MODERN WIRELESS

May

1/-

Vol. V. No. 8. Edited by JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E. May, 1926.

A SUPERHETERODYNE FOR THE OPEN AIR

By G. P. Kendall, B.Sc.

HOW TO MAKE: **A SIX-VALVE SUPERHETERODYNE RECEIVER.** *By G. P. Kendall, B.Sc.*
A SINGLE CONTROL FOUR-VALVE RECEIVER. *By A. Johnson-Randall.*
A COMBINED REACTION THREE-VALVE SET. *By E. H. Berry.*
A MULTIPLE-CIRCUIT SINGLE-VALVE SET. *By E. J. Marriott.*
A MASTER-OSCILLATOR TRANSMITTER. *By R. W. Bloxam.*
AN INDISPENSABLE TESTING UNIT. *By H. J. Barton-Chapple, B.Sc., D.I.C., A.M.I.E.E.*

CIRCUITS THAT WILL NOT HOWL. *By J. H. Reyner, B.Sc., A.C.G.I., D.I.C., A.M.I.E.E.*

SINGLE OR MULTIVALVE? *By Percy W. Harris, M.I R.E.*

IMPROVISING AERIALS FOR THE COUNTRY OUTING. *By A. V. D. Hort, B.A.*

CONTENTS

Vol. V. MODERN WIRELESS. No. 8

	PAGE
A Superheterodyne for the Open Air By G. P. KENDALL, B.Sc.	915
In Passing	922
Pay Attention to All Your Battery Adjustments ... ... By A. JOHNSON-RANDALL.	924
A Master-Oscillator Transmitter ... By R. W. H. BLOXAM.	926
Single or Multi-valve? ... ... By PERCY W. HARRIS, M.I.R.E.	931
Improvising Aerials for the Country Outing ... ... By A. V. D. HORT, B.A.	933
A Single Control Four-valve Receiver ... ... By A. JOHNSON-RANDALL.	936
Circuits that Will Not Howl ... By J. H. REYNER, B.Sc. (Hons.), D.I.C., etc.	941
From My Notebook ... ... By H. J. BARTON-CHAPPLE, Wh. Sch., B.Sc. (Hons.), etc.	944
A Combined Reaction Three-valve Set ... ... By E. H. BERRY.	946
A Chat on Filament Resistances ... By P. H. WOOD, B.Sc. (Hons.), F.P.S.L.	951
Regular Programmes from Continental Broadcasting Stations	954
An Indispensable Testing Unit ... By H. J. BARTON-CHAPPLE, Wh. Sch., B.Sc. (Hons.), etc.	956
An Analysis of some Common Switching Faults ... ... By JOHN UNDERDOWN.	960
Local Reception on Frame Aerials... By D. J. S. HARTT, B.Sc.	962
A Multiple Circuit Single-valve Set By E. J. MARRIOTT.	965
Developments in Single-valve Reflexes ... ... By W. S. PERCIVAL, B.Sc. (Hons.)	971
Experimental Circuits Worth Trying By C. P. ALLINSON, A.M.I.R.E.	974
Will Low-frequency Amplification Increase Your Range? ...	981
Tested by Ourselves	994
Television and the Future ... By HUGO GERNSBACK, F.R.S.	1005

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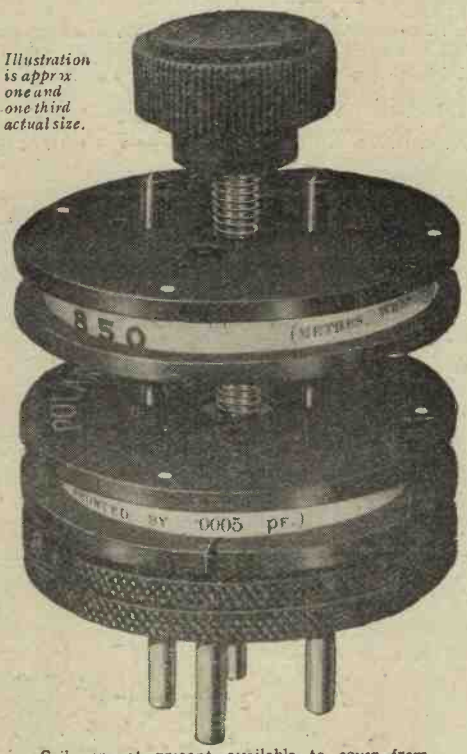

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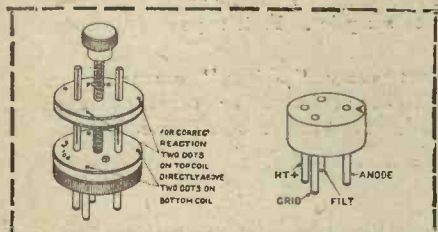

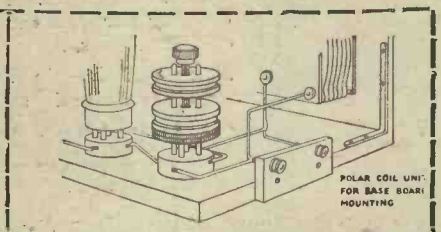

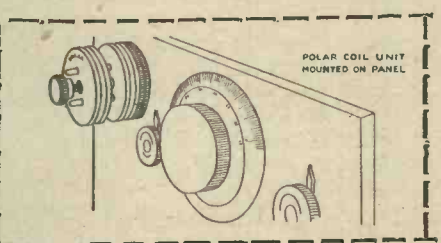

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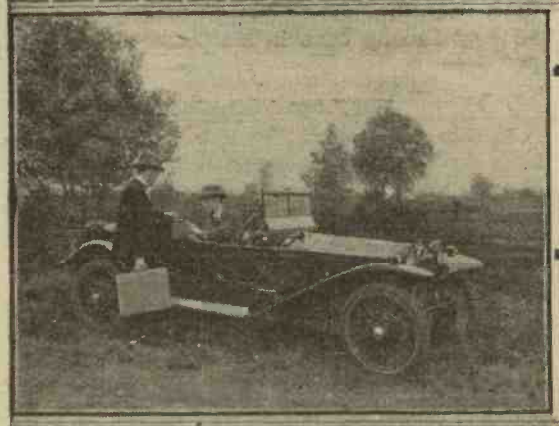


A SUPERHETERODYNE FOR THE OPEN AIR

By G.P. KENDALL, B.Sc.

Mr. Kendall describes in this article a portable receiver which will appeal to all readers desiring a set for use in the open-air which will give a wide choice of programmes on the loud-speaker from British and foreign stations.

THERE are many people who affect to doubt whether the portable wireless set is really anything more than a toy appealing to a limited public; but my experience of the superheterodyne as an adjunct to motoring convinces me that there is a great deal more in it than that. To anyone to whom broadcasting has really become a habit, the boon of being able to take a set around with one, particularly at holiday times, is really very considerable, and it is truly at such times that one realises to the full what a blessing broadcasting can be.

In Touch with Civilisation

No one will fail to appreciate this point who has had my experience of arriving at a small country place to spend the night, tired after a long day's run, and feeling with relief that it is only necessary to unpack the portable super to be in touch with civilisation once more, with the assurance of an evening's entertainment at a time when one is too tired to do very much but sit and listen.

Limited Space

Among portable sets, the superheterodyne must of necessity take a very high place, since its ability to give satisfactory results upon a frame aerial is a great advantage when working in a limited space where it is not possible to put up anything in the nature of an extended aerial. To me, it has always seemed the inevitable choice when one is deciding upon the circuit for a portable set; but there are a number of somewhat awkward problems to be settled before it can be used very satisfactorily.

Really Self-contained

Take first the question of whether to make the set really and truly self-contained or not; now, experience seems to show that to make a superheterodyne entirely self-contained in its own carrying case involves an outfit of very considerable bulk and weight. First, there will be the set itself, which is not likely to contain less than six valves if loud-speaker results are desired. Then we have the L.T. battery, which will almost certainly be of the accumulator type, and the H.T. battery, which should be capable of giving something like 100 volts and quite a considerable current. Next, there is the frame aerial, which will presumably be of the folding type, unless it is wound inside the cabinet, and also the loud-speaker.

The Dictates of Experience

Experience of both types has given me a preference for the arrangement in which the installation is in two separate units: one consisting of the set itself and containing only the grid-bias battery, and the other being a crate containing the batteries and the folded-up frame aerial, and possibly a small type of loud-speaker, although this latter is a

The finished receiver complete with case is a portable unit in every sense of the word.

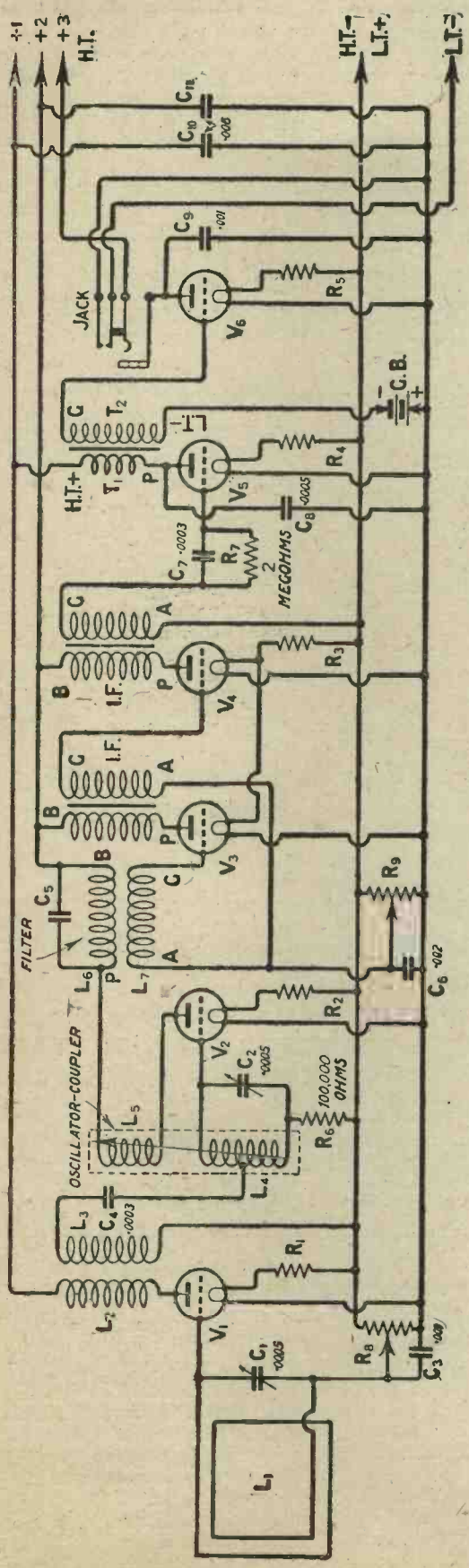


Fig. 1.—A simplified diagram of the theoretical circuit employed.

point best left to the preference of the individual user, who will no doubt adapt whatever loud-speaker he may already have in his possession to portable purposes.

Weight and Size Reduced

In this way it is possible to keep down the dimensions and weight of the set itself to quite small limits, and the problem of transport is considerably simplified provided that it is understood that we are not contemplating actual carrying by hand for any considerable distance, but rather the treatment of the set as small and readily-handled luggage.

The portable superheterodyne which I have built for use this season as an outcome of a very considerable amount of experimental work, represents a fairly satisfactory compromise between the opposing considerations of careful spacing out of the parts of the set and the production of a small and compact receiver. The actual set itself is constructed upon a vertical panel, 12 ins. by 6 ins., with a baseboard, 12 ins. by 13 ins., and, as previously stated, the only battery incorporated is the one for grid bias.

No Loss of Efficiency

Although the set is thus reasonably compact, there does not seem to have been any loss of efficiency following upon such crowding as was thought permissible in designing the receiver, and the results which the set has given have been so good as to satisfy me that the instrument is of a sufficiently high standard of performance to justify its use for general superheterodyne work, in addition to its portability.

Accomplishments

To give a general idea of what it has done in my hands, I would mention that it is the only set with which I feel confident in obtaining loud-speaker results from Aberdeen in London, whatever the conditions, since upon every occasion when I have made the experiment, simply setting the two dials to the recorded readings and swinging the frame to the appropriate bearing has always resulted in Aberdeen coming in on the loud-speaker at a good and steady strength which could be held indefinitely. This was done, moreover, without the necessity of working the intermediate-frequency amplifier anywhere near the verge of self-oscillation, so that quality remained quite good.

Some Stations Received

Allowing for local conditions and assuming an average state of affairs, upon a 30 in. square frame aerial, the set has always been capable of giving loud-speaker results from all the main B.B.C. stations, several relays, more particularly Swansea and Nottingham, and, of course, a very large number of Continental stations. The German stations in particular come in at really surprising loud-speaker strength, such transmissions as those of Hamburg requiring to be softened down before they are at all comfortable in a moderate-sized room.

Selectivity

Selectivity also is decidedly above the average of the superheterodynes which I have tried in the past, it being readily possible to receive both Manchester and Cardiff without interference from 2LO at a distance of about eight miles from the London station. (To do this most easily I used a special oscillator-coupler and a special aperiodic intervalve-transformer, of which details will be given later.)

Functions of the Valves

The set employs six valves, and these carry out the following functions: the first is a high-frequency amplifier at the frequency of the incoming signal, the second is a combined oscillator-detector operating on the Tropadyne principle (with certain slight modifications), this being followed by two valves acting as intermediate-frequency amplifiers, second detector, and one stage of low-frequency amplification, which is found to give adequate loud-speaker results from a very large number of stations, so that one can depend upon a choice of programmes at practically every possible location in the British Isles.

Controlling Self-oscillation

The tendency to self-oscillation on the part of the intermediate-frequency amplifier is controlled by means of a potentiometer, which can be regarded as a reaction control upon the long-wave side, and another potentiometer is provided to perform a similar function for the high-frequency valve in front of the detector-oscillator. Both these sections of the set would normally oscillate if the grid circuit return were made to filament negative, under proper conditions, and therefore an ample control of reaction is provided, that on the first valve serving as reaction into the frame aerial circuit, with a marked improvement in signal strength and selectivity.

Tuning Controls

There are only two actual tuning dials, these being those of the two variable condensers tuning the frame circuit and the oscillator circuit, so that searching is a relatively easy business, provided that it is understood that tuning with a superheterodyne is naturally rather critical. The only other controls upon the panel are the two potentiometer knobs, and, of course, the on-and-off switch for the filament which is represented by the jack into which the loud-speaker plug is inserted, this act turning on the set.

Fixed Resistors

No adjustment of filament current is provided other than the control provided by the use of fixed resistors, which are mounted upon the baseboard of the set and are of the interchangeable variety, so that one can choose values to suit the particular type of valve in use at the time.

The first H.F. valve is coupled to the detector-oscillator by means of an aperiodic transformer. The oscillator-coupler is, in the simple form to be described this month, a home-made component, the intermediate-frequency input filter and intervalve transformers are of the Silver-Marshall type, which are well-known to give a very high degree of selectivity and amplification per stage, while the L.F. valve is also transformer coupled.

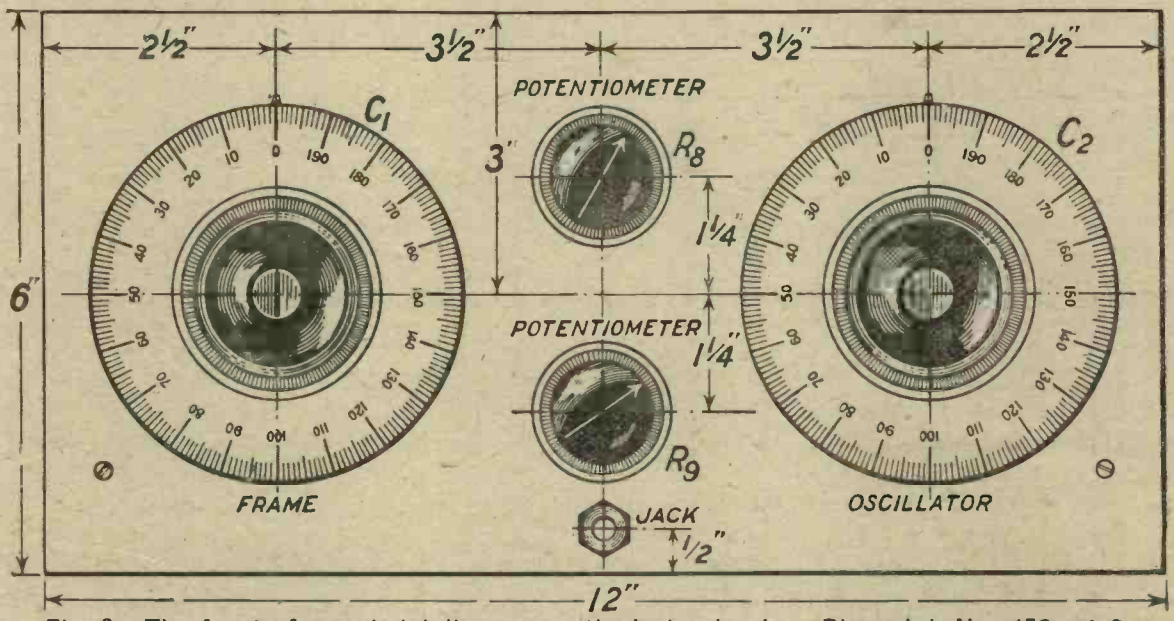


Fig. 2.—The front of panel details are particularly simple. Blueprint No. 158a, 1/6 post free.

Components Incorporated

One panel 12ins. by 6ins. by ¼in. (Carrington Manufacturing Co.).

One baseboard 12ins. by 13ins. by ⅜in. (Carrington Manufacturing Co.).

One pair brackets (Carrington Manufacturing Co.).

One special cabinet (Carrington Manufacturing Co.).

Two .0005 Remler variable condensers (Rothermel Radio Corporation of Great Britain, Ltd.).

One former and socket for oscillator-coupler (Burne-Jones & Co., Ltd.).

Two potentiometers (Yesly Electrical Supplies, Ltd.).

Five fixed resistors and sockets (Burndept Wireless, Ltd.).

One 100,000 ohm resistance (L. McMichael, Ltd.).

Six "Clearer Tone" valve-holders (Benjamin Electric, Ltd.).

One plain board mounting valve-holder (Burwood Concessionaires, Ltd.).

One special aperiodic H.F. transformer (Burne-Jones & Co., Ltd.).

One set Silver-Marshall intermediate transformers and filter (Rothermel Radio Corporation of Great Britain, Ltd.).

One L.F. transformer, 5 : 1 ratio (Brandes, Ltd.).

One fixed condenser .0003 (Watmel Wireless Co., Ltd.).

One fixed condenser .0005 (Watmel Wireless Co., Ltd.).

Two fixed condensers .001 (Watmel Wireless Co., Ltd.).

One fixed condenser .002 (Watmel Wireless Co., Ltd.).

Two fixed condensers .006 (Watmel Wireless Co., Ltd.).

One grid condenser and leak .0003 and 2 megohms (Watmel Wireless Co., Ltd.).

One single-filament jack (Igranic Electric Co., Ltd.).

One telephone plug (Igranic Electric Co., Ltd.).

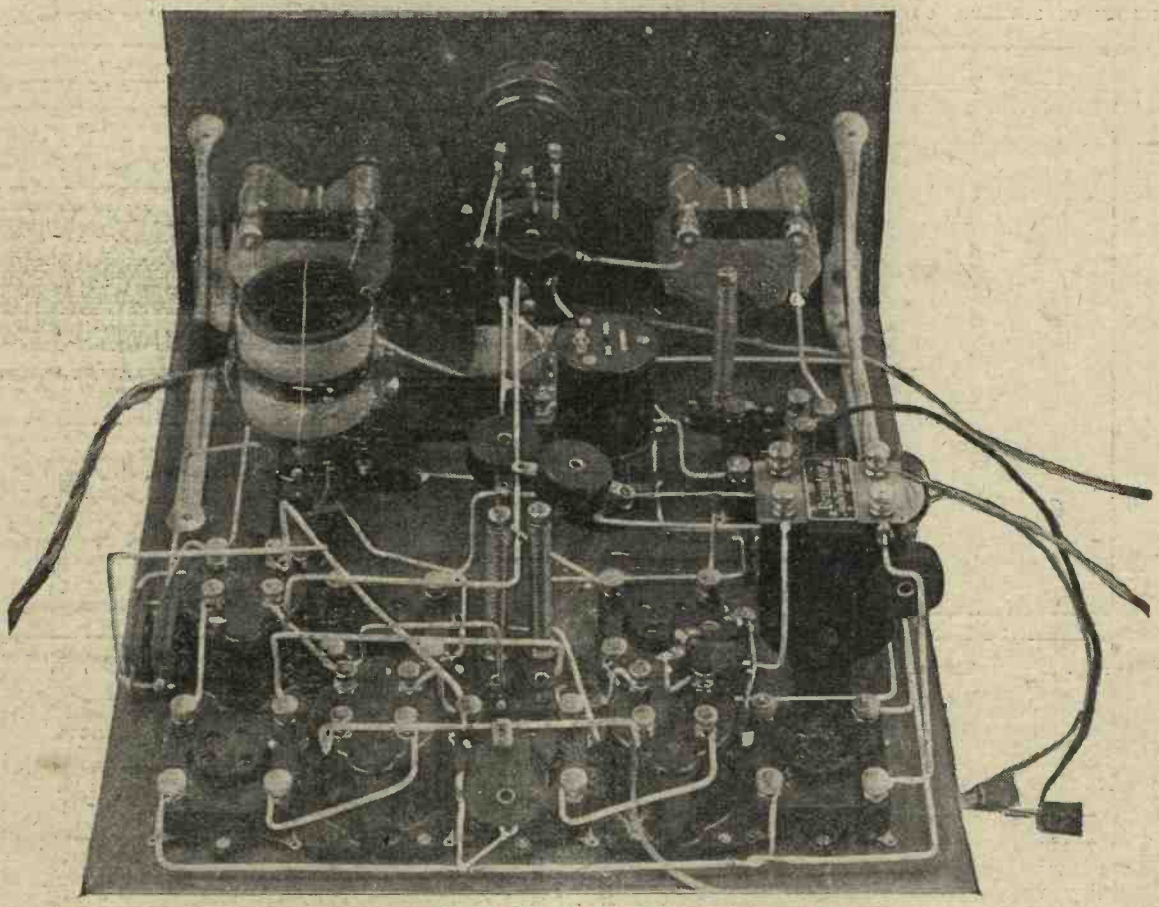
Packet Radio Press panel transfers. Glazite, etc.

The Cabinet

The set is contained in a special carrying case, whose general details may be gathered from one of the photographs accompanying this article, in which it may be seen that there is a flap-door which lets down to disclose the panel with its controls, and another which opens back to disclose the interior of the set, so that valves can be changed, and so on. A carrying handle is provided on one of the smaller sides of the box, the overall dimensions of the case being such that it is a quite readily handled article of luggage.

An Efficient Frame Aerial

Upon the larger lid of the box I have mounted the socket of the frame aerial, removing this from the wooden base upon which it was originally mounted by the makers of the frame. At this point I should like to emphasise that the quality of the frame aerial used with a superheterodyne has a greater bearing upon the results which will be obtained than many people quite realise. Therefore, be sure that your frame aerial is really efficient, and if you are buying a new one to use with this set, give the preference to one which has a convenient mounting arrangement which can be transferred to the lid of the box, since this is a very convenient position for the frame and economises space in travelling. The one which I use was made by Messrs. Beard and Fitch, which has such a mounting scheme and proves to be quite efficient in operation.



No space has been wasted in the layout of this portable receiver.

No Terminals

It will be observed that there are no terminals of any sort on this set, and it should be explained that this arrangement has been adopted after considerable thought and practical experience, which has shown me that for a portable set in particular all that is required is a set of flexible leads coming out of the receiver, of which the further ends can be attached up to the batteries, when the instrument is to be used. You will see on the wiring diagram several flexible leads emerging from the set, being soldered into position at the appropriate points, and going to the various batteries, their destinations being marked upon them. A convenient length for these leads is 6 ft., since one can then place the set upon the table, with the batteries upon the floor beneath.

There is no lead for high-tension negative, and I would explain that high-tension negative is connected direct to low-tension positive on the batteries themselves. These various leads emerge through the larger lid of the box, and in this lid I have cut small slots so that it may be shut with the leads in position; while when the set is to be carried about, the leads are disconnected from the batteries and simply pushed loosely into the box.

