penetrating the screen. This is not the case, and the screening effect is really produced by a totally different mechanism.

Let us consider a simple coil of wire as shown in Fig. 3. If we have a varying current flowing round this coil, then there will be a magnetic field produced which will spread out from the coil axially somewhat in the manner shown by the dotted lines. If then we bring another coil close to the first coil, some of the magnetic field produced by the first coil will upset the second, and will set up currents in the second coil. This is the phenomenon known as magnetic coupling.

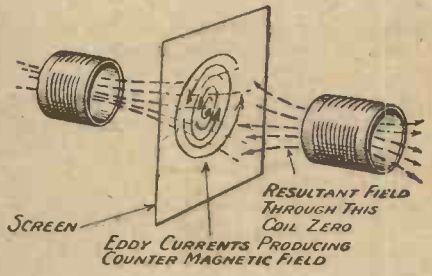


Fig. 4.—The magnetic field from one coil will produce eddy currents in the screen which will cancel out the effect of the field.

Eddy Currents

Let us now place a sheet of copper a short distance away from the first coil, as shown in Fig. 4. The effect of the magnetic field reaching this copper screen will be to produce very small circulating currents in this sheet. The copper behaves as if it consisted of a large number of very small single-turn coils, each of which would have its appropriate current induced therein.

Why are Screened Coils Used?—*continued.*

These currents are known as "eddy currents."

What They Do

Now, the important fact about these eddy currents is this: These currents

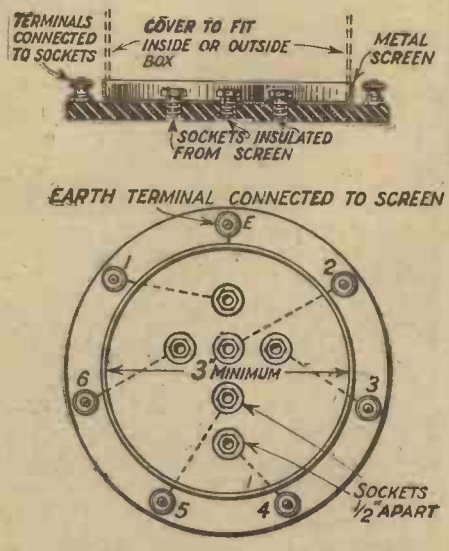


Fig. 5.—The standard mounting of the type of screened coil developed by the author is shown here.

in turn produce magnetic fields of their own, and the average effect of all the eddy currents is to produce a fairly large magnetic field. It can be shown theoretically and confirmed by experiment that the direction and magnitude of this magnetic field produced by the combined effect of all the eddy currents in the copper screen are practically equal and opposite to those produced by the coil itself. This means that on the other side of the screen the magnetic field due to the first coil is practically cancelled out by the magnetic field produced by the eddy currents in the screen.

The screen therefore does not wipe out the magnetic field of the coil in any way, but it produces an equal and opposite magnetic field which cancels out the effect of the original field. Obviously the results are just the same, but the actual production of the results is achieved in a slightly different manner.

Practical Problems

Now, the difficulty with magnetic screening is this: In order to achieve complete shielding it is necessary to enclose the coil on all sides in a metal box. Capacity shielding may be achieved fairly simply by a single earth plate placed in an appropriate position, but for magnetic shielding a complete cover is required. The screened coils which have been developed therefore are designed to be practically complete, the only holes in the box being those necessary in order to bring the connections through the base.

Losses Due to the Screen

The question of the size of the screen is one of considerable importance, and no little experimental work was done before the actual dimensions of the screens were decided. It will be apparent at once that the production of eddy currents in the copper screens demands the expenditure of a certain amount of energy. This absorption of energy from the coil is bound to detract from its efficiency to a small extent, and will show up as an increase in the effective resistance of the coil.

Importance of Screen Design

It might be thought at first that this would render the whole principle useless, but this is not the case. The further away we go from the coil, the less is the strength of the magnetic field, and correspondingly the less will be the eddy currents producing the counter field outside the screen. Some experiments were therefore carried out in order to find the effect on the resistance of the coil of placing the screen at varying distances, and it was found that if the screen was placed within a certain distance, the losses introduced were very considerable.

Material for Screens

If, on the other hand, the screen was kept at least half an inch away from the coil in a radial direction, and one inch away from the actual end of the coil axially at each end, then the extra resistance introduced into the circuit was not excessive. The metal of the screen had considerable effect, the lower the resistance of the metal the less being the loss introduced. Copper or aluminium is necessary, therefore.

Standard Dimensions

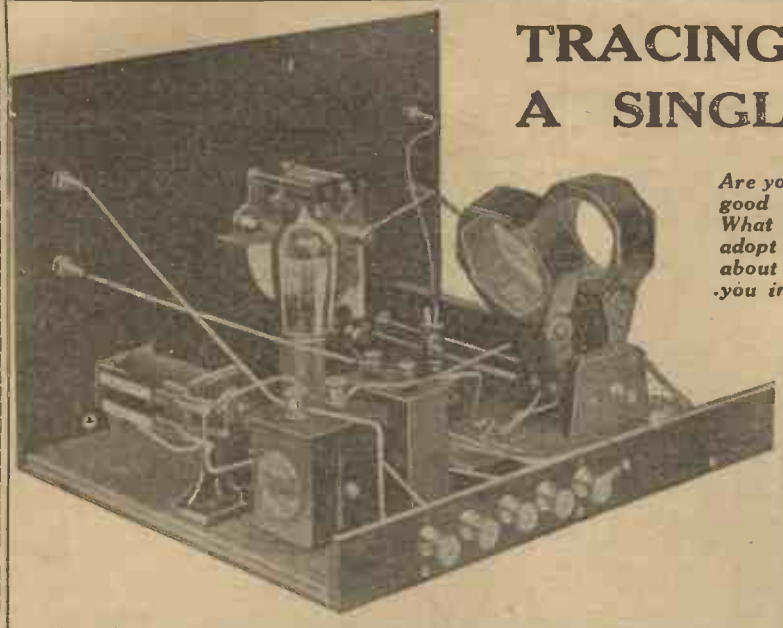
Even with this arrangement, however, the coils would have been somewhat bulky if the usual 3-in. diameter coils had been used, as this would have necessitated 4-in. screens. As a result of a certain amount of experiment, therefore, it was decided that reasonably efficient results could be obtained with a 2-in. diameter coil and a 3-in. to 3¼-in. diameter screen, which is the standard pattern now on the market.

Effect of Wavelength Range

One other point may be mentioned in connection with the use of these coils, and that is that the presence of a screen not only alters the effective resistance of the coil to a small extent, but also the inductance. This means that if the coil is tuned in to a certain wavelength with the screen in place, and the screening cover is then removed, the tune of the circuit will alter considerably, and an increase in tuning condenser will be required in order to restore the circuit to its tuned condition.

TRACING TROUBLE IN A SINGLE-VALVE SET

Are you helpless when your set ceases to give good signals or breaks down altogether? What system of locating the trouble do you adopt? If you are uncertain how to set about it, these notes will be of assistance to you in discovering the cause of any simple fault in your set.



A faulty connection to the moving block of a "swinging" coil-holder is often responsible for puzzling noises.

IN this article the writer proposes to deal with the possible sources of trouble in single-valve receivers, whether arising from faulty design, construction, or unforeseen events after the set has been in use. From time to time articles have appeared which should enable the beginner to trace faults in either high-frequency or low-frequency amplifiers, and, with the help of these few remarks, he should be able to locate trouble in practically any type of radio receiver.

A Simple Circuit

The diagram in Fig. 1 shows the ordinary conventional single-valve circuit, reaction in this case being controlled by means of variable coupling between the coils, and the points at which trouble may possibly occur are numbered.

Dealing with these points in numerical order, we may summarise the symptoms in each case.

Aerial Disconnection

Should there be a break at (1), the set will tend to oscillate hard, and signals will, of course, be abnormally weak. Probably the quickest way of determining whether this has really occurred is to detach the aerial lead from the set, and note whether much difference in signal strength results. If the aerial really is connected, signals should, of course, become very much weaker than they are. If, however, there is a long lead to the earthing switch, and the aerial has become disconnected at that point, although there will be a difference in signals when the lead is taken off the aerial terminal, it should not be very noticeable.

A Useful Test

A break at point (2), *i.e.*, anywhere in the A.T.I., will, generally speaking, be very simple to detect, since, should the reader be anywhere near an electric railway or tramway, or even have electric-light mains within a short distance of his house, a hum will immediately be heard on breaking the circuit at this point. Should there be no guide of this nature, the set will, of course, refuse to oscillate, and no signals other than perhaps *very* weak traces of the local station, if the reader is very close to it, will be heard.

If two fingers are placed across the points which should normally be the extremities of this coil (a break being suspected), a sharp click will generally indicate that one is present.

Examine the Earth Lead

Point (3) indicates a break of any description anywhere between the set and the earth. This point is apt to be a little troublesome in some circumstances, since a set may apparently be functioning fairly well, even with the earth disconnected. Generally, however, a faulty earth connection will cause instability in the receiver, and, most noticeable of all, severe hand-capacity effects when the condenser across the A.T.I. is approached. One quite reliable way of making sure that there really is a break in the earth lead is to switch on the set, listen to a fairly weak signal, and, with a moistened finger, touch the gas-pipe or water-pipe. A click or sudden disappearance of the signal may be taken as a fairly sure indication that the earth lead is in trouble somewhere.

A fault at point (4) is a very simple matter to detect, since no H.T. current can flow through the 'phones, and on disconnecting one tag of the 'phones the usually healthy "plop" will not be heard.

Testing Condensers

(5) indicates a faulty grid-condenser, or a defective connection to one side of it. Here again, should the reader be close to any form of A.C. supply, a hum will most probably be heard. Failing any definite indication of a fault in this position, it will be advisable to test the condenser with a 4½-volt flash-lamp battery and a pair of headphones. A click heard on "making" the circuit, but not on breaking it, shows that the condenser is in order. No click at all will, of course, prove that the circuit is completely broken at some point. For this reason do not connect the leads from the battery and headphones directly across the condenser, but from the grid pin of the detector valve to the point at which the lead from the grid condenser joins the A.T.I. Any fault in the leads from the condenser will thus be shown up. Actually the soundest method is probably the substitution of another condenser.

Grid Leak Troubles

A faulty grid-leak (6) is, as a rule, much more easy to detect, aural methods being satisfactory in nearly

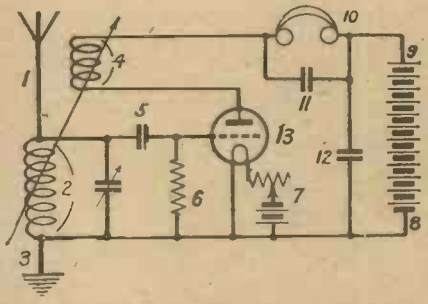


Fig. 1.—The numbers on this circuit diagram are referred to in the article as a convenient way of checking the circuit.

every case. A loud howl or ticking noise when the reaction coupling is fairly tight is a sure sign that the grid-leak is either cut right out of circuit or of much too high a value.

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Specification :

The new **ORMOND** *Precision* Straight Line Frequency Condenser embodies the famous **ORMOND** Slow Motion Friction Drive. Special ball bearings ensure a smooth action, giving a liquid-like movement, facilitating precise tuning adjustments with noiseless operation.

Its construction is very robust. It has bright brass vanes, perfectly rigid, and the heavily nickelled and polished end-plates ensure minimum eddy current losses.

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It has an anti-capacity earthing shield which may be fitted, insulated from the condenser, and earthed by a separate connection. This is particularly useful when condenser is used in circuits where both electrodes are at radio frequency potential. Easy to mount, one and three hole fixing.

Terminals and soldering tags for connections.

Note the low prices :

·00025 micro farad	...	19/-
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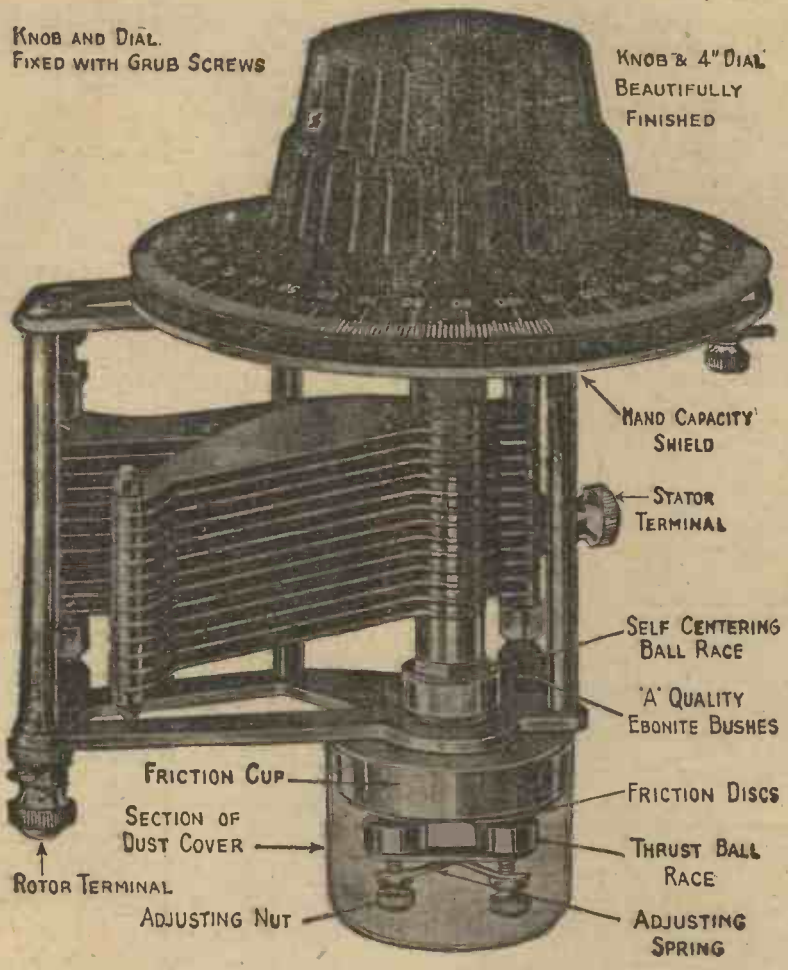
Complete with Knob and 4-in. Dial.

Without Friction Control but with 3-in. Dial and including Hand Capacity Shield.

·00025 micro farad	...	11/-
·00035 ,, ,,	...	11/6
·0005 ,, ,,	...	12/-



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This is the ORMOND S.L.F. CONDENSER which has fully demonstrated our claim for its superiority. It is made with exact precision in our own factories by British labour from the finest quality materials and designed to be scientifically correct. The specification at side will interest you—certainly the low prices quoted there should cause you to join the ranks of the thousands who are now changing over to ORMOND S.L.F. 'SLOW MOTION' CONDENSERS.

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Tracing Trouble in a Single-Valve Set—*continued*

Serious distortion also results sometimes from a defective or unsuitable grid-leak.

Low-tension Circuit

(7) is intended to cover either a break in the leads from the low-tension battery, a break in the leads from the L.T. terminals in the valve itself, or a defective filament rheostat. Any of these will, of course, be shown by the failure of the valve to light. Substitution of another valve should be tried before searching for a fault, however, in case the one normally in use has been burnt out.

Is the H.T. Connected?

A break in the circuit at point (8) will result in total absence of signals, and is best detected by removing and replacing the wander plug from the negative end of the battery several times. If no vigorous clicks are heard it may be taken for granted that there is no connection from this point to the negative side of the L.T. battery, or, alternatively, that the circuit is broken at point (9), or somewhere in the H.T. battery itself. A high-reading voltmeter is the most useful way of deciding whether there is any trouble with the battery, however. A break at (10) may be found by removing the telephone tag from the terminal which is connected to the positive H.T. terminal, and touching it upon the positive end of the battery. If signals then resume their normal strength it may be assumed that a faulty connection between the 'phones and the H.T. terminal was the cause of the trouble.

Any break in the H.T. circuit (*i.e.*, at the points 8, 9, 10 or 4) will, of course, result in the total absence of signals, and also of clicks on removing the 'phones from their terminals, and thus be fairly easily diagnosed at once.

Telephone Condenser

A defective condenser across the telephones (point 11) may cause various forms of trouble. If there is a short-circuit in this condenser, or a serious leak amounting to a "short," signals will be absent or very weak. If there is a break, either in the condenser itself or in the leads to it, no difference other than the fact that the set will not oscillate quite so readily as usual may be noticed. On the other hand, signals may sound "tinny" or "thin," particularly if a note magnifier is used after the detector. In this case an audio-frequency howl may be set up.

Shunt the H.T. Battery

The absence of a large condenser in position (12) is also not very noticeable in some circumstances, for instance, when the H.T. battery is new and giving its full-rated voltage. With an older battery, however, its absence will be shown by crackling or "frying" noises, or, if note-magnifiers are used, perhaps a tendency to howl when the set is just on the oscillation point.