The Frame Connections

The connections of the frame aerial are taken straight to the terminals of the variable condenser which tune the frame circuit, the ends of the flexible leads from the frame being provided by the makers with spade tags. Two notches are then cut at the edge

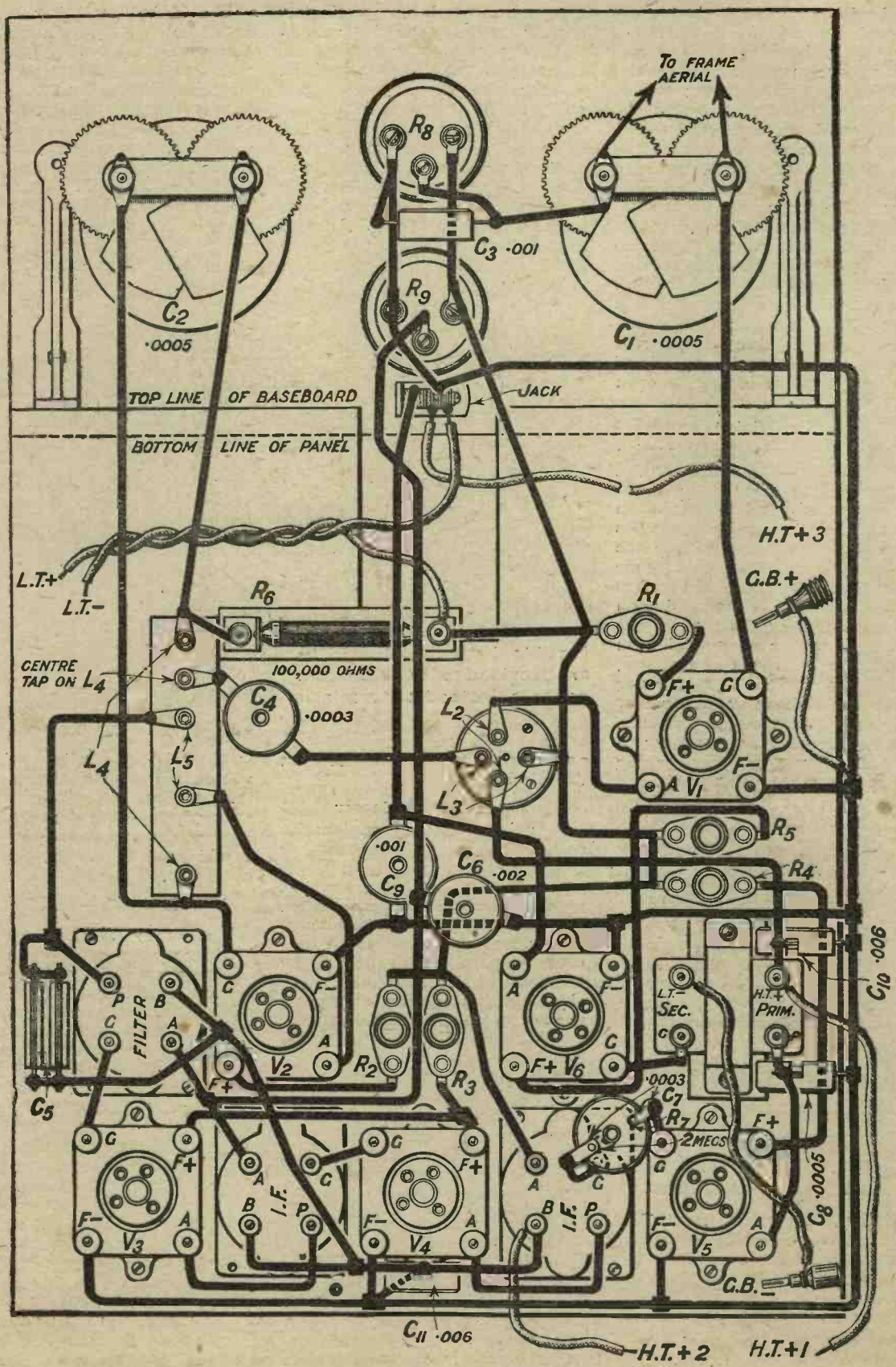


Fig. 3.—Wiring this superheterodyne will not present undue difficulty if reference is made to this diagram, which is a reduction of the full-size Blueprint No. 158b, 1/6 post free.

of the lid for these leads to pass through. It will be realised that my object has been to procure the maximum of simplicity and absence of complication; whilst anyone who is inclined to make what would be, perhaps, a neater job, can fit a couple of terminals on the box, of course, insulated from the wood, with flexible leads from the inner side of these terminals down to the variable condenser. It would then be necessary to disconnect these leads before it would be possible to pull the set out of its box; but this should be only a minor objection. The frame could then be connected to the terminals on the outside of the box, without having to open the lid.

The Wiring

So far as the actual construction of the set itself is concerned, I do not think that very much description is called for, since the various diagrams and photographs upon these pages will convey the information without wasting time on written instructions. The various components may be mounted upon the baseboard or the back of the panel, as the case may be, in accordance with the illustrations, and then comes the task of wiring up. I would like to urge the reader very strongly not to rush this task, but to take his time, and try to copy the arrangement of wiring shown in the photographs as closely as he can.

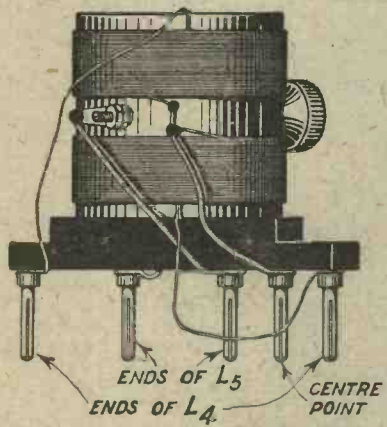
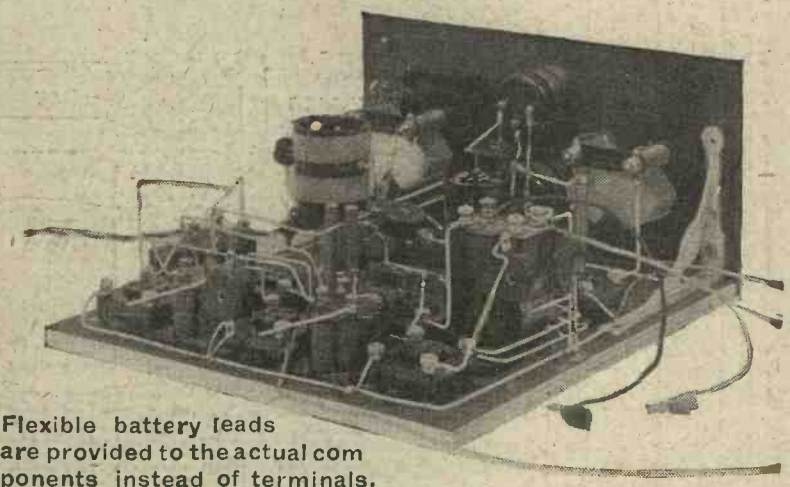


Fig. 4.—A sketch of the home-made oscillator-coupler.

If the photographs are studied in conjunction with the wiring diagram, it will be discovered that those wires which are at all bunched together are all at filament potential, the important wires, such as grid and plate leads, being quite short and well spaced away from all other wires. Try to copy this arrangement closely, and note particularly the way the wires are arranged around the oscillator-coupler and the aperiodic high-frequency transformer coupling the first valve to the oscillator-detector.

Upon the completion of the wiring it will be observed that there are two extra leads to be attached, in addition to the long leads, namely, the two short lengths of flex bearing plugs upon their ends for connection to the grid-bias battery. This battery, it should be mentioned, is carried fastened to the side of the box, so that it is not necessary to provide space upon the baseboard for it.



Flexible battery leads are provided to the actual components instead of terminals.

The Filter Condenser

A point requiring explanation concerns the intermediate-frequency intervalve transformers, and the input filter, these being supplied in a "matched" set by Messrs. Silver-Marshall, with a fixed condenser (or condensers) to be connected in parallel with the primary terminals of the input filter. The value of this condenser is not given in any of the diagrams, for the simple reason that it varies with each set of transformers and filter; the point is that you must be careful to use the condensers supplied with the set of transformers, and *not* to use any other value than the one with which you are provided. This is important, since the matching of the intervalve coupling units is carried out fairly accurately by the manufacturers.

The Aperiodic Transformer

The actual constructional side of the work will be concluded by considering the two plug-in units, namely, the high-frequency transformer used to couple the first H.F. valve to the oscillator-detector, and the interchangeable oscillator-coupler.

The H.F. transformer is of the aperiodic type, and you can quite easily make up one for yourself, if you are inclined towards constructional work, by taking one of the ordinary barrel-type plug-in transformers and rewinding it with No. 40 single silk covered Eureka or similar resistance wire, putting on one-third more turns than you took off when you removed the original copper wire windings. For example, if you found that there were 120 turns in the primary winding originally, put on 160 turns of the resistance wire, taking care to bring out the ends to the same pins upon the base of the transformer as those to which the original windings were connected.

Transformer Connections

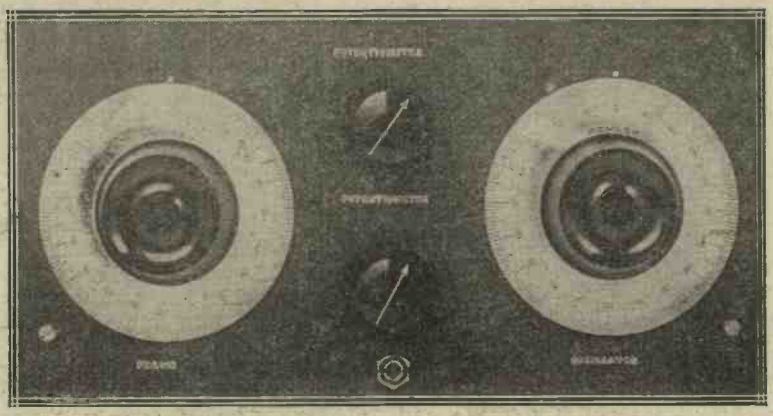
If the transformer is improvised in this way, the connections which I have given in the wiring diagram will be found correct, but if some other type of aperiodic transformer is used it may be necessary to modify the connections in accordance with the instructions supplied by the makers, but I do not advise such a procedure, since it is likely to lead to somewhat different results from those which I obtained with my set. Those who do not care for constructional work of this sort can obtain the transformer ready wound specially for the set from various firms, including Messrs. Burne-Jones, who made the one illustrated in the photographs of the set.

Next month we shall be dealing with a special type of H.F. transformer for use here, intended to minimise direct pick-up, but the one specified will be found to give perfectly good results, with a good degree of selectivity. The im-

proved type will be intended rather for use at very short distances from a broadcasting station, where the problem of direct pick-up is a rather serious one.

The Oscillator Coils

The oscillator-coupler is an interchangeable unit making use of the plug-and-socket arrangement used upon the special H.F. transformers incorporated in Mr. Harris's "Special Five" receiver. This consists of a five-pin base plugging into a five-point socket. Upon the removable base is mounted a small rotor and stator arrangement like a miniature variometer, consisting of two pieces of ebonite tube of suitable sizes, carrying the necessary windings. The outer winding constitutes the tuned grid coil of the oscillator valve, and the small rotary coil inside the reaction coil. A centre tapping is made to the outer grid coil by the simple expedient of winding half the coil on each side of the spindle of the rotor, counting the turns carefully.



Only two tuning-controls are required on the panel.

Turn Numbers

On the coupler visible in the photographs, and which I recommend the constructor to make up first, there are 40 turns on either side of the centre tapping, making 80 turns in all, No. 36 d.c.c. wire being used. The wire is secured in position by a light coat of shellac, after winding.

The rotor carrying the reaction coil consists of 38 turns of the same wire, roughly pile-wound or bunch-wound on the tube, in order to get the requisite number of turns into the small space available. This coil should be wound before the other, the two ends being brought out and connected to the two little spindles upon which the coil turns, and it should then be inserted in the main former.

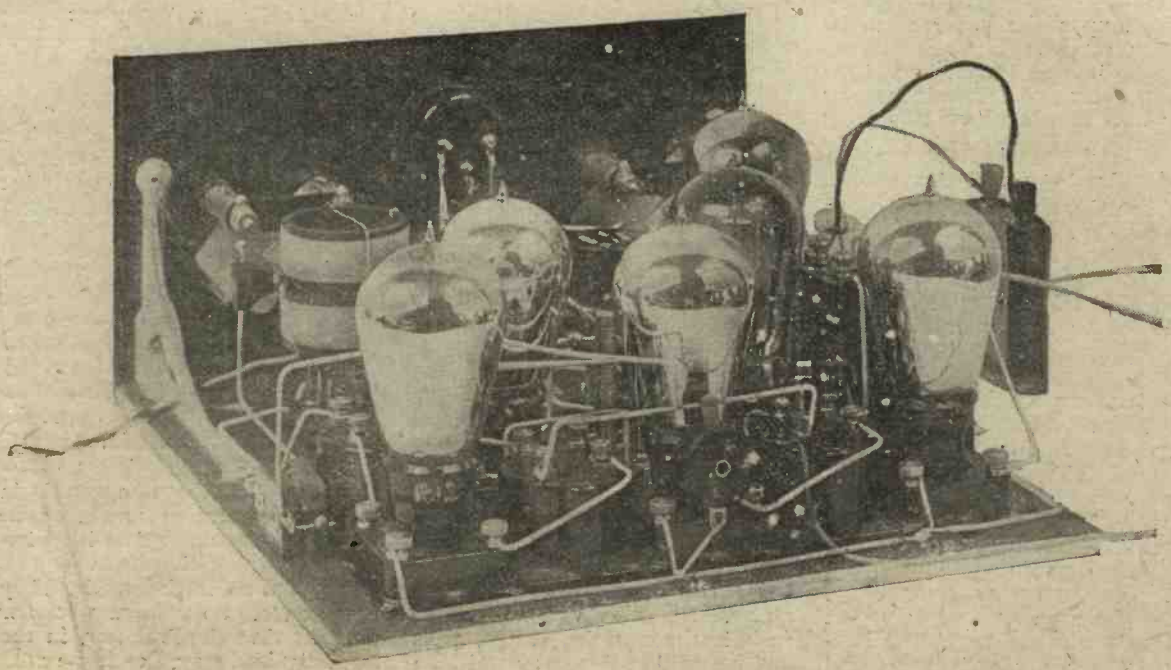
These formers, ready for winding, can be obtained from Messrs. Burne-Jones, who made the one illustrated, and a number of other firms, some of them who will, no doubt, also be prepared to supply the coupler ready wound for use. I give the necessary particulars, however, for the benefit of those who look on such constructional work as a part of the pleasures of the home building of sets.

The necessary dimensions are as follows :—Stator—2 ms. dia. and 2¼ ms. long. Rotor—1¼ ms. dia. and 1 m. long.

The Centre Tapping

It is necessary to locate the centre point upon the oscillator-coupler grid winding with a certain amount of accuracy, if the circuit is to function correctly, and I will describe how it can be determined whether the centre point has been found correctly. When the set is finished, insert the various valves, fixed resistors, etc., and the loud-speaker plug. Set the upper potentiometer at least half-way round towards the positive end, and try the effect of turning the lower potentiometer from right to left.

(*Continued on page* 988.)



The grid-bias battery shown on the right is actually fixed to the side of the containing box.

WHENEVER I receive a letter from the Editor of the *Little Puddleton Gazette* I always feel sure that something is going to happen, and usually it does. It was therefore with a pleasant sense of impending adventure that I picked up an envelope that the post had brought that morning. Even before I had opened it I knew that it had come from the *Gazette* Office, for I recognised the secret signs upon its face. The *Gazette's* typewriter has suffered so many

. . . hard at work in his garden.

years of relentless pounding that its mechanism has become slightly dislocated; in fact the operator never knows what is going to be printed upon the paper when he presses a given key. Sometimes it is a different letter; sometimes it is nothing at all; but it is never the letter that he thinks it is going to be.

Confirming my Deductions

When therefore I observed upon the envelope an exceedingly mangled version of my name I realised that only one machine could have produced it. My Sherlockian deductions were confirmed by the well-known thumbprint of the sub-editor - reporter - compositor -office boy-chauffeur in the corner near the stamp. On turning the envelope over I found on the other side the prints of all his four fingers to make assurance doubly sure. Feeling pretty certain that if he had written to me the Editor would also have despatched a missive to my friend and collaborator Professor Goop, I put the envelope in my pocket and strolled round to "The Microfarads." On my arrival I found the Professor hard at work in his garden.

Springtime in the Garden

The Professor is, as you know, a man who puts his whole heart into anything that he takes up. I had never previously found him engaged in horticulture, but he told me as soon as I entered the gate that he had resolved in future to make it one of his hobbies. "Gardening," he said, with a bland smile, "has so far been carried out in a very haphazard way by amateurs. None of them as yet have tackled it in a really scientific manner. I am proposing to introduce into gardening thoroughly scientific principles which will shortly bear fruit. Do you see? Bear fruit. A neat little joke, is it not. He, he, he!"

Grafting Proposals

Being in one of his expansive moods, the Professor did quite a lot of talking whilst I settled down in a deck chair and closed my eyes in order to be able to listen without distraction to the words that fell from his lips. I gathered that in his opinion grafting was a thing that had never been properly developed.

The Professor proposed to ease the labours of his cook by grafting onions on to his sage bush and plums on to his apple trees. When I asked if he was proposing to graft fools on to his gooseberry bushes his reply was so rude and so personal that I refrain from quoting it. Had it not been so hot we should probably have quarrelled. As it was, he went on elaborating his great idea, telling me that he was grafting a vine on to his cherry tree in order to simplify the making of cherry brandy.

Gardening and H.F. Oscillations

Apart from grafting his latest and greatest idea was a means of making use of high-frequency oscillations for promoting ultra-rapid growth amongst flowers and vegetables. He had, I found, rigged up a frame aerial which he had pointed directly towards Snaggsby's abode. His idea was to receive with it the squeaks, chirps, yells and howls that Snaggsby emits in the course of his experiments in search of a non-radiating receiving set, and to divert the energy received by means of a suitable reflecting screen for the benefit of the tender shoots of his beds and borders.

A Fine Race

So engrossed was he in his latest hobby that I had considerable difficulty in making him bring his mind to bear upon any other subject. At last, however, I succeeded in making him realise that I had received a letter from the Editor of the *Gazette* and that probably a similar missive was awaiting him indoors. Once he had grasped the idea he downed tools with the greatest enthusiasm and set off at breakneck speed for the house, to see what the post had brought him. Had it not been that each of his boots was decorated with about a hundredweight of the Little Puddleton clay, I believe that he would have beaten me in the run in. As it was I won by a short head. The Professor seized the bundle of letters that awaited him and took them into the drawing room where he was unfortunate enough to find Mrs. Goop.

An Earthy Argument

Some women are most unreasonable. Certainly Mrs. Goop was on that occasion, for instead of allowing us to open our letters in peace she launched out into a violent diatribe upon the condition of the Professor's boots. When I told her

Some women are most unreasonable.

that he had been engaged in scientific gardening and that he was now combining it with wireless by turning the drawing room carpet into an earth-mat she fairly flew at me. So pointed were her remarks that the Professor, in the most dignified way, shook the mud from off his feet and led the way into his study.

The Message

Arrived there, we both opened the fateful letters. They were couched in similar terms: would we very kindly call upon the Editor at our earliest convenience. I suggested to the Professor that it might be as well if he changed his boots before we adjourned to the *Gazette* Office, and he departed in search of replacements. He returned after a short interval striking a distinctly new note in natty footwear by sporting gym shoes and spats.

A prolonged search in the hall failed to discover his own head-

Striking an entirely new note.

covering, but, being a man of resource, the Professor, supplied the deficiency by donning a red and green school cricket cap that belongs to his eldest young hopeful. He was so taken with his appearance when he surveyed himself in the looking glass that he decided on the spot to adopt the cap permanently for both town and country wear.

The Great Plan

Upon reaching the *Gazette* Office we were shown at once into the Editor's room. The great man greeted us warmly and proceeded without delay to unfold his plan. Though the better known European broadcasting stations had been visited and described, he told us, by Captain Bungge, no one had so far investigated the humbler ones.

"All of us," he went on, "hear them heterodyning each other and everybody else; but that is as far as it goes. To us they are simply whistles and nothing more. I propose to send forth a commission consisting of your good selves to visit some of these stations and to write full reports upon them for the columns of the *Gazette*. No expense will be spared. You shall have my car, behind which you will tow Professor Goop's world-famous Pushable Receiving Set. I need not ask whether you will accept; I can see in your faces that you do. When can you start?"

A Quick Start

"Now," said the Professor. "As soon as we have drawn the first month's expenses," I amended. Without a word the Editor wrote a cheque and handed it to me. Within the hour our preparations for the journey had been completed and we were en route for Kastoff, the capital of Yugo-Toblazia, with the Professor at the wheel.

Novel Driving Methods

The Professor has a style of driving that is peculiarly his own. Years of devotion to wireless have made it impossible for him to refrain from twiddling constantly anything that can be twiddled. At one moment he sweeps open the throttle and the car under his control leaps forward as though something had kicked it. At the next he does something with the air lever and the engine suddenly konks out. He is also rather inclined to forget at times of emergency which thingmejig does what. Hardly had we started when a little contretemps occurred.

The First Accident

We were proceeding slowly along the High Street when General Blood Thunderby stepped off the pavement right in front of us. The Professor stepped heavily upon the accelerator instead of the brake pedal and knocked him flat. The impact slowed down the car, but just as the irate warrior was emerging from behind it the Professor was unfortunate enough to get into reverse and to floor him once more. After explanations and apologies we proceeded on our way, the General roaring after us that he trusted that our tour would be a very extended one. Once we had left the town behind us we forged ahead at splendid speed.

Sine Waves

We were nearing Bilgewater Magna when it occurred to the Professor to show me exactly what sine waves were with the help of his steering gear. "If," he said after zig-zagging for a few moments from side to side of the road "you will now look behind at our wheel tracks you will see perfect sine waves." I looked round. "I can't see them," I said. The Professor looked round too. The amplitude of the ensuing wave was such that there was no room on the road for it, and we came to rest in a broad ditch at the side. We reached Bilgewater Magna towards midnight under one farm-horse power.

Health-giving Atmosphere

On the following day we decided to make for Newhaven, where we would take the boat for Dieppe. With myself at the wheel the journey was naturally accomplished without mishap. As we were nearing Newhaven it occurred to both of us that it would be positively unfair to the *Gazette* if we failed to spend the night in the health-giving atmosphere of Brighton.

A Week Later

A week later I leaned from my deck chair towards the Professor's and dug him in the ribs. "Don't you think," I remarked, "that we ought to be getting on towards Kastoff?" "As soon as we are feeling strong enough," replied he, "we will start. But meantime, in order not to disappoint our good friend the Editor I have sent a report of the Kastoff station to Professor Gobemouche in that city, and he will post it to Little Puddleton. The report is an excellent one. In it I have mentioned that the aerial wires are supported by masts and that transmission is accom-

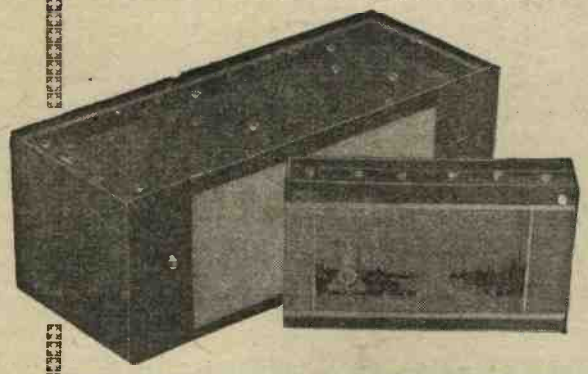
I leaned from my deck chair . . . and dug him in the ribs.

plished by means of valves, a microphone being invariably used in the studio. Meantime, my dear fellow, I feel that a visit to the pierrots followed by a bathe would help both of us wonderfully to build up our reserves of health and strength." THE LISTENER-IN.

Wireless in South America

In the Argentine, the number of wireless receiving sets in use is estimated at 200,000. The Broadcasting Association has a membership of 350, composed of importers, jobbers and retailers, who pay a monthly fee for the operation of the broadcasting stations, of which there are one Government, two commercial and two private stations giving regular concerts. There are three wireless clubs in Buenos Aires and about twenty in the provinces, and the only amateur restrictions contemplated affect transmitters handling traffic in competition with the State Telegraph. The taxing of broadcast listeners is considered to be impracticable! In view of the last-named fact an influx of emigrants may shortly be expected.

PAY ATTENTION TO YOUR BATTERY ADJUSTMENTS



By
A. JOHNSON-RANDALL

Critical adjustment of all battery voltages is essential for the best working of your receiver

MUCH of the successful operation of a broadcast receiver depends upon the correct adjustment of battery voltages. In fact it may be said that incorrect values of low-tension or anode potentials will in certain cases prevent the set from functioning. This is particularly the case with the filament voltage, since it will be observed that signals only become audible when the contact arms on the rheostats pass a certain position on the resistance element.

The Essential Units

There are two essential batteries in any receiver and these are the low-tension and high-tension units. In addition, if loud-speaking is desired, for good reproduction a small grid-bias battery is employed on the low-frequency side. These batteries are indicated in Fig. 1 as B_1, B_2 and B_3 respectively.

The First Step

The first step towards the reception of signals from the point of view of the batteries will be to light the filaments of the valves, and this should be undertaken with some care, especially if dull-emitters are used—with the 60-milliampere type of valve, over-running the filament may result in a lost emission. It is usual practice to specify 30-ohm rheostats with valves of this class and with a 4-volt accumulator about two-thirds of the total resistance should remain in circuit.

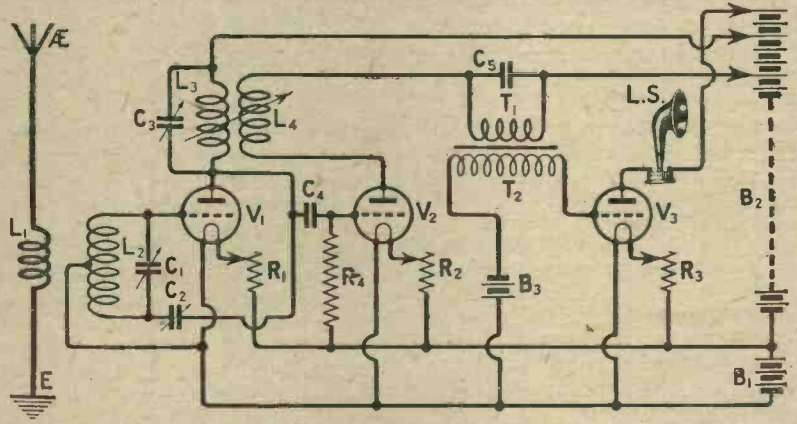


Fig. 1.—The essential batteries of a receiver are indicated as B_1, B_2, and B_3 in this diagram.

A Practical Case

In the case of three dry cells connected in series being employed, giving a total E.M.F. of approximately 4.5 volts, the contact arm should be "just on." I have stressed this point rather much owing to the detrimental results produced by over-running the valve.

Fortunately the danger is not present to the same extent with most of the other types of valves; for instance, if those of the 3·8-4 volt type were employed it is highly probable that the accumulator chosen would consist of two cells giving a total E.M.F. of 4 volts.

Similarly for valves of the D.E.R. or D.E.2 class one would use a 2-volt battery and in the case of the popular ·25-ampere power-valves, which are generally rated at 5·5-6 volts, a 6-volt battery.

A Simple Calculation

To find the resistance required in circuit in order to maintain the correct filament voltage is quite a simple matter. A glance at the box in which the valve is packed will usually show a minimum value for this voltage; for example, the box in which a D.E.3 valve is sent out has marked on the side, "Filament voltage 2·8-3 volts."

Subtract the lower voltage value from the voltage of the low-tension battery and divide the result by the rated filament current, which is also marked on the box. The answer you obtain will be the resistance required to reduce the low-tension battery voltage to the correct value as specified by the makers for that particular valve.