A Common Fault

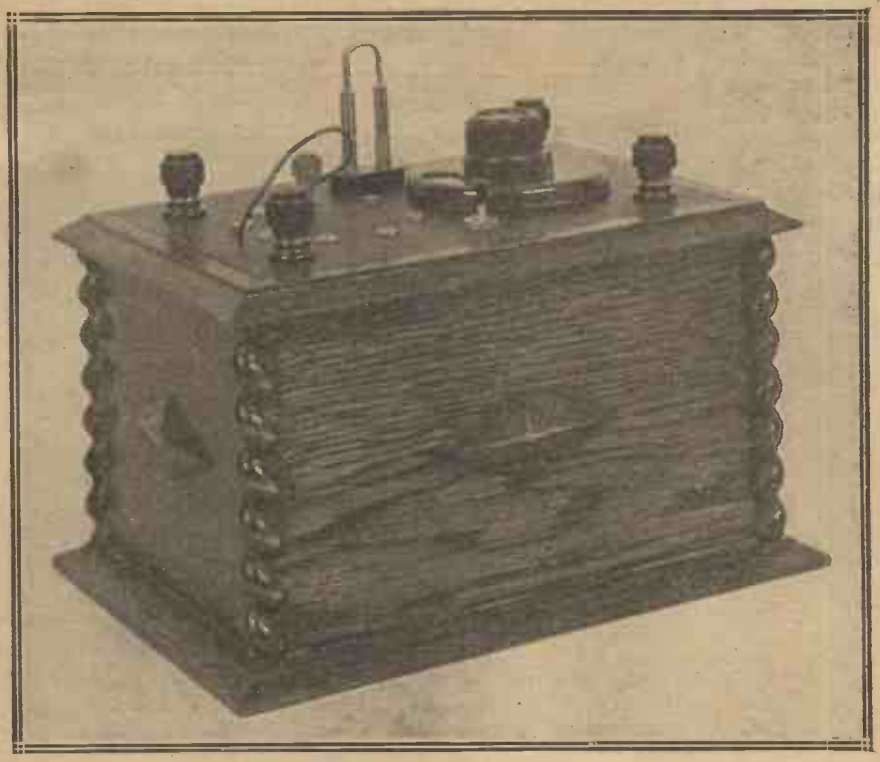
Last, but by no means least, is the point (13), intended to cover trouble either in the valve itself or in the connections to the pins. All kinds of puzzling effects that do not seem to be due to any of the other kinds of trouble may arise from faulty connections between the pins on the valve itself and the sockets of the holder. The valve should periodically be removed and the legs opened out or scraped clean with a penknife.

W. L. S.

THE "CASKET" CRYSTAL SET

By H. BRAMFORD

The receiver described in this article will be found both selective and "flexible." It is suitable for the reception of Daventry as well as for stations in the lower band of wavelengths.



AT the present time the keynote of efficiency in the design of crystal receivers is still simplicity, if the best results are to be obtained. It has undoubtedly been found that complications in the way of intricacies relating to circuits, or switching arrangements, or multi connections to various studs, etc., all result in a certain amount of loss of energy. It is obvious that this is a great drawback, particularly in the case of crystal sets, where the utmost amount of signal strength is desirable. The receiver about to be described in this article has therefore been designed with these points in mind, in addition to which the completed set presents a particularly neat and artistic appearance when made, rendering it most suitable as an ornamentation in any part of the home. Variometer tuning has been selected as being most efficient, as well as one of the most simple arrangements in operation.

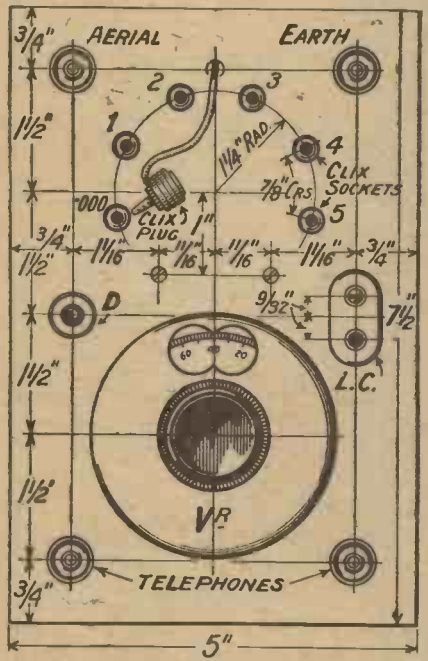


Fig. 1.—All drilling centres may be obtained from this drawing. Blueprint No. C.1065A.

A fixed condenser of .0001 microfarads is placed in series with the aerial for constant aerial tuning, and a "multiple fixed condenser" is connected across the variometer windings, to enable the set to be used with different sized aerials.

The material which was actually used for the construction of the set is listed below.

BUILD THIS SET WITH

One "Casket" cabinet (Camco).
One ebonite panel measuring 7½ in. by 5 in. by ⅜ in.
One variometer (Igranic Electric Co., Ltd.).
One multiple fixed condenser (C.A.V.).
One fixed condenser, .0001 (Dubilier Condenser Co.).
One permanent detector (R.I., Ltd.).
One coil socket with shorting plug.
Four terminals (Belling Lee).
Six Clix sockets (Autoveyors).
One Clix plug (Autoveyors).
Two 4 B.A. screws.
Six 4 B.A. nuts.
Glazite, and small piece of insulated flex.

Approximate cost, £2.

Constructional Details

The actual construction of this receiver is a comparatively simple matter. First drill the panel in accordance with the front of panel diagram. Particular care should be given to the drilling of the holes, which are mounted radially, as shown, to receive the Clix sockets, as they are placed to correspond with the "multiple fixed" condenser, mounted upon the back of the panel. When the panel has been drilled proceed to mount the four terminals, followed by the single-hole fixing variometer, the loading coil plug and socket, and the crystal detector. In mounting the latter, care should be taken not to scrape the crystals against each other, as the sensitivity of the detector may be impaired. The front of panel assembly is then completed by securing the five Clix sockets, as shown. The only components to be mounted from the back of the panel are the fixed multiple con-

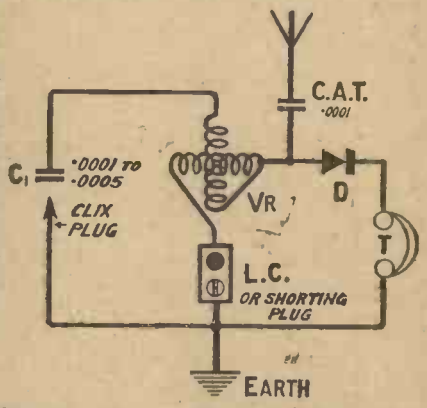


Fig. 2.—The crystal and 'phones are tapped across part of the variometer windings, while the "multiple fixed condenser" is connected across the whole variometer.

The "Casket" Crystal Set—*continued*

denser and the C.A.T. condenser. The former is screwed down in such a way that its tags make contact with the ends of the Clix sockets, as may be seen from the back-of-panel diagram. Those who wish to ensure that contact is perfect, may solder at each point, but this will not be found to be absolutely necessary if the condenser is secured firmly.

The Wiring

The set is easily wired up, as will be seen from the back-of-panel diagram, Fig. 3, which is self-explanatory. The following notes, however, may be observed. The aerial terminal connects to one side of the C.A.T. condenser, the other side of this condenser connecting to the end of the detector which is farthest from the back of the panel, and to the lower *spindle* connection of the variometer. The other side of the detector connects to one of the telephone terminals, the remaining telephone terminal connecting to one side of the loading coil and thence to the earth terminal, from which a flex lead is taken as shown. The remaining side of the loading coil connects to the variometer terminal marked "earth." The variometer terminal marked "aerial" connects to the Clix socket indicated as .000. The flex lead is passed through the hole provided in the panel—the end being equipped with a Clix plug.

Circuit

The theoretical circuit diagram,

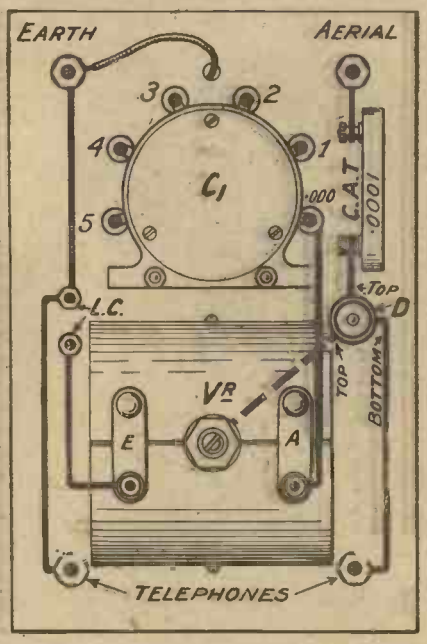


Fig. 3.—The broken line indicates that the wire is taken beneath the variometer. Blueprint No. C.1065B.

which is very simple, is shown in Fig. 2.

Operating the Set

The operation of this receiver is no difficult matter, and the best results possible should be obtained if the following notes are observed. First connect up aerial, earth and 'phones to their respective terminals. If the local station is to be received, insert the shorting link in the loading coil plug and socket. Have the variometer dial set at zero. It should be noted that when the dial reads in this position, the rotor of the variometer should be at right angles to the stator. To tune in the local station, rotate the dial until signals are heard at their loudest, having the Clix plug in socket .0001. Next ascertain that the detector is functioning at its best by gently re-setting. This is done by lifting the plunger knob, turning round and lightly releasing. When satisfied that the detector is in a good position, try out various values of capacity across the variometer as indicated, by removing the Clix plug to one of the other sockets. It will then soon be found which value is most suitable. For the reception of Daventry, the link is removed from the coil plug and socket, and a loading coil inserted in its place. This coil should be a number 150 or 200.

WIRING IN WORDS

All directions are given as viewing the set from beneath the panel.

Join the AERIAL terminal to one side of the fixed condenser C.A.T.

Join the other side of the fixed condenser C.A.T. to the top contact of the crystal detector and also to the bottom (centre) contact of the variometer.

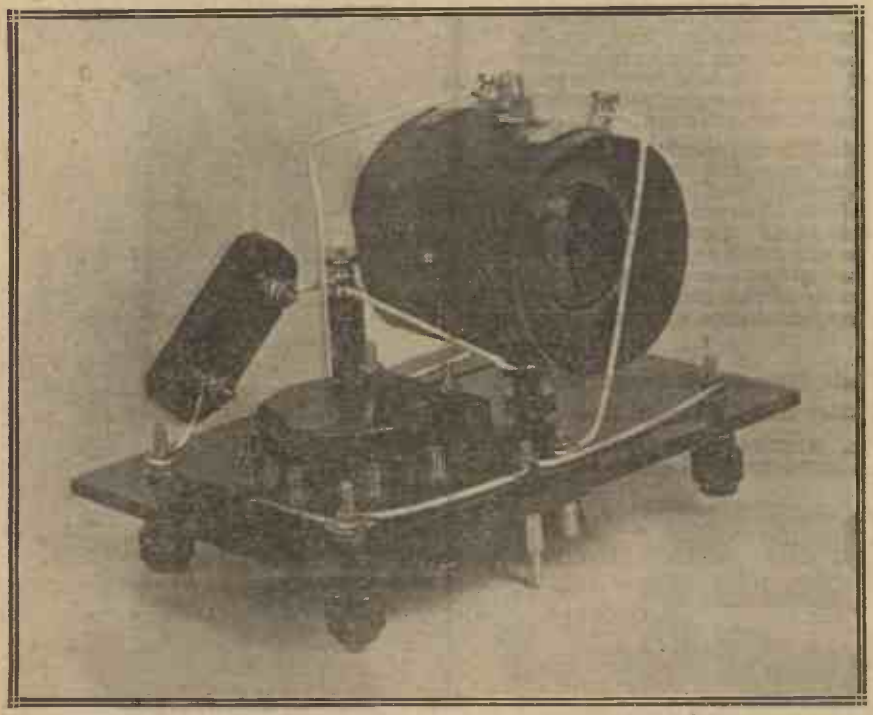
Join the bottom contact of the crystal detector to one TELEPHONE terminal.

Join the other TELEPHONE terminal to one side of the LOADING COIL block, and also to the EARTH terminal.

Join the other side of the LOADING COIL block to the EARTH end of the variometer winding.

Join the AERIAL end of the variometer winding to the .000 terminal on the fixed condenser C1. If necessary, solder the six tapping points on the fixed condenser C1 to the six Clix sockets.

Attach a flexible lead, with a Clix plug on the other end, to the EARTH terminal.



The lead to the lower spindle connection of the variometer may be clearly seen from this photograph.

Radio dips into History

NOW Radio—newest of all the Sciences—seeks inspiration from the Middle Ages. Just as the warrior of old was clothed in impenetrable metal to ward off the arrows and javelins of his foes, so, in this latest development of Radio, coils are being enveloped completely in metal to ward off the strong magnetic fields thrown out by adjacent coils and by other parts of the circuit.

Copex Coils finally remove the last trace of uncontrollable oscillation due to interaction. The Receiving Set becomes wonderfully stable and astonishingly selective. At a mile and a half from 2 L.O. with the "Five Fifteen" it is possible to lose London entirely on a degree or two of the dials and bring in other B.B.C. stations on a complete background of silence. Such amazing selectivity has only previously been possible with the Super Heterodyne—now it is brought within reach of a Set using only two H.F. stages.

Copex Coils are the original copper-shielded coils designed in collaboration with Mr. Reyner of the Radio Press Laboratories. Their six pin base permits an instant interchange of alternative coils for other wave lengths—one copper shield only is required for each stage.

Make up your mind to build one of these wonderful new Radio Press Sets now and use Copex Copper shielded coils. You will be astounded at its exceptional selectivity—at its improved stability—at its remarkable ease of operation—and, above all, at its wonderful purity of tone and complete absence of mush.

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The Mewflex Three
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The Distaflex Two
("Wireless Constructor," October, 1926)

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*A Marconi Royalty of 12/6 per valve holder is due when the complete kit and panel are purchased together for building this set. This Royalty must be forwarded with remittance for parts.

Prices for Copex Shields & Coils

Copex Copper Shield (patent applied for) complete with six pin base	15 0

INTERCHANGEABLE COILS.

	250/550 Metres.	1000/2000 Metres.
Split Primary Type		
Aerial Coil	6/-	6/-
H.F. Transformer ...	10/-	10/-
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H.F. Transformer ...	10/-	14/-
Reinartz Type Coil	10/-	14/-

Note:
Only copper can give the perfect self-cleaning contact so essential for perfect shielding.

P.S. 5656

WHICH SET SHALL I BUILD?

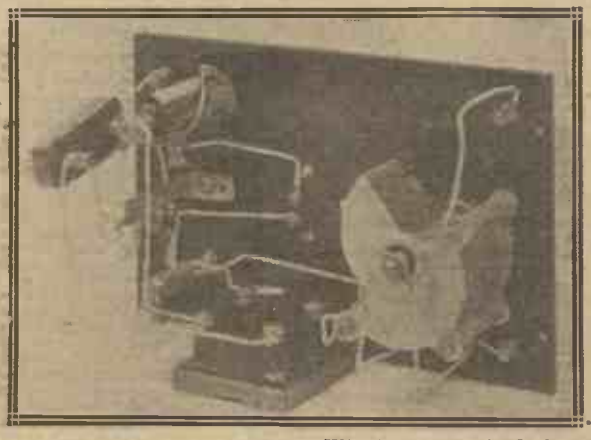
By C. E. M.

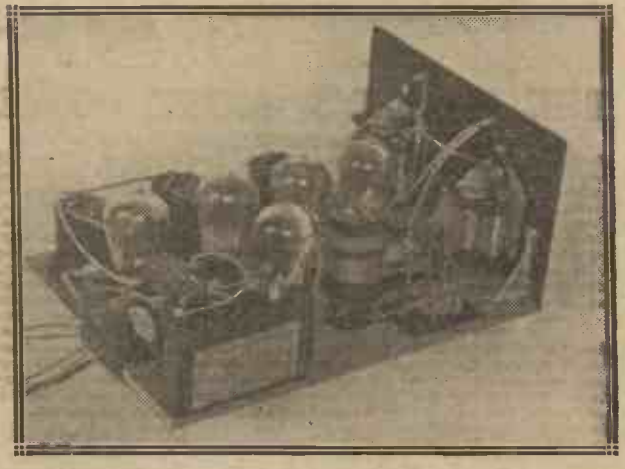
What determines your choice of a set? Are you hesitating between two valves and five, and wondering which will be best? If you are uncertain how to decide, read this article. It will show you the points to consider, and will perhaps help you to choose the set which will satisfy your needs.

EVERY month sees the publication of new receivers, which claim to be better than, or as good as, those which have gone before, and the problem of deciding upon which to build becomes increasingly difficult.

How Many Stations?

In the first place, what really determines the choice of a receiver? What is there in one particular design which creates a desire to possess it greater than any other set? The answer in many cases is that the author's claims as to the number of stations which can be received have roused a longing to do the same thing. The deciding factor in these circumstances is the *number* of stations which may be received, and it is upon this point that so many people judge even the simplest sets.





Which is it to be? Crystal, single-valve, or multi-valve set?

There is, without a doubt, a great fascination in being able to listen at will to either Hamburg, Aberdeen, Dublin, or any other station, but merely because a receiver is designed to receive the local station at really pure loud-speaker strength does not necessarily mean that this set is any less efficient or up to date than the long-range receiver.

Volume or Distance

The two sets are not in the same class; they may, in fact, be the very best at the moment for their own particular work. A specially-designed loud-speaker set for local work will, for instance, usually give a purer result on local work than, say, a five- or six-valve set, designed especially for distance, when receiving the same station, though generally the long-range set will be the more expensive. The decision as to which set to build should at all times, therefore, be governed by what is required of it, and in those cases where long range is required, then the very best set that one can afford should be the one to build. On the other hand, if the majority of listening to be done is concentrated upon the local station, still build a good set, but let it be one especially designed for this class of work.