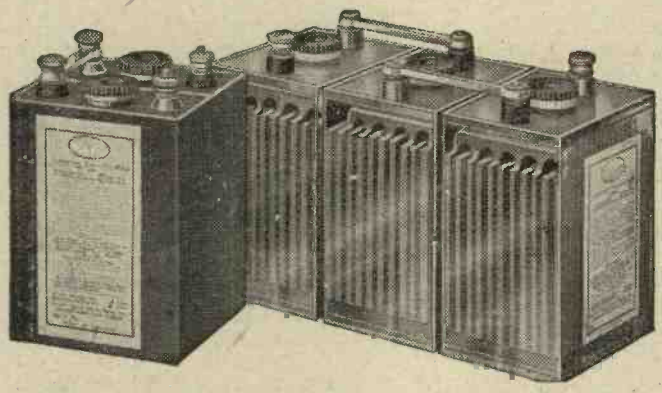
An Example

For example, subtracting 2·8 volts from 4 volts gives 1·2 volts. Dividing this by ·06, *i.e.*, the rated

filament current, gives 20 ohms, which is the minimum resistance. If two valves in parallel are controlled by one rheostat this value should be halved. When the resistance of the rheostat is known—the leading makers mark this value on the containing box—the approximate position of the contact arm along the winding can be quite easily judged.

Anode Voltage

We next come to the adjustment of anode voltage. The first point is that the H.T. voltage which should be applied to the high-frequency valves and to the detector is in practically all cases lower than that employed for the low-



Whatever the voltage of your accumulator, take care so to adjust your filament rheostat that the correct voltage is applied to the valve.

frequency stages. Most high-frequency valves require an anode voltage of about 45-60 volts, and the detector valve used in the majority of modern receivers needs about the same.

H.T. and Oscillation Control

Adjusting the H.T. voltage to the H.F. valve or valves by decreasing it slightly will very often make all the difference between an uncontrollable set with unsatisfactory reaction control and a docile receiver with which it is possible to creep right up to the threshold of oscillation, a state of affairs so useful and in many cases essential for successful long-distance reception.

A Good Plan

If oscillation persists in spite of all attempts to discover a remedy it is a good plan to shunt *each* tapping on the H.T. battery with a fixed condenser of large capacity. Cases have occurred to my knowledge where even this has not been successful in curing the trouble. Upon the existing battery being replaced by a new one, however, the symptoms have disappeared, but in nine cases out of every ten the use of a condenser as suggested will effect a cure.

Adjustments on the L.F. Side

On the low-frequency side of the receiver with the vast majority of valves in use at the present time from 100-120 volts anode potential will give very excellent loud-speaking. This voltage with the correct type of valve and grid-bias will permit sufficient safe grid swing for all loud-speaker work in the home.

Grid-bias

This now brings us to the question of grid-bias. The grid battery consists of a number of small dry cells connected as shown at B_3 in Fig. 1, and by means of a small wander plug similar to those used in the ordinary H.T. batteries it is possible to apply a negative potential to the grid of the low-frequency valve in order that the working point on the valve characteristic shall be in the correct position for distortionless magnification.

The most useful size of grid battery for normal work is one tapped at every 1·5 volts from 0-9 volts.

The Value to Employ

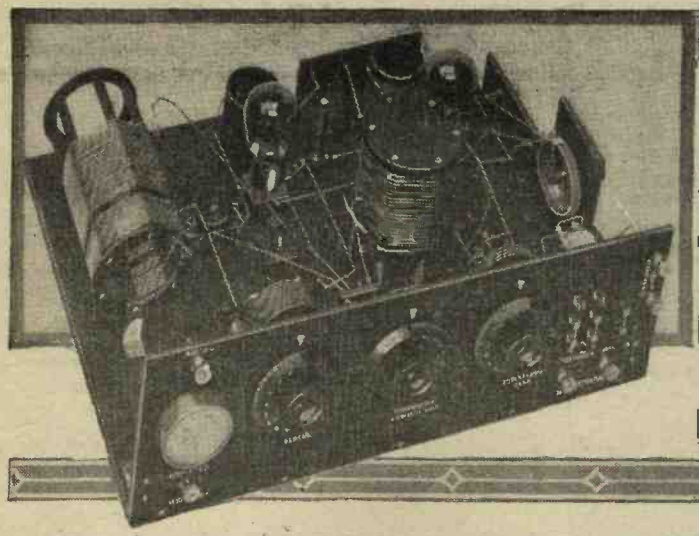
The grid-bias to employ for different values of H.T. voltage is frequently marked on the box in which the valve is packed. Failing this, the makers are usually only too willing to supply the necessary information. Capt. H. J. Round has given a useful "rule of thumb" method of determining the approximate grid-bias to use.

A "Rule of Thumb" Method

The rule is to obtain the amplification ratio of the particular valve from the maker's list and to divide this figure, multiplied by two, into the H.T. voltage it is intended to employ.

For example, the amplification ratio of the Marconi D.E.5 valve is seven. Multiplying this by two gives fourteen. Suppose it is intended to use an H.T. voltage of 100. Then fourteen into 100 gives roughly seven volts, which is the grid-bias to be used at that particular anode voltage.

Actually in practice it would be necessary to use 7½ volts owing to the fact that the grid battery would only be variable in steps of 1½ volts.



A MASTER-OSCILLATOR TRANSMITTER

By R. W. H. BLOXAM, (5 L S.)

Details of a very efficient 10-watt transmitter for working on 45 metres which will be appreciated by all experimenters.

FOR some reason or other the master-oscillator as a system of generating high-frequency oscillations seems to have been neglected by amateur transmitters generally, and particularly the transmitter using powers of about 10 to 12 watts, although a little reflection will show that for low-power work this system has a particular usefulness, if long range working is desired, with a minimum expenditure of energy.

A Constant Frequency

The master-oscillator has one tremendous advantage over all other types of valve transmitters, in that the frequency of the emitted wave, and therefore the wavelength itself, remains absolutely constant during operation. Other conditions being equal, it is possible that the range of a constant frequency set may be 50 per cent. greater than that of the usual oscillator with ordinary coupling arrangements.

It is interesting to note that the master-oscillator system is used very extensively in commercial and other large transmitting stations almost to the exclusion of other types. Here, however, the matter is also influenced by the large powers that have to be handled.

No "Swinging" Effect

The constant-frequency transmission enables the receiver to be set dead on the wave, and it may then be "forgotten," the signals being clearly readable or telephony intelligible without the annoying "swinging" effect otherwise so often present, necessitating constant readjustment of tuning and inevitable loss of part of the message—if any of it is readable at all.

A Similarity

Fundamentally, the ordinary transmitting valve oscillator, in

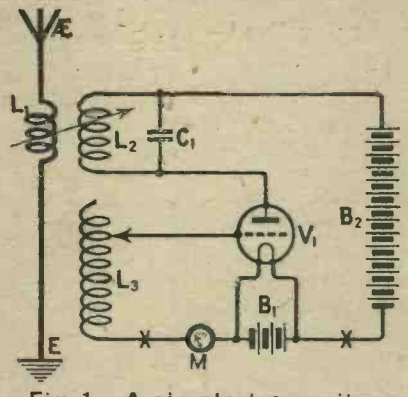


Fig. 1.—A simple transmitting circuit.

which a single valve is employed, is very much like a single valve receiver with regeneration produced by magnetically coupling the grid and anode circuits, a circuit quite familiar to readers of MODERN WIRELESS.

Fig. 1 shows a simple transmitting circuit commonly used by amateurs, the oscillatory circuit L_2 C_1 being transferred to the anode circuit, the arrangement being termed "series feed." The aerial circuit is coupled to the high potential (anode) side of the anode coil.

A Self-excited Arrangement

The grid coil L_3 is the reaction coil in the transmitting arrangement, and the number of turns is varied suitably until a point is obtained where the reaction or feed-back of energy is sufficient to overcome the L_2 C_1 circuit resistance, and maintain the anode circuit in a state of continuous oscillation, the aerial being energised by reason of its coupling to the anode circuit. The arrangement is self-excited, and therefore the oscillations produced are constant in frequency, and interrupting the oscillations by keying in any of the usual places such as X renders the system suitable for morse-code transmission.

Instability

The circuit however, is not perfectly stable, and is liable to be easily upset by changes of capacity (such, for instance, as those produced by an aerial swinging in the wind) or by fluctuations of anode supply voltage, etc. One of the best methods of obtaining efficient operation with this circuit is to utilise a grid circuit milliammeter at "M," aiming for the lowest current consistent with stable oscillation.

The Difference

Now let us see how the master-oscillator power amplifier differs. The principle involves the use of a self-excited generator of oscillations as before, but this is not directly coupled to the aerial circuit as in the simple one-valve transmitter. Instead, the output of the oscillator is utilised to control the grid of another valve—the

amplifier—the output of the latter being coupled to the aerial circuit. A typical arrangement is shown in Fig. 2, V_2 being the oscillator

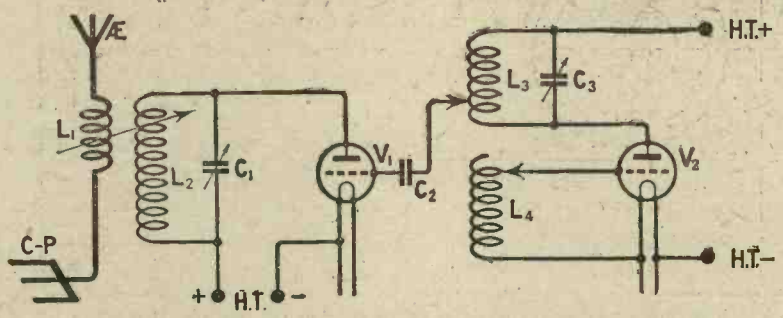


Fig. 2.—The essential features of the master-oscillator power amplifier.

valve, the arrangement of which is seen to be identical with that of Fig 1.

The amplifier comprises the valve V_1 and the oscillatory circuit L_2 C_1 which is tuned to the frequency of L_3 C_3. The grid of the amplifier connects to a condenser C_2—which is necessary here, owing to the series-feed arrangement of the oscillator, by which L_3 is at full H.T. potential—but in any case a grid condenser and leak are necessary, although these and the filament circuit connections have been omitted, for the sake of clearness.

A Tapping

The grid condenser of V_1 connects to a tapping on L_3, and by varying the position of this tap the exciting voltage produced on the grid of the amplifier may be regulated, the voltage being highest when connected to the anode end of L_3.

This is perhaps a somewhat crude way of expressing the action of the grid tapping. Actually when L_3 C_3 is oscillating, potential "nodes" are set up across L_3, and the position of the tap has to be regulated so as to provide effective excitation of the amplifier grid. Any change of frequency in the oscillations of L_3 C_3 will cause alteration of the "nodal points," and consequently the tap must be readjusted accordingly.

The 10-watt Transmitter

Having briefly reviewed the principles underlying the operation of the master oscillator, we wil now consider the practical construction of such a transmitter, designed to operate on a normal input of about 10 watts.

It will be apparent from what has been said before regarding the oscillator portion of the circuit that any of the usual three-electrode valve oscillator arrangements will be suitable, provided it is capable of producing sustained oscillations of the desired frequency.

A Reduction in Coils

The oscillator of Fig. 2 comprises separate grid and anode coils, so that a transmitter built on these lines would require four coils in all.

By using the well-known Hartley auto-coupled circuit for the oscillator, the number of coils required is reduced to three, and the construction is thus simpler.

The controls on the panel should be carefully manipulated.

Instead of the series-feed for the anode power supply the parallel system is used in the actual instrument. There does not appear to be any particular advantage in one or the other for low power, but in the layout adopted, parallel-feed is more convenient from the wiring point of view.

A Satisfactory Wave'ength

The instrument was designed for operation on a 45-metre wavelength, this wavelength having proved particularly satisfactory for daylight communication—both C.W. and telephony—up to distances of 500–800 miles with low powers. Some readers, however, may desire to operate on higher wavelengths, and their experience will guide them as to the necessary alterations in the design of the inductances and capacities in the oscillatory and aerial circuits, or these may be calculated from the usual formulæ.

The circuit of the complete transmitter is shown in Fig. 3.

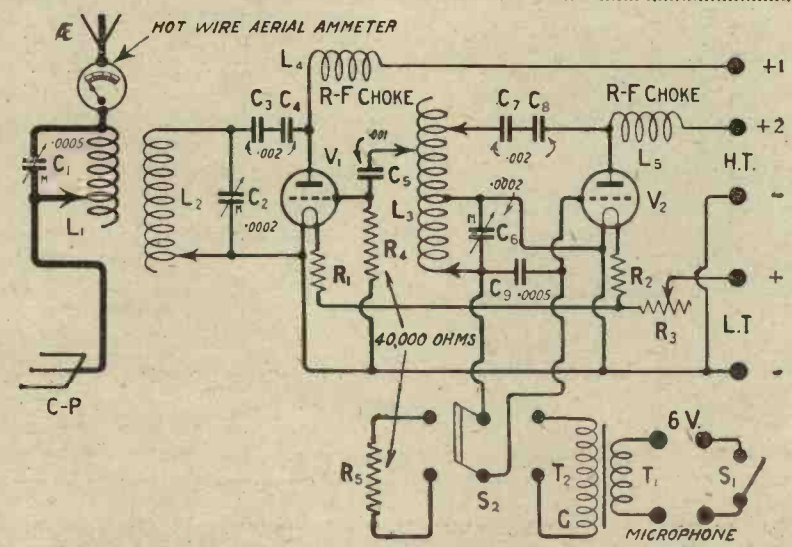


Fig. 3.—Details of the theoretical circuit are given in this diagram.

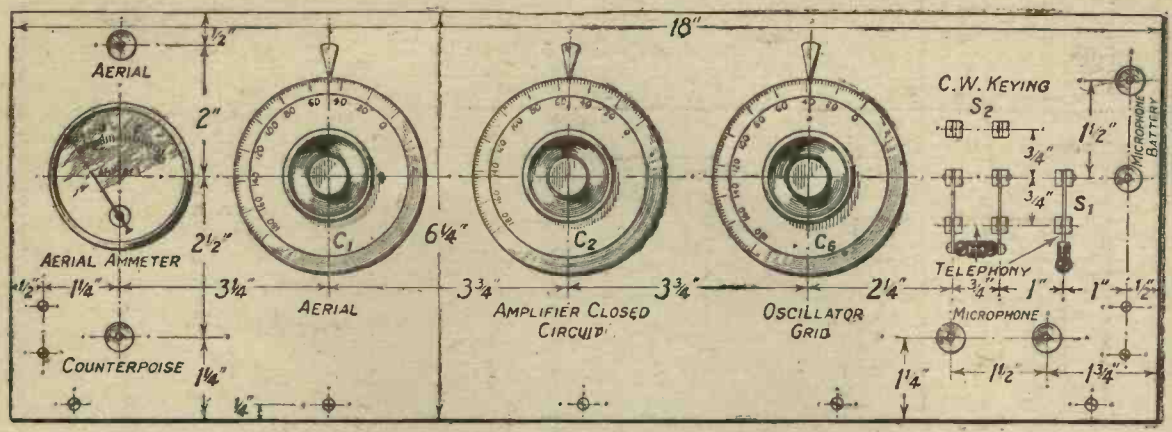


Fig. 4.—A full size blueprint, No. 159a, can be obtained post free if desired.

It is important to minimise, as far as possible, any magnetic coupling between L_2 and L_3, so that these coils are mounted well apart with their magnetic fields at 90 deg., as will be seen from the photographs.

Minimum Losses

At the high frequency at which this set was designed to work, it is important to reduce to a minimum the losses in inductances and condensers, and also the stray capacities between the wiring and various components. All fixed condensers and valve holders are mounted upon small porcelain "bobbin" insulators, in order to raise them above the baseboard.

The valve-holders are of special "low-capacity" type, with a minimum of dielectric material between the sockets.

The Components

The components used, with the exception of the grid leaks, are all as employed for receiving purposes, and a complete list is given below.

One wooden baseboard, 18 ins. by 12 ins. by ½ in.

One ebonite panel, 18 ins. by 6¼ ins. by 3/16 in. (Silvertown Co.).

Two panel supporting angle brackets.

Two ebonite terminal strips, 3 ins. by 1½ ins. by 3/16 in. (Silvertown Co.).

One ebonite strip (for rheostat), 4 ins. by 2½ ins. by 3/16 in. (Silvertown Co.).

One .0005 variable condenser (A. J. Stevens & Co., Ltd.).

Two .0002 variable condensers (A. J. Stevens & Co., Ltd.).

Two special "low loss" valve holders (N. V. Webber & Co., Ltd.)

Two 1.5-ohm resistors and screw holders (Burndept Wireless, Ltd.).

One 3-ohm rheostat, all-metal type (Burndept Wireless, Ltd.).

One microphone transformer (Burndept Wireless, Ltd.).

One D.P. change-over panel mounting switch (A. F. Bulgin & Co.).

One S.P. change-over panel mounting switch (A. F. Bulgin & Co.).

Three "Decko" dial indicators (A. F. Bulgin & Co.).

One 0 to .25 amp. hot-wire ammeter (Burndept Wireless, Ltd.).

Two 3½ in. dia. "low-loss" coil formers (Collinson Precision Screw Co., Ltd.).

Eleven nickel-plated terminals.

Four .002 fixed condensers (A. J. Stevens & Co., Ltd.).

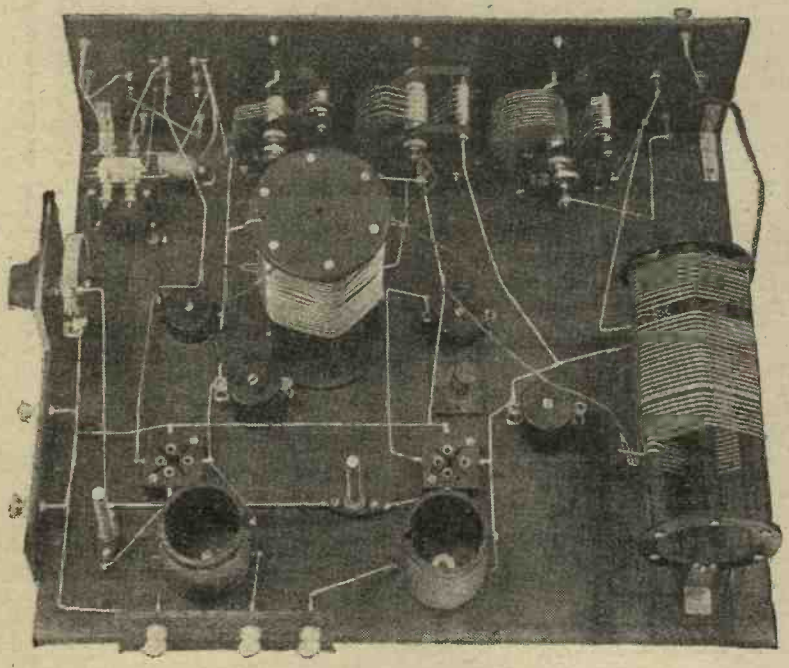
One .001 fixed condenser (A. J. Stevens & Co., Ltd.).

One .0005 fixed condenser (A. J. Stevens & Co., Ltd.).

Two pieces of ebonite tube, 2 ins. dia. and 2½ ins. long.

One pound 18 S.W.G. tinned copper wire.

Half doz. paper clips



The special middle variable condenser was used in lieu of an ordinary .0002 as it happened to be available when constructing the transmitter.

The Grid Leaks

The grid leaks are of 4,000 ohms resistance, and were made by winding No. 36 S.W.G. Constantan resistance wire on short lengths of ebonite tubing, the domestic sewing machine being commandeered for the purpose. They are not wound non-inductively, and in this connection the writer has made many experiments with grid leaks for transmitters, and in general his experience is that the value is not at all critical, anything from 2,000 to 20,000 ohms appear-

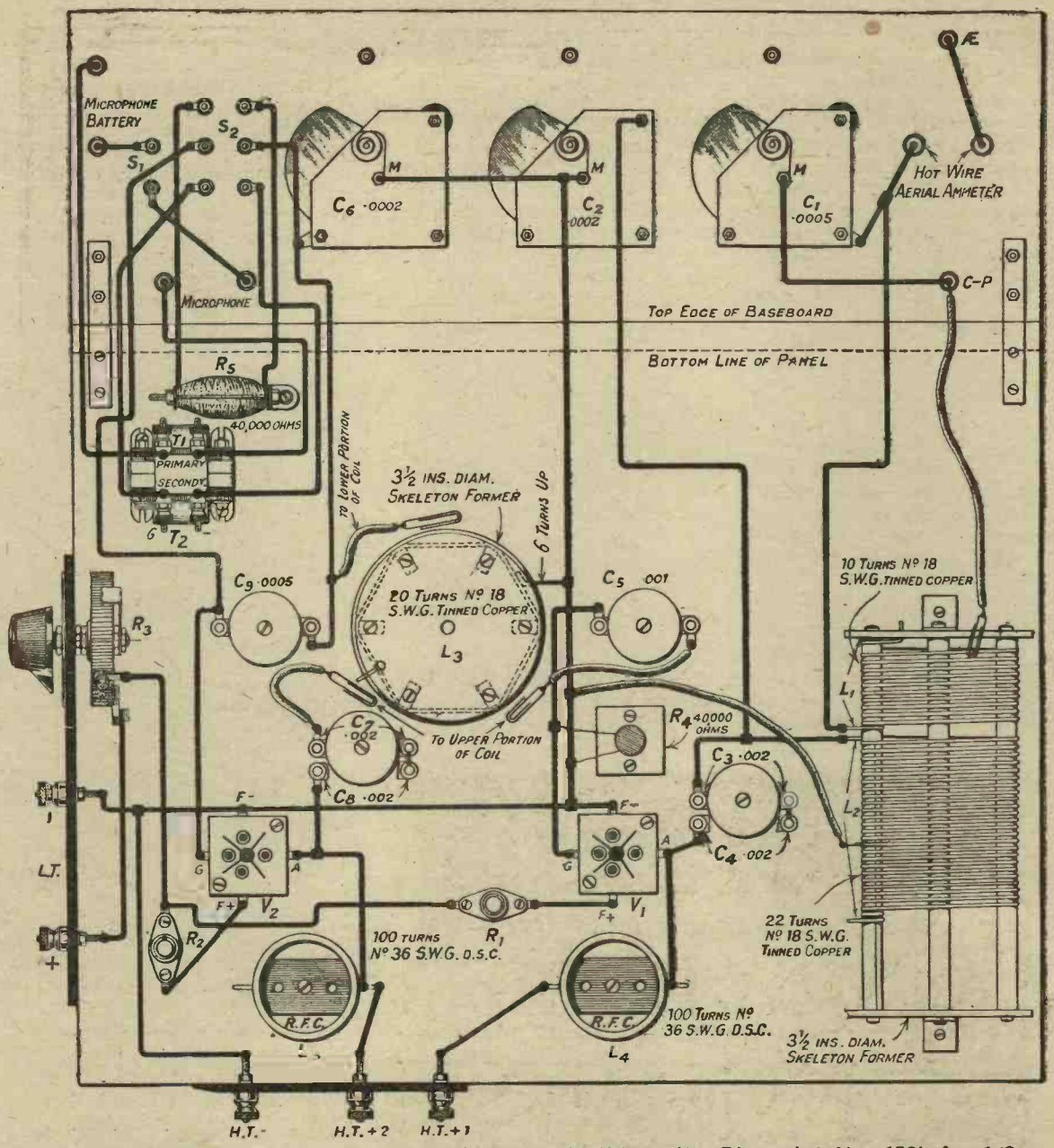


Fig. 5.—All the components are well spaced in this unit. Blueprint No. 159b for 1/6, post free.

ing satisfactory, provided the grid turns or grid condenser are adjusted accordingly—this in respect of 10-watt transmitters.

Radio-frequency Chokes

The radio-frequency chokes L_4 and L_5 in the H.T. supply leads consist of 100 turns of 36 S.W.G. D.S.C. wire, wound on 2 in. dia. ebonite tubes. The value is not critical, provided the inductance is several times greater than that corresponding to the working wavelength. The chokes should be kept well away from inductances, in order to prevent interaction of the stray fields.

Screw-in interchangeable resistors are provided for the valve filaments, enabling valves of dissimilar types to be employed. A master rheostat R_3 controls both valve filaments for rapid switching on and off.

Blocking Condensers and Inductances

The anode circuit blocking condensers C_3, C_4, C_7 and C_8 consist of duplicate condensers in series, thus dividing the H.T. potential across each, in order to provide a factor of safety; the condensers having to carry radio-frequency currents in addition to the D.C. H.T. potential applied across them. Single condensers have however been used with D.C. voltages up to 500, without trouble, but this is not advised.

The aerial and the amplifier anode inductances L_1 and L_2 are wound on the same "low-loss" former ($3\frac{1}{2}$ in. dia.), with a $\frac{1}{2}$ in. space separating the coils, L_1 consisting of 10 turns and L_2 22 turns; while L_3 consists of 20 turns on a similar former. The spacing between turns is approximately $\frac{1}{8}$ in., and ordinary paper clips are used for the variable tapping connections.

Panel Details

The panel details are given in Fig. 4 and no difficulty should be experienced in mounting the necessary components; while Fig. 5 gives the complete wiring diagram and should be carefully followed when making up the transmitter.

The hot-wire aerial ammeter has a range of 0 to .25 amp.; while on the panel immediately above and below it are situated the aerial and earth terminals. The three H.T. terminals are situated at the back of the baseboard, and the L.T. terminals at the right hand end, next to the rheostat.

Telephony and C.W. Working

For telephony, grid circuit modulation is employed, the arrangement of which will be followed from Fig. 3 a double-pole two-way switch connecting the modulation transformer secondary winding across the oscillator grid condenser C_9 in one position and the grid leak in the other for C.W. A single-pole switch is fitted in series with the microphone and the microphone battery.

A six-volt battery is connected to the two upper right hand terminals on the panel to excite the microphone primary circuit.

Keying

For C.W., keying is effected by means of a resistance placed in the H.T. lead from the battery to H.T.+1, with the key connected across it. When the key is up the resistance comes into circuit, and reduces the radiation to about one-third its normal value. Owing to the fact that the amplifier never ceases oscillating, the emitted wave remains quite steady and keying clicks are minimised thereby.

Adjusting the Apparatus

Adjustment of the circuit is easy if carried out methodically. An absorption wavemeter is used consisting of a 5-turn inductance, variable condenser and a small flashlight bulb joined in series. This can be calibrated easily against the receiver by means of the well-known "resonance click" method.

Usually the power rating of the oscillator valve V_2 should be not less than 25 per cent. of that of the amplifier. For high power work it is usually desirable to employ valves of more nearly equal power rating. In the present instrument a Mullard D.F.A. 6 is used as the oscillator, and another as the amplifier, but valves of a similar type can be employed.

With both valves alight, and the H.T. to the amplifier disconnected, the anode tap, grid tap and grid condenser of the oscillator are adjusted, until by means of the absorption wavemeter, oscillation is indicated at the required frequency. The amplifier H.T. is now connected.

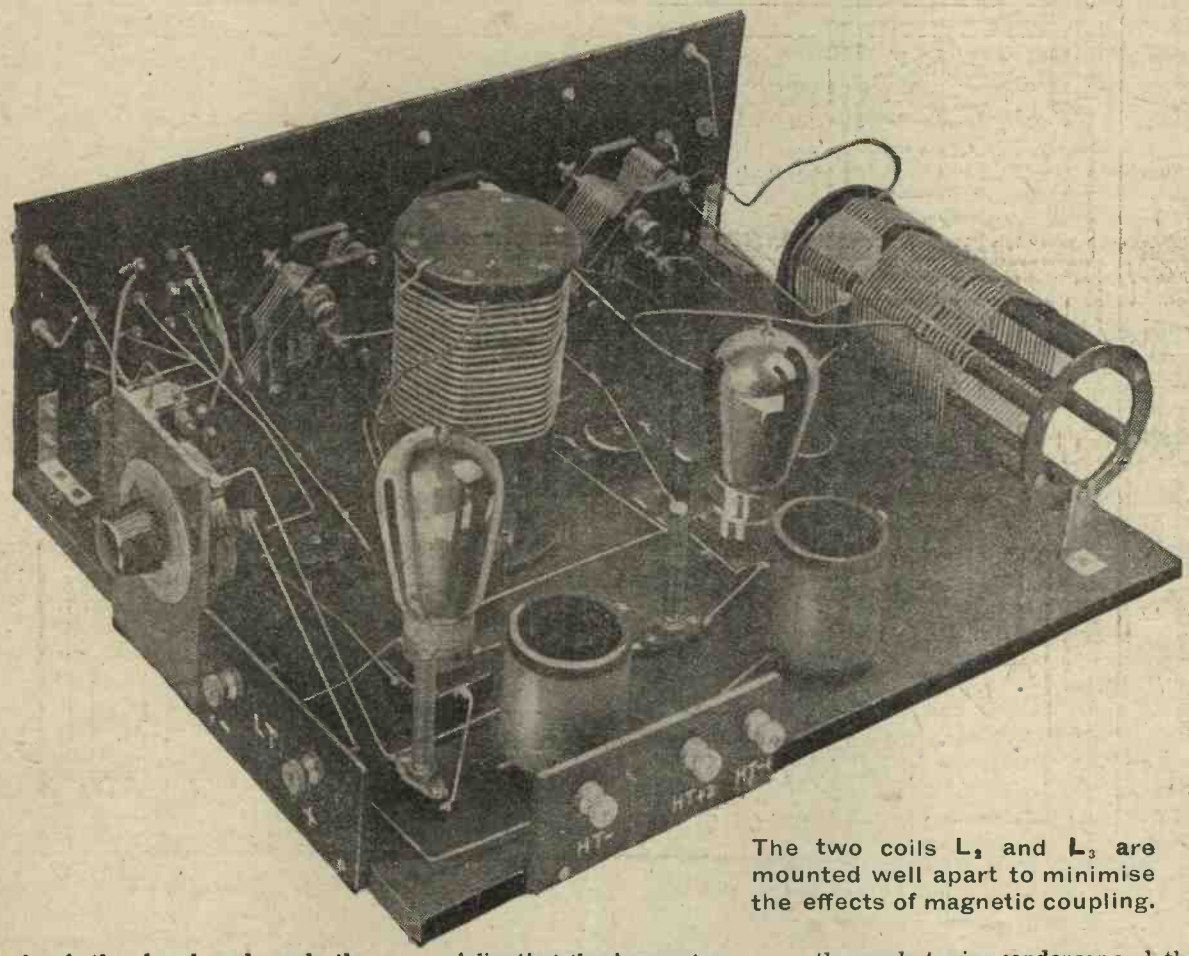
Using the Wavemeter

With the aerial circuit disconnected, the tap on to coil L_3, the anode tuning condenser and the grid tap are now varied, until by approaching the wavemeter to L_2 maximum strength of oscillations is indicated. The aerial circuit should now be connected and brought into tune by means of the variable condenser and the tapping on the inductance.

At 5LS the radiating system consists of a 70 ft. single wire aerial and 50 ft. counterpoise, and for 45 metre work the aerial is tuned to the third harmonic.

Consistent Results

The instrument has exceeded expectations in ease of operation and consistent results and good telephony has been reported in Bristol, Southport, Cambridge, etc.



The two coils L_2 and L_3 are mounted well apart to minimise the effects of magnetic coupling.

Single or Multivalve?

The Pros and Cons Discussed

By Percy W. Harris, M.I.R.E.

THE downward tendency in valve prices which has showed itself in the last year or two, has already had a distinct influence on the relative popularity of single- and multi-valve sets. When the bright emitter reigned supreme, few experimenters could face with equanimity the problem of providing the low-tension current for a five- or six-valve set, and when the superheterodyne receiver first made its appearance, its tremendous filament consumption was, perhaps, its greatest drawback.

Current Consumption

For example, a seven-valve superheterodyne using bright emitters throughout, consumed about 4½ amperes, whereas the same instrument can nowadays be run quite efficiently with a total filament current of less than half an ampere. Similarly, the wane in popularity of reflex sets can be attributed in a large measure to the growing use of the dull emitter valve, for the saving of filament current by reflexing is nowadays no great advantage.

The home constructor is so often faced with the problem of "single- or multi-valve" that a little time spent in considering the pros and cons of the subject will not be wasted. Let us, then, see first of all what can be said for the single-valve set.

The Single-valve Set

Single-valve sets can be divided into "straight" and "reflex" sets. In spite of the remarkable claims made from time to time for some new single-valve circuit, there is a very definite limit to what can be obtained from such a set of the "straight" variety. If we are prepared to sacrifice quality, and if the circuit is carefully designed and laid out, a very considerable volume of signals can be obtained from such an instrument. Indeed, in a good low-loss circuit with suitable components, valve and battery supply, a measure of loud-speaking can be obtained up to ten miles from a broadcasting station which many people would consider satisfactory for a small room.

Marked Effects

To obtain such sensitivity, however, the valve must be worked very close to the oscillation point, and it is here that the distortion, due to reaction, is very marked. Even with the brightest of bright emitters, the current consumption does not much exceed three-quarters of an ampere at 3½ to 4 volts, and the drain on the high-tension battery is very small. Furthermore, the cost of the components for a straight single-valve set is relatively low.

Reflex Receivers

When we come to reflex sets employing a single valve, the valve can be used simultaneously as a high-frequency and a low-frequency amplifier, a crystal being used as the detector. Here again, with a properly designed receiver, remarkable results can be obtained, and from 5 to 10 miles from a broadcasting station really adequate loud-speaker strength is obtained with the average aerial. What is often overlooked, however, is that the cost of the components in a single-valve reflex receiver is practically the same as in a three-valve set, for with modern valves, which are not critical as to filament current, a single rheostat will serve quite adequately for three valves.

A Comparison

Comparing a reflex receiver using a valve acting as a high- and low-frequency amplifier with a crystal as rectifier with a "straight" three-valve set, consisting of a high-frequency valve, detector and one note magnifier, using a common filament resistance, we find that the only additional parts required, other than valves, are two additional valve sockets and a grid condenser with leak. The cost of the grid condenser and leak is balanced by the saving on the crystal detector, so that roughly speaking the additional cost is but a shilling or two for the two valve sockets.

The actual saving, of course, is on the cost of the two extra valves, and the lowered anode current consumption from the high-tension battery, as well as the reduction in filament current which, in the reflex circuit is a third of that required for the three-valve straight circuit.

Better Results

With the small power type of valve a three-valve set takes no more current than a single-valve reflex using a bright emitter, while if ·06-ampere valves are used, the saving in current by using a reflex in place of the three-valve set is negligible in practice. Furthermore, the straight three-valve set with one stage of high-frequency, a valve detector and one stage of note magnification will give definitely better results than the best single-valve reflex with crystal detector.

The Small Power Valve

The biggest problem in multi-valve radio is the provision of an adequate anode current supply, particularly with the deservedly popular small power valves using a ·25-ampere filament current at about 5 to 5½ volts. Many listeners do not realise the tremendous drain these valves exert upon the high-tension battery. To give you a practical example, a very popular bright emitter valve ("general-purpose" variety) with 60 volts on the anode, takes, at zero grid voltage, 1½ milliamps, whereas the same maker's ·25 ampere small-power valve, worked under identical conditions, takes 4 milliamps. This means, of course, that the small power valve, while taking only one-third of the filament current compared with a bright emitter, takes nearly three times the anode current. Of the two, the filament current is much the cheaper and easier to provide. The length of life of a high-tension dry battery is rapidly shortened if we draw too big a current from it.

With a load up to 3 or 4 milliamperes, the ordinary size of high-tension battery will have a life of about nine or twelve months at the most, and even when nothing whatever is drawn from it, it will not last any longer, but above the figure mentioned, the ordinary size of high-tension dry battery is unsuitable, and will rapidly depreciate.

American Practice

In America, where five-valve receivers using small power valves are by far the most popular, the small size of high-tension battery has been abandoned long ago in favour of very large and heavy 45 volt units (two of which are used in most of the receivers) themselves each as heavy as the average 30 or 40 ampere-hour accumulator. This large type of high-tension battery is available in this country, and I see that the Ever-Ready people are now supplying similar batteries of identical size and of British manufacture.

Such batteries have a life of six or nine months, even when used with small power valves in a five-valve set. Twenty or twenty-five milliamps is no unusual load for such a five-valve receiver, and is far greater than should be taken from the ordinary size of high-tension battery.

Volume and Quality

It is now recognised by all experienced workers that adequate volume accompanied by good quality is only obtainable with multi-valve sets, unless, of course, we confine our attention to a nearby station. Some amateurs, particularly in their early wireless days, are inclined to push each valve to its limit of amplification, revelling in the great volume so obtained and ignoring the heavy sacrifice of quality entailed.

A set with one or two stages of high-frequency, a detector and two stages of low-frequency, can be made to bring in a number of stations other than the local at full loud-speaker strength without the need of any valve being pressed to the limit. Those readers who have not yet had the pleasure of listening to distant stations on such a set will be surprised to find how "near" they sound, as compared with signals of the same volume from the same station obtained with a smaller number of valves pressed to the limit. Indeed, the criticism of the quality of foreign station reproduction is too often based upon opinions gained from distorting receivers.

The Service Required

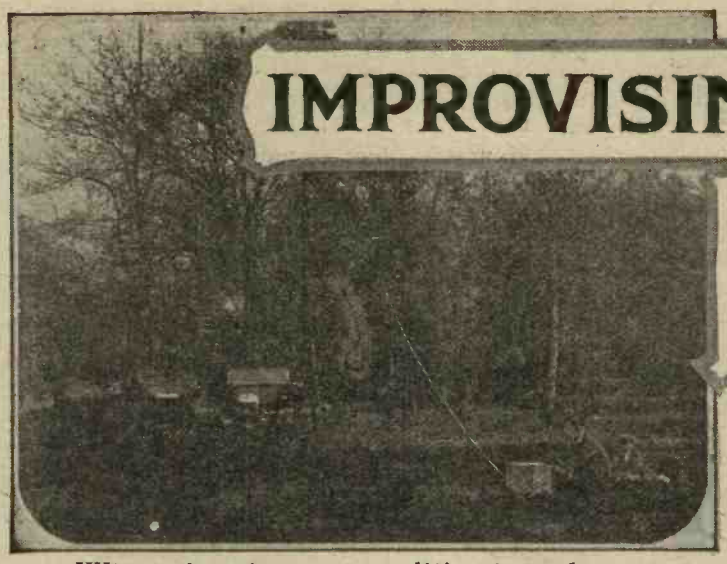
After all, so much depends upon the kind of service you expect to get from your wireless receiver. Too often the "freak" or exceptional reception conditions obtaining on a particularly good evening are used as a basis for choosing a receiver or a circuit. Winter conditions, too, are invariably better for long distance reception than those ruling in summer time. Many listeners only use their sets after dark, and would be surprised if they listened in daylight to find what small penetrating power a single-valve set possesses under such conditions.

Even a five-valve set with two stages of really efficient high-frequency amplication will not bring in all of the B.B.C. stations in daylight. A six-valve receiver can however do this, and by utilising the latest information available, such a receiver will be described in the next issue of MODERN WIRELESS.

A Strange Fact

Strangely enough, far too many listeners are content with poor quality in reproduction, and for this reason will put up with the distortion which inevitably arises in pressing a single valve to its utmost limit to obtain volume. As I have indicated earlier in this article, if you are prepared to sacrifice quality, then the multi-valve set may seem rather an extravagance, but personally, knowing the excellent quality of the broadcasting now available, I invariably use a multi-valve set, even for the local station, being quite content to obtain slightly less amplification per stage, for this is accompanied by first-class quality.

I can safely say that the majority of the wireless experts of this country use multi-valve sets in preference to single-valvers, dull emitters in preference to bright emitters, and a minimum amount of reaction amplification.



IMPROVISING AERIALS FOR THE COUNTRY OUTING

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

When planning an expedition into the country, the problem of suitable aerials arises if a receiving set is to be taken. The suggestions made in this particularly interesting article merit the earnest consideration of all our readers.

NOW that Easter is well past and we have had a good taste of really warm and dry weather, there is every inducement to get out of doors at week-ends and at other times when opportunity offers and the weather is kind enough. No doubt a great many people prefer to leave wireless behind them on such occasions, but there must also be a large number of enthusiasts who like to take their receivers with them even for short trips into the country. The wireless set may be put to various uses when it is taken away out of the town. It may be employed simply to pass the time in the ordinary way, furnishing a pleasant background of broadcast music at a picnic, for example, or even supplying the necessary "orchestra" for an open-air dance in the evening.

Employing the car battery will obviate the necessity for an additional accumulator.

Enlightening Information

There is also a good deal of interest in experimenting with the receiver out of doors. There is, first of all, the novelty of hearing the broadcast programmes in unfamiliar surroundings; the performance of the receiver when it is used on a temporary aerial away from houses and railways may also provide some enlightening information. It may be found that the receiver gives surprisingly good results both in long-distance reception and on the local station when it is thus removed from the "screening" of its normal environment.

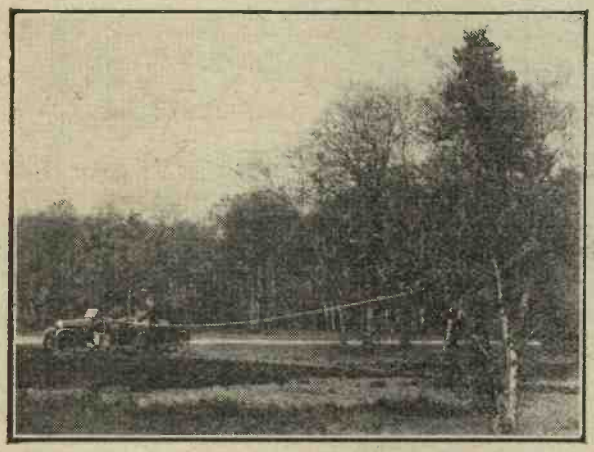
Temporary Aerials

The erection of a suitable aerial for temporary use out of doors probably presents a problem to many people sufficiently serious to make them hesitate about taking out the receiver at all. Of course, if one has a superheterodyne receiver, this problem is non-existent, but even with modern developments the superheterodyne is not yet everybody's instrument. To put up an aerial for the ordinary type of set is not really such a difficult matter, and it is the purpose of this article to show how easily temporary aerials may be erected out of doors. It will be apparent that more ambitious aerials may be erected by the same methods if desired; but the object here is to describe the simplest way of putting up a wire or otherwise forming an aerial so as to get good results with a minimum of trouble.

Transport

Those who have cars to take them will, of course,

be able to carry quite heavy apparatus, and the car battery may be used for supplying the necessary low-tension current for the valves. They can take also an earth pipe or earth mat and even light masts for erecting the aerial. If everything has to be carried by hand, however, these refinements will usually prove unnecessarily burdensome. It will then be sufficient to take, besides the set



Supporting one end of the wire on the motor-car is a convenient arrangement.

itself, a coil of 100 feet of rubber covered stranded cable, the insulation being either soft or vulcanised, an additional short length for the earth lead, and a large jack-knife or short iron spike with a terminal on it.

Insulated Wire

The advantage of taking insulated wire is that there is really no need to have separate insulators as well. When an aerial is to remain in the same place for some time, it is necessary to insulate it carefully with porcelain or other insulators. If the wire is to be up for only a short time, however, the separate insulators may be dispensed with, without serious loss of efficiency, the covering of the wire itself being relied upon.

A High Aerial

The photographs on these pages will show some of the various arrangements which may be tried. As with the aerial which is in permanent use at home, it is of advantage to get the wire as high above the ground as possible. Trees often afford a convenient means of supporting one end of the wire, or even both ends if desired. Unless extreme height is required, there is no need to climb the tree chosen in order to fix the aerial. A piece of a broken branch or a stone should be tied securely to the end of the wire, and thrown up over a convenient branch. If the weight at the end is heavy enough, it can then be pulled up close against the branch over which the wire has been thrown, and it will stay there securely enough to enable the wire to be stretched tight between the tree and the receiver.

At the receiver end the wire may be tied to a short wooden peg in the ground, or, better still, to a bush a few feet above the ground. For the earth connection the jack-knife may be used, the end of a short lead from the earth terminal of the receiver being jammed in the hinge of the blade as it is opened; the blade is then pushed into the ground. If there is a pond anywhere near an excellent earth can usually be secured by taking a lead to it; it will be found best to bare of insulation the part of the lead actually in the water, this part being a few feet long and not merely an inch or two.

A Use for the Motor-Car

When the receiver has been brought out in a car, the car itself may conveniently be used to support one end of the aerial wire, as shown in one of the photographs. Here the aerial is stretched tightly between a small tree and the steering wheel of the car, the receiver being on the car, where the batteries are handy, in order to save the dry cells which properly belong to the receiver. No attempt is made in this case to get the aerial up to any great height. The full length of the wire is used, and the set is placed right at one end as before.

A Suitable Site

In selecting the actual site for the aerial when trees are to be used as supports, the fringe of a belt

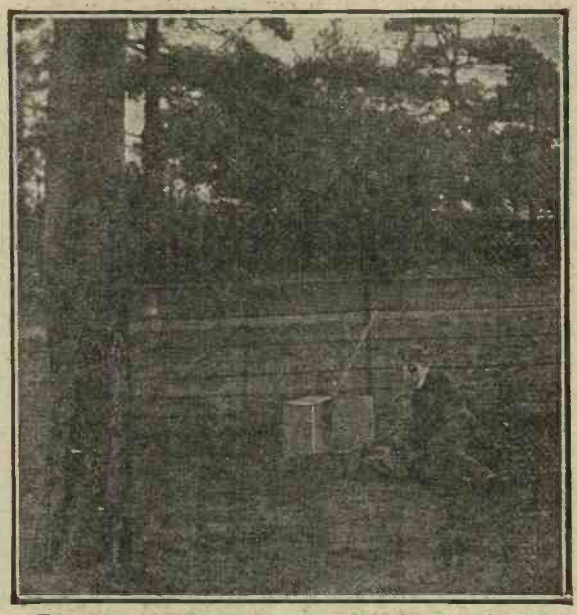
Where possible the free end of the aerial should be slung over the branches of a high tree.

of trees may be expected to provide a better place than the middle of a group of them. Note should also be made of the direction of the local station, if it is desired to receive this, and if possible the aerial wire should be so placed that it points either directly towards or directly away from this direction, preferably the latter. In this connection it may be found interesting to try the

directional effect of different positions of the aerial on the signals received from the local station. By placing the aerial wire at right angles to a line joining the receiver and the station, it may be found possible to reduce the strength of signals considerably, thereby assisting in the reception of other stations, which are normally obliterated.

A Ground Aerial

In open country, where there are no trees or other natural supports available for the aerial wire, the experiment may be tried of laying an insulated wire straight out along the ground.



The use of an iron fence as an aerial is an expedient worth trying.

With this arrangement and with those that are to be described it will be worth while to test several different types of earth connections in order to get the best results. Besides the direct earth with a knife or metal spike, a counterpoise may be tried, consisting of several yards of insulated wire laid on the ground. It will quite likely be found that the position of this counterpoise wire relative to the aerial wire or connection has an appreciable effect on signal strength.

An Example

For example, with an overhead aerial, the counterpoise may be tried either directly underneath the aerial or as a continuation of it in the same line, or in any intermediate position. With some types of aerial connection it may be found best to dispense with the earth altogether. It is impossible to lay down any hard and fast rules about the erection of temporary aerial systems of this sort, as local conditions will be the deciding factor in the efficiency of any given arrangement.

Using a Fence

Fences, either of the iron bar type or those with galvanised wire supported on wooden or concrete posts, will often obviate the necessity of putting up any overhead wire at all. A short lead should be taken from the receiver to the wire of the fence and that is all that is needed. If a fence close to a railway is used, or one in a locality where power or light mains are not far off, trouble may be experienced from interference from this source. It will sometimes be found possible to reduce the interference from this cause by inserting in series with the aerial lead to the fence wire a condenser of large capacity.

Tree Aerials

A more or less "freak" type of aerial which may be tried with success is the trunk of a tree. To utilise this, the blade of a knife should be driven well into the trunk, so that it penetrates into the green wood under the bark, and a lead attached to this from the aerial terminal of the receiver.

Generally speaking, however, the use of such unusual aerial systems will be confined to experiments. The more conventional type of wire aerial may be expected to give better and more consistent reception.

The Aerial Wire

A word about the actual wire used for the aerial may not be out of place. If stranded copper flexible cable is used, of the kind which has a soft rubber covering, care should be taken not to strain it too tightly between the supports. If it is overstrained, the rubber insulation may crack, so that the strands are exposed to oxidisation. Under such circumstances the fine strands will soon become brittle and the cable be ruined.

A Useful Type of Cable

A very suitable type of wire to use for these temporary aerials is the steel stranded cable with vulcanised insulation, which is readily obtainable nowadays. This is composed of a number of fine strands of steel wire with one or more strands of copper. This cable will stand any strain that it is likely to be subjected to when in use as an aerial. It is open to question whether such steel stranded cable is suitable for continuous use for permanent aerials, owing to the fairly ready oxidisation of the strands in spite of the insulating covering, this later deteriorating under the influence of the weather. For temporary use, however, it should prove quite satisfactory.

Satisfactory Results

It will be seen that there is ample scope for experiment in the use of a receiver out of doors. It will in a great many cases be a pleasant surprise to find that the receiver functions so well under such conditions as a contrast to the moderate results which are often all that can be expected from it in the town. Provided that one does not expect to get big signal strength at too great a distance from the desired station, quite unambitious receivers and simple aerial systems which are light to carry and easy to erect and dismantle will be found to be well worth while taking out for a few hours away from the streets and buildings.

A SINGLE CONTROL FOUR-VALVE RECEIVER

By A. JOHNSON-RANDALL.

Readers desiring a set for the local station and Daventry with a single control will find this receiver admirable for their needs.

THERE must be a very large number of listeners who, being interested in wireless solely as a means of entertainment, wish for nothing more than a simple receiver capable of receiving the local station and with the minimum number of controls.

For the Music Lover

Super-selective receivers with many stages of highly efficient high-frequency amplification which to the enthusiastic experimenter are so attractive, make no appeal to this class of broadcast listener. The music lover asks merely for a set, which, in addition to giving pure reproduction, can be switched on or off at will by one simple movement of a switch.

The receiver described in this article is of the above type and has been designed with the object of supplying the needs of those who desire to listen to the local station only.

The Result of Experience

The circuit, which is shown in Fig. 1, was decided upon after a considerable amount of thought and as a result of experience with a multitude of different arrangements extending over a number of years. There are four valves which function as follows: V_1 amplifies the incoming high-frequency oscillations which are transferred with the aid of the aperiodic transformer L_3 L_4 to the detector valve V_2. This transformer, which requires no tuning condenser across either of its windings, provides a moderate degree of amplification over a wide band of frequencies.

Retaining Simplicity

It is not claimed that such an arrangement will give results greater than about 60 per cent. of those obtainable with an efficient tuned stage, but to retain extreme simplicity a certain amount of efficiency had to be sacrificed since the use of a tuned stage would have necessitated an extra tuning control.

Anode Current Rectification

The detector valve V_2 rectifies on the anode current principle, sometimes called the bottom bend,

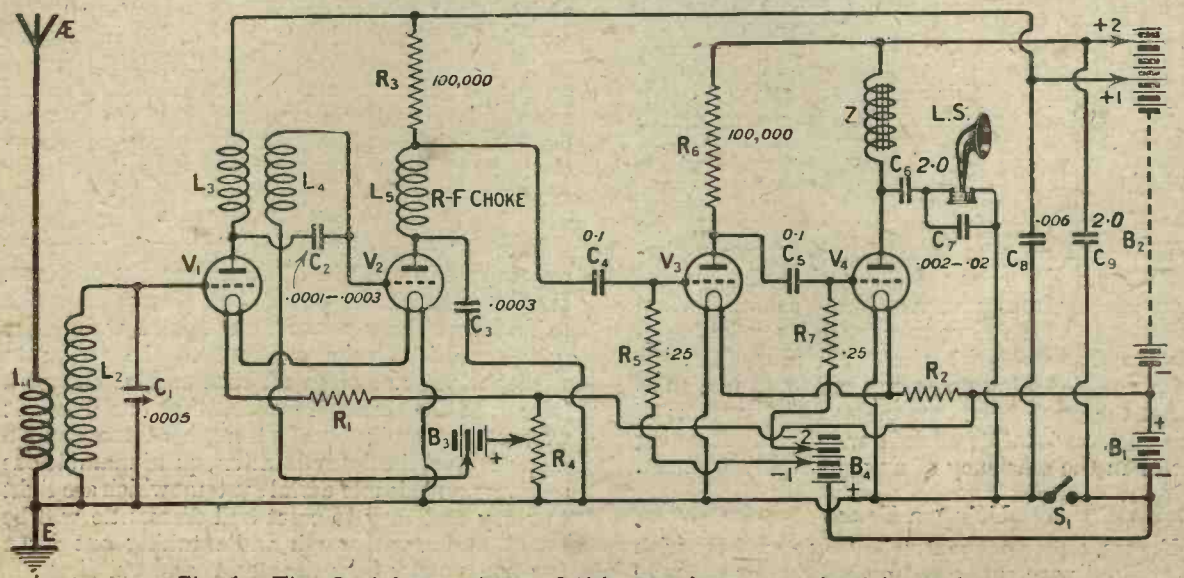


Fig. 1.—The first two valves of this receiver are wired in series.

this method possessing special advantages when the receiver is employed at short distances from the local station. The rectified impulses are afterwards amplified

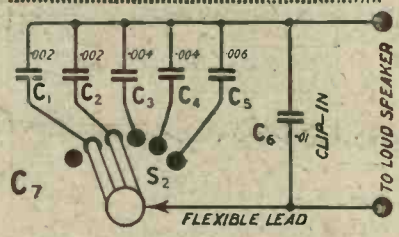


Fig. 2.—Details of the tone-control unit.

by means of the two resistance-coupled stages V_3 and V_4.