Questions of Expense

Obviously, the more popular sets are those which give a choice of programme, and in this connection only the very latest type of set should be built. This will, of course, be governed to some extent by financial ability, and for that reason a receiver should be chosen which calls for an expenditure within one's limit.

Use Good Components

Unfortunately for some listeners, they have been misguided enough either to buy cheaper components than those specified in the construction details of the particular receiver they wish to build, or else have utilised certain components already in their possession. These latter may, of course, be suitable, but more often than not they are of different value to those specified, and the set upon completion does not give the results that were expected.

Quality First

Rather than make mistakes of this

Which Set Shall I Build?—*continued*

kind, it is better and safer to decide upon a receiver which lies within one's financial ability, even though it may use fewer valves and have a shorter range, instead of building a bigger set and trying to save money by equipping it with cheap components of unknown manufacture.

How Many Valves?

For really efficient long-distance work a set of outstanding merit is required, and, unless a reflex circuit is employed, five or six valves will generally be used.

For satisfactory loud-speaker reception of the local station, however, the number of valves to use need not exceed four, these being a high-frequency stage, the detector, and two low-frequency stages. It is preferable that no reaction be used in the circuit, and the last valve, at any rate, should be of the power type used with a high value of H.T. and a similar value of grid bias.

Choosing the Loud-Speaker

For either the long-range or local receiver the loud-speaker should be a good one if faithful reproduction is desired. This does not necessarily mean that the instrument need be expensive, for there are now upon the market many really good specimens at quite reasonable prices.

Matched Dial Readings

The set that is capable of receiving all the B.B.C. stations and all our Continental friends on the loud-speaker is unquestionably the more interesting instrument, and in these modern days need not be at all difficult to operate. The tendency today is for all the tuning dials to be matched, and so, by setting them all at zero, and proceeding round the dials one degree at a time, keeping all the dial readings the same, the operation of picking up the distant station becomes as simple as handling a set for reception of the local station only.

Construction Simplified

The actual constructional requirements in present-day multi-valve sets are also less likely to defeat the man who has never built a receiver before, and, with the modern methods of stabilising, the chances of non-success are distinctly remote. For these reasons the choice of, say, a single-valve set, merely because the reader has never made a set before, is a wrong road to journey, for sooner or later he is bound to be discontented with his small set, and to favour one of the larger variety, necessitating, therefore, further expenditure in components, bigger batteries, and so on.

Avoid False Economy

A big set will do big things right from the moment of completion, but a small set can rarely be improved upon by occasional additions to the extent of doing the same things as the bigger sets. The growth from, say, one valve to many may be progressive, but with each addition it is not unusual to introduce some small defect in the general layout of the whole, which means loss of efficiency to some greater or lesser degree; particularly is this so where H.F. stages are added on the unit system.

In conclusion, the choice of a set should be determined by what is expected of it, the amount of money that one can spend, and—last, but not least—what the designer says it will do.

As used in the "Night Hawk"

by Mr. Percy W. Harris
(Editor of "Wireless Constructor")
and in other well-known Receiving Sets

Eleven exclusive Eureka features

1
Absolute rigidity of fixed plates ensured by unit construction.

2
Moving plates clamped together to permit fine spacing with absolute security.

3
Special method of construction eliminates the possibility of fixed and moving plates short circuiting.

4
Ball-bearings ensure smooth silken action under all conditions.

5
Dual connections (cone and pigtail) guarantee continuously silent performance.

6
Electrical losses so low as to be quite negligible. An invaluable feature for short-wave use.

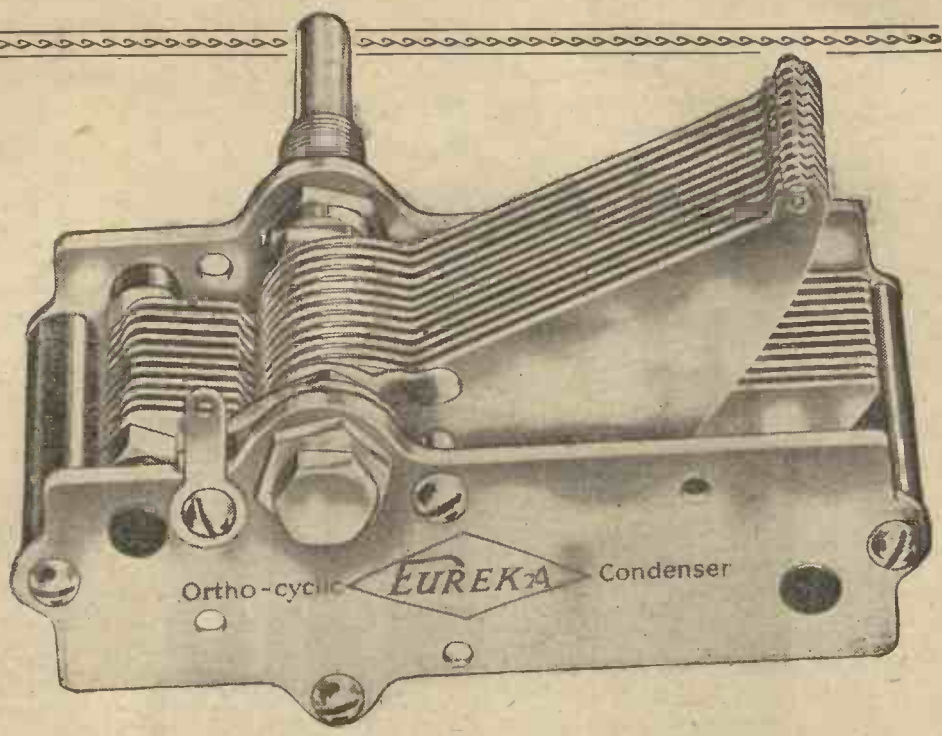
7
Generous and readily accessible soldering tags.

8
Equipped for panel mounting as one-hole or four-hole, whichever preferred.

9
Positive stops at both ends of scale.

10
Compact design permits a panel depth when closed of less than two inches. The .0005 mfds. Ortho-cyclic takes up much less room than most .0003 mfds. condensers.

11
Highly polished and beautifully finished throughout—a perfect example of British craftsmanship.



NOW!

Space out your Stations as evenly as the rungs of a ladder

AT last there is available a British Condenser which takes out all the guesswork of station finding and ensures a standard of selectivity which is almost incredible. The new Eureka Ortho-cyclic is a fine precision-made instrument designed to give mathematically equal spacings between all wavelengths throughout the whole of the scale. Within the first 15 degrees on the dial you will find 15 wavelengths of 10 kilocycles separation. Fifteen only—one to each degree! And the same precise separation will be found all through the scale. Yet in the ordinary condenser used under the same conditions you would find 51 *wavelengths crowded into the same 15 degrees.* An absurd overcrowding just where you need the greatest separation to ensure workable selectivity. No wonder wave-traps and similar gadgets are necessary to separate the wanted from the unwanted stations.

Add to this astounding performance a host of other electrical and mechanical features and you'll understand why the Eureka Ortho-cyclic is unrivalled for performance, uniformity and enduring dependability. Before choosing your variable condenser ask to see the Eureka. To every discriminating wireless man its beautiful workmanship will be irresistible.

Portable Utilities Co., Ltd. (*Eureka Radio Products*), 8 Fisher St., London, W.C.1

Prices:
·0003 mfds. 14/6
·0005 mfds. 15/6

EUREKA
ORTHO-CYCLIC

Manufactured by the makers of the famous Eureka Transformer

TALKS TO BEGINNERS

(*Concluded from page* 1070)

1925) I was able to describe a six-valve Neutrodyne receiver, using three stages of high-frequency amplification. This was known as the Anglo-American Six, and it achieved a great popularity owing to its great range and purity. This was the first popular neutrodyned multi-valve receiver built in this country.

The Search for Efficiency

Having now reached the stage at which we could get amplification without introducing deliberate losses into the circuit, the attention of the experimenters was then turned to the fact that many of the indirect losses which had before been neglected could be removed and the efficiency still further improved. For example, the earlier high-frequency transformers of the slotted barrel type were wound with fine wire, and were of appreciable high-frequency resistance, this resistance, indeed, playing a considerable part in giving stability.

The "Elstree Six"

With the removal of the necessity for introducing resistance, it occurred to many experimenters to see to what extent the high-frequency resistance of such transformers could be reduced, and gradually things have been improved to such a degree that the modern high-frequency transformer is a very remarkably efficient instrument. The wonderful efficiency of the now famous Elstree Six Receiver, first described in *Modern Wireless*, and now being built by thousands of home constructors throughout the country, is largely due to the very efficient coils used in making up the high-frequency transformers.

Further Developments

The interaction problem is now being tackled in several different ways. If the magnetic field of one coil strays through the set and acts on other coils, much loss of efficiency may result, and the remarkably clever work of Mr. J. H. Reyner, B.Sc., at the Elstree Laboratories, in developing screened coils is already well known.

"Binocular" Coils

Another method of preventing the spreading of unwanted fields is the use of "astatic" coils, such as the "binocular" type, in which, owing to the peculiar arrangement of winding the field is concentrated. Personally I have done more work on this type of coil than on shielded coils, while Mr. Reyner has specialised more on the shielded type. The "astatic" coil of the binocular type is that utilised in the Night Hawk receiver described in this issue, and is one of the reasons for the efficiency of the instrument.

A NEW ERA IN WIRELESS RECEPTION

RADIO PRESS STAR SETS

Standardised Designs for all Purposes

WITH the forthcoming changes in wavelengths, and particularly the arrangement of the European stations upon a "kilocycle" basis, it is fairly safe to say that a new era of reception is approaching. Interference between European broadcasting stations, hitherto so prevalent at times, will no doubt be reduced to the absolute minimum, and it will be possible to receive almost every active station in Europe at some time.

It is, therefore, only natural that new receivers should be developed, in a class of their own, of such a type that the tuning controls are reduced to a minimum, so that anyone, even if he has no previous operating experience, will be able to enjoy the advantages of these developments.

The "Elstree Solodyne"

One such receiver is the "Elstree Solodyne," described by Mr. J. H. Reyner, B.Sc., in the September number of MODERN WIRELESS. This receiver, with only *one* tuning control, is capable of picking up fifty stations at loud-speaker strength. Five valves only are employed to perform this remarkable feat (two of these being high-frequency amplifiers) and the set is relatively small and compact.

It is impossible to compare a set of this nature with the "Elstree Six," since the whole character of the set is quite different. Just as one man may purchase a motor-car simply with a view to obtaining high speeds with it, whereas another may spend the same amount of money upon a much slower car, perhaps on account of better accommodation and comfort for the family, so one class of listeners will prefer the "Elstree Six" and another class the "Solodyne." Neither set is better than the other. The former may be made to give longer range and slightly greater selectivity. On the other hand, there are four controls to be manipulated, as compared with the single control of the "Solodyne." The "Elstree Six" is a set of really substantial size, whereas the "Solodyne" is small and compact.

Star Sets

Such sets as these two and many others will in future be known as the Star Sets of the Radio Press, and the special attention of our readers will consequently be drawn to all such receivers of very exceptional merit. Hitherto we ourselves have never attempted to differentiate between the different sets appearing in our periodicals, chiefly on account of the fact that every receiver published is put through very rigid tests at Elstree and is thus required to come up to a certain standard. In future, however, we intend to make it quite clear which are the Star sets, and these receivers will be the subject of lectures and demonstrations.

Standard Designs

In the past a certain lack of confidence has arisen owing to the fact that certain receivers have subsequently been modified. The original S.T.100 was changed and published in an improved form, and some readers tended to "wait until they had finished fooling with the design." This will not happen in the case of the Star sets. They will remain standardised, because when they are published everything possible will have already been done with regard to the design of the receiver.

Receivers for Everybody

Other receivers described must, however, not be looked upon as inferior, since they all do the work for which they are intended. They may not be so simple to operate, or so handsome in appearance, but the cost will, of course, be much lower. Just as a Rolls-Royce and a really good car of cheaper make are not expected to give the same performance, so, although two given sets may both be doing the job they were intended to do, one will undoubtedly be superior to the other.

Nothing but the Best

Many of the Radio Press Star receivers will employ the screened coils developed at the Elstree Laboratories, but at the same time, for the benefit of those who wish to use something cheaper, we shall continue to supply designs which will give the reader everything he desires at a considerably lower cost.

Although the reader must naturally expect to sacrifice something by building a cheaper set, there is obviously no reason why he should not enjoy the benefit of the research work done at Elstree. The cheapest sets pub-

(*Concluded on page* 1104.)

A NEW ERA IN WIRELESS RECEPTION

(concluded from page 1102)

lished will be vastly superior to older Radio Press sets, of however excellent design. We confidently expect, moreover, that they will stand far above any sets published elsewhere than in our journals.

Star Sets Already Published

Two Star sets are published in this issue, namely, the "Night Hawk" and the "Distaflex Two," full information being given for the construction of these receivers to be found elsewhere. In the September number of MODERN WIRELESS, there is the "Solodyne," already mentioned, and the "Mewflex," a three-valve reflex receiver which is of high selectivity, and is absolutely *non-radiating*.

"The Elstreflex"

In the issue of WIRELESS (dated September 18), which appeared yesterday (September 14), the "Elstreflex" was described. This set is a typical example of a Star set, while at the same time it is very cheap and economical. This same issue of WIRELESS also contains a Free Gift for all readers.

On another page in this issue will be found details of the Radio Press Tour, which is organised in such a way as to give an opportunity to all who are interested in the Radio Press Star Sets to see and hear them for themselves.

Which is to be Yours?

If you find that one of the Star sets suits your pocket, your requirements regarding range, selectivity or simplicity, *build it at once*. You will be absolutely safe in doing so, and while a six-valve set will obviously give better results than a three-valve set, you may be quite confident that you are building the best possible set in its particular class.

WORKSHOP HINTS
FOR THE
HOME CONSTRUCTOR

Mahogany—Finishing and Polishing—Makeshift Cabinets—Bench Drills—Tightening Loose Valve Pins—Making Fast Ends of Windings.

MAHOGANY

MANY constructors are now making use of panels of mahogany or some other hard wood to replace ebonite. Until but a few months ago a wooden panel was hardly ever seen, though there is no reason whatever why they should not be used in sets of modern design, in which the

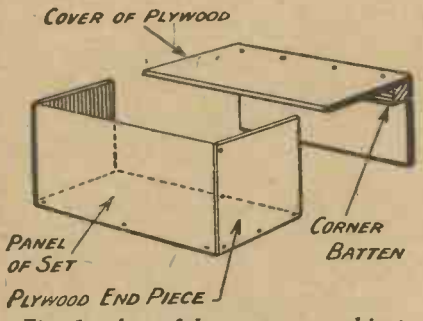


Fig. 1.—A useful temporary cabinet may be made in this way.

majority of the components are mounted upon the baseboard, the only instruments upon the panel being the variable condensers and in some cases a potentiometer and possibly one or more jacks. Since all of these can be so arranged that the metal parts which come into contact with the panel are at high-frequency earth potential, it is quite unnecessary to have expensive insulating material such as ebonite, and hard wood makes an excellent substitute.

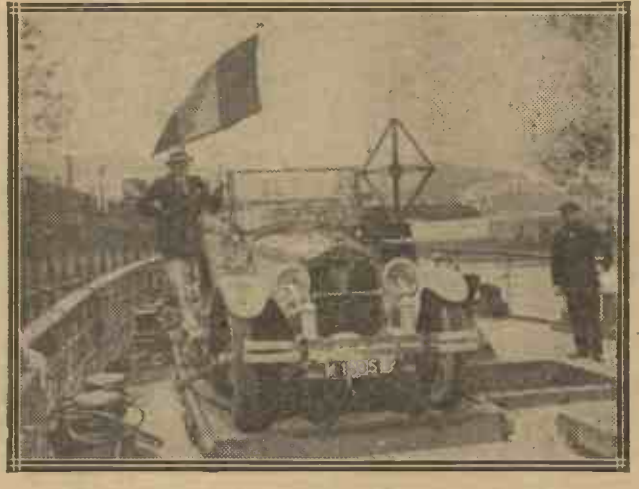
Wood-Working

Those who have been accustomed to working in ebonite will find hard wood a very different kind of material. To begin with, the twist drill is not suitable for making any but small holes, such as those used for the screws which fasten the panel to its side supports. To make neat, clean-cut holes for condenser bushes and the like it is best to use a brace and an auger bit. But do not run the bit right through as you would a drill when making holes in ebonite. Should you do so, you will find that it will tear its way out on the far side. As the careful constructor likes to have that part of his set which is inside the cabinet just as neatly finished as the rest, a job of this kind will not please him. Instead of running the bit right through, proceed as follows: turn it in until the screw point comes through upon the far side; then drill from the other side, using the hole made by the point as centre. In this way you will find it easy to make perfectly clean holes with no ragged edges.

Enlarging Holes

When it is necessary to enlarge a hole in hard wood, the best tool to use for the purpose is a "D" bit. This can be bought for about a shilling from any tool shop, and it is an all-round useful tool to add to one's equipment, since it can also be used for working ebonite. Mahogany is exceedingly tough stuff to saw and plane; the constructor will save himself a great deal of time and trouble if he purchases his panels, ready cut to size and planed up, from his local carpenter.