Resistance-capacity coupling, although not giving the same degree of amplification as can be obtained with transformer or choke coupling, possesses the merits of magnifying uniformly at all frequencies, and in addition does not present the same difficulties in design as do the other methods mentioned.

Interesting Features

A filter circuit in the anode feed of V_4 isolates the loud-speaker windings from the steady anode current, which in the case of some of the power-valves on the market may be quite considerable. No filament resistances are provided since the set has been designed to operate with certain types of valves in conjunction with suitable fixed resistors. By connecting the filaments of the first two valves in series their total current consumption has been kept equal to that of one of them, with the additional advantage that 4- or 6-volt valves of the .25 ampere type can be used in the low-frequency stages.

A Possible Combination

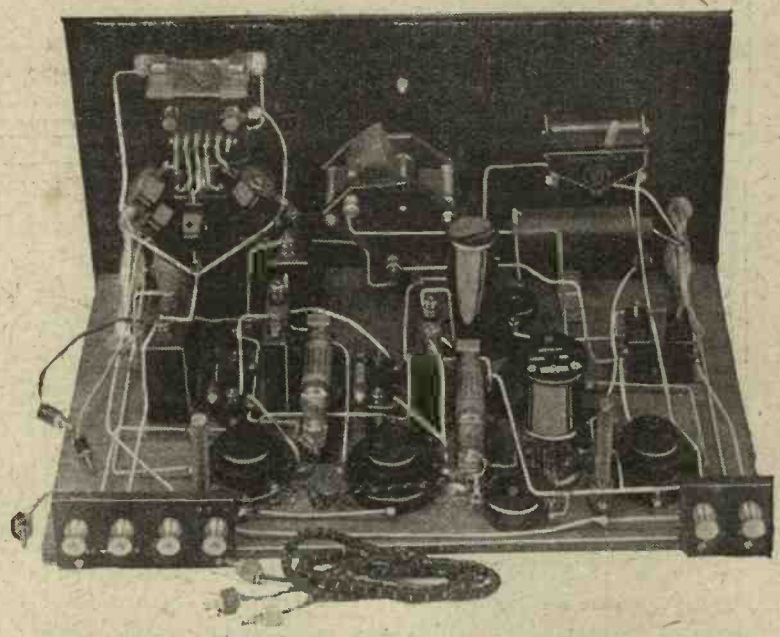
For instance, with a 6-volt accumulator one could use a couple of 6-volt valves for V_3 and V_4 and two suitable 3-volt valves for V_1 and V_2.

In this way filament resistances can be dispensed with, an ordinary "on and off" switch being used instead.

Tone Control

A tone control is provided across the loud-speaker terminals to enable the tone of the instrument to be adjusted according to individual taste. (For details see Fig. 2.)

Such a circuit forms a simple and foolproof arrangement which once tuned into the local station can be left and merely switched on and off as required.



The components are arranged in a particularly compact manner.

Components

To construct the receiver the following components will be necessary, but it should be noted that the makes mentioned can be replaced by any others of equivalent quality, as advertised in the columns of this journal, although space should be taken into consideration.

One special cabinet provided with battery accommodation (Carrington Manufacturing Co.).

One baseboard size 16 ins. by 9 ins. (Carrington Manufacturing Co.).

One 16 ins. by 8 ins. by $\frac{3}{16}$ in. insulating panel (American Hard Rubber Co.).

Two terminal strips—one 2 ins. by 2 ins. and one 4 ins. by 2 ins.

Two small angle brackets.

Two baseboard mounting coil sockets.

One ·0005 variable condenser (Radio Communication Co., Ltd.).

Four "Anti-phonic" valve-holders (Burndept Wireless, Ltd.).

One potentiometer (Radio Instruments Ltd.).

One 5 point switch (Radio Instruments Ltd.).

One baseboard mounting valve socket (Burwood).

One aperiodic H. F. transformer (Magnum). 300-600 metres type.

One Radio-frequency choke (Lissen, Ltd.).

Two anode resistances—100,000 ohm (Mullard Radio Valve Co., Ltd.).

Two 0·1 microfarad Mansbridge condensers (Dubilier Condenser Co., (1925) Ltd.).

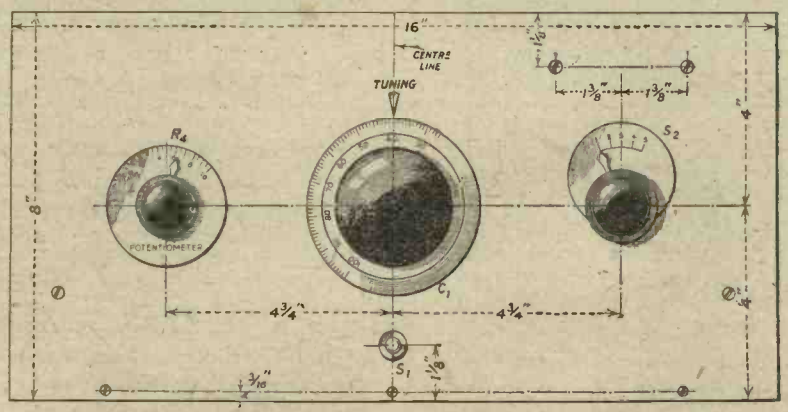


Fig. 3.—The switch S_2 is the tone-control unit of the receiver. Blueprint No. 160a, 1s. 6d., post free.

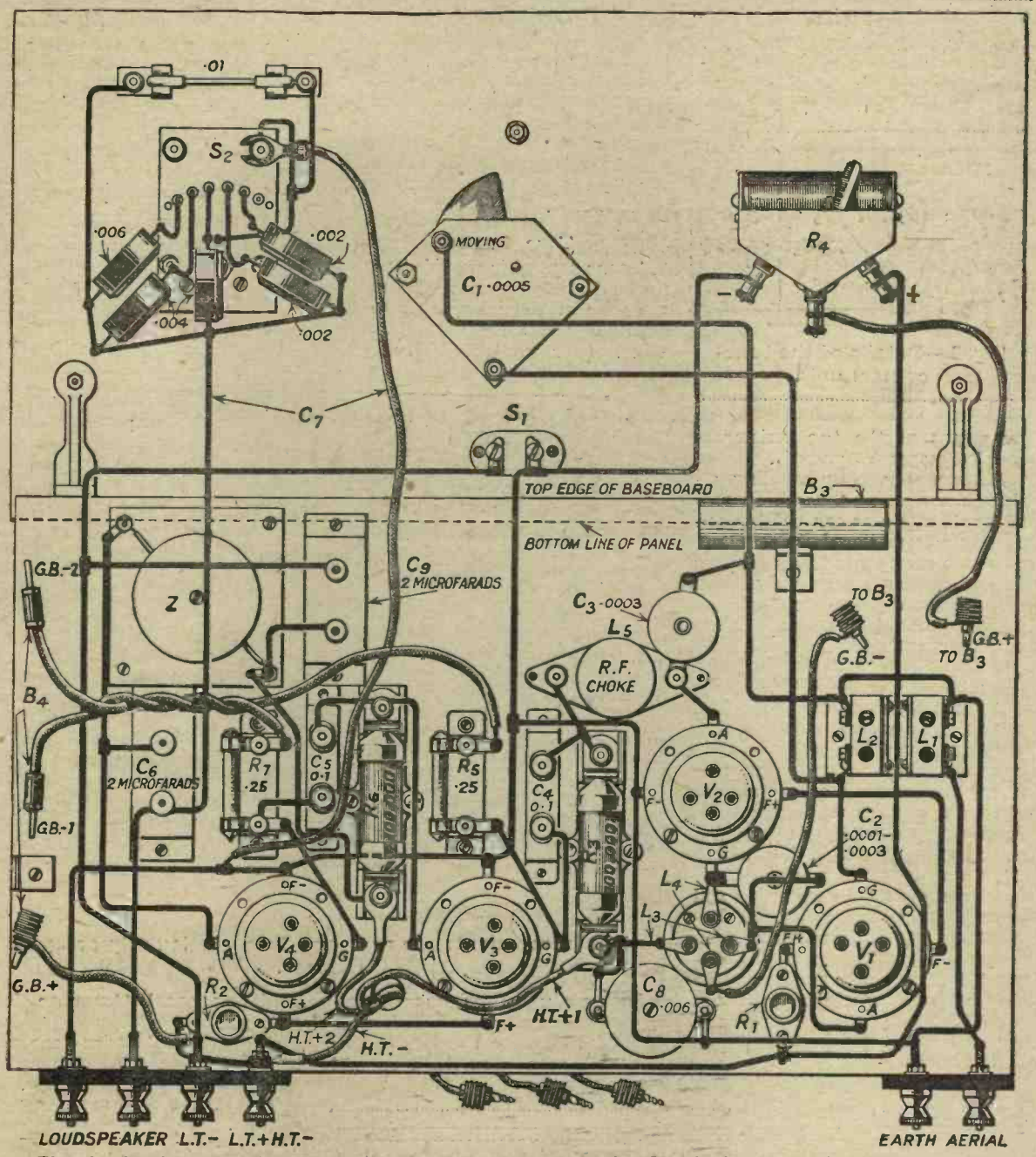


Fig. 4.—Laying out the components and wiring will be facilitated by reference to this diagram. Blueprint No. 160b, 1s. 6d., post free.

Two ·25 megohm resistances with holders (Dubilier Condenser Co. (1925) Ltd.)

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

Two 2 microfarad condensers (Telegraph Condenser Co.)

One ·006 fixed condenser (A. J. Stevens and Co. (1914) Ltd.).

One ·01 clip-in condenser with clips (L. McMichael, Ltd.).

Five tone-control condensers—two of ·002, two of ·004, and one of ·006 microfarad (Watmel Wireless Co.).

Two ·0003 fixed condensers (Watmel Wireless Co.).

One push-pull switch (Igranic Electric Co., Ltd.).

Six terminals.

Two fixed resisters (the resistance of these is given later) with holders. (Burndept Wireless, Ltd.).

A quantity of Glazite and a set of Radio Press panel transfers.

Eight wander plugs and flex.

One 4·5-volt grid battery and one 9-volt grid battery.

Simple Panel Layout

The panel layout is extremely simple, since all the components mounted thereon are of the one-hole fixing type, and a single ⅛ in. drill will suffice in each case. Referring to Fig. 3, the potentiometer may be seen mounted on the left of the panel and the tone-control switch on the right. In the centre is the ·0005 variable condenser and immediately underneath is placed the filament "on and off" switch.

Practical Hints

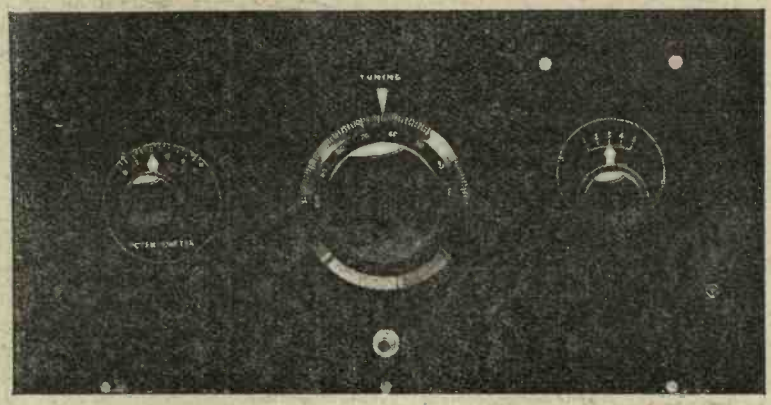
The dimensions given in the panel layout diagram should be followed carefully, the necessary centre lines being marked out with the aid of a scriber and steel rule. After this the centres for the holes may be punched ready for drilling. It is a good plan to run a small pilot drill through before proceeding with the $\frac{3}{8}$ in. drill, to prevent the latter from wandering.

Having drilled the panel fix it to the baseboard, countersinking the screw holes where necessary with the aid of a rose bit, and secure the two terminal strips to the back of the baseboard in the positions shown in Fig. 4. The terminals on these strips are placed one inch apart, between centres. The components may now be mounted on the panel and baseboard, and the set is ready for wiring.

Wiring-up

Wiring-up is a comparatively easy matter provided that a clean hot iron, a supply of non-corrosive soldering paste and some blowpipe solder are available. In the case of this particular receiver the wiring will be simplified if the leads to the filaments and filament control switch are commenced first.

The use of insulated wire makes the work much easier for the novice, since the fact of two of the wires touching will not lead to the same dangers as would be the case with bare wire. The writer finds that an old safety razor blade is very useful for removing the insulating covering. The tone-control condensers should be soldered into position after the remainder of the wiring is completed.



Simplicity is the keynote of the front of panel.

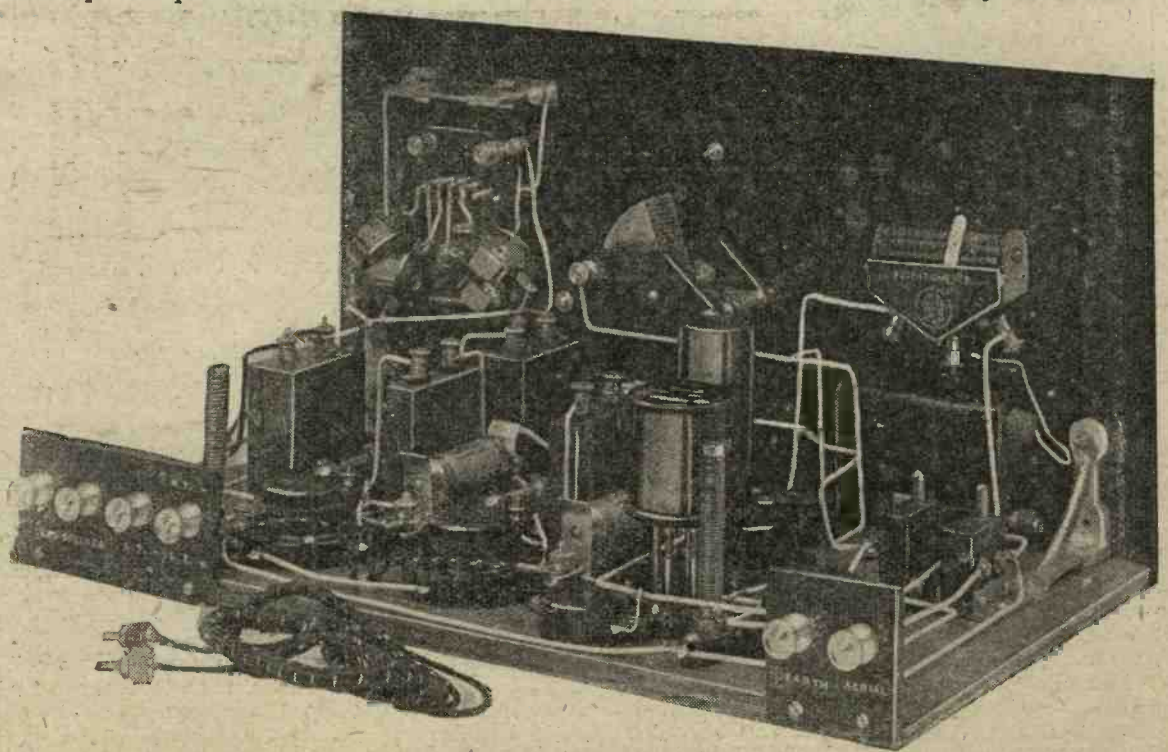
Operating the Set

To operate the receiver proceed as follows:—Connect up the two low-tension leads to the terminals marked L.T. + H.T.—and L.T.— and having screwed two suitable fixed resistors into the sockets and inserted the correct valves, pull out the switch-knob. The valves should now light. All being well join up the two H.T. + leads to the points marked H. T. + 1 and H. T. + 2, having previously attached the H. T.—lead to the terminal marked L.T. +. H.T.—.

Insert the H.T. + 1 wander-plug into, say, the 60-volt socket of the H.T. battery and the H.T. + 2 into the 120-volt socket.

The H.T. Units

For sets of this description the writer prefers two large sized 60-volt units of the Columbia type, since he has found this type of battery to give more economical and consistent results than the small sized units so frequently employed. The cabinet is sufficiently large to take two 60-volt Columbia or similar batteries. The negative grid-bias plug should be inserted at a tapping in G.B. 1, which gives a voltage recommended by the makers of



The small grid-bias battery is used for anode-current rectification.

the valves V_3 and V_4 for the particular anode voltage used.

The small battery B_3 may be tapped at, say, 3 or 4·5 volts. Connect up the loud-speaker and the aerial and earth leads to the terminals so marked, after which the coils L_1 and L_2 may be inserted into their sockets.

Suitable Coils

For the 250-500 metre band of wavelengths L_2 may be a No. 60 coil and L_1 a No. 35, 40, 50, etc. The correct size for L_1 is a matter for experiment, since much depends upon the wavelength of the local station and upon the size of the aerial. With a small aerial the writer finds a No. 50 coil best for the reception of 2 LO and with a large aerial a No. 35 or 40. For Daventry a No. 250 is correct for L_2 and a No. 100 or 150 for L_1, although experiment is again necessary in the latter case.

Avoiding Oscillation

Place the potentiometer towards the negative end, that is, rotate the knob in a clockwise direction, and then adjust the condenser C_1 until signals are heard. Find the best position for C_1 and readjust the potentiometer until the best results are obtained.

At the same time a readjustment of H.T. + 1 may be tried, but it should be remembered that a point will be reached when a further increase of H.T. may make the receiver oscillate.

Recommended Types of Valves

Using a 6-volt accumulator the following types of valves will give good results.

V_1, Marconi or Osram D.E.3, B.T.H. B 5, Ediswan A.R. 06, Mullard D. 06, etc.

V_2, D.E. 3b or equivalent type.

V_3, Marconi or Osram D.E. 5b or Mullard D.F.A.4, etc.

V_4, Marconi or Osram D.E.5., B.T.H. B.4, Ediswan P.V. 5D.E., Mullard D.F.A 1, etc.

The Resistors

With these valves the fixed resistors can have a value of ·75 ohm in the case of R_3 and 5 or 7·5 ohms for R_1. The 7·5 ohms resistor is preferable. The Burndept H.L. 310 and H. 310 will also be quite suitable for V_1 and V_2, but the fixed resistor R_1 must then have a value of about 5 ohms.

Tone-Control Switch

The constructor may be puzzled as to the use of the tone-control switch. It will be seen from the separate diagram that condensers are connected to the switch points in such a manner that capacities ranging from ·002—·01 microfarad can be obtained. By clipping in a ·01 condenser in parallel the total capacity becomes ·02.

Adjustment

The tone-control is best adjusted on a speaking voice or solo instrument, the true effect not being so marked on a full orchestra, although too much capacity will certainly result in a muffled tone.

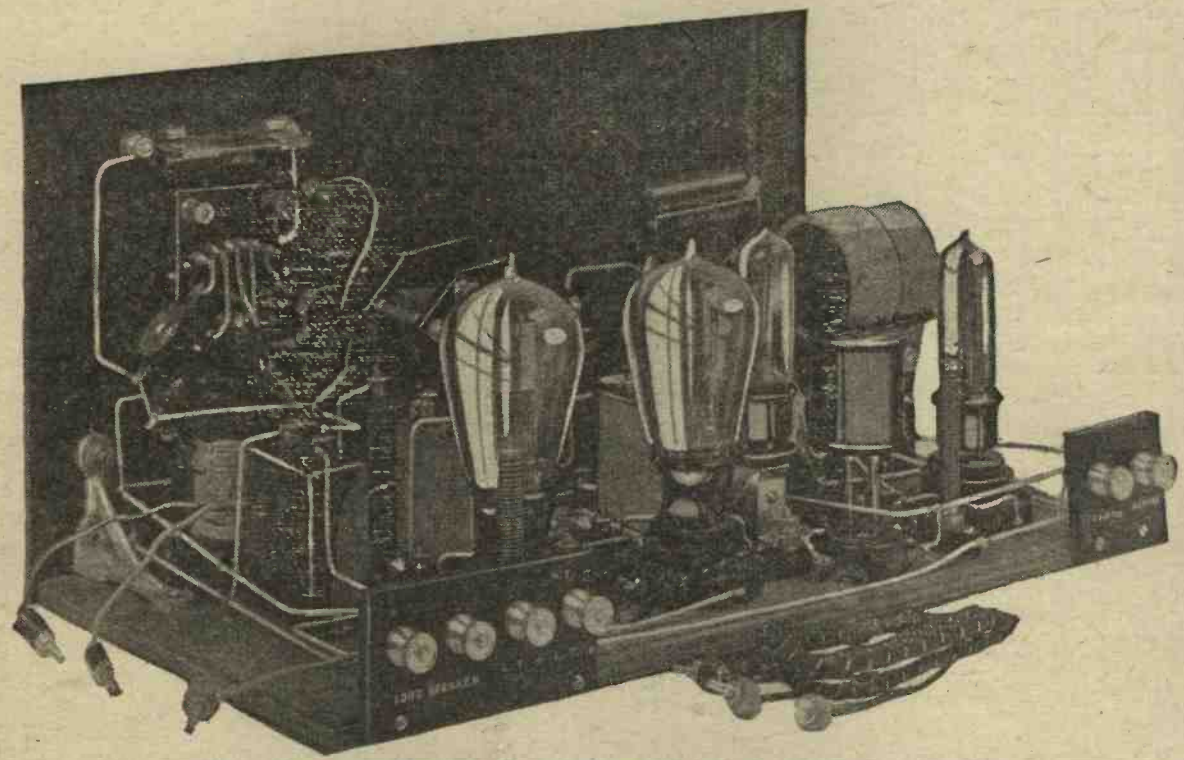
Receiver Tests

The set was tested upon an aerial at a distance of 15½ miles from 2LO. A No. 40 Lissen coil was plugged into the L_1 socket and a No. 60 into L_2.

The valves I employed were V_1 a D.E.3 or B.T.H. B.5, V_2 a D.E.3b, V_3 a D.E.5b, and V_4 a D.E.5. The fixed resistor in series with V_1 and V_2 had a resistance of 7·5 ohms and that in series with V_3 and V_4 a value of ·75 ohms. 60 volts H.T. applied to V_1 and V_2 and 120 volts to V_3 and V_4 gave very good loud-speaking from two instruments joined in series, viz.; a large Brown and a C.A.V. The values of grid-bias were 1·5 volts for V_3 and 7·5 volts for V_4. The set required an H.T. voltage of about 100 applied to the anodes of V_1 and V_2 before self-oscillation occurred.

Daventry

For Daventry a No. 150 coil in the L_1 socket and a No. 250 for L_2 sufficed, a suitable aperiodic transformer being used instead of the 300-600 metre pattern employed for the reception of 2LO.



Note the arrangement of condensers for the tone-control unit.

Circuits that will Not Howl

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

Non-radiating circuits are of particular importance at the present moment and the practicability of certain arrangements is discussed at full length.

CONSIDERABLE interest has been aroused lately concerning the subject of non-radiating circuits. It will be topical therefore, to discuss the practicability of such circuits generally and to review the methods which have been, or can be, adopted to produce such an effect. A non-radiating circuit, of course, is one in which it is possible to apply reaction up to the limit of oscillation, and even beyond, without in any way causing interference to neighbouring reception.

A Miniature Transmitter

A straightforward single-valve reaction receiver does not comply with this condition, because if the reaction coupling is increased beyond the point at which the set commences to oscillate, then continuous high-frequency oscillating currents are produced in the aerial circuit, so that the system acts as a miniature transmitter, and will set up corresponding currents in all the aerials in the vicinity. In other words, it will radiate. If these other aerials are tuned to the same wavelength as that of the interfering aerial, then interference will result, and this is usually evidenced by whistling or howling.

The Need for Reaction

As the same time the use of a reaction control is often extremely useful, it being almost impossible to receive distant stations on a simple type of circuit unless some form of reaction is incorporated in the receiver. Unless, therefore, we are to sacrifice the efficiency of the receiver as a whole, we must devise some means whereby reaction is possible, but any oscillations produced must not be transferred to any appreciable extent into the aerial.

The Early Art of Radio

In the early days of broadcasting an attempt was made to prevent any possible trouble from radiating receivers by only permitting the sale of receiving apparatus which was so designed as to be non-radiating. The art of radio reception was by no means as far advanced in those days, and the only method by which the non-radiating condition could be complied with was by the sacrifice of the efficiency in the receivers.

This, among other causes, ultimately led to the repeal of the limitation, and we passed through an era in which extreme efficiency was the primary object. Practically every receiver during this period was of a radiating character.

The Case of H.F. Amplification

It was found very soon, however, that efficient circuits could be obtained in which the possibility of interference was only comparatively slight, and still more recently we are beginning to arrive at the stage of completely non-radiating circuits, which are every bit as effective, if not more so, as the original pattern of radiating circuit.

Where high-frequency amplification is employed the matter is comparatively simple. All that is necessary is that the reaction adjustment, if any,

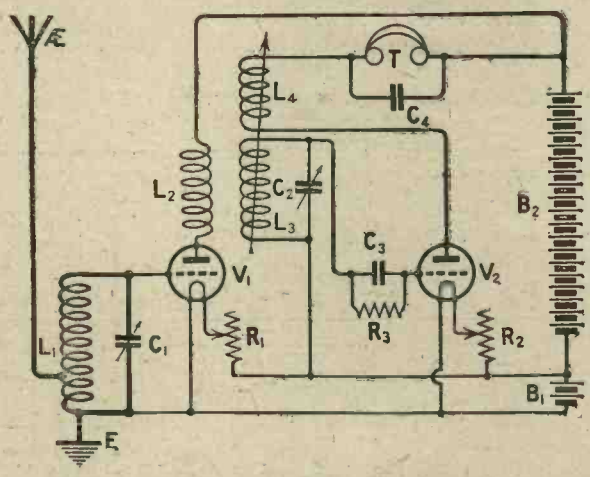


Fig. 1.—Reaction applied to an intermediate stage in the receiver reduces interference.

shall not be applied to the aerial circuit direct, but shall be applied to a later stage of the receiver. For example, a circuit such as that shown in Fig. 1 could be employed.

Here we have a tuned aerial circuit, the voltages developed across the condenser C_1 being applied across the grid and filament of the first valve. The anode circuit of the valve is transformer-coupled to the second valve, the secondary of the transformer being tuned. Reaction is provided by means of a coil coupled to the secondary of this transformer

Interference Reduced

If the circuit oscillates, therefore, the oscillating current takes place in the circuit of the transformer and not in the aerial circuit, so that this circuit may be handled with less danger of interference. Unfortunately, as it stands there are two objections to the circuit. In the first place, the arrangement is not completely non-radiating because any oscillations produced in the circuit L_3 C_2 will

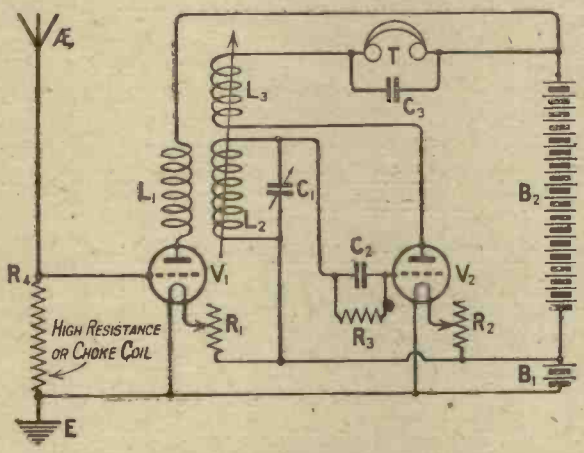


Fig. 2.—A high resistance or choke coil in this aerial enables V_1 to act as a non-return device.

cause current to flow through the capacity between the electrodes of the valve V_1 back into the aerial circuit, and so will cause the radiation of interfering oscillations to one's neighbours.

In the second place, this circuit, as it stands, cannot be made efficient without the danger of sufficient stray coupling between the circuits L_1 C_1 and L_3 C_2 to cause continuous oscillations in both these circuits. If this happens, of course, then the circuit L_1 C_1 will contain violent oscillations, and these will produce considerable radiation with consequent interference.

Overcoming Difficulties

Methods of overcoming these difficulties have been suggested from time to time. Such methods have usually taken the form of introducing a high resistance or a suitable choke coil in the grid circuit of the valve V_1 in place of the tuned circuit L_1 C_1. Fig. 2 shows a circuit of this type, the operation of this circuit being briefly as follows:—Currents are produced in the aerial circuit due to the wireless waves, and these currents flow through the high resistance, or choke, as the case may be, and so cause voltages to be produced across the terminals thereof. These voltages are applied between the grid and filament of the valve, and are amplified in the normal manner.

The energy received in this manner causes currents to be produced in the circuit L_2 C_1, these currents being at a maximum when the circuit is tuned to a particular frequency, so that all the normal properties of the tuning are retained.

A Non-return Device

On the other hand any oscillations which may be set up in the circuit can only be transferred to the aerial via the stray capacity couplings in the valve and its associated leads, and since there is no tuned circuit in the aerial, the energy received by this means can only produce the very feeblest current in the aerial circuit, and so only produce very small radiation. The valve, therefore, acts as a non-return device, permitting energy to be received from the aerial but not permitting any energy in a latter part of the circuit to be transferred back again.

An arrangement such as this, however, only serves to aggravate the second disadvantage of the original circuit considered. That is to say, the tendency to the production of continuous oscillations not under the control of the normal reaction adjustment is overcome in this case by a very distinct loss of efficiency.

Other Solutions

A much better solution of the difficulty, therefore, is to employ a neutralising arrangement on the first valve. Any of the normal neutralising methods may be employed, two suitable circuits being shown in Figs. 3 and 4. The first of these is the "Huntsman" Two circuit, as described by Mr. Percy Harris in the *Wireless Constructor* for March, 1926. Here we have a tuned grid circuit, and a tuned anode circuit with reaction applied to the second circuit. The first valve is correctly

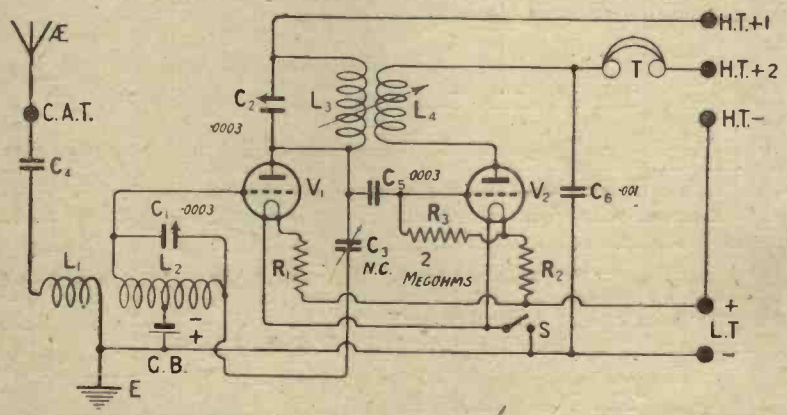


Fig. 3.—The original circuit of the "Huntsman" Two receiver.

neutralised by a split-coil method, so that any tendency towards uncontrollable oscillation is obviated. At the same time the first valve is doing a satisfactory share of the work, and is operating in an efficient manner.

Finally, any oscillations which may be produced in the tuned-anode circuit of the valve cannot affect the aerial circuit in any way. The only manner in which energy can be transferred to the

aerial circuit is by means of the stray capacity coupling existing in the valve, and this is completely neutralised (if the circuit is correctly adjusted) by the feed-back through the neutralising condenser shown.

A Useful Circuit

Another circuit which achieves the same result is that shown in Fig. 4, in which a split-condenser method of neutralising is employed, this latter method having been developed by the Radio Press Laboratories. Here again the first valve is operating efficiently, and if the neutralising arrangement is correctly adjusted there can be no feed-back of energy from the oscillating circuit into the aerial, and reaction may be used as much as desired without any fear of interference.

Correct Adjustment

The important point to note about both these circuits is that they operate best when they are correctly adjusted. In order to obtain the most satisfactory results it is essential that the first valve shall be correctly neutralised. When this is so, no trace of uncontrolled oscillations can be found from top to bottom of the condenser scale. Once the receiver has been adjusted to this condition, it is in a non-radiating state, so that the very adjustments which give the most satisfactory results also achieve the desired non-radiating condition. This is a most important point, because if a non-radiating circuit is required to be inefficient, and if better results can be obtained by permitting the circuit to radiate, then, human nature being what it is, there is a temptation to use the circuit in a radiating state.

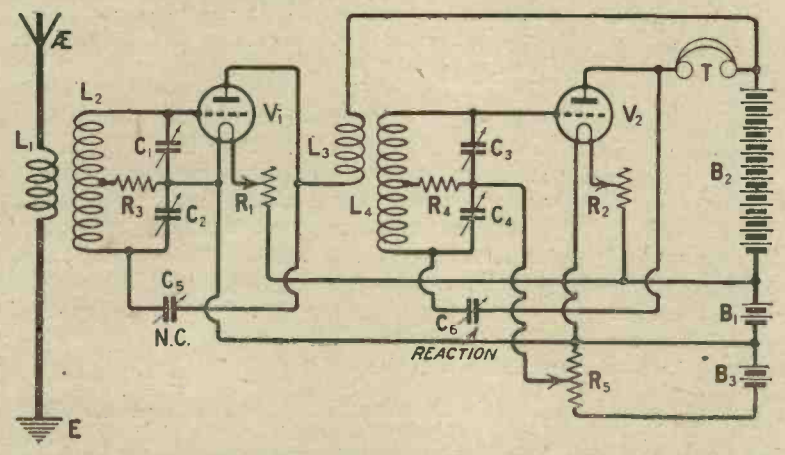


Fig. 4.—A split-condenser method of neutralising developed by the Elstree laboratories.

Other Non-radiating Circuits

Many of the designs of Radio Press receivers which have recently been published have been non-radiating. One has only to glance through the pages of the recent publications to note how many of the circuits employ a neutralised high-frequency stage as the first valve of the receiver. This is the only essential for a non-radiating receiver, and the development at the present time is in the direction of making the neutralising foolproof to a large extent. If this can be done, then there will be little question about the correctness of adjustment of the several circuits, and non-radiating receivers will become a practical proposition.

A Poor Aerial

We see, therefore, that where two or more valves are employed, of which the first is a high-frequency amplifier, a non-radiating receiver is fairly simple to achieve. Moreover, an increasing number of people nowadays are using high-frequency amplification, because it is reaching such a pitch of perfection that a marked improvement in the results is now obtained. With a high-frequency stage one's reception depends very much less on the actual aerial used, and distant stations can be received with comparative ease on quite a poor aerial.

A Difficult Proposition

When one comes, however, to the consideration of single-valve circuits the problem is very much more difficult. We may state the case as follows: — It is necessary to find some arrangement which will receive energy from the aerial and will transfer it to the particular circuit of the receiver. At the same time any energy in the circuit of the receiver must not be transferred back to the aerial. We have just seen that where a separate valve is permissible we have a very convenient non-return action which enables us to comply with these somewhat stringent conditions. With a single-valve circuit, however, we must make the circuit itself supply this non-return action, and it will at once be realised that this is an extraordinarily difficult proposition.

A Triggered Effect

A form of non-radiating circuit, which has been devised by Lea and Ree, is that in which the circuits oscillate at a different frequency from that being received. It is possible to include in the valve circuit two additional oscillating circuits, one in the grid and one in the anode circuit, and so to arrange matters that should the valve start oscillating at the normal frequency being received, then these additional circuits are promptly triggered, as it were, and set in oscillation, whereupon they immediately take control and damp out the normal oscillation.

Operating such a circuit in practice, therefore, one would obtain normal reaction up to the point of oscillation, and the receiver would theoretically show normal sensitivity right up to this point. Assuming the receiver oscillated, however, it would change from the frequency being received to some totally different frequency, and would not cause interference in the vicinity.

From my Notebook

by

H. J. BARTON-CHAPPLE,

Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

Sundry items of technical interest to all our readers.

I WAS interested to see that at a recent debate held at the Royal Society many world-famous scientists were in agreement that a Heaviside layer does exist. As readers probably know, the reason for the travel of wireless waves round the earth's curvature has been attributed to the existence of an upper layer in the atmosphere which is a non-conductor of the electro-magnetic waves.

This theory was first propounded by Oliver Heaviside, and is therefore known by his name, and many important observations have been made to establish experimentally the theory propounded. The exact action is not yet thoroughly understood, but one professor finished his contribution to the discussion by saying that it was necessary either to accept the theory or to assume that the earth was flat!

EXPERIMENTS with crystal amplifiers are still being made by many keen wireless enthusiasts, and I see that a London inventor lays claim to the perfection of a fairly simple means for obtaining results at loud-speaker strength from a crystal set, and it is possible that the apparatus in question will be put on the market in the near future.

Full details are not yet available, but the invention is understood to incorporate a system which makes use of an electro-magnetic relay. This functions even with particularly weak incoming signals, owing to the delicacy of the relay mechanism and an extremely sensitive controlling "tongue."

AFTER wearing headphones for a time while working a receiving set it is frequently found that the ear-cap and diaphragm become covered in moisture. This is liable to cause the diaphragms to rust, and the telephones should be thoroughly wiped after use to remove all trace of the moisture.

If the diaphragms show signs of oxidisation, the ear-caps should be carefully removed and the thin metal discs wiped with a rag which has been preferably soaked in paraffin. A recurrence of the rust can then be prevented by smearing on the outer surface of the diaphragm a thin layer of vaseline.

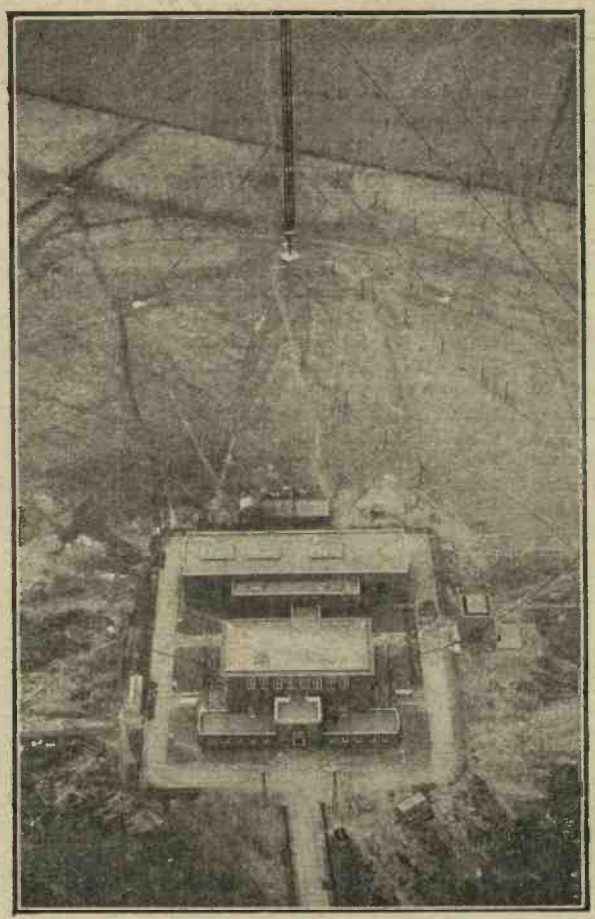
WHEN making tests on any of your wireless instruments, never fail to record the methods you employ, while the results and observations should be made in a note-book of some kind. It is very easy to forget dial settings and readings on any measuring instruments you may use, but if you mark down all the figures a great deal of time will be saved.

FREQUENT insertion and removal of a valve from its holder often causes the ordinary split type of valve pin to become a loose fit in the valve-holder, due to a slight relaxation of tension in the brass legs. Recourse to the usual remedy of opening the pins with a penknife or similar tool sometimes causes one half of the pin to snap off unless great care is taken. This fact led to the development of the leaf pin, and following this a new type of valve leg is making its appearance on the market, which tends to overcome some of the previous difficulties.

A proper spring effect is given by a slightly convex shape, so that a firm contact is secured in the socket, and, in addition, the valve leg is hollowed, which enables the lead from the valve to be passed through the centre of the pin and soldered to it at the tip.

NON-RADIATING circuits are being given a certain amount of prominence again, as the natural outcome of the continued persistence of certain listeners in causing interference by oscillating their receiving sets. In this connection readers should note that Mr. Percy W. Harris described in the March, 1926, issue of the *Wireless Constructor* a sensitive non-radiating two-valve receiver, which he called the "Huntsman" Two.

Tests on this receiver, which were made at our Elstree laboratories, showed that another listener working a set in the same laboratory was not interfered with in the slightest degree by persistent oscillation in the "Huntsman" receiver. The construction of this set is quite simple and advantage is taken of what is known as the "Rice" method of neutralisation in the incorporated design.



The Post Office Station at Rugby as it appears from the top of one of the 820 ft. masts.

A NEW type of apparatus called the "Colloid" battery charger has recently been invented by Monsieur M. Andre, a well-known French scientist. The principle consists of using the properties of unilateral conductivity of certain metals when converted into a colloidal state. The resistance of the valve, which contains no filament, varies from a practically infinite value during one half of a cycle to a zero value during the following half cycle. This property and the very low internal resistance of the valve during the latter half gives a maximum efficiency.

The "Colloid" is a comparatively small instrument, the rectifier being fitted inside a small case, in the interior of which is a transformer for the purpose of reducing the voltage from the mains. The rectifying valve, a test lamp and the battery to be charged are connected to the secondary winding. Outwardly the valve has the appearance of a perforated metallic tube bearing a screw socket at its base, and containing a rectifying cell. The instrument will no doubt be appreciated by amateurs who have A.C. mains, as it is designed for rectifying any alternating current with a voltage of 110/120, 40/60 cycles, and special models for 120/220 volts and 25 cycles are on the market.

THE extent to which radio is reaching out into isolated regions is well illustrated in the case of Greenland. It should not be assumed from this that the inhabitants of this polar region are keen radio fans. It is believed, however, that the installation of radio is an essential for the safety of the many hundreds of fishing vessels which frequent the neighbouring waters. The Danish Government, therefore, working in conjunction with the Government of Iceland, have decided to erect three wireless stations. One of these will be put up on the east coast and will be controlled by Denmark. The other two will be erected on the west and north-west coasts of Iceland respectively.

These stations should prove of international value. In the Greenland area originate many of the atmospheric disturbances which effect the climatic conditions of Europe and America. Thus, as these stations are designed primarily for the transmission of meteorological data, they are of particular importance, and will perform a service to many countries. It has not yet been disclosed what power will be used or what wavelengths and call signs will be allotted, but it is believed their construction will be finished within a month or two.

IN a recent patent taken out by Mr. P. W. Willans a method for the compensation of distortion in low-frequency amplifiers is described, where the valves are coupled by transformers. Reaction is employed between the input and output circuits of the amplifying valves, in order to compensate for the distortion which is indicated as being due to three possible causes, viz., magnetic leakage, alteration of the winding impedance due to self-capacity between the individual turns and variation of impedance as the natural outcome of frequency fluctuations.

As a result of certain experiments carried out at our Elstree Laboratories, a six-valve receiver has been developed, and full details of this set will be given to readers in next month's MODERN WIRELESS.

A Combined Reaction Three-Valve Receiver

by E. H. BERRY.

Provision is made in this receiver to vary both the inductive reaction and capacitative control so that the proportion for smooth reaction may be secured.

COMPROMISE is as essential in the design of a wireless receiver as it is in most things in life. A high degree of selectivity often entails the provision of such a multiplicity of tuning controls and coil tappings that the beginner or even the more advanced constructor and operator is loth to adopt such a design. Where, then, to compromise between great selectivity and many controls and a lower degree of selectivity and one or few controls is the problem which faces all designers.

The degree of selectivity is such that the London station may be eliminated and Bournemouth received at loud-speaker strength, and while this degree of selectivity is not exceptional it nevertheless ensures adequate separation of most of the stations on those wavelengths close to the station being received.

The Reaction Control

The reaction control is noticeably smooth (vide our laboratory report), and the feature of the reaction design is that both the inductive reaction and capacitative control may be varied so that it is easy to obtain the best proportion for smooth reaction. It enables the receiver to be so adjusted that it will not oscillate at all, a position being obtainable where the set is close to the oscillation point with the reaction condenser in its maximum position.

Another Feature

Another feature of the design is its freedom from radiation. Even when the set is oscillating a very small amount of radiation takes place and the minimum amount of annoyance to one's neighbours results.

It is not always desirable to employ three valves, and provision has been made whereby only two may be used.

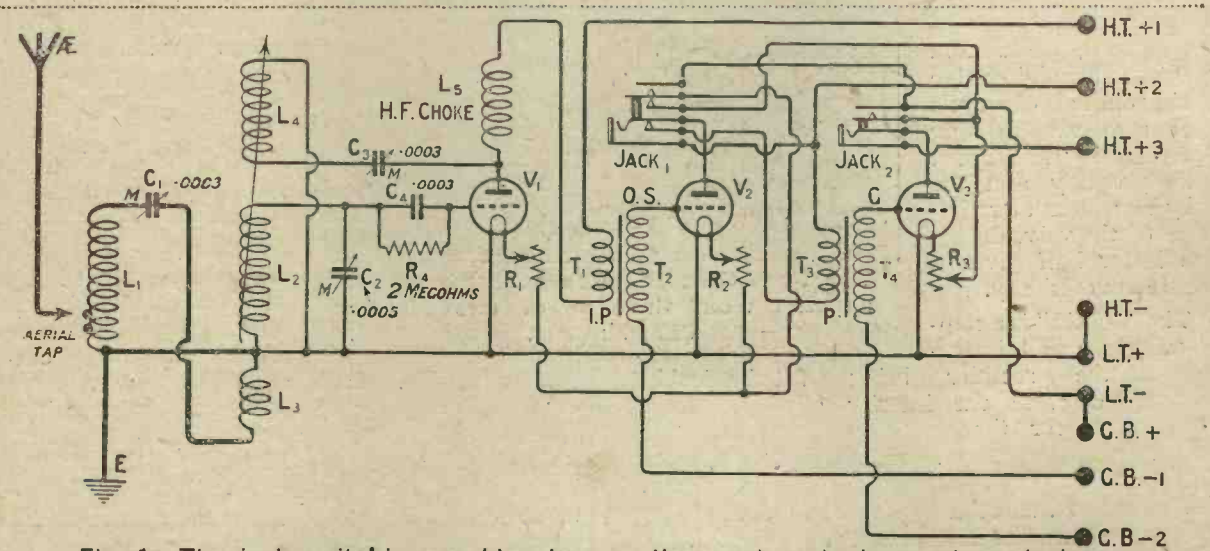


Fig. 1.—The jack switching enables two or three valves to be used as desired.

Two Main Controls

The receiver which is described in this article has three tuning controls, but as one is a fine control of reaction this really reduces the essential tuning controls to two.

The problem of what type of switching to employ is not easy of solution. I have in the past tried various switching devices, but for general efficiency and little complication in the wiring I think that

the plug and jack system has many advantages when utilised in low-frequency circuits.

Transformer coupling has been employed, partly because it offers under certain circumstances as great an amplification per stage as any other form of intervalve coupling, while it is also eminently suited to switching arrangements.

employed, together with the fact that no leads are attached to the front, tends to improve the receiver's appearance.

The Circuit

The circuit (see Fig. 1) is of a modified Reinartz type employing a variable inductive reaction coupling, which is wound round on the rotor of the vario-coupler placed so as to react into the grid coil instead of coupling with the aerial coil. Preceding the three-coil arrangement is a special tuned circuit to increase selectivity, which is of a form suggested by Mr. J. Scott-Taggart in "Wireless," Vol. I., No. 4. This circuit employs a Lissen X coil in series with a ·0003 variable condenser, the whole being placed across the loose-coupled aerial coil of the tuner unit.

A clip is provided from the aerial terminal to clip on to the best tapping of the Lissen X coil, or, if desired, the clip may be attached to one of the connections on the coil-holder for use with an ordinary coil.

The latter arrangement, of course, decreases the selectivity of the circuit. Terminals have been provided for a separate H.T. tapping to each valve and also two grid-bias terminals.

It is usually advisable to make such a provision, as by this means, various types of valves may be used and each one worked most efficiently.

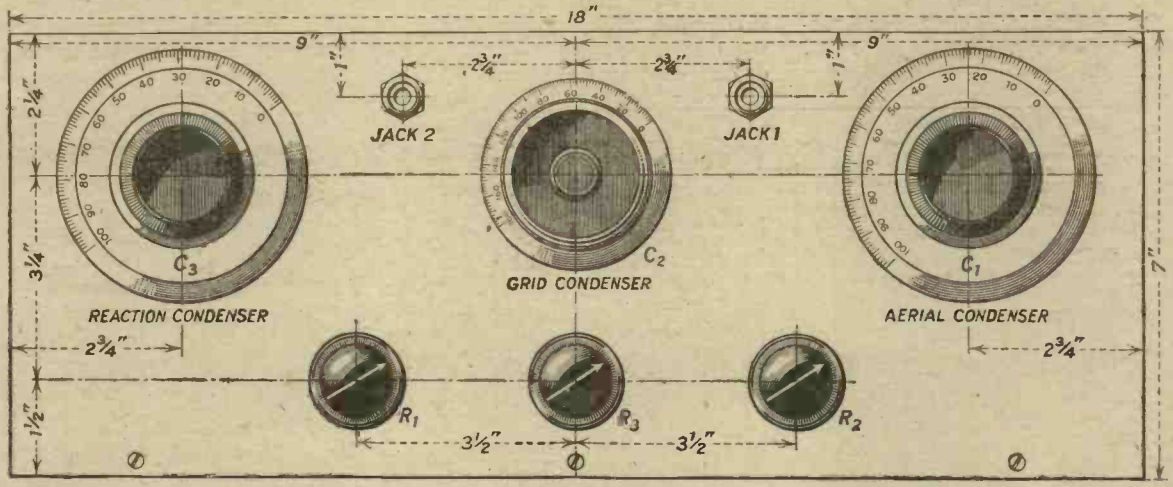
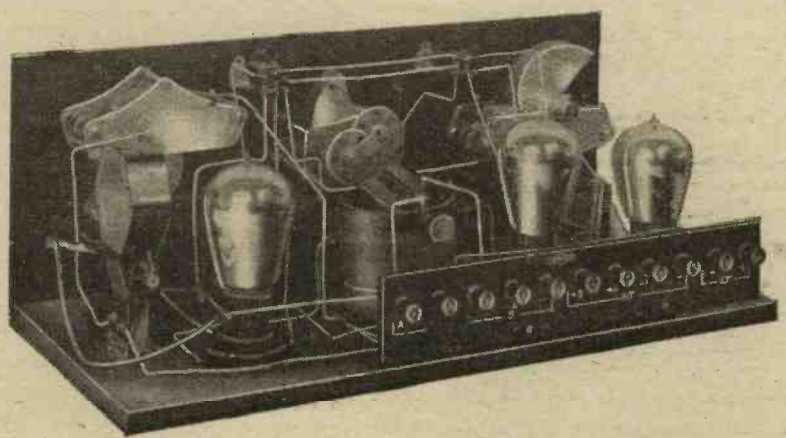


Fig. 2.—Complete panel details may be obtained from this diagram. Blueprint No. 157a may be had for 1s. 6d. post free.

Controlling the L.T. Supply

The jacks used control the filament circuit. On inserting the plug into the jack marked No. 1 two valves are in use, the action of inserting the plug completing the filament circuit and lighting two valves. When the plug is inserted into jack No. 2 all three valves are in use, the three filament circuits being completed by this operation.



The plug-in coil on the left of the receiver is of the "X" type.

Appearance

This feature, therefore, obviates the necessity for a make-and-break switch in the low-tension circuit or the removal of any leads when the set is not required for use.

The photographs will disclose the fact that the panel layout is symmetrical, and the type of cabinet

No reservoir condensers have been included, as in my own case these are incorporated as an essential portion of the H.T. unit.

Components

A list is given here of the actual components incorporated in the set. It should be clearly understood, however, that there exists a large number of equally efficient components which may be employed, the list merely being given for the guidance of those constructors desiring to duplicate the receiver completely.

The usual warning is given that care should be taken when substituting other components to see that they will be suitable for the amount of space allowed.

One cabinet, to take panel 18 ins. by 7 ins., complete with loose baseboard 18 ins. by 8⅝ ins. (Peter Curtis, Ltd.)

One ebonite panel, guaranteed free from surface leakage, 18 ins. by 7 ins. by ¼ in. (British Ebonite Co., Ltd.)