Capt. L. F. Plugge, who is well known to our readers, started at the end of July on an extensive tour of Europe. Here he is seen leaving Dover with his wireless-equipped car.



FINISHING AND POLISHING

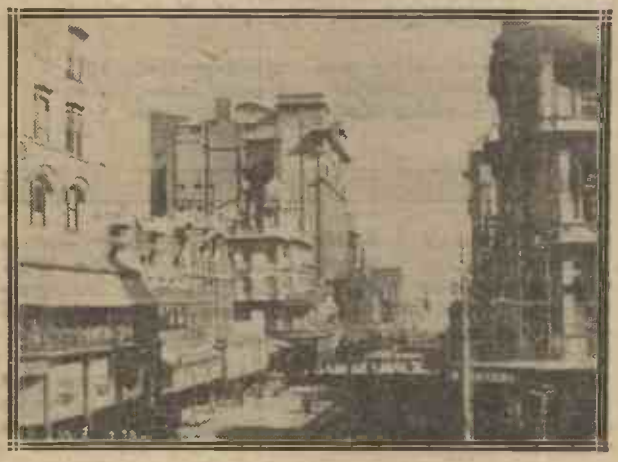
MAHOGANY and other hard woods, such as oak and teak, will take a beautiful finish, and their appearance when the set is finished will amply repay the spending of a little time and trouble over them. If you decide to have mahogany for your panel, choose if possible a piece of rich dark colour; some mahogany is quite light in colour and this does not look nearly so well for panels. A well-marked grain will add to the beauty of the finished panel. Oak and teak should also be dark and well grained. Begin by laying the panel face upwards on the bench and rubbing it down thoroughly with the finest grade of glasspaper. This task will be made very much easier if you wrap the glasspaper round a flat piece of wood an inch or so in thickness, four or five inches long, and a couple of inches wide. Continue rubbing, not merely until all visible roughness has disappeared, but until the surface of the wood has a smooth, satiny feeling. Then give a liberal dressing with linseed oil and leave the panel until this has thoroughly dried. You may find when the oil has dried in that the grain of the wood has risen a little. In this case rub down again and re-dress with oil. If desired quite a high polish can now be produced by treating the panel with beeswax—and elbow grease!

MAKESHIFT CABINETS

IF one goes in for making up quite a number of wireless sets during the year, as many constructors do, the

Workshop Hints—*continued*

cabinet problem is apt to become rather serious; many people are in fact deterred from making up big sets largely on this account. I recently hit upon a very useful scheme for making quite good-looking emergency or temporary cabinets at very small cost by a method which entails the expenditure of but little time or labour. These cabinets are exceedingly useful in a variety of ways. Sometimes, for example, it happens that you have made up a set which you do not intend to be permanent; it therefore seems hardly worth while to go to the expense of providing it with a cabinet, but if it is installed in all its nakedness in a living room, only an enthusiastic wireless man could possibly find it anything but rather an eyesore. Or, again, so much may have been spent upon the components of a large set that it is not convenient for the moment to purchase a cabinet. The emergency contrivance to be described overcomes this difficulty, since the biggest set can be decently clad in mahogany at a cost of a few shillings.



The aerial of the Johannesburg (J B) station is situated on a high building in the heart of the city.

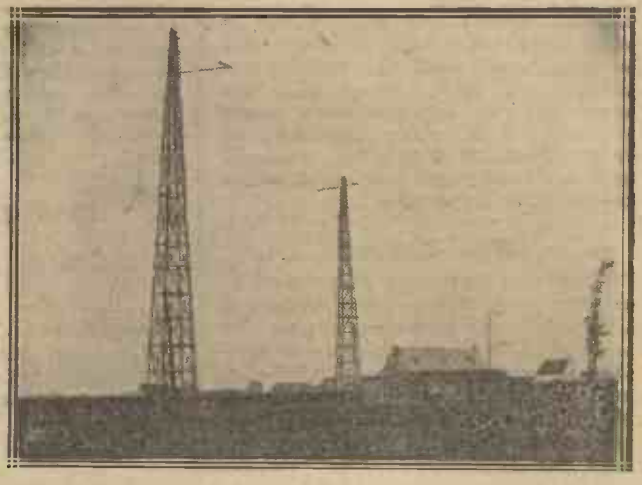
Plywood

The temporary solution of the cabinet problem is provided by the beautiful plywoods which are obtainable very cheaply at the present time. These are made of three layers of wood, the middle one being arranged so that its grain is at right angles to that of those on the outside. For this reason plywood is immensely strong, and if we use material of reasonable thickness no trouble from warping will be experienced. The plywood I recommend is that which is used a great deal nowadays for making shop counters. It is $\frac{3}{16}$ inch or $\frac{1}{4}$ inch in thickness, with a layer of mahogany, teak, rosewood, oak, maple, walnut, or some other good-looking wood upon the outside. If rubbed down and oiled in the way recommended for wooden panels and given a final treatment with furniture polish, plywood of this kind will take on a beautiful finish, and with it really good emergency cabinets can be made in a ridiculously short time.

Construction

The way in which the simplest form of plywood "cabinet" is made is shown in Fig. 1. From your local builder or joiner obtain two end pieces, each of the same height as the panel and as wide as the baseboard plus the thickness of the panel. Attach these as shown in the drawing by means of screws driven into the edges of the panel and the baseboard. The cover is made from two pieces of plywood, only one of which need have a hardwood veneer, which are fixed at right angles to one another by means of screws driven into a corner batten, as shown in the drawing. The top of the cover should have the same width as the end pieces and should be as long as the panel plus twice the thickness of the end pieces. The back, which may be of common soft plywood, is of the same length as the cover, its height being that of the panel less the thickness of the cover. Cuts are made in the back to allow it to fit over the terminal strips fixed to the rear edge of the baseboard. The cover simply slips on to the baseboard with its end pieces, and may be secured in place by means of swing hooks. The whole of the inner part of the set is thus immediately accessible.

A very solid appearance is given to the whole affair if the panel is provided with a mitred frame made from narrow picture moulding. When this is used, the width of the end pieces will be that of baseboard plus panel plus moulding. It should be noted that whilst these emergency cabinets give quite a good appearance to the receiving set, they in no way prevent its being put into a solid cabinet at any subsequent time; all that one has to do in this case is to remove the plywood end pieces, when the baseboard and panel can be slipped into their new cover in the ordinary way.



The transmissions from the Ostend Aerodrome station are probably familiar to those who listen on the longer waves.

BENCH DRILLS

AT this time of the year many constructors are overhauling their workshop equipment and adding to it with a view to a building campaign during the autumn and winter months. I would recommend any who contemplate the purchase of new tools to consider seriously the advisability of purchasing a bench drill, if one is not already installed in the workshop. Though the bench drill is by no means an expensive machine, it enables one to tackle a great many jobs that would be difficult, if not actually impossible, with the hand or breast drill. Bench drills suitable for wireless work can be purchased at prices ranging from just over £1 up to £4 or £5.

Choosing Your Tool

In choosing a bench drill there are several rather important points to

WORKSHOP HINTS—*continued*

remember. The first concerns the chuck, which must be capable of taking drills up to ⅜ inch; do not, however, purchase one with a chuck much larger than this, or you may find that it is not capable of properly gripping small fine drills. See that the distance between the chuck and the table, when the former is raised to its highest position, is ample; nothing is more annoying than to find

Fig. 2.—This type of bench drill, with a lever feed, is recommended to the constructor for general use.

when you have mounted a ⅜-inch drill that there is not room for the work and a block of wood beneath it. Next make sure that there is plenty of room between the centre of the drilling table and the body of the drill; some appliances are built on such narrow lines that you cannot make holes with them along the centre line of a 9- or 10-inch panel. A 6-inch clearance here is desirable.

Mounting the Drill

The next point to look to is the table itself, which should be heavy and solid and arranged to take a vice that can be fixed firmly in position. For wireless constructional work it is really unnecessary to have more than one speed, since one can regulate the revolutions of the drill by the rate at which one turns the crank.

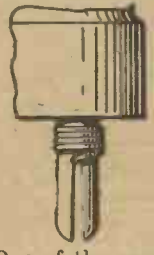


Fig. 3.—A piece of wire fixed in the cleft of a valve pin will ensure a good contact with the socket.

One of the most important points of all is the system of feed. I do not like the automatic feed, which is usually either too fast or too slow for the work in hand. The hand feed would be perfectly satisfactory if one had three hands—one to turn the crank, one to hold the work, and a third to turn down the drill! The best is, I think, the lever feed, with which one can dispense with the need of a third hand in times of emergency by hooking a suitable weight on to the lever. The drill seen in Fig. 2 is a very good type, and the constructor will find that it is of great assistance to him in doing all kinds of jobs where it is essential that holes shall be made straight.

TIGHTENING LOOSE VALVE PINS

IN not a few valves the pins are so flimsy that poor contact is made with the legs of the holder even if one has recourse to the old precaution of splaying them out at intervals with a penknife. A most useful tip is seen in Fig. 3. Take a piece of wire of No. 24 or No. 26 gauge and force its end up into the cleft between the prongs. Secure it in position by taking two or three turns round the pin. The prongs will now be forced apart and good contact is ensured, however thin they may be.

MAKING FAST ENDS OF WINDINGS.

MANY of those who make their own coils must be puzzled at times to find a way of soldering the outer end of the wire to its terminal or tag without allowing it to go slack in the

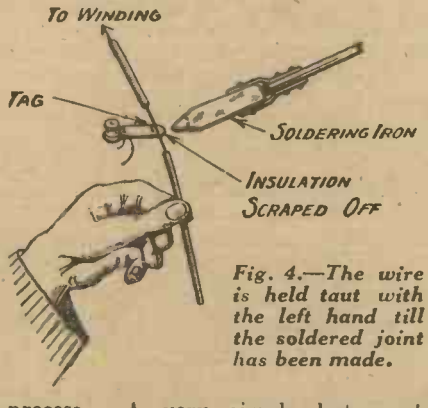
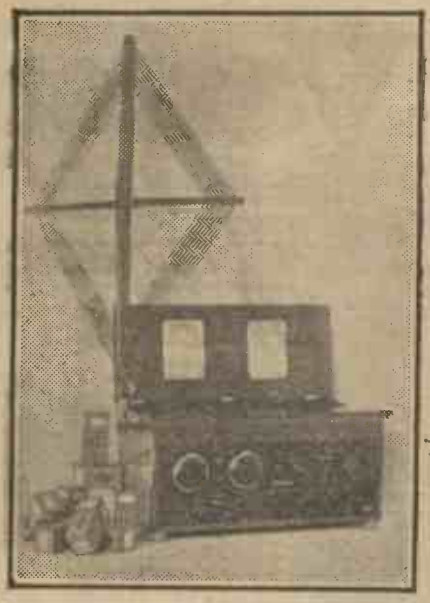


Fig. 4.—The wire is held taut with the left hand till the soldered joint has been made.

process. A very simple but most effective tip is that shown in Fig. 4. The wire is not cut short off when winding is finished, but it is kept stretched by the left hand.

Scrape away the double cotton or double silk covering until a sufficient length of wire is bare to allow soldering to the tag to be accomplished. Apply a very small amount of flux, and with a hot iron run on a small blob of solder. The tension applied by the left hand may be released as soon as the solder is cool, when the wire may be cut off short at the tag or terminal.



HAVE YOU TRIED THE SUPERHET?

By JOHN UNDERDOWN

Do you know that if you are in possession of a receiver with transformer-coupled H.F. stages of amplification, you can with little difficulty or extra expense convert it into a super-heterodyne? In this article various methods of carrying out the necessary alterations are discussed, with full practical details.

THERE must be, I am convinced, a very large number of experimenters who would like to enter the realm of superhet reception but who are deterred from doing so because appreciable expense is involved and probably, too, a set, which is giving perfectly satisfactory results, will be placed out of commission. Where, however, the constructor has a receiver with two or more transformer-coupled H.F. stages it is a comparatively simple and inexpensive matter to try various superhet circuits, and it is proposed in this article to outline certain methods of achieving this end.

Utilising the Existing Set

Many readers will have sets employing Mr. Harris's well-known "Transatlantic" circuit, consisting of two tuned H.F. stages, detector, etc., plug-in transformers of barrel type being tuned by a dual condenser. Others will possess various neutralised sets, such as the "Anglo-American-6," or the "4-Valve Long-Range Neutrodyne," described by the writer in the January, 1925, issue of *Modern Wireless*. The possession of such receivers forms an admirable basis for further experiments, but little trouble being involved. This is especially so in the case of "Transatlantic"-type sets, and a circuit diagram of a typical receiver of this kind is given in Fig. 1.

Slight Alteration Necessary

Considering the theoretical details of this circuit it will be observed that there are two H.F. stages, both being tuned, a detector with reaction on to the aerial coil and a single transformer-coupled note magnifier. It will be at once apparent that the two H.F. valves can readily be used as the intermediate-frequency amplifiers of the superhet, and that it is only necessary to couple to the receiver either a combined oscillator-detector, such as the Tropadyne arrangement, or a first detector and a separate oscillator.

The Tropadyne Arrangement

The Tropadyne arrangement, which employs a single valve to carry out the combined functions of oscillator and first detector, makes an immediate appeal from an economical standpoint, and I consider that this arrangement should give little trouble to the beginner. In fact, my first supersonic heterodyne receiver was a 5-valve set, employing a combined oscillator-detector coupled to the "4-Valve Long-Range Neutrodyne Set," which latter was altered to utilise ordinary transformer coupling, the neutralising arrangements being discarded since difficulty was experienced in obtaining stable working on wavelengths above 3,000 or 4,000 metres. With this receiver, working on an ordinary frame aerial, it was found possible, after dark, to obtain several of the British and Continental broadcasting stations at good loud-speaker strength, tuning being simple and the selectivity such that, at 12 miles south-east of 2LO, Manchester was obtained completely free from interference from the London station.

Adding the Oscillator-Detector

To add an oscillator-detector, employing the Tropadyne circuit, the first step to take is slightly to alter the Fig. 1 arrangement. The two leads to the reaction coil block, shown as A and B, should be disconnected, and the plate of V3 should be taken directly to the left-hand side of C5 and T1. The L2 coil block will then serve to take the primary coil of the filter transformer L2 L1, seen in Fig. 2. The aerial coil holder, L1, then accommodates the secondary of the filter transformer, aerial and earth being dispensed with.

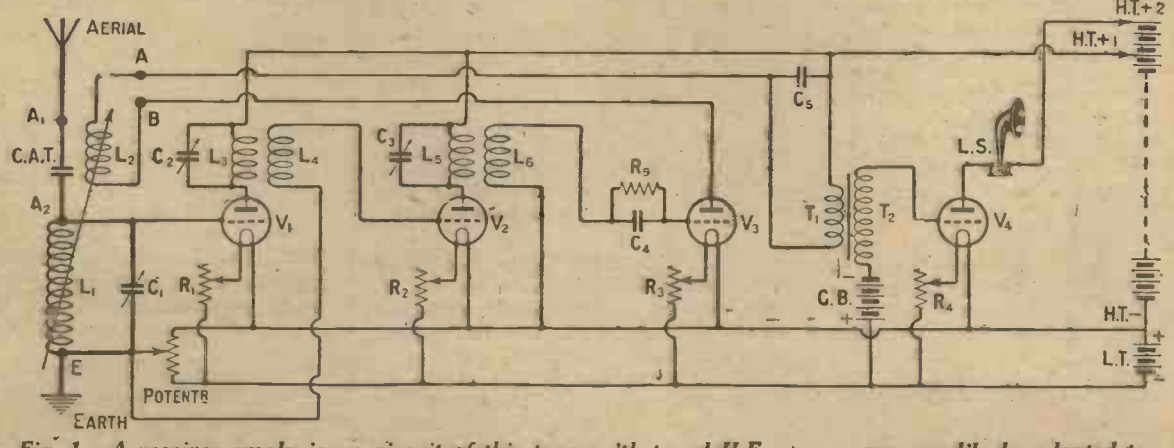


Fig. 1.—A receiver employing a circuit of this type, with tuned H.F. stages, may readily be adapted to function as a superheterodyne.

Coil Sizes

In my original experiments L1 and L2 were Gambrell H. coils tightly

Have You Tried the Superhet?—*continued*

coupled, and the by-pass condenser C9 was of .0003 capacity. In the two H.F. transformer sockets, L3 L4 and L5 L6, two barrel-type H.F. plug-in transformers of the 2,500-7,000-metre range were utilised. My original oscillator coupler will be seen in one of the photographs, a very crude arrangement being employed here, consisting of two coils of 24 D.C.C. wire wound on an old piece of cardboard tubing 3¼ in. diameter. The grid coil of the oscillator, O1 in Fig. 2, consisted of 49 turns, the tapping X being taken at the centre turn. The plate coil, which is wound on in the same direction and is started at ¾ in. from the upper end of the grid coil, consisted of 30 turns.

The Connections

The lower end or beginning of the oscillator coil O1 is connected to the grid of the oscillator valve, the centre tapping goes to the grid condenser C7 and the upper end of the coil goes to the gridleak R7. The beginning of the plate coil is connected to the primary coil of the filter L2 and to C9, whilst the upper end or finish of the same winding is taken to the plate of the oscillator valve. The grid coil is tuned by a parallel condenser, preferably of geared type and of .0005 capacity. The frame aerial shown in Fig. 2 may consist of 12 to 14 turns upon a frame with 3-ft. sides, the turns being spaced ¼ in. The frame condenser C6 should be of .0005 capacity.

The Gridleak

The gridleak, R7, of the combined oscillator-detector has considerable bearing upon the functioning of this valve, and here in my early experiments I found one of really high resistance, for example, 10 to 15 megohms, to be preferred. A .06 ampere valve, actually a Radio-Micro, was then used. From later experiments, however, using modern valves of the high-impedance type, I have found it better to employ an anode resistance of 100,000 ohms, this value giving an increase in signal strength and overcoming the tendency of the oscillator to squeal on the lower settings of the oscillator condenser.

A Simple Matter

From the foregoing remarks it will be seen that it is a very simple matter to alter certain existing sets to try a simple superhet circuit, and the only extra components required are those indicated to the left-hand side of the dotted lines in the figures. Assuming, therefore, that an oscillator coupler has been wound, a frame is available, and that in the L2 and L1 coil holders suitable coils, such as Gambrell H. coils or their equivalent in other makes, namely, Nos. 300 or 400, and the longer wave H.F. transformers are available, the procedure to adopt in tuning is as follows:—

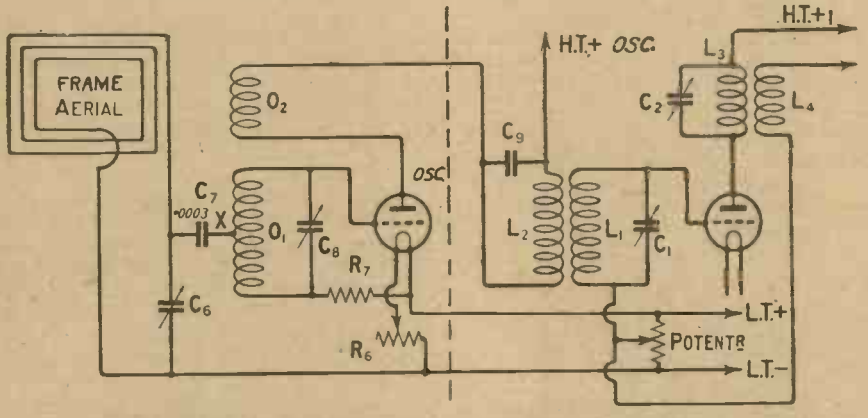
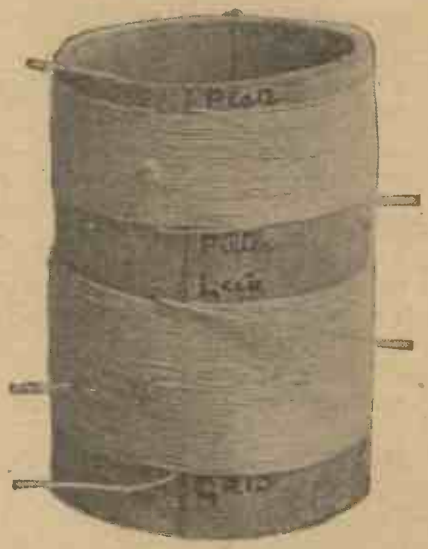


Fig. 2.—An oscillator-detector valve, employing the Tropadyne system, may be connected to the Fig. 1 circuit as shown here.

Adjust the H.F. tuning condensers or dual condenser C2 C3 to some intermediate value, say 50 degrees, and, with the oscillator valve extinguished, rotate C1, when clicks will be heard as the set goes into and out of oscillation, the potentiometer slider being suitably set towards the negative end. Midway between these two clicks, which in certain cases may appear to be merged into one, the circuits of the long-wave side are in tune. An idea is thus obtained as to the divergence of readings between the C1 condenser and the dual condenser or the two condensers C2, C3.



The original oscillator coupler employed by the author. The grid coil with its centre tapping is the lower winding on the former.

Not Critical

The tuning on the long-wave side will be by no means critical, and this part of the receiver may be left adjusted as mentioned above, oscillation being checked by means of the potentiometer. The next steps to take are to switch into circuit the combined oscillator-detector valve by means of its filament rheostat R6, employing a voltage here of the order of 70 or 80

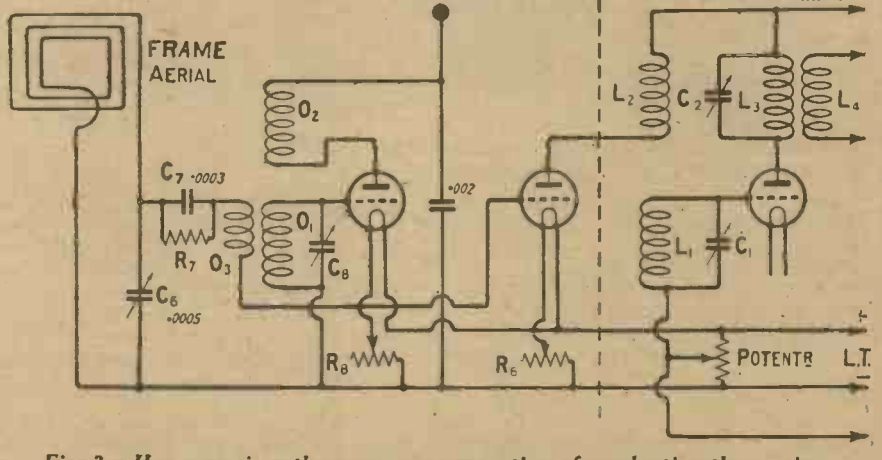


Fig. 3.—Here are given the necessary connections for adapting the receiver to use a separate oscillator valve.

Have You Tried the Superhet?—*continued*

volts (with most valves), and to adjust the frame and oscillator condensers. Unless the tapping point X on the O1 coil is at the exact electrical centre or nodal point it will be found that when the oscillator circuit is in tune with the frame circuit the oscillator will go out of oscillation, this being announced by a click or plop. No notice should be taken of this phenomenon, for a start, since it will provide useful information as to how nearly in tune are the two circuits.

Searching for Signals

Now, beginning with the frame condenser C6 at its minimum setting, increase this condenser reading by one or two degrees at a time whilst slowly swinging the oscillator condenser over 20 or 30 degrees on each side of the point where the click is heard. By following this sequence in tuning throughout, the local station should be heard, and when this transmission is obtained attention should be paid to the long-wave side. This latter, although approximately in tune throughout, is not necessarily tuned to the wavelength of the primary circuit of the filter L2, C9, and adjustment of the settings of C1, C2 and C3 should be carried out, in conjunction with slight adjustment of the oscillator condenser C8, until maximum signal strength is obtained, the necessary alteration of the potentiometer setting being made to keep the long-wave side away from the oscillating condition. This sounds somewhat complicated, but in practice it will be found quite easy, and an hour or two's handling of the set will allow the "feel" of it to be obtained.

The oscillator coupler was subsequently made up in the more compact form shown here.

An Improved Oscillator Coupler

The oscillator coupler previously described is somewhat bulky, and a more compact component may be constructed by employing a 2-in. diameter former, in which case O1 should consist of 60 turns of 30-gauge d.s.c. wire, and O2 should be of 30 to 35 turns of the same gauge wire, spaced at ¼ in. from O1. The connections will be as given for the larger coil. A coil of the above size, together with a plug-in oscillator coupler which I now employ, and which was wound for me by Messrs. Peto-Scott Co., Ltd., will be seen in one of the photographs.

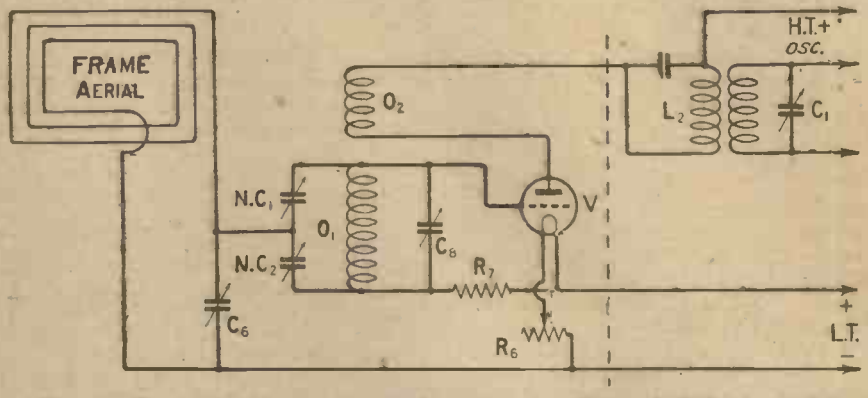


Fig. 4.—By means of the two small condensers NC1 and NC2 the nodal point on the coil O1 may readily be obtained, the Tropadyne system being in use here.

The nodal point with this latter coil is obtained by means of a balancing condenser, a similar arrangement to that of the Fig. 4 circuit being utilised.

The Separate Oscillator Arrangement

Some constructors may prefer to try the separate oscillator arrangement and for this the necessary circuit is outlined in Fig. 3. The oscillator coils may be of the same size as previously indicated, but the pick-up coil O3 should be of 10 to 15 turns. This may be a hank-wound coil, of any suitable gauge wire, such as 24 d.c.c., arranged to slide within the tube upon which O1 and O2 are wound, the best coupling position being found by experiment. There is no need, with this arrangement, to tune the primary of the filter transformer.

Utilising Neutralised Receivers

Where the set to be employed for the long-wave side, etc., of the superhet employs an earlier neutralising system, I would suggest that it be altered to ordinary H.F. transformer coupling, and that the neutralising condensers be employed in a balancing arrangement, allowing the nodal point of the oscillator coil O1 to be found with a greater degree of accuracy than is otherwise possible. The necessary connections for this modification are indicated in Fig. 4. NC1 and NC2, which are two neutralising condensers, should be set at maximum capacity for a start, and the effect of slightly decreasing the capacity of each in turn should be noted, when it will be found that the phenomenon of audible clicks when the oscillator circuit comes into tune with the frame circuit may be eliminated. When this occurs the neutralising condensers are adjusted to give no interaction between the two tuned circuits, but some slight benefit may ensue if this balance is slightly upset, as a reaction effect, useful when receiving distant stations, is thus introduced.

Values

Throughout the diagrams uniformity in lettering components has been observed, and the coils, etc., of the long-wave side, indicated in the beginning of the article, will be suitable for all the circuits shown.

A POINT TO WATCH

NOW that dull emitter valves are on the market from whose filaments no visible glow is seen when the correct low-tension current is passing, it behoves every constructor to be particularly careful to switch off the receiving set when called away from the room. Of course, the set will "speak for itself" if a loud-speaker is in use, but when telephones are being employed there is really no indication that the set is still "alive."

In the earlier days, when the incandescence of the valve filaments was plainly visible, the small valve windows had a great vogue, but with non-glowing valves extra precautions must be taken to avoid waste of battery power through leaving the set on.

A SIMPLE VARIABLE CONDENSER

A SIMPLE variable condenser may be made from the tin-foil discs such as are to be found with any type of air-tight two-ounce tobacco tin. All that are required are the discs from two such tins, a piece of ebonite, some cardboard, paper, 6BA rod, two 6BA screws, one ebonite knob bush 6BA, three 6BA nuts, and one 6BA terminal head. The diagram shows clearly the constructional details of this useful component, which takes up very little space in a receiver.

Construction of Fixed Element

If the device is built into the receiver, it will be necessary to drill three 6BA tapped holes, as shown. Disc A represents one of the circular tin foils with a clearing hole cut in the centre. Disc B represents a thin cardboard disc of similar size, also with a clearing hole in the centre. These two discs are secured to the panel, as shown, by means of the two 6BA screws.

The Moving Element

For the moving element, three discs will be required. Disc C represents a thin cardboard disc of small diameter, having a central hole to clear 6BA. Disc D represents the remaining circular tin foil cut to a

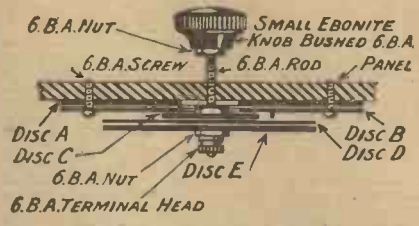


Fig. 1.—If a quicker adjustment is desired, a spindle of larger diameter than 6BA may be used.

somewhat smaller diameter, also with a 6BA clearing hole in the centre. Disc E represents a stout cardboard disc with a central 6BA clearing hole. All three discs are clamped together upon a short length of 6BA rod, as shown, by means of 6BA nuts. This is then assembled to the panel by screwing the projecting portion of the 6BA rod through the panel from the underside, and finally equipping the end with the bushed ebonite knob and locknut.

Connections

Connections from the variable condenser to the receiver are made by taking one lead from one of the 6BA panel screws between disc A and disc B. The moving connection, which should be made with flexible wire, is taken from between the 6BA terminal head and nut.

Operation

To use the condenser, it is only necessary to rotate the ebonite knob, thus decreasing or increasing, as the case may be, the distance between the two tin-foil discs. Very fine adjustments may be made with a condenser of this type, ranging from practically zero to .0005 microfarads approximately, in addition to which it is of small size, its contacts are certain, and its construction is cheap and efficient.

H. B.

THE "DISTAFLEX TWO"

(*Concluded from page 1062*)

Until this skill is obtained, it is simply necessary to insert the telephones in jack No. 2 or jack No. 1 if preferred, and tune the stations in. On removing the plug the signals will be put through on to the loud-speaker terminals on the back of the set. It may possibly be necessary to retune the last circuit slightly, but this is a matter which will easily be found out in practice.

Choice of Transformers

A word of warning may be given concerning the transformers. The actual make of transformer is not too critical provided a high-quality component is used. It is essential, however, that the secondary winding of the transformer shall have a low self-capacity, since this winding acts as a choke to any high-frequency parasitic oscillations which may tend to be produced in the circuit.

The use of the transformers specified is therefore to be recommended, but those readers who already possess transformers which they wish to use can do so in certain cases. A list of suitable alternative transformers which have actually been tried in the receiver will be published next month.

Note this Carefully

Under no circumstances whatever must a condenser be connected across the secondary of the transformers. No high-frequency currents have to pass through this channel, and if such a condenser is provided it will immediately permit parasitic oscillations to occur, and the receiver will burst into inaudible and uncontrollable oscillation which simply makes it dead and lifeless.

Further operating details, together with the settings for the various long-wave stations obtained with the Daventry coils, and a long list of suitable valves to use will be given in next month's issue. The instructions for building the receiver are, however, complete in this article, so that the intending constructor need have no hesitation in commencing the construction of the receiver.

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A WONDERFUL FREE GIFT BOOKLET, THE RAPID STATION GUIDE, will be presented with every copy of the October issue of MODERN WIRELESS. The wavelength redistribution of European stations will make this presentation Booklet so extremely useful that you should go to your newsagent to-day without fail and put this issue on order.

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

The Contents for the October issue will include:

HOW TO BUILD AN EIGHT-VALVE SCREENED-COIL SUPERHETERODYNE
By G. P. KENDALL, B.Sc.

MODERN DESIGN IN SIMPLE SETS
By J. H. REYNER. B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

HOW TO BUILD AN H.T CHARGING UNIT
By the Staff of the Elstree Laboratories.

MORE ABOUT THE 'ELSTREE SOLODYNE

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For "The Wireless Constructor" at our Elstree Laboratories.

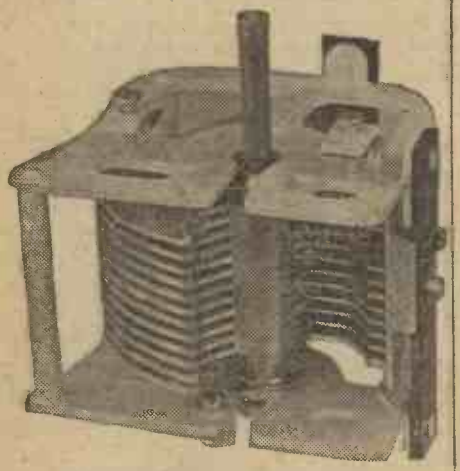
"Ebonart"

MESSRS. REDFERNS have submitted to us some samples of their "Ebonart" panels for wireless apparatus. This material is similar in appearance to ordinary ebonite, and in fact appears to be a high grade form of this commodity.

On test it was found to be exceedingly good. It was easy to work without being in any way "cheesy." It did not soften too easily with heat, a point which should render it less liable to warp due to changes in temperature. It was also very strong from a mechanical point of view.

A sample of mahogany finished material proved less strong than the more homogeneous black sample, but otherwise it was in every way equal to the first.

This material is the best we have tested for some considerable time, and we can recommend it.



The Cleartron Di-Kast Condenser is of robust construction.

Valves

WE have received a selection of valves from Messrs. Radio Valves, Ltd. Two of these were of the bright-emitter type with tubular bulbs, the valve legs being carried in an insulated base of brown material. At the rated filament potential of 3.5 volts, a current of .5 of an ampere was taken, while their impedance and amplification ratio taken at 80 volts plate potential were 55,000 ohms and 10 respectively.

When compared in a three-valve set with "R" valves of known performance, these valves were found to give satisfactory results as H.F. amplifiers, detectors, or L.F. amplifiers.

Two other valves also submitted were of the "R" type, but with spherical pipless bulb. The filament current at 4.2 volts was .7 amps., and, when measured at a plate voltage of 80, the impedance was found to be 30,000 ohms and an amplification ratio of 13.3.