Two ·0003 variable condensers, low loss. (Igranic Electric Co., Ltd.)

One ·0005 "Gecophone" variable condenser, low loss. (General Electric Co., Ltd.)

Three 30-ohm filament rheostats (Yesly Electrical Supplies, Ltd.)

Two jacks. One double-filament type and one single-filament type and plug to fit. (King Quality Products, Inc.)

One Tuner unit. (Burne-Jones and Co., Ltd.)

Three "Lotus" "Buoyancy" valve-holders. (Garnett, Whiteley and Co., Ltd.)

One first-stage low-frequency intervalve transformer. (Gambrell Bros., Ltd.)

One "Erla" concert grand low-frequency intervalve transformer. (C. G. Vokes and Co.)

One coilholder, single, for baseboard mounting. (Burne-Jones and Co., Ltd.)

Construction

No difficulties should be met with in the construction of this receiver, and a few minutes spent in the perusal of the wiring and drilling diagrams in conjunction with the photographs will enable a clear idea of the completed receiver to be obtained.

The Panel and Baseboard

Mark out the panel, using a steel rule and scriber, closely following the dimensions given in the panel drilling diagram of Fig. 2.

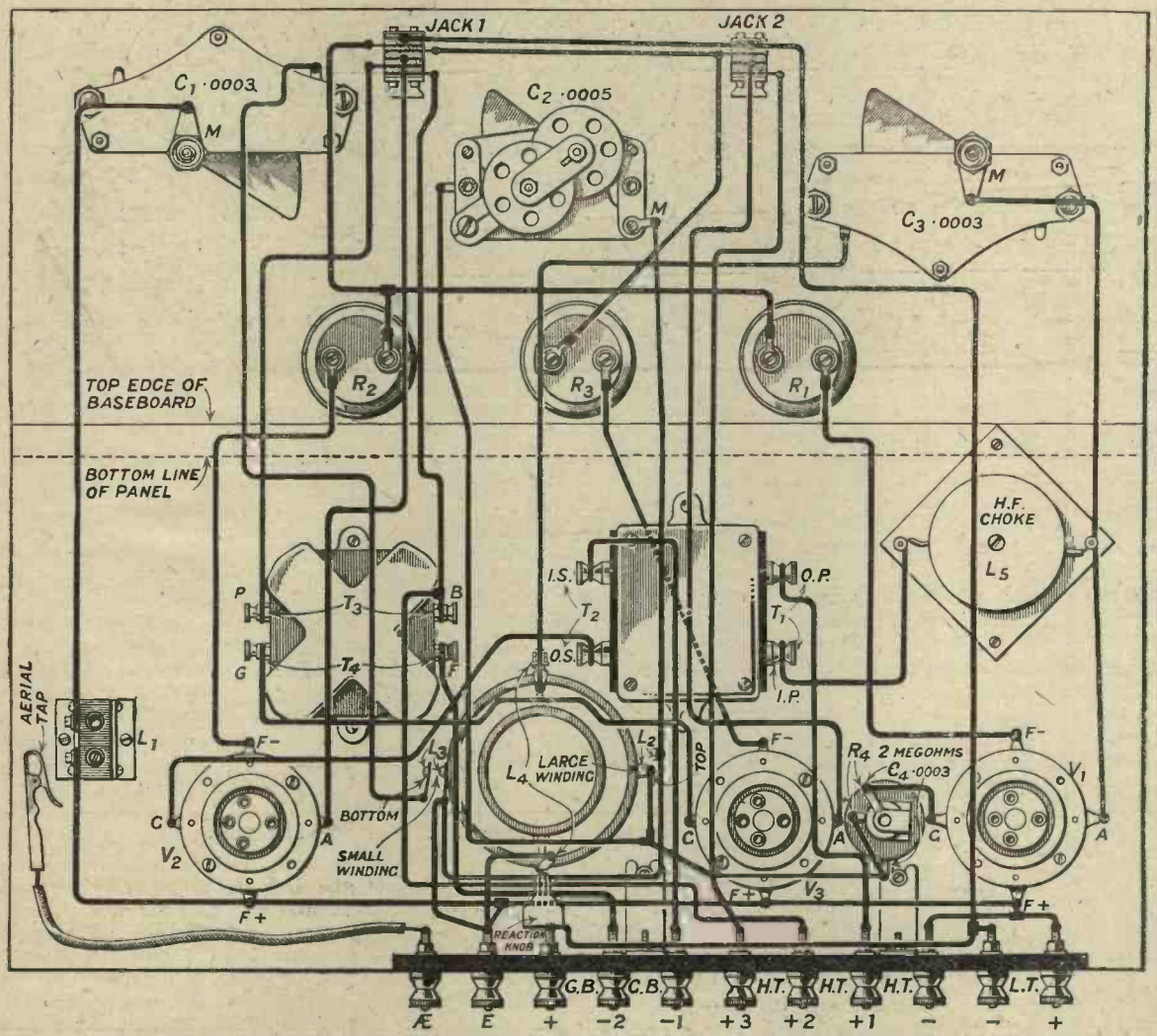


Fig. 3.—The wiring may be followed from this diagram. Readers preferring a blueprint, however, may obtain one, No. 157b, price 1s. 6d. post free.

One "Success" H.F. Choke. (Beard and Fitch, Ltd.)

One Dorwood ·0003 fixed condenser with grid leak clips. (Herbert Bowyer and Co.)

One 2-megohm grid leak. (Dubilier Condenser Co. Ltd.)

One terminal strip, carrying eleven terminals.

One spring clip. (Collett.)

Glazite for connections.

Screws, etc.; small length of flex. Radio Press panel transfers.

The setting out of the baseboard is quite straightforward, and although the receiver is designed to be very compact there is yet ample room for all the components. It will be noticed that one of the filament leads is carried underneath a transformer. It is necessary, therefore, after having mounted all the components to ensure that they are not fouling one another, to remove this transformer.

The layout is a little unconventional, the tuning condenser C_1 being on the right-hand side of the set when facing the panel.

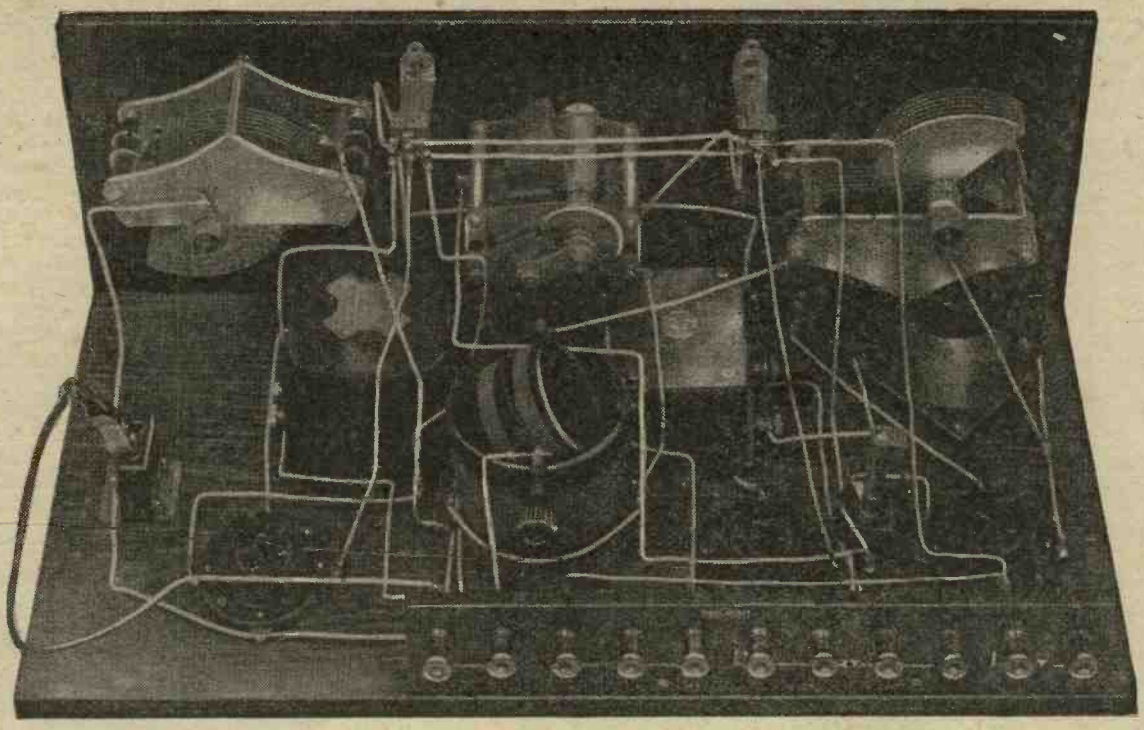
A Departure

The position of the valves on the baseboard is also a departure from the usual arrangement, the middle valve being the second note magnifier, and this should be borne in mind when inserting the valves and adjusting the grid bias and H.T. Also the middle rheostat controls the last valve.

Wiring the Receiver

The wiring diagram, Fig. 3, shows the wiring in the clearest possible manner. As mentioned previously, one of the leads from the rheostat to the valves is taken under the transformer. Wire up the filament circuit first, leaving the connection from L.T. to the top connection of jack No. 2 until the last.

The grid leak and condenser are in parallel, two connections on



The rotor of the tuner unit is the reaction coil in this particular receiver.

the "Dorwood" unit being soldered together. A small leaflet enclosed with the condenser will illustrate which two tags to connect if this is not quite clear from the wiring diagram.

The other wiring should present little difficulty, but before leaving the subject it may be as well to mention that the greatest care should be taken to wire the jack connections exactly as shown in the wiring diagram.

Testing

Before actually working the receiver it is a useful protective test to connect up the L.T. circuit, insert the valves and place the plug into each jack in turn to make sure that the valves light, at the same time trying each filament rheostat. Next connect the L.T. leads to the H.T. terminals in turn, and this indicates—if the valves do not light—that there is no possibility of applying the H.T. voltage across any of the valves, and thus burning out their filaments. Now connect up all the terminals, aerial, earth, grid bias, H.T. and L.T.

About 45 volts should be used on the detector, 90 volts on the first amplifying valve, with about 4½ volts grid bias and, say, 120 volts on the last valve and 9 volts grid bias.

Valves

The receiver works well with all makes of valves, although the best results will be obtained with the power type of valve, such as the Mullard P.M.4 or B.T.H. B.4.

I found the Osram D.E.5b in the detector stage, followed by two D.E.5's in the amplifying stages, gave excellent results.

Reference to the Elstree report will show that the set worked quite well with all the valves tried, including the general-purpose type.

Having inserted suitable valves and taken tappings from the H.T. battery to obtain the recommended voltages, you may now start tuning in your local station.

Tuning Operations

Rotate aerial condenser C_1 together with the grid tuning condenser C_2, setting the variable condenser C_3 to its maximum position. Arrange the reaction coil rotor with its axis at right angles to the axis of the stator, as this gives the minimum reaction coupling.

On hearing the local station rotate the reaction coil until signals are the loudest. This is essential, as both the maximum reaction and reverse reaction positions are obtained when the rotor is concentric with the stator.

Should the receiver go into oscillation rotate the variable condenser C_3 towards its minimum position.

Further Details

The reaction coupling may now be increased while the condenser C_3 is decreased. The most flexible control is usually obtained when the inductive reaction coupling is of such a degree that the set is just off the oscillation point, about two-

Extracts from the Elstree Test Report.

A.—The set worked well with all valves tried, but the D.E.5 type gave the best results. General-purpose valves also worked well.

B.—The reaction control was extremely good, and the idea of being able to vary both the inductive reaction and the capacitative control enabled the best proportion for smooth reaction to be secured.

C.—This receiver was fairly selective, London and Bournemouth being separated.

D.—The stations heard included: London, Bournemouth, Munster and Birmingham on the loud-speaker, with Dublin, Stuttgart and Aberdeen at telephone strength.

thirds towards the maximum setting of the condenser C_3.

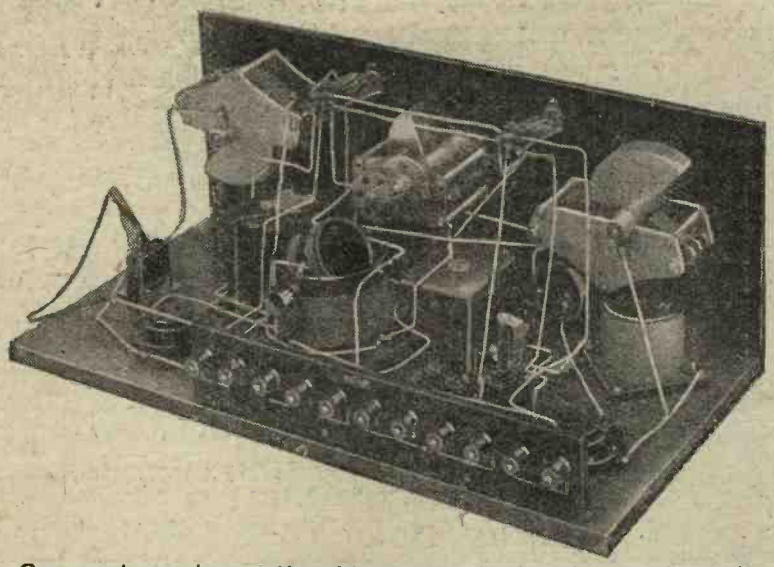
The tuning will be found to be noticeably sharp, and unless care is taken to rotate the dials slowly it is easily possible to miss a station.

It is unnecessary to give any coil values, for the only plug-in coil needed is the Lissen X coil, a No. 50 or 60 usually being found the most suitable.

Test Report

This receiver when tested on my own aerial, situated about a mile from 2LO, gave loud-speaker results on London, Bournemouth, Birmingham and another station which did not give its call sign. Bournemouth was received with a background of London, which was more or less to be expected in view of the close proximity to 2LO.

Because of limitations of space and accommodation my own aerial and earth system is very far from ideal, especially for the reception of the more distant stations.

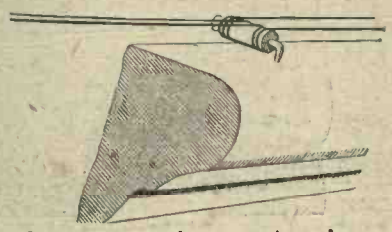


Compactness is a noticeable feature in this three-valve set.

Loud-speaker extension leads.

RATHER than move a complete receiving set from one room of a house to another room, it is better to run a pair of long leads for the loud-speaker from the set to the room in which it is desired to employ the loud-speaker. There are of course various ways of accomplishing the necessary wiring, but the following method recently used by the writer will perhaps appeal to others by reason of its cheapness and ease of construction.

The leads are of No. 22 copper enamelled wire and are placed so as to be almost invisible behind the picture rail which runs round the room in which the wireless set is used. To hold the two wires in position, a number of half-inch nails were employed. These nails were driven into the picture rail on the wall side and as near to the wall as possible. After being driven in vertically, they were carefully bent over so as to be almost horizontal, and each nail was then covered with a small piece of stout rubber tubing. To secure the wire leads, each wire was twisted twice round the rubber-covered nail and made to grip the rubber firmly, the wires being kept about a quarter of an inch apart on the nails.



Loud-speaker extension leads can be conveniently accommodated behind the picture rail.

It is possible to run leads in this way for a considerable distance and arrange them so that the leads are out of sight except where they have to pass through a doorway.

E. H. C.

AN IMPORTANT ANNOUNCEMENT.

Make a note of it in your diary.

THE Radio Press Laboratories have developed a particularly efficient six-valve receiver which has been called "The Elstree Six," and full constructional and operating details will be given to our readers in the June issue of MODERN WIRELESS.

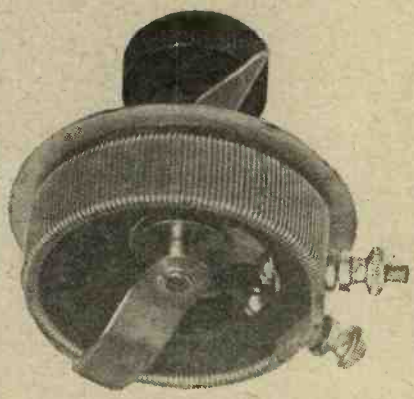
A brief summary of its salient features is as follows:—

1.—Absolutely stable from 150 to 5000 metres without alteration of the neutralising condensers.

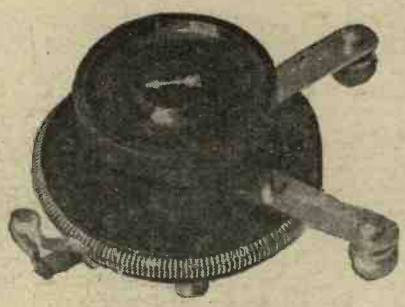
2.—All the B.B.C. main and relay stations together with the Continental stations can be received. On a number of occasions at Elstree all the relay stations have been received in broad daylight.

3.—All condenser dial readings are identical.

4.—The selectivity is such that Manchester is free from London at a distance of 1½ miles from 2LO. Cardiff has a very faint background of 2LO.



A Chat on Filament Resistances



By PHILIP H. WOOD, B.Sc. (Hons.), F.P.S.L.

Although often neglected, filament resistances are important components in a receiver, and this interesting article emphasises their particular features.

THE filament resistance occupies a somewhat curious place among its fellow components in the receiving set. Its function is to control the current passing through the filament of the valve by varying the resistance in the low-tension circuit, thereby regulating the temperature of the filament and the electron emission. It may, therefore, be regarded as taking no part in the actual tuning and reception, but as acting in the capacity of a restraint or control upon one particular unit, namely, the valve.

A Filament Rheostat

Most of the filament resistances now in use are of variable type and are commonly known as rheostats. Now, strictly speaking, *all* variable resistances are rheostats—a potentiometer or variable grid leak is as much a rheostat as a variable filament resistance, so that it is both convenient and technically correct to call a variable filament resistance a *filament rheostat*.

A Suitable Value

Now, as stated above, the filament rheostat must be of such a resistance that it introduces into the filament circuit of the valve sufficient additional resistance to reduce the current passing to the requisite value; or, in other words, to "drop" the battery voltage to the value specified for the valve in use.

Finding the Valve Resistance

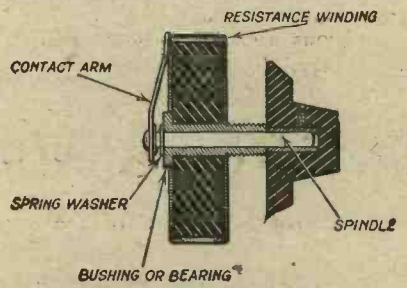
The filament of the valve itself has a certain resistance, and this must be taken into account when calculating the additional resistance necessary to reduce the voltage drop across the filament to its correct value. The valve resistance may be calculated easily from the Ohm's Law expression that

$$\text{Resistance (ohms)} = \frac{\text{Voltage in volts.}}{\text{Current in amperes.}}$$

Hence if the rated voltage of the valve is divided by the rated current consumption then the result is the resistance of the valve filament. To take an example, the resistance of a 3-volt ·06 ampere valve is 3 ÷ ·06 = 50 ohms.

The Total Value

Now suppose a battery of higher voltage than that required by the valve is to be used for heating the filament. It will be necessary to use a larger total resistance to reduce the current passing to the rated value, and applying the Ohm's Law relationship again it will be seen that the *total* resistance necessary is obtained by dividing the battery voltage by the rated current.



A spring wasner will improve the contact between the arm and the bearing.

But part of this total resistance is already provided by the resistance of the valve filament itself, so that the minimum resistance of the filament rheostat that must be included in the circuit is found by subtracting the valve resistance from the total necessary resistance.

The Extra Resistance

It is obvious, however, since both of the expressions used have the same denominator (the rated current) that they can be combined and the final simplified formula is:—

$$\text{Extra resistance necessary} = \frac{\text{Battery voltage} - \text{Rated voltage.}}{\text{Rated current.}}$$

That is to say, the filament rheostat must have a resistance equal to the difference between the battery and rated voltages divided by the rated current consumption of the valve. To take an example, suppose one wishes to work a 2·8 volt ·06 ampere valve from a 4-volt accumulator. Here the difference between the battery voltage (4) and the rated voltage (2·8) is 1·2 volts, the rated current is ·06 amp., hence the resistance of the filament rheostat must be at least 1·2 ÷ ·06 = 20 ohms to avoid over-running the filament.

Suggested Values

In practice it is advisable to have a rheostat with a resistance rather higher than the minimum required, so that the valve may be "turned down" slightly if desired. Overleaf is a table giving the resistance values necessary in order to work various types of valves from dry cells and accumulators, together with the filament rheostat recommended.

The First Consideration

When a rheostat is to be purchased the first consideration must be its resistance, which should be suited to the valve and battery in use. Here the appended table will

prove of use in most cases, but since it is impossible to list all kinds of valves, the formula given previously may have to be employed to find the resistance suitable when a valve of somewhat uncommon rating is employed.

The values given in the last column of the table need not be strictly adhered to, although the filament rheostat should have a resistance not less than that recommended for the particular case. Again, it is inefficient to use a high-resistance component where one of considerably lower resistance will suffice, since it means that it is necessary to work on only a small section of the resistance winding, and fine control becomes impossible.

Overheating

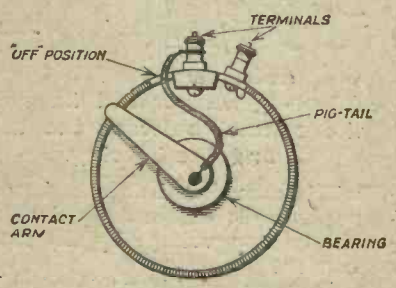
This question has another bearing, too, as the high resistance rheostats are wound with fine wire incapable of carrying the heavy current demanded by, say, a bright-emitter valve. As a general rule it is not advisable to employ a "dull-emitter" type of rheostat with any valve taking more current than, say, a third of an ampere. Slight heating of the resistance windings of a rheostat does little harm unless the hot wire comes in contact with an ebonite moulding or panel, in which case the ebonite may suffer.

The resistance winding is well protected in this particular rheostat.

Valve Rating.		Battery in use.	Minimum extra resistance required.	Rheostat recommended.
Voltage in volts.	Current in amps.			
5–5·5	·7	6 v. accum. ...	·7 ohm ...	3 or 5 ohms.
5–5·5	·25	6 v. accum. ...	2 ohms ...	5 or 7 ohms.
5·5–6	·12	6 v. accum. ...	4 ohms ...	10 ohms.
5·5–6	·06	6 v. accum. ...	8 ohms ...	15 ohms.
4	·7	4 v. accum. ...	—	3 or 5 ohms.
		6 v. accum. ...	3 ohms ...	5 or 7 ohms.
3·7	·1	4 v. accum. ...	3 ohms ...	5 or 7 ohms.
		4·5 v. dry cells ...	8 ohms ...	15 ohms.
		6 v. accum. ...	23 ohms ...	30 ohms.
3·5–4	·06	4 v. accum. ...	8 ohms ...	15 ohms.
		4·5 v. dry cells ...	17 ohms ...	20 ohms.
3	·06	4 v. accum. ...	17 ohms ...	20 ohms.
		4·5 v. dry cells ...	25 ohms ...	30 ohms.
2·8	·06	3 v. dry cells ...	3·3 ohms...	5 or 7 ohms.
		4 v. accum. ...	20 ohms ...	25 or 30 ohms.
		4·5 v. dry cells ...	28 ohms ...	30 ohms.
2	·3	2 v. accum. ...	—	3 or 5 ohms.
1·8	·35	2 v. accum. ...	·6 ohm ...	3 or 5 ohms.
1·8	·12	2 v. accum. ...	1·7 ohms	5 ohms.
		3 v. dry cells ...	10 ohms	15 ohms.
1·1	·25	1·5 v. dry cell ...	1·6 ohms	3 ohms.
		2 v. accum. ...	3·6 ohms	5 ohms.

Questions of Design

Once the question of the resistance required has been settled, consideration may be given to the design of the rheostat. The majority of wirewound filament rheostats are circular in form, a contact arm of springy brass or copper being mounted on a spindle at the centre so as to follow the resistance windings when rotated. In some other types the contact arm is fixed, while the winding rotates.



An unsatisfactory rubbing contact can be cured by adding a "pigtail" connection.

Types of Winding

The resistance winding itself can be made as a spiral to form a kind of self-supporting tube, which can be laid in a groove cut in the disc, drum or bobbin of the rheostat, or it can be wound under tension on to a fibre strip, the strip being afterwards bent to the requisite circular shape. Another form consists of a plain bobbin with a specially shaped spiral wire contact arm.

Points to Note

Careful examination of the windings should be made, and the following points noted. If the winding is of spiral self-supporting form it should be fitted into a groove which is of adequate depth to keep it firmly in position and afford reasonable protection from damage, while the wire should be sufficiently strong and springy to bear the contact arm without flattening under the pressure. The turns should be of equal diameter and evenly wound.

In the case of the "strip" form, the fibre former should be tough and the windings equally spaced and firmly fixed so that they are not displaced or dragged aside by the motion of the contact arm.

The "Off" Position

There should be a definite "off" position at one end of the arm's travel, with a slight tapering of the winding (except in the flat strip type) to allow the arm to slide gently on to the wire when re-engaged without causing damage.

As for the arm itself, it may take one of a number of forms, but should be springy enough to make firm and *continuous* contact with the resistance element over the whole of its path. The pressure should not be so strong as to deform or cause undue wear of the wire windings, however, and some means of adjustment of the tension should be available.

Remedying a Loose Joint

Frequently the arm is tightly fastened to the spindle and electrical connection is made to it *via* the metal bushing, which forms a bearing for the latter. A loose joint between arm and spindle can often be remedied with a little solder, while if a nut provides the method of fixing the remedy is obvious.

A Good Fit

The spindle should be a good fit in the bushing used as a bearing, and it is often an advantage if a spring washer is interposed between the contact arm and the bushing to ensure a good electrical contact between the two. It is quite an

easy matter to fit a short insulated flexible " pig-tail " connection here, and an unsatisfactory rubbing contact between spindle and bushing can be cured in this manner. This idea seems worthy of note, although the writer has never seen it carried out, except on his own apparatus. The bearings should be sufficiently long to prevent side-play or " wobble " of the spindle.

A Desirable Feature

Returning to the contact arm itself, smoothness of operation is a very desirable feature. A " noisy " rheostat, which produces a grating sound in the headphones when adjusted, is decidedly objectionable, and no remedy suggests itself. However, if the contact is rotated two or three times when purchasing, a very good idea of the relative smoothness of operation may be obtained, the contact tension tested, and the behaviour of the windings under pressure noted.