Satisfactory results were obtained in a three-valve receiver using these valves as H.F. detector, or L.F. amplifier, these results being on a par with those obtained with an "R" valve of a known performance.

Two valves of the .06 type were also tested, and were found to take their rated current of .06 amp. at a potential of 3 volts. An impedance of 27,000 ohms, and an amplification factor of 10, were obtained at an anode potential of 80 volts, while their performance was up to standard.

These valves, further, appear to have a low capacity, since only a small value of the neutralising condenser was required to stabilise them when used in a neutralised stage of H.F.

Cleartron Di-Kast Condenser

AN interesting component has been sent to us for test in the Cleartron Di-Kast Condenser. This is an attempt to produce on an economical scale a real precision condenser. The stator and rotor plates are each die-cast in one piece and subsequently assembled in a suitable skeleton framework. A spring connection is taken from the moving plates, and soldering tags are provided for the actual contact.

Two-hole fixing is provided for, a drilling template being supplied; but the instrument is somewhat difficult to fit and was not as rigid, when in position, as it should be. The rated capacity of the sample submitted was .0005, and on test this figure was found to be substantially correct.

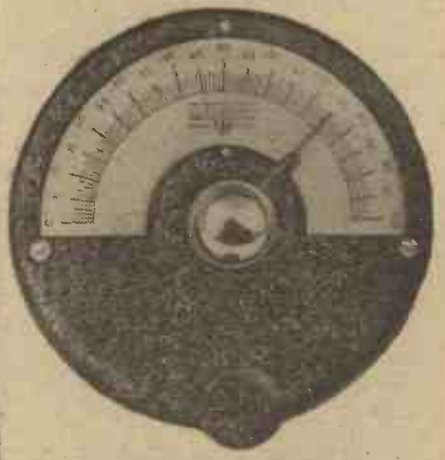
The bearing which is provided is in the form of a spring washer of special construction, and while this gives a smooth and easy motion, it is possible, by exerting pressure upon the plates, to produce end play, with consequent variation of the capacity.

This criticism, however, is of minor importance, and is only inspired by the fact that the remainder of the workmanship is of excellent quality. For ordinary use we have no hesitation in recommending this condenser.

Cleartron Micro Station Selector

WITH the Cleartron Di-Kast Condenser we were supplied with a micro station selector. This is a slow-motion dial, the adjusting knob causing a rotation of the spindle through a reduction mechanism which moves the condenser spindle, and at the same time operates a pointer operating over a scale reading from 0 to 100.

The finish of the job is good, and the dial in operation was found to be free from backlash and smooth in action. The reduction mechanism is ingenious and simple. It consists of a wheel 3 in. in diameter provided with a rubber tyre, and engaging with this is a small roller to which the actual operating knob is fixed. The whole is enclosed in a metal case so protecting it from damage, dust, dirt, etc., and we can recommend this component to our readers.



Fine readings are made possible with the Micro Station Selector, control being by means of the small knob at the bottom.

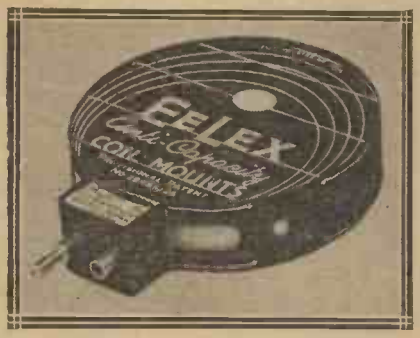
S.P.D.T. Knife Switch

A NEAT and well-made single-pole double-throw knife switch has been sent to our laboratories for exam-

Apparatus Tested—*continued*

ination and report by Messrs. A. F. Bulgin & Co., Ltd.

The switch presents a pleasing appearance when mounted, all visible metal parts being nickel plated. Contact is established by means of three spring sockets, the centre spring of which has the lever arm mounted on it, and the arm simply slips into the



The "Eelex" coil mount consists of a coil plug and hollow shell to contain a suitable winding.

other two sockets as required, the sockets, of course, being fitted one on each side of the centre spring. The box itself is utilised as a drilling template, while a further good point is that soldering tags are provided. When in use a good electrical contact is made; it is simple to mount, and we have no hesitation in recommending it to our readers.

Anti-Capacity Coil Mount

A NEW anti-capacity coil mount has been marketed by Messrs. J. J. Eastick & Sons, of Bunhill Row, E.C.

This accessory consists of a strip of fibre material folded to the shape of the usual type of plug-in coil. At the bottom of the strip a plug and socket are inserted, and kept in position by means of the fibre which is folded somewhat after the manner of a cardboard box lid.

Connections are made to the coil by means of screws or soldering tags, and when the coil is in position the fibre strip and cardboard side-pieces (which can be cut to suit the size of the coil constructed) keep the coil rigid.

"All-Wave" Tuner

MESSRS. C. S. DUNHAM have submitted to us for test and report one of their "All-Wave" tuners.

This instrument consists of a composition tube 3½ in. in diameter and 5½ in. long, which carries two windings, one of thick and one of thin wire.

Tappings are provided so that the various amounts of inductance may be used, while a small rotor revolving

The "All-Wave" tuner, submitted by Messrs. C. S. Dunham, is designed for one-hole fixing.

within the tube carries a winding by means of which reaction may be applied. Terminals are provided for making connection to the reaction coil, the spindle of which carries a graduated dial and knob for controlling the amount of reaction.

When tested in the aerial circuit for tuning a three-valve set employing a .0005 variable condenser, the range of this instrument was found to be from 250 to about 2,800 metres, a satisfactory degree of overlap being obtained on each of the tappings.

See page 1112 for Formo Transformer.

Gifts for EVERY READER

Mr. John Scott-Taggart, F.Inst.P., A.M.I.E.E., Technical Director, in this issue describes THE ELSTREFLEX RECEIVER — the first two-valve reflex receiver to give selectivity and range—a wonderful set giving alternative programmes on the loudspeaker.

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In addition to the article by Mr. John Scott-Taggart the contents include :—

Secrets of Modern Radio Efficiency. The first of a series of articles. By J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

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Stereoscopic Broadcasting. By CAPT. H. J. ROUND. M.I.E.E.

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PROTECT YOUR ACCUMULATOR

NO matter how carefully it is handled, the low-tension accumulator is always liable to be short-circuited when experiments are being conducted or a receiving set is being tested out. The deleterious effects accruing from this can be completely overcome if some form of enclosed fuse is used to replace one of the ordinary

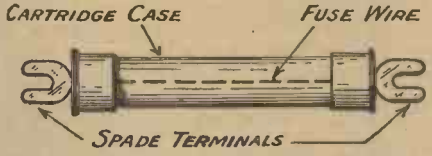

Fig. 1.—A fuse of the type shown is convenient to handle, and may save the accumulator from serious damage.

connecting links between the individual two-volt units of a four- or six-volt accumulator.

Reference to Fig. 1 will indicate the type of fuse suggested, ordinary spade terminals being provided to fit under the accumulator terminal units. The cost of such an accessory would be quite small, and the reason for employing an enclosed fuse is to avoid any possibility of danger from fire as a result of the fusing of the wire and the dropping of molten metal on to the celluloid case.

THE "NIGHT HAWK"

(*Continued from page* 1052)

that of the S.L.W. The fact, however, that two small fixed condensers in series are used across the variables will slightly alter the curve, and you will not get a perfect straight-line reading of the frequencies plotted against degrees. This slight alteration, however, will not be found any practical disadvantage.

Constructional Details

It will be found that all of the components on the baseboard can be mounted and practically entirely wired up before the front panel is attached. I suggest to you as a convenience in construction that you mount the three condensers, switch and reaction condenser on the front panel, attach the brackets, and then stand the whole assembly in position against the baseboard, while you lay out your parts according to plan. When you have these all in place, you can secure them in position, remove the front panel assembly and get on with your wiring, only finally attaching the front panel when you have done practically all the work on the baseboard. This will be a great convenience, and will help you to obtain neat wiring with the minimum of trouble.

Valves to Use

In the Night Hawk I have rather concentrated on the use of the 2-volt valves which have recently been developed with such success. While I do not wish to convey the impression that the Night Hawk will not work just as well with 4- or 6-volt valves, I do wish to emphasise that it has been very thoroughly tried with the 2-volt, which seem to suit it excellently. In the two high-frequency stages and the detector I have used the Cossor .1 high-frequency valves very successfully, and in the two audio-frequency stages the Cossor Stentor Two with thoroughly satisfactory results. The remarkably high efficiency in current consumption of modern valves is indicated by the fact that with these five Cossor valves the total filament consumption is .6 of an ampere at 2 volts, or, expressed in another way, 1.2 watts. A year or two ago a single bright-emitter valve consumed between 2 and 3 watts; incidentally, the results obtained with these low-consumption valves are far better than those we used to get with the old bright-emitters.

I have also used with success the Mullard P.M.1 valves in the first three sockets, and the P.M.2 valves in the last two sockets; the current consumption of these valves is the same, i.e., .1 of an ampere at 2 volts for the radio-frequency and detector valves, and .15 of an ampere at 2 volts for the audio-frequency valves.

You will notice that I have fitted a

(*Concluded on page* 1126.)

THE "NIGHT HAWK"

(*Continued from page* 1125)

35-ohm resistance for the first three valves and a 6-ohm resistance for the audio-frequency valves. The reason for this is that some readers may desire to try the set with the .06 ampere type of valve in the first three stages, and a 35-ohm resistance will enable even a 6-volt accumulator to be used with these valves. If it is intended to concentrate on 2-volt valves of the type described, however, it is only necessary to provide two 6-ohm resistances. In any case, once you have got good results with this set, reduce the filament current as far as you can without detracting from the results. Both makes of valves will work well below 2 volts without loss of efficiency, and by reducing the current you will prolong the life of the valves.

For those who like the 6-volt valves or have a supply of them which they want to use, I may say that the ¼-ampere 5.5- to 6-volt valves of the "small power type" work excellently in this set, and for the first three sockets I would recommend (for those who desire to use this type of valve) the high-impedance type designed for resistance-capacity amplification.

High Selectivity

At Wimbledon, Cardiff and Manchester can be completely separated from the London transmissions, being tuned in entirely on the loud-speaker. When you realise that on the same aerial at Wimbledon with a good modern crystal detector it is possible to obtain sufficient strength on a loud-speaker to make the news items audible on the other side of a quiet room when one listens carefully, you will realise that to get rid of the London signals and to receive Cardiff and Manchester without interference means selectivity of a very high order.

NOTE.—Complete details are given on these pages to enable you to build the "Night Hawk," and constructors need not hesitate to begin the construction of this set immediately. Blue prints of the diagrams may be obtained on application, with the coupon to be found elsewhere in this issue.

Further notes on neutralising and operation will be given next month.

THE NEW BROADCASTING WAVELENGTHS

The proposed new wavelengths are given in the table below, and it should be noted that they are at present only provisional. They are due to come into operation, however, on or about September 15th.

Geneva Plan Wave-length.	Name of Station.	Country.	Present Wave-length
588.2	Vienna II	Austria	530
	Linköping	Sweden	467
	Grenoble PTT	France	475
577	Madrid II	Spain	392
	Joenköping	Sweden	265
566	Berlin II	Germany	562
	Orebroe	Sweden	237

Geneva Plan Wave-length.	Name of Station.	Country.	Present Wave-length
566	Bloemendaal	Holland	—
555.6	Budapest	Hungary	546
545.6	Sundsvall	Sweden	545
535.7	Munich	Germany	485
526.3	Riga	Latvia	480
517.2	Vienna	Austria	590
508.5	Antwerp	Belgium	—
500	Zürich	Switzerland	515
	Helsingfors II	Finland	522
	Karlstad	Sweden	—
491.8	Aberdeen	Great Britain	496
	Birmingham	Great Britain	477.5
483.9	Berlin	Germany	505
476.2	Lyons PTT	France	480
468.8	Elberfeld	Germany	259
	Bergen	Norway	350
454.5	Boden	Sweden	1,200
477.8	Paris PTT	France	458
441.2	Brno (Brünn)	Czecho-Slovakia	527 (?)
434.8	Bilbao	Spain	415
428.6	Hamburg	Germany	392.5
422.6	Rome	Italy	425
416.7	Stockholm	Sweden	427
411	Berne	Switzerland	436
405.4	Glasgow	Great Britain	422
400	Mont de Marsan	France	390
	Cadiz	Spain	355
	Falun	Sweden	370
	Warsaw	Poland	—
	Koszice	Czecho-Slovakia	—
	Bremen	Germany	?
394.7	Frankfurt	Germany	470
389.6	Toulouse Radio	France	430
384.6	Manchester	Great Britain	378
379.7	Stuttgart	Germany	446
375	Madrid	Spain	373
370.4	Oslo	Norway	382
365.8	Graz	Austria	397
361.4	London	Great Britain	363.5
357.1	Breslau	Germany	416
353	Cardiff	Great Britain	353
348.9	Prague	Czecho-Slovakia	365.5
344.8	Seville	Spain	357
340.9	Paris Petit Parisien	France	358
337	Copenhagen	Denmark	340
333.3	Naples	Italy	350
	Reykyavik	Iceland	—
329.7	Nürnberg	Germany	340
326.1	Belfast	Great Britain	440
322.6	Leipzig	Germany	452
319.1	Dublin	Ireland	390
315.8	Milan	Italy	320
312.5	Newcastle	Great Britain	404
309.3	Marseilles PTT	France	351
306.1	Bournemouth	Great Britain	386
303	Münster	Germany	410
300	Bratislava	Czecho-Slovakia	300
297	Agen	France	318
	Leeds	Great Britain	343.5
	Hanover	Germany	297
	Carthagena	Spain	330
	Jyvalskala	Finland	301.5
294.1	Dresden	Germany	294
	Trollhättan	Sweden	345
	Bilbao	Spain	418
	Valencia	Spain	400
	Liège	Belgium	280
291.3	Lyons (Radio)	France	280
288.5	All British Relays, except Leeds and Bradford		
283	Dortmund	Germany	387
280.4	Barcelona	Spain	324
277.8	Caen	France	332
	Barcelona II	Spain	462
	Seville II	Spain	300
275.2	Angers	France	275
	Madrid III	Spain	340
	Eskilstuna	Sweden	243
	Zagreb	Jugo-Slavia	—
272.7	Cassel	Germany	273
	San Sebastian	Spain	343
	Norrköping	Sweden	260
260.9	Gothenburg	Sweden	290
254.2	Bradford	Great Britain	308
	Kiel	Germany	233
	Malaga	Spain	—
252.1	Montpellier	France	238
	Stettin	Germany	241
	Umea	Sweden	—
250	Gleiwitz	Germany	251
245.9	Toulouse PTT	France	260
241.9	Königsberg	Germany	462
240	Helsingfors (1)	Finland	318
238.1	Bordeaux	France	—
229	Malmoe	Sweden	270
219	Kovno (3)	Lithuania	—
217.4	Luxemburg	Luxemburg	—
211.9	Kiev	Russia	281
204.1	Gäffle	Sweden	208.9
	Salamanca	Spain	—
202.7	Christianhamn	Sweden	202
	Asturias	Spain	—
201.3	Oviedo	Spain	—

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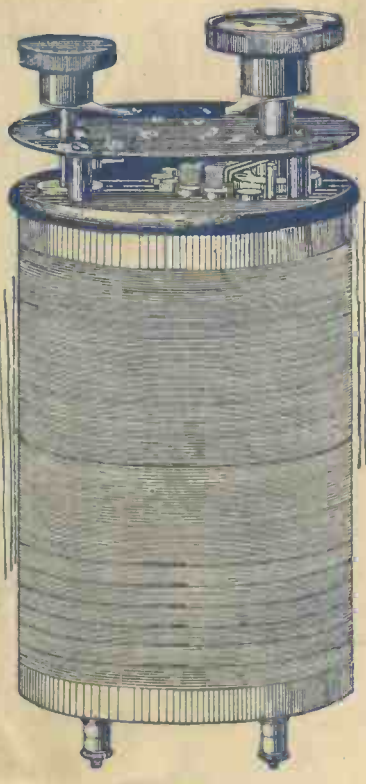

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HOW TO BUILD YOUR OWN WIRELESS SET

A Guide to the Choice of Tools, Preparation of Panels, Drilling, Countersinking, Soldering and other Processes in the Home Building of Wireless Receivers

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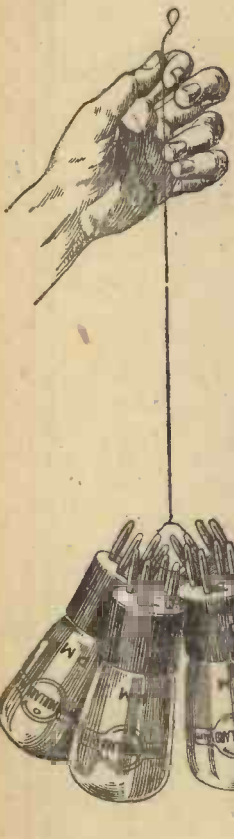

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HOW TO BUILD YOUR OWN WIRELESS SET

□ □ □

INTRODUCTION

THE construction of wireless receivers possesses a technique of its own which is distinct from that applicable to other forms of constructional practice in the workshop. It is not implied that any special difficulty is likely to be experienced in wireless constructional work. In fact, quite the reverse is the case; but there are certain principles to be grasped and rules to be followed, if the finished receiver is to justify the time spent on its construction.

Anyone with a knowledge of workshop practice in wood or metal working will have no difficulty in adding to his knowledge an appreciation of the methods employed with the materials and operations encountered in wireless work. Those who have no previous experience of this kind will find, in the building of a receiver, an occupation which is as simple as it is fascinating, with an added incentive to careful work in the expectation of future performance and enjoyment.

It is no small advantage to many people that a receiver of quite elaborate design may be constructed without the employment of special tools and without heavy workshop operations. It is possible, in fact, to build a receiver with no more elaborate equipment than a kit of small tools, and with an ordinary table as a "bench."

The purpose of this booklet is to indicate to the intending constructor how he can best set about building his receiver and how the various operations necessary may be carried to a successful conclusion. Numerous hints and tips, which are the result of practical experience in constructional work, are included, so that the man who has built more than one receiver already, no less than the beginner, will find much that will be helpful to him in future constructional work. With this booklet ready to his hand for reference it may safely be said that anyone will be able to undertake the construction of a wireless receiver with complete confidence in the ultimate success of his efforts.

CONTENTS

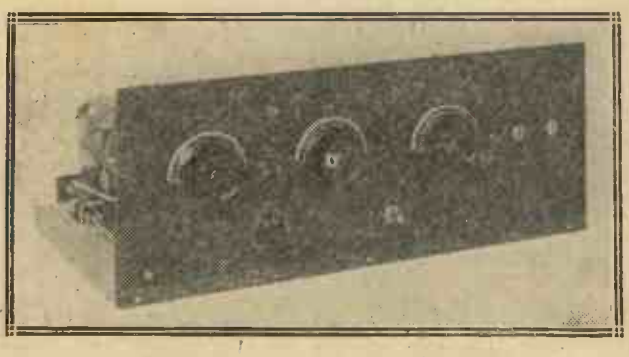
HOW TO BUILD YOUR OWN WIRELESS SET

By the Technical Staff of "The Wireless Constructor"

□ □ □

MATERIALS

The principal material which has to be "worked," that is to say, drilled or cut to shape, in the construction of wireless receivers is ebonite, or "hard rubber," as it is commonly termed in America. In order to appreciate the methods employed in the working of ebonite, it is necessary to have some knowledge of its composition. Incidentally, the hints given also apply to other materials (not ebonite) specially made for wireless panels.



A typical product of the "home constructor."

The principal constituents of ebonite are rubber and sulphur, varying quantities of other substances being added according to the particular process of manufacture and the purpose for which the ebonite is intended.

Owing to the fact that ebonite softens when heated and hardens again on cooling, it can be moulded fairly readily into certain shapes. A failing which is exhibited by ebonite in this direction is that if this type of moulding is again heated, the elasticity of the compound will assert itself, the ebonite tending to return to the original shape which it possessed before it was moulded. It will then harden again on cooling, naturally in a distorted form. In commercially moulded ebonite this difficulty is surmounted by forming the ebonite in the moulds before it is cured.

Sheet ebonite of good quality should cut and drill cleanly, the latter operation producing a tough unbroken "shaving." Since the material is brittle, it requires certain precautions in handling when being drilled or otherwise worked, adequate support for the part under treatment and the neighbouring parts being necessary to obviate the danger of splitting the sheet or flaking away its surface.

The inparting of a good surface to ebonite sheets is often done in the first instance by pressing the sheets between layers of tinfoil. A certain amount of this tinfoil adheres to the surface of the ebonite, and it naturally would interfere with its insulating properties if left there. Ebonite sheets or cut panels are

now obtainable with a guaranteed surface insulation. The tinfoil has been removed from the surface of these panels, the panels being subsequently polished or "matted" by mechanical processes. The intending constructor will be well advised to insist on a guaranteed panel when he is purchasing ebonite, as the constructional work may then be put in hand directly without any preliminary treatment of the ebonite.

If for any reason a sheet of ebonite is obtained which is not of the "guaranteed" type, the whole surface of both sides should be well rubbed down with fine emery cloth. The cloth should be fine enough not to cause serious scratches on the surface, which would be difficult to remove afterwards. When the surface has been well rubbed down in this way, and all traces of the tinfoil have been removed, the surfaces may be polished. For this plate powder or rouge may be used, a very little turpentine being used as a lubricant. The polishing is done with a soft cloth, rubbed all over the panel, at first fairly hard, and finishing off lightly.

When drilling, sawing, or filing ebonite, it should be borne in mind that this material very quickly wears down the cutting edges of steel tools. For this reason it is best to reserve for the working of ebonite a special set of tools.

In drilling, a twist drill should be used, and the drill must be turned slowly so that it really does cut its way through the ebonite and not simply grind a hole out. If drills are used in this way, they will keep their cutting edge for a much longer period. Twist drills as used for metal work may be used, though greater satisfaction will result from the use of drills specially set for ebonite. A fair amount of pressure is required to drill a clean hole in ebonite without "grinding," and the danger here is that the ebonite may break away on the far side just as the drill emerges. To guard against this the ebonite should be drilled on a flat piece of wood and should preferably be clamped to it. As a further safeguard when drilling large holes, a small drill should be run through the sheet first as a "pilot" for the larger one. Then the full size hole should be drilled half-way through from each side of the sheet. The beginner will be well advised to try a few experiments in drilling on an odd scrap of ebonite before trying his skill on the panel to be used in a receiver, paying particular attention to the need for drilling the holes at right angles to the surface of the ebonite. Heating of the tools is to be avoided in all operations on ebonite. If the drills are turned slowly, there should be no risk of this, and a little turpentine as a lubricant will assist matters.

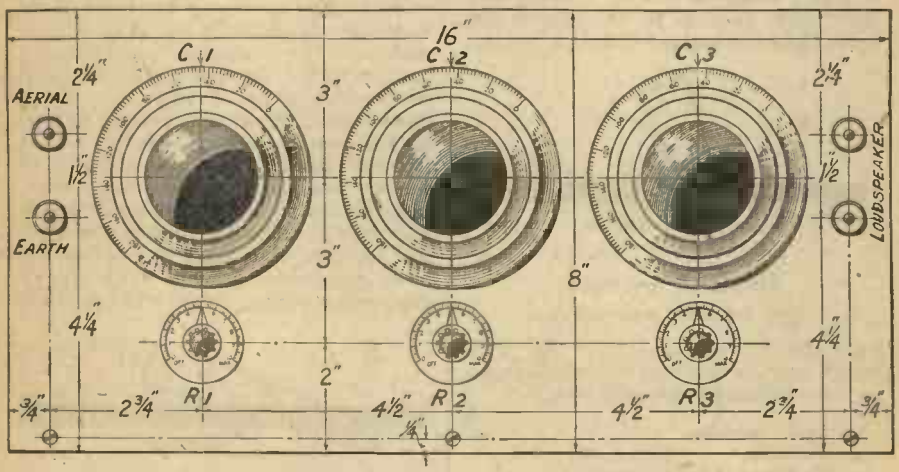
When tapping holes in ebonite for the accommodation of threaded bolts the tap should be turned slowly and should be frequently withdrawn from the hole and cleaned. Failure to do this will result in damage to the thread formed. A drill of the correct size should be used before tapping, too large a drill being avoided, as a shallow thread in ebonite will be practically useless. The constructor will find that in most cases he can dispense with taps altogether and drill clearance holes instead. If the work is neatly done, screws on the panel of the receiver, so long as the heads are properly countersunk, will not detract from the appearance of the finished instrument.

Countersinking should preferably be done with a "rose" bit, the hole being sunk slowly and frequent tests of its depth being made by placing the correct size of screw in position in the hole. Alternatively a twist drill of medium or large size may be used for countersinking. In this case it will usually be necessary to use two drills, one for the "skirt" of the hole, and one of smaller size worked in far enough to give sufficient clearance under the head of the screw to enable it to bed down flush with the surface of the panel. So long as care is exercised in the choice of a drill exactly matching in size the diameter of the head of the bolt to be used, cheese-headed bolts can be neatly sunk into the surface of the panel. The procedure in this case is to drill the necessary clearance hole for the shank of the bolt and then with the correct size of drill to enlarge this hole from the front of the panel. As described previously, the head of the bolt should be frequently tested in the hole to ensure that the latter is not made too deep. The head of the bolt should preferably be a tight fit in the hole, so that the action of screwing on the nut behind the panel

draws it down into the recess provided without any unsightly gap round the head.

As panels and strips of ebonite are nowadays obtainable ready cut to the desired size and shape, the constructor will not necessarily be confronted with much sawing. Any sawing that is done, however, should be carried out with a fine-toothed saw. A backed tenon saw is admirable for this work, while for small cuts a hacksaw is quite suitable. In sawing ebonite, the handle of the saw must be kept down close to the panel, as no "grain," so that it is liable to split in any direction, and not necessarily in a line with the cut being made.

After a cut has been made with the saw, it will usually be necessary to trim up the edge of the panel. This is best done with a file. The panel should be clamped in a vice, with a wood block on each side of it to prevent scratching of the surface, and the file used with a diagonal motion across and along the edge. The file should be handled in such a way as to cut and not to rub away the material, and fairly frequent



All drilling centres may be obtained from front-of-panel diagrams of this type.

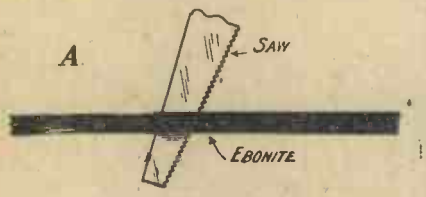
is indicated in the accompanying sketch (page 6). If the saw is held too upright there will be a great danger of the teeth catching in the material, with consequent damage to the tool and probable splitting of the panel. Particular care should be exercised when nearing the end of a long cut. The ebonite should be well supported to prevent it from splitting, and the handle of the saw should be gradually lowered until at the end of the cut the blade is horizontal, and the last quarter inch of the cut is made in this manner. The chief danger in the splitting of ebonite lies in the fact that the material possesses

cleaning of the teeth of the file may be necessary, especially if the ebonite is at all soft. The file used for ebonite should be kept for this purpose. If it is used sometimes for metal and sometimes for ebonite, particles of metal may be lodged in the ebonite and seriously impair its insulating properties.

Generally speaking, ebonite should be worked more slowly than other materials, great care being taken to make the tools do the work and not to force them. Turpentine, applied sparingly, is the best lubricant to use in all operations.

TOOLS

In the construction of a receiver some small tools will be required, but it will not usually be necessary to have anything in the way of a complete workshop, though, of course, the possession of workshop facilities will be an advantage. Failing this, a good strong table will form an adequate "bench." A vice or clamp will only really be needed if extra constructional work is to be carried out, apart from the construction of a receiver



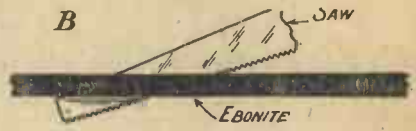
Incorrect method : bad for saw and panel.

from bought components. The tools which may be regarded as indispensable to the constructor are as follows :—

Centre punch.
Dividers.
Steel rule and set square.
A pair of wire-cutting pliers, preferably with side cutters.
A sharp pointed scriber, for marking out the panel.
A screwdriver.
A geared hand-drill with a set of Morse twist drills from $\frac{1}{16}$ to $\frac{1}{4}$ in., and one $\frac{3}{8}$-in. drill. ($\frac{1}{4}$-in. shank).
Outfit for soldering. This may be obtained complete as an outfit, or the following will be needed :—A soldering iron, with a $\frac{1}{4}$ to $\frac{1}{2}$-lb. bit ; some soft (tinman's) solder, or some form of paste solder ; with the tinman's solder some form of flux : resin is suitable, or a paste flux may be used. Acids and corrosive fluxes should not on any account be used.

Other tools which will be found useful, but which are not essential are—a pair of wire-bending pliers, a set of small files of various shapes, a square for marking out the panel, a steel rule or straight-edge, and a centre punch and hammer.

Three principal types of receiver design will be available to the intending constructor, the difference between them lying in the disposition of the panel relative to the component parts and the cabinet. The panel may be placed either vertically, horizontally or in a sloping position. The horizontal panel type of instrument has the convenience from the constructors' point of view that all, or practically all, the components are carried on the panel. Owing, however, to the fact that the valves, etc., in this type of receiver are placed outside the cabinet, and that the hand of the operator has to pass over the top of the cabinet to reach the controls, this type of receiver has lately gone out of fashion. This type or that with a sloping panel, which is really



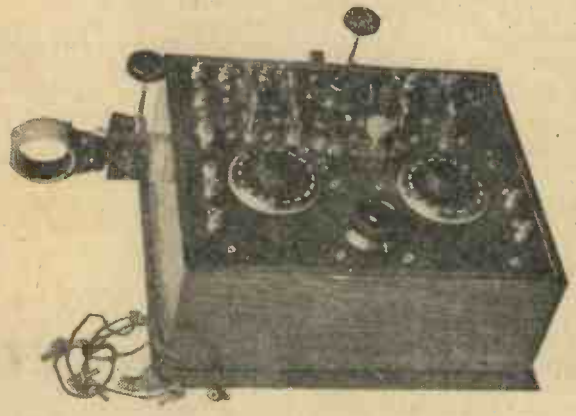
The correct method.

only a variation of the same arrangement, is most commonly used nowadays for special purposes, as, for instance, for wireless measuring instruments.

The type of cabinet most in favour for receivers and most satisfactory from every point of view, is that in which the panel is vertical, or nearly so, the component parts being disposed both on the panel and on the baseboard. All the components are inside the cabinet out of harm's way, the only external projections being the switches, tuning controls and terminals.

The intending constructor who has never built a wireless receiver before will be well advised to follow instructions which give him in detail a complete description of how to build the receiver which he wants. Such instructions are to be found in the Constructional Envelopes published

by Radio Press, Ltd.; descriptions of a number of different receivers are available in this series of Envelopes, each of which contains very full and detailed instructions for the constructor, with photographs and scale drawings of the arrangement of the parts. A wider choice of design may be made by studying the pages of the Radio Press journals; full details for the benefit of the constructor are always given with every receiver of which a description is published. A list of the component parts required for the receiver and complete working drawings are given, and a postal request will bring a full-size blueprint of the layout of the



A typical "horizontal panel" type of receiver.

particular receiver decided upon. The beginner will do best to purchase the list of components specified in the description of the receiver. If he does otherwise, he will not be able to follow the instructions exactly, since the design given will have been made for components of a certain size and shape, and others may not fit easily into the space allowed. If care is taken to purchase components of good quality and to see that they will fit into the receiver, there is, of course, no reason why such components should not be used, but if simplicity in the constructional work is required, then the published list should be adopted. The more experienced man will probably like to choose his special favourites in components.

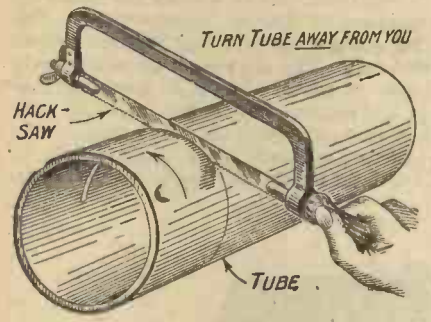
If the instructions given are carefully followed, the constructor may rest assured that the completed receiver may not only be brought into immediate use, but that it will give him every satisfaction.

Let us assume now that the constructor has before him the description and working drawings of the receiver which he wishes to build and that he has also the necessary components for its construction. The first thing to do is to read the instructions through. This may seem an unnecessary piece of advice, but it is given because in his eagerness to begin work the constructor may read the beginning of the instructions and start work, only to find later on that, owing to a slight error on his part or because he has not fully grasped the purport of some instruction, the finished receiver cannot boast of the sound and accurate workmanship that he would desire.

The first operation to be performed will be the marking out of the panel. A sheet of paper (newspaper will do, being soft) should be laid on the table and the panel placed face downwards on this. The tools needed now will be the scriber, steel rule and square. A pair of dividers will also be useful for checking the accuracy of the marking. Pencil lines should not be drawn on the panel since these will be difficult to erase altogether afterwards, and they may be the cause of surface leakage between the components

on the panel, since graphite is a conductor of electricity.

For marking out the panel the front of panel drawing or blueprint will be required. It should be noted that this drawing will represent the front of the



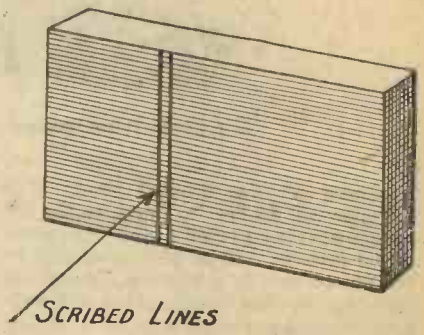
This shows the proper method of cutting an ebonite or cardboard tube.

panel, while the marking is to be done on the back. It will be necessary, therefore, to reverse the dimensions mentally and to be sure to do this throughout the marking, as otherwise the drilled holes will not be correctly placed for the components.

In marking out a panel, centre lines should first of all be scribed at right angles to the edges of the panel and all measurements should be made outwards from these lines. The advantage of adopting this method over the method of measuring from the edges of the panel for all points to be marked is that any slight inaccuracy in the original cutting of the panel will not upset the layout of the markings.

When the holes have all been marked, every measurement should be checked over again to ensure that it is correct. Once the drilling has been done, corrections will mean that unsightly holes are left in the panel, completely spoiling the appearance of the receiver. Corrections to the scribing will do no such damage, since these are all on the back of the panel.

If the constructor is making up a receiver to his own design, or if he is following a published design but has obtained some components which are of different dimensions from those described, he will not be able to utilise the published diagram to assist him in laying out the components which are mounted on the panel. In this case a certain amount of preliminary work will be necessary before any of the marking of the panel can be carried out. The first thing to do in this case, having decided on the approximate arrangement of the components, is to cut out a sheet of paper of the exact size of the panel, and to lay out on it all the components which are to be mounted on the panel. It will then be possible to arrange them in such positions that they have ample space on the panel, and their positions may be marked on the sheet of paper. This sheet may then be used as the drilling diagram, and the necessary dimensions may be transferred from it to the back of the panel itself. The constructor must again be careful to see that he does not confuse the back and the front of panel when marking off the dimensions on the back. The safest way to guard against this will be to lay the components out on the paper as though it represented the back of the panel. If



Two scribed lines serve as a useful guide for a hacksaw cut.

the marks for the drilling centres are then marked on the paper, they may be transferred to the panel by laying the paper on the panel and pricking through the marks with the point of the scriber. This will obviate the necessity of laying out any measurements on the panel itself.

DRILLING

After the marking has been checked, the drilling of the holes may be undertaken. Until some experience has been acquired in the use of the drill, it will be a good plan to use a small drill, say 1/16-inch, for all the holes, enlarging them to the correct sizes subsequently. A small drill is much easier than a large one to centre on the correct point properly, and the small hole will act as a guide to the drill of larger size.

No attempt should be made to drill a hole at a marked point until a slight indentation has been made at this point to prevent the drill from wandering over the surface of the ebonite. This may be done either with a centre punch lightly tapped with a hammer, or else the point of the scriber may be pushed into the ebonite at the required points and used to enlarge the prick thus made in the surface. This latter method has the advantage that it is easy to mark the exact point required with the fine point of the scriber. The point should not be pushed in too deep, or the end of the scriber may be broken off in the hole.

Having run through all the holes with the small drill, the diagram should be referred to again, the components checked against the positions which they are to occupy and the correct sizes drilled. To obviate the risk of the face of the panel breaking away where the points of the larger drills emerge, the holes made with these should be drilled half way through from each side of the panel.

The " sloping-panel " type of receiver was popular in this country for some time.

If there are any one-hole fixing components to be mounted which require holes of a size beyond that of the drills at hand, the largest available drill should be used and the hole should then be reamered out to the correct size with the tang of a file. This operation should be done slowly, first from one side of the panel and then from the other, care being taken that the file does not take too big a cut and jamb in the hole.

If the panel is to be of the vertical type, the next operation will be to fix it to the

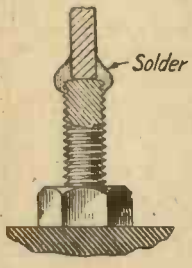
baseboard. This should be done with both panel and baseboard in position in the cabinet, to ensure that they register properly and fit into the cabinet easily. If the baseboard is, say ⅜-in. thick, four or more holes, evenly spaced, should be drilled along the lower edge of the panel, 3/16-ins. from the edge and countersunk for the heads of wood screws. When the panel and baseboard are placed in the cabinet, screws are put in these holes and the panel is thus secured to the baseboard. An additional support will be needed for the panel, to carry the weight of the components mounted on it. This will be furnished by metal right-angled brackets. These should be screwed down to the baseboard in a position close up against the panel while both are still in the cabinet. Then they can be removed from the cabinet, and the positions for the holes for the bolts to secure the brackets to the panel marked with the scriber. The drilling of these holes and the insertion of the bolts will make ready for the mounting of the components.

In mounting the components it is most important to follow the instructions carefully, since the order in which they are to be mounted may not be the obvious one. It will quite often be necessary to do some part of the wiring in the angle between the panel and the baseboard before many of the components on the latter are screwed down, as otherwise this part of the receiver will be inaccessible when all the components are mounted. If the makers of the various parts include with them any instructions for mounting, these should be studied, since failure to do so may result in permanent damage. With attention to these points the mounting of the components is really the easiest part of the construction. The layout of the components on the baseboard should be accurately followed from the diagram, particular care being taken where necessary to see that valves and coils are allowed ample clearance. It will be as well when placing the other components to place the valves and coils in position in their holders, so as to be sure that the correct clearances are being left.

The "vertical-panel" or "American"-type of receiver is undoubtedly the most popular at the present time.

WIRING

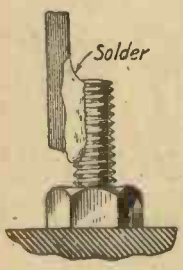
Various methods of wiring a receiver are open to the constructor, such as stiff or flexible wires attached to terminals and stiff or flexible wires soldered to tags and to terminal shanks. For experimental work, that is to say, in receivers in which the circuit is to undergo constant changes it will be satisfactory enough to



A fair method.

secure the ends of the connecting wires under the heads of the terminals so that they can be readily removed; flexible wires may also be used under these circumstances, though they always have the grave disadvantage lying loose about the receiver and probably introducing unexpected and unwanted capacity and other effects.

The most satisfactory way of wiring for

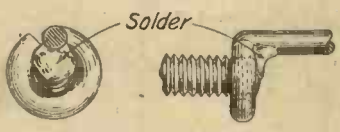


Better, but inconvenient.

permanence and consistency is to use stiff wire, not less than No. 18 S.W.G, and to solder all the connections. The ends of the wires need not necessarily be soldered to the actual shanks of the terminals in all cases; they may be soldered to tags which are secured under the heads of the terminals. This makes good electrical connections, while if the receiver is dismantled the wiring can be readily removed without injury to the components.

While the receiver is being wired the back-of-panel wiring diagram should be at hand, and each wire as it is put in should be crossed out on the diagram. This will save the annoyance which would be caused later on if some small wire is accidentally omitted.

The wiring diagram should be carefully followed with regard to the positions of the wires and each length of wire should be bent to the exact shape required and cut to length before either end of it is fixed in position. A little time and care spent in gauging the size and shape of the connecting wires in this way will be amply



Good, and simple.

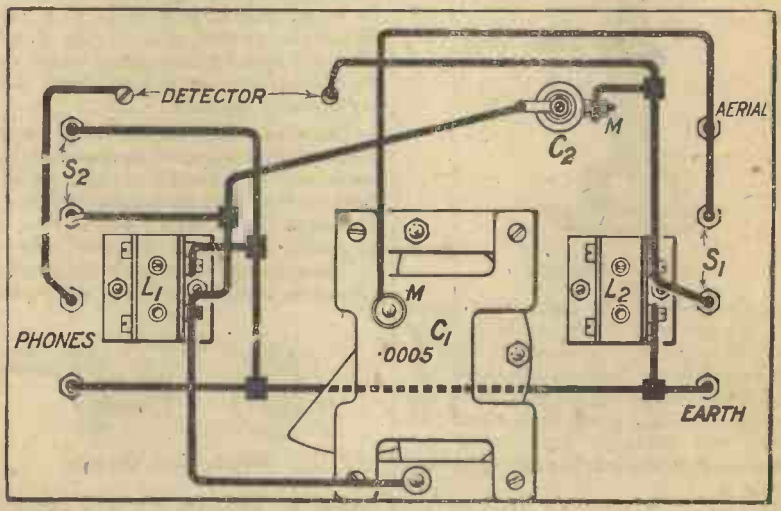
repaid by the resulting neat appearance and good performance of the receiver. The layout of the wiring of a receiver is a most important part of the design, and it may be that a single wire wrongly placed will affect adversely the whole operation of the receiver. Carelessly placed wiring in a receiver with one or more stages of neutralised high-frequency amplification, for example, may so affect the functioning of the high-frequency valves that when the receiver is brought into operation it will be found quite impossible to neutralise them properly.

Soldering is an operation which will present no difficulties to the constructor so long as everything soldered and used in soldering is kept scrupulously clean. A dirty iron or tags covered with a coating of flux and dust will only lead to exasperation, with little hope of completing a

single joint satisfactorily. With cleanliness, on the other hand, it will soon be found that soldering is delightfully easy and that there is a real fascination in making neat and efficient joints. It may be possible to make joints of a sort with haphazard methods, but they will not be neat and they will most certainly be far from efficient; they will only lead to trouble later on in the operation of the receiver, if, indeed, it can be made to function at all in the first instance.

The first consideration in soldering is the heating of the iron. A smoky flame, such as that provided by a wick oil lamp is quite unsuitable, since the unburnt carbon will be deposited on the iron and will quickly render it unusable. A methylated spirit stove will be suitable, if somewhat wasteful. A gas ring or small blow-lamp will be the best. If the iron is heated in a coal fire, it should not be put right into the heart of the fire, as then it will be fouled by the ashes and will be in danger of being overheated. A tin, such as a cocoa tin, should be put into the middle of the fire, and the iron can then be placed inside this with safety; it should be carefully watched, however, to see that it is not allowed to get red-hot.

The correct temperature for the iron will soon be recognised after experience, but at first the following procedure should be adopted. Leave the iron in the flame for about two minutes; take it out and put a very little flux on one of the surfaces. If the flux merely smokes and does not burn away at once, put the iron back in the flame for another minute. When the flux burns away as soon as it is applied to the iron, touch the end of a stick of solder on the face of the bit. This should at once melt and run on to the surface of the bit. It may be necessary to rub the melted solder at first with a piece of wire to make it run properly on the face of the bit. With a new iron all the faces of the bit should be tinned in this way, special attention being paid to the angles of the bit. This layer of tinning will prevent the bit from becoming oxidised and pitted. Subsequently, when a well-tinned iron is heated, the solder will run easily over its faces as soon as it is brought into contact with them, provided, of course, that the iron is hot enough. For this reason the faces of the iron should always be kept tinned, so that the iron is always clean and ready for use.



A typical back-of-panel wiring diagram. All soldered connections are shown by "blobs."

The operation of soldering pieces of metal together, such as wires to wires or wires to terminals demands that the solder be amalgamated with the surfaces of the parts to be joined. If this amalga-

mation is not properly carried out, the joint may appear to be sound, but in fact it will not be sound either mechanically or electrically. For proper amalgamation the surfaces to be joined must be absolutely clean and they must be heated temporarily to the correct temperature. Dirty surfaces or too low a temperature will lead to faulty joints; too high a temperature will often mean failure because of rapid oxidation of the surfaces, quite apart from possible damage to surrounding objects or parts of the components under treatment.

The constructor need not be scared by this into thinking that the correct temperature is a critical matter, since in practice there is a wide margin, and so long as everything is clean, temperature will not be a serious consideration.

There are various forms of flux for soldering, the purpose of them being to remove the thin film of oxide which forms on the surface of any metal exposed to the air, so that the surface may be perfectly clean for soldering. Corrosive fluxes of any sort are to be avoided. They may be very handy for soldering quickly without much preparing of the surfaces, but they are almost certain to give trouble later on, since the least trace of a corrosive flux left in a joint will gradually eat away the metal, causing noises in the receiver and ultimate failure of the joint. Resin is the cleanest and safest flux to use. When it is used the surfaces must be cleaned with great care, and the iron will need to be slightly hotter than with other fluxes. Resin can be confidently recommended as a flux, since no harm can be done by using excess of it, and because traces of it left when the work is finished will do little if any damage. Paste fluxes, such as Fluxite, are also quite suitable, but care must be taken to remove all traces of them from the panel and other parts when the soldering is finished, as otherwise they will tend to pick up dust and to cause leakages and noises in the receiver which will be difficult to trace to their source.

Most wireless components nowadays have soldering tags fitted under their terminals and these are usually ready tinned. The layer of tinning on them is, however, thin, and a good deal of time and trouble will be saved if all these tags are tinned before the wiring is commenced, a small blob of solder being left on each one. This operation can be done in a small flame without the iron at all. The tag is held in a pair of pliers in the flame, and when it gets warm a trace of flux is put on it. The end of a stick of solder is then applied to the tag and gently rubbed about on it until it melts and runs over the surface. Care should be taken with thin tags not to heat them to a red heat, as if this is done they will become oxidised, the original tinning being burned off, and they will have to be cleaned up with emery paper or a file before they can be retinned.

The ends of all the prepared connecting wires should be treated in the same way, whether tinned wire is used or not, a small blob or layer of solder being left on the end of each. The shanks of the terminals mounted on the panel or terminal strip, which have no soldering tags, should be well tinned at the tip. To do this the soldering iron must be used. The tips of all the shanks must first be cleaned quite bright and smooth with emery paper or a fine file. Then a trace of flux is put on each and they are ready for the tinning. The hot iron, carrying a good blob of solder on one of its faces, is brought into firm contact with the shank of the terminal and held there for 5 to 10 seconds. Slightly longer may be necessary in the case of a thick terminal, owing to the extra time needed to heat up the terminal sufficiently for the solder to take, but the iron should not be held on longer than is absolutely necessary. Overheating will do no good, and it will in all probability heat the terminal sufficiently for the heat to run down its shank and soften the panel where it passes through the latter. This would make the terminal loose in its hole, and might also permanently disfigure the face of the panel, since a small ring of the ebonite would soften and bulge round the head of the terminal.

With the terminals, tags and wires tinned, the receiver is ready for the actual connections. The wires nearest to the panel and the baseboard should be fixed first, and also any others which are in awkward positions. To solder a wire in position, lay it exactly as it will be when fixed, resting, for instance, with one end on a tag and the other on the shank of a terminal. Hold it firmly by the centre with the pliers, in such a way that it can

be kept quite steady. Then, having run, a small blob of solder on to the iron, bring its face into contact with both the end of the wire and the tag and keep it there for a few seconds. The solder should at once run into the joint and the iron may be removed. Hold the joint perfectly steady till the solder has set. The moment at which the solder sets, which with small joints will be almost immediately, will be apparent from the fact that the surface of the blob of solder in the joint will contract slightly at the moment of hardening. A good tug should then be given to the joint to make sure that the solder has taken properly, after which the other end of the wire can be similarly dealt with. If the joint does break away, both the wire and the tag should be cleaned again and retinned. Any attempt to remake the joint without this precaution will most likely result in failure and will only be waste of time.

Certain types of components, constructed of moulded ebonite, need special precautions in soldering. In such components connecting bolts are set in the moulding, with soldering tags under nuts on these bolts. If the constructor attempts to solder direct to these tags he runs a risk of softening the moulding and loosening the bolts. The best course to adopt here is to remove the tags from the bolts and solder the necessary wires to them away from the receiver, replacing the whole assembly when it is cool. If soldering direct to the bolts or to the soldering tags on them is unavoidable, the iron should be well heated and it should not be kept in contact with the tags or bolts longer than is necessary to make the joint.

Flexible wires, such as are used for connections to the moving sockets of coil holders and for similar components, should have their insulation stripped for about half an inch at each end, after which the loose strands should be tinned together into a solid wire, either in a flame or with the help of the soldering iron. They can then be soldered to tags or terminals in the same way as the other wires. Any tendency on the part of the insulation to unravel may be checked by wrapping a small piece of insulating tape or sticking plaster round the end of it; this will also prevent moisture from getting in under the insulation and causing corrosion of the fine strands.

After the completion of the soldering and before the receiver is tested, the wiring should be checked over to ensure that no errors have been made. Also the panel must be cleaned of all traces of flux. Resin will do no particular harm if left, since it sets hard and does not tend to pick up dust. Paste flux of any sort must all be cleaned away, especially the sputterings on the panel resulting from the application of the hot iron. A fairly stiff small brush and a little methylated spirit will be of assistance for this.

The receiver is then ready for its preliminary tests, and if these are satisfactory, for the service for which it is intended.

Drill Sizes

B.A. Thread.	Tapping size. Morse.	Tapping size. Morse or ins.
8	51	43
6	44	34
5	40	30
4	34	27
2	26	3/16
1	19	3
0	12	B

Coil Winding

Turns per inch with various gauges (to nearest ½-turn).

S.W.G.	S.S.C.	D.S.C.	S.C.C.	D.C.C.
20	26½	25½	24	21½
21	29½	28	26½	24
22	33½	31½	29½	26½
24	42	40½	35½	31
26	50½	47½	41½	36
28	60½	56	48	40½
30	72	67	54½	44½
32	81½	75	63½	50½
34	93½	85½	70½	55
36	110	101	86	64
38	133	120	100	78
40	159	141	114	—
43	204	179	—	—
47	303	250	—	—

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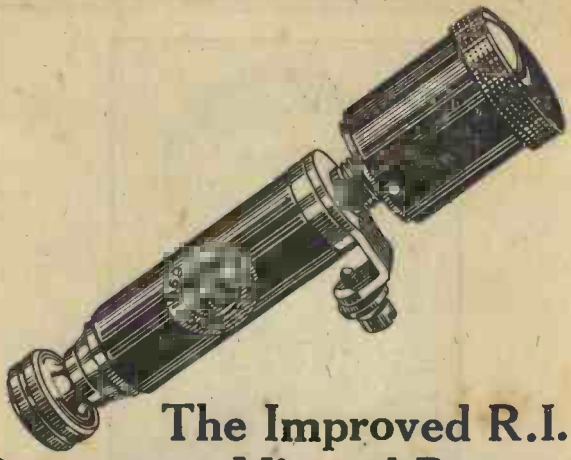

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