Soldering Tags or Terminals

The general arrangements provided for making connections should be studied—good soldering tags will be useful if the rheostat is to be permanently incorporated in a set, but screws or terminals are often handiest for general use, provided that they are of reasonable size.

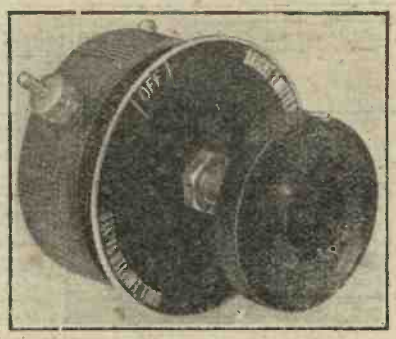
Dual Rheostats

Dual rheostats seem much in demand nowadays, and they are exceedingly useful where one still uses bright emitters on occasion. Two windings are provided in this component, one of fine wire for the dull-emitter type of valve and the other of heavier gauge wire for bright emitters. These windings are usually of about 25 and 6 ohms resistance respectively, and are joined by a bridge piece or by some sort of gap which gives an indication of the point where the contact arm is about to pass from one winding to the other.

When using dull-emitter valves enclosed in the modern type of cabinet it is essential that one should be aware of the fact that one is leaving the high resistance portion of the rheostat, and it should be possible to feel the change-over quite distinctly.

A Difficulty

Except for this point the same remarks apply to both dual and ordinary forms of filament rheostats and to potentiometers. It is difficult to give advice regarding carbon-compression and other non-wire types of rheostat. Those of reputable make are excellent, and if one keeps to the well-known brands they can be used with confidence, although they cannot be examined in any detail owing to their construction.



Dual rheostats are useful where both dull- and bright-emitter valves are used.

One-hole Fixing

Most filament rheostats make use of the one-hole method of fixing, and since they are comparatively small this means of mounting is quite satisfactory. A clearly-marked dial is a great asset, especially where no master-switch is employed and each individual rheostat has to be adjusted every time the set is to be brought into use.

Trouble may be experienced by the knob or dial turning on the spindle and so nullifying any readings which may have been taken. If a grub screw is used to fasten the knob a small flat filed on the spindle will provide a good bearing for the end of the grub-screw and prevent the fault mentioned.

Results of Long Use

Other faults which may occur after prolonged use may often be cured. A new contact arm can easily be made, while a bad contact can be improved by bending the arm to press more firmly on the windings. A break in the windings can often be mended with the aid of a little solder, although the job is somewhat tricky.

The wire windings of discarded filament rheostats should be preserved, as the coiled wire can be used to make fixed resistors for use with dull-emitter valves.

Summary

To sum up, the chief points to be noted are as follows :—

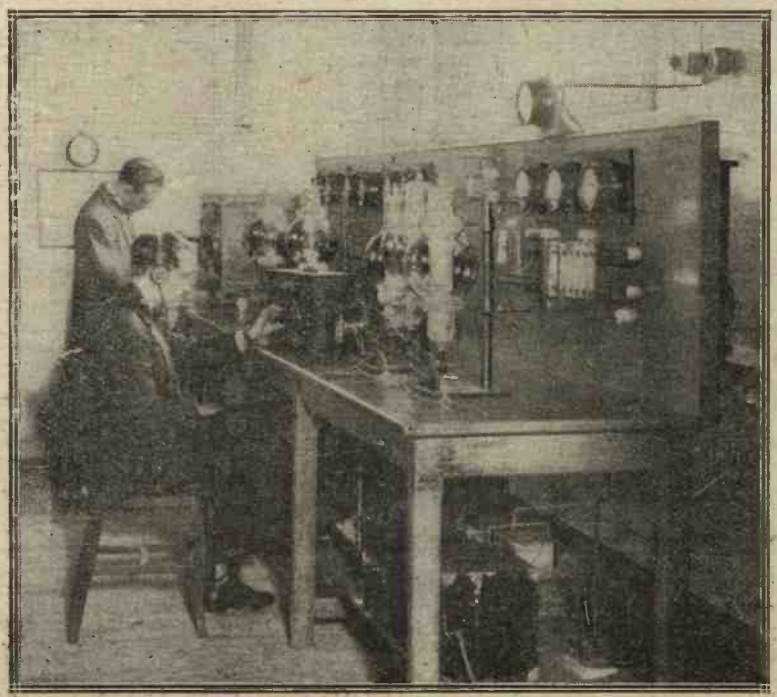
Resistance of value to suit valves and batteries in use.

Windings firm and not easily displaced.

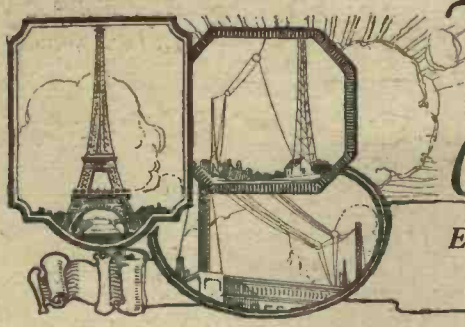
Smooth and positive contact between windings and arm over whole range.

Definite " off " position desirable.

Reliable connection to moving element.



Engineers at work on the control-board of the Radio Paris station, Boulevard Haussmann.



Regular Programmes from Continental Broadcast Stations

Edited by CAPTAIN L. F. PLUGGE, B.Sc., F.R.Ae.S., F.R.Met.S.

Time reduced to British Summer Time.

Corrected up to May 1st, 1926.

WEEKDAYS.

B. S. T.	Name of Station.	Call Sign and Wavelength.	Closing Time or Approx. Duration.
a.m.			
7.40	Eiffel Tower	FL 2650 m.	5 mins.
9.2	Eiffel Tower	—— 2650 m.	3 mins. Sp.
10.23	Eiffel Tower	—— 2650 m.	5 mins. Sp.
10.40	Radio Paris	CFR 1750 m.	10 mins.
10.40	Hilversum	NSF 1050 m.	10 mins.
11.0	Eiffel Tower	FL 2650 m.	20 mins.
11.20	Eiffel Tower	—— 2650 m.	10 mins.
12.14	Eiffel Tower	—— 2650 m.	10 mins.
p.m.			
12.30	Radio-Paris	CFR 1750 m.	2 p.m.
12.57	Nauen	POZ 3000 m.	8 mins. Sp.
3.0	Eiffel Tower	FL 2650 m.	20 mins.
4.0	Zurich	—— 513 m.	6 p.m.
4.45	Eiffel Tower	—— 2650 m.	15 mins.
4.45	Radio-Paris	CFR 1750 m.	1 hour.
5.0	Kiev	—— 780 m.	7 p.m.
6.0	Leningrad	—— 940 m.	9 p.m.
6.0	Warsaw	—— 380 m.	8 p.m.
6.15	Frankfurt	—— 470 m.	8.15 p.m.
6.30	Stuttgart	—— 446 m.	7.30 p.m.
6.30	Radio-Castilla	EAJ4 340 m.	8.30 p.m.
6.30	Union-Radio	EAJ7 373 m.	8.30 p.m.
6.30	Eiffel Tower	FL 2650 m.	7.30 p.m.
6.30	Moscow	—— 451 m.	8 p.m.
6.40	Brunn	—— 521 m.	9 p.m.
7.0	Hamburg	ha 392 m.	8 p.m.
7.0	Leipzig	—— 452 m.	8 p.m.
7.0	Radio-Barcelona	EAJ1 325 m.	8 p.m.
7.15	Oslo	—— 382 m.	8 p.m.
7.30	Stockholm	SASA 428 m.	11 to 12 p.m.
7.30	Munich	—— 488 m.	11 p.m.
8.0	Radio-Vizcaya, Bilbao	EAJ11 418 m.	11 p.m.
8.0	Stuttgart	—— 446 m.	11 p.m.
8.0	Goteborg	SASB 286 m.	10.30 p.m.
8.0	Malmo	SASC 270 m.	10.30 p.m.
8.0	Sundsvall	SASD 545 m.	10.30 p.m.
8.0	Boden	SASE 1200 m.	10.30 p.m.
8.0	Oslo	—— 382 m.	10 or 12 p.m.
8.0	Hamburg	ha 392 m.	11 p.m.
8.0	Lausanne	HB2 850 m.	9.30 p.m.
8.0	Copenhagen	—— 347.5 m.	1 to 3 hrs.
8.0	Radio-Cadiz	EAJ3 357 m.	10 p.m.
8.0	Berne	—— 435 m.	11 p.m.
8.0	Radio-Wien	—— 531 m. and 582.5 m.	10.30 p.m.
8.0	Prague	—— 368 m.	10.30 p.m.
8.0	Radio-Paris	CFR 1750 m.	10 p.m.
8.0	Agen	—— 318 m.	15 mins.
8.0	Eiffel Tower	FL 2650 m.	10 mins.
8.10	Hilversum	NSF 1050 m.	10.40 p.m.
8.15	Konigsberg	—— 463 m.	10.15 p.m.
8.15	Zurich	—— 513 m.	10 p.m.
8:15	Leipzig	—— 452 m.	10 p.m.
8.15	Frankfurt	—— 470 m.	11 p.m.
8.15	Breslau	—— 418 m.	10 p.m.
8.15	Radio-Belge	SBR 264 m.	10.10 p.m.
8.30	Radio Toulouse	—— 430 m.	11 p.m.
8.30	Ecole Sup. des Postes	FPTT 458 m.	11 p.m.
8.30	Munster	ms 410 m.	10.45 p.m.
8.30	Budapest	—— 560 m.	12 p.m
8.40	Rome	1RO 425 m.	11 p.m.
8 45	Geneva	—— 760 m.	10 p.m.
8.45	Royal Dutch Meteorolog. Inst.	KNML 1100 m.	5 mins.
9.0	Soro	—— 2400 m.	9.30 p.m.
9.0	Milan	1MI 320 m.	11 p.m.
9.0	Voxhaus	b 504 m. and 571 m.	midnight
9.0	Konigswusterhausen	AFT 1300 m.	midnight
9.0	Radio-Cartagena	EAJ 16 335 m.	11 p.m
9.10	Eiffel Tower	FL 2650 m.	11 p.m.
10.0	Radio-Barcelona	EAJ1 325 m.	2 to 3 hours
10.0	San-Sebastian	EAJ8 343 m.	11 p.m.
10.0	Radio Club Sevillano	EAJ5 357 m.	11.30 p.m.
10.0	Radio-Catalana	EAJ13 462 m.	1 a.m.
10.30	Radio-Iberica	EAJ6 392 m.	2 to 3 hours
10.30	Union-Radio	EAJ7 373 m.	1 a.m.
11.10	Eiffel Tower	FL 2650 m.	5 mins.
11.44	Eiffel Tower	—— 2650 m.	3 mins. Sp.
12.57	Nauen	POZ 3000 m.	8 mins. Sp.
a.m.			
1.0	Radio-Cadiz	EAJ3 357	half-hour.

SUNDAYS.

B. S. T.	Name of Station.	Call Sign and Wavelength.	Closing Time or Approx. Duration.
a.m.			
7.40	Eiffel Tower	FL 2650 m.	10 mins.
9.2	Eiffel Tower	—— 2650 m.	5 mins. Sp.
10.23	Eiffel Tower	—— 2650 m.	3 mins. Sp.
11.10	Hilversum	NSF 1050 m.	12.10 p.m
11.30	Konigswusterhausen	AFT 1300 m.	12.30 p.m
p.m.			
12.14	Eiffel Tower	FL 2650 m.	10 mins.
12.30	Radio-Toulouse	—— 430 m.	5 mins.
12.45	Radio-Paris	CFR 1750 m.	1.45 p.m.
12.57	Nauen	POZ 3000 m.	8 mins. Sp.
3.0	Radio-Luxembourg.	—— 1200 m.	3.30 p.m.
3.10	Hilversum	NSF 1050 m.	5.10 p.m.
5.0	Radio-Castilla	EAJ4 340 m.	7 p.m.
5.40	Bloemendaal	—— 315 m.	2 hours
6.0	Leningrad	—— 940 m.	9 p.m.

B.S.T.	Name of Station.	Call Sign and Wavelength.	Closing Time or Approx. Duration.
	SUNDAYS (Contd.).		
6.0	Malmö	SASC 270 m.	8 p.m.
6.0	Warsaw	—— 380 m.	8 p.m.
6.15	Zurich	—— 513 m.	7.30 p.m.
6.25	Hilversum ..	NSF 1050 m.	8 p.m.
6.30	Eiffel Tower ..	FL 2650 m.	8 p.m.
6.40	Brunn	NSF 521 m.	9 p.m.
7.0	Hamburg ..	ha 392 m.	8 p.m.
7.0	Radio-Barcelona	EAJ1 325 m.	7.30 p.m.
7.0	Breslau	—— 418 m.	11 p.m.
7.0	Helsingfors ..	—— 318 m. and 522 m.	9.30 p.m.
7.30	Voxhaus ..	b 504 m. and 571 m.	midnight
7.30	Munich	—— 488 m.	10.30 p.m.
7.30	Konigsberg ..	—— 463 m.	10 p.m.
8.0	Oslo	—— 382 m.	midnight
8.0	Berne	—— 435 m.	11 p.m.
8.0	Prague	—— 368 m.	10.30 p.m.
8.0	Copenhagen ..	—— 347.5 m.	10.30 p.m.
8.0	Radio-Wien ..	—— 531 m. and 582.5 m.	10.30 p.m.
8.0	Lausanne ..	HB2 850 m.	9.30 p.m.
8.0	Hamburg ..	ha 392 m.	11 p.m.
8.0	Stuttgart ..	—— 446 m.	11 p.m.
8.0	Radio-Cadiz ..	EAJ3 357 m.	10 p.m.
8.0	Budapest ..	—— 560 m.	midnight
8.0	Munster ..	ms 410 m.	11 p.m.
8.0	Radio-Agen ..	—— 318 m.	15 mins.
8.0	Radio-Paris ..	CFR 1750 m.	10.45 p.m.
8.0	Eiffel Tower ..	FL 2650 m.	10 p.m.
8.15	Zurich	—— 513 m.	10 p.m.
8.15	Geneva	—— 760 m.	1 hour
8.15	Leipzig	—— 452 m.	10 p.m.
8.15	Radio Belge ..	SBR 264 m.	10.10 p.m.
8.30	Ecole Superieure	FPTT 458 m.	11 p.m.
8.30	Radio Toulouse	—— 430 m.	11 p.m.
8.30	Bilbao	EAJ9 415 m.	9.30 p.m.
8.30	Frankfurt ..	FL 470 m.	12 p.m
8.40	Rome	1RO 425 m.	11 p.m.
8.50	Hilversum ..	NSF 1050 m.	10.30 p.m.
9.0	Milan	1MI 320 m.	11 p.m.
9.0	Soro	—— 2400 m. 1500 m. and 1150 m.	9.30 p.m.
9.0	Radio-Cartagena	EAJ16 335 m.	11 p.m.
9.15	Petit-Parisien ..	—— 333 m.	10.30 p.m.
10.0	Radio-Club-Sevillano	EAJ5 357 m.	12 p.m.
10.0	San-Sebastian ..	EAJ8 343 m.	12 p.m.
10.0	Radio-Catalana	EAJ13 462 m.	midnight
11.0	Radio-Iberica ..	EAJ6 392 m.	2 hours
11.0	Union-Radio ..	EAJ7 373 m.	2 a.m.
11.44 a.m.	Eiffel Tower ..	FL 2650 m.	3 mins. Sp.
12.57	Nauen	POZ 3000 m.	8 mins. Sp.

B.S.T.	Name of Station.	Call Sign and Wavelength.	Situation.	Nature of Transmission.	Closing Time or Approx. Duration.
		SPECIAL DAYS.			
5.0	Radio-Belgique	SBR 264 m.	Brussels ..	Tues., Thurs., and Sat., Concert, followed by News.	6 p.m.
6.15	Rostow	—— 1000 m.	Russia ..	Weekdays except Tuesday. Lectures ..	7.15 p.m.
7.0	Nijni Novgorod	—— 860 m.	Russia ..	Tues. and Thurs. Concert and Opera ..	11 p.m.
7.0	Sokolniki ..	—— 90	Russia ..	Mons., Weds. and Fri., experimental Transmissions.	8.30 p.m.
8.30	Ryvang	—— 1150 m.	Denmark ..	Tues., Wed. and Sat. Concert	10.30 p.m.
8.30	Le Matin ..	CFR 1750 m.	Paris	Saturday, Special Gala Concert	11 p.m.
9.15	Petit-Parisien ..	—— 333 m.	Paris	Tues., Thurs. and Sat., Concert (Items announced in English as well as French)	11 p.m.
10.30	Radio-Luxembourg	—— 1200 m.	Luxembourg	Thursdays, Dance Music	11.30 p.m.
11.0	Oslo	—— 382 m.	Norway ..	Saturday, Dance Music from Hotel Bristol	midnight

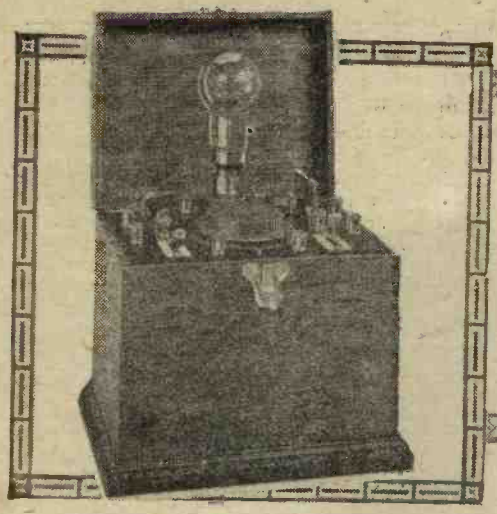
The following are relay Stations :—

Cassel, 273.5 m., 1.5 kw., relays Frankfurt.
Elberfield, 259 m., 1.5 kw., and Dortmund, 283 m., 1.5 kw., relay Munster.
Nuremberg, 340 m., 1.5 kw., relays Munich.
Gleiwitz, 251 m., 1.5 kw., relays Breslau.
Stettin, 241 m., 0.45 kw., relays Voxnaus.
Dresden, 294 m., 1.5 kw., relays Leipzig.
Bremen, 277 m., 1.5 kw., and Hanover, 296 m., 1.5 kw. and Kiel 230 m., 1.5 kw.
Graz, 397 m., 0.5 kw., relays Radio-Wien Sun., Mon., Thurs., and Sat.
Hjorring, 12.50 m., 0.25 kw., and Odense, 810 m., 0.25 kw., relay Copenhagen ; sometimes Ryvang.
Lyons La Doua, 480 m., 0.5 kw., Marseilles, 350 m., and Toulouse, 310 m., relay Ecole Superieure, Paris.

The following Swedish Relay Stations are now working, using 200 watts :—

Gävle, 325 m. ; Umea, 215 m. ; Eskilstuna, 243 m. ; Saffle, 245 m. ; Kalmar, 253 m. ; Norrköping, 260 m. ; Jonköping, 265 m. ; Orebro, 237 m. ; Trollhattan, 322 m. ; Varbörg, 340 m. ; Karlstad, 221 m. ; Falun, 370m. (400 watts) ; Linköping, 467 m. ; Karlsborg, 1350 m. ; and Karlskrona, 195 m.
These stations relay Stockholm as a rule, but also occasionally one of the other four main Swedish stations.

NOTE.—On and after May 15th subtract one hour from times given for Hilversum and Bloemendaal.



AN INDISPENSABLE TESTING UNIT

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

Accurate measurements of resistances and capacities are made possible with this simple testing unit.

ALL home constructors and wireless experimenters are beginning to realise that accuracy in working is a desirable feature, and in view of this fact it becomes essential to know the actual values of resistances, capacities, high-tension voltages, etc., in order to ensure that a particular receiver when constructed will incorporate components of the desired value.

Possible Faults

Frequently troubles in a receiver are traced to pieces of apparatus which, according to their marking, should be of a certain value, but which, on test, prove to be faulty or have become damaged as a result of misuse. These remarks have particular application to grid leaks, anode resistances, fixed condensers and variable condensers, so that if any apparatus is available which will enable capacities and resistances to be measured, the experimenter is in a position to locate defects quite definitely.

A Cheap Unit

Unfortunately, the cost of the measuring instruments and attendant apparatus is usually high, but the testing unit described in this article can be constructed quite cheaply, and will thus fill a long-felt want. A desirable feature is the accuracy with which the measurements may be made, as resistances and capacities can be determined to within 5 per cent., and to a figure much less than this if reasonable care is taken during the operation. This fact, coupled with the ease and rapidity with which the measurements are carried out, should be in themselves sufficient to warrant the earnest consideration of all wireless enthusiasts.

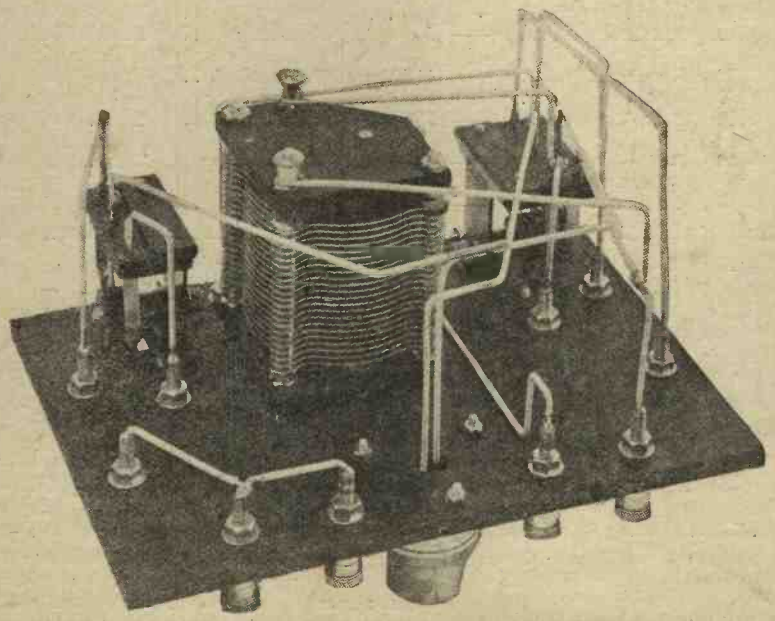
Fig. 1. The simple circuit for converting a D.C. current into a pulsating current.

The Neon Lamp

The unit in question makes use of the properties of a neon lamp, and for the benefit of the uninitiated a short description of the principles involved will serve a useful purpose and also act as a guide to future experiment for those so inclined. Perhaps the most familiar type of neon lamp is the "Osglim" made by the General Electric Co., the one employed in this case being of the "beehive" pattern.

An Interesting Property

The space within the lamp contains nearly pure neon, which is one of the five completely inert gases present in small quantities in the atmosphere, and amongst the lamp's many properties is the interesting one of converting a direct current supply into a regular pulsating current. This intermittent discharge takes place when



One wire is run close to the panel to prevent fouling the moving plates of the condenser.

the lamp is shunted with a condenser C and is supplied from a D.C. source through a resistance R as indicated in Fig. 1.

The voltage necessary to "strike" the lamp should be about 160 volts, and experiments have shown that under these circumstances the period of the flashes (T) is proportional to the product of R and C.

A Useful Relationship

In other words, if C is kept constant and R is varied a linear relation exists, and similarly if R is kept constant and C varied a linear relation between the flashing and the capacity exists. Thus T becomes a measure of R and C within certain wide limits, and the flashes can be made to take place from slow countable ones up to values well beyond the audible frequencies. Thus, if a pair of telephones is included in the circuit of Fig. 1 a musical note will be heard over the acoustic band of frequencies.

A Ballast Resistance

If the Osglim lamp is examined it will be found that a ballasting resistance is included in the cap, and it is sometimes preferable to remove this for conducting certain experiments, but this will only be necessary when measurements of a fairly low resistance are to be made; for capacity measurements its presence does not influence the results.

Removing the Resistance

If removal of this resistance is desired a small flame must be applied to the cap end of the lamp to melt the solder securing the lead-in wires and also to soften the cement which holds the bulb in the cap. Care must be taken, of course, to ensure that the flame does not play on the glass. The cap can then be pulled away, the resistance element removed, and the brass cap refixed in position with some suitable cement such as seccotine after resoldering the leads to the contact points.

Having dealt in a brief manner with the theoretical aspect of the possibilities of a neon lamp for making some interesting measurements, attention will now be turned to the construction of the actual testing unit which will enable measurements to be carried out in a rapid but particularly accurate manner.

The Theoretical Circuit

Details of the theoretical circuit are given in Fig. 2, where R_1 is a resistance whose value is known accurately, while R_2 is the resistance under test, a rapid change-over from one resistance to the other being made possible by the single-pole change-over switch S_1 S_2. C_3 is the condenser under test, while C_1 is a calibrated variable air condenser with a known fixed condenser C_2 in parallel for increasing the capacity to any desired value within the limits of the apparatus available. The change from the known to the unknown value is accomplished by the double-pole change-over switch S_3 S_4.

Telephones are inserted in the circuit at T and the high-tension battery is joined to the remaining terminals.

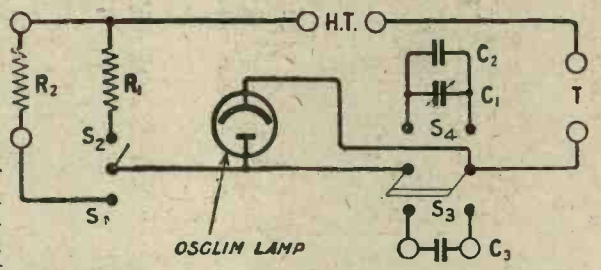


Fig. 2.—Switches S_1 S_2 and S_3 S_4 enable resistances and capacities to be measured as desired.

The actual neon lamp is connected across the pivot portions of the double-pole switch.

For the Potential Constructor

Compactness was a feature borne in mind, and potential constructors of this instrument are advised to give careful attention to the details enunciated. For the benefit of those who wish to duplicate the unit in every respect a complete list of the components employed is appended in accordance with usual practice, and where deviations are made to suit the convenience of the constructor particular care must be taken to ensure that the substituted articles are of good quality and can be accommodated conveniently in the allotted space.

Components

One ebonite panel, 8 ins. by 6 ins. by ¼ in. (British Ebonite Co., Ltd.).

One polished oak cabinet, 6 ins. deep to take above panel, with lid, 1½ ins. deep (Pickett Bros.).

One .001 Cam-vernier variable condenser (Radio Communication Co., Ltd.).

Three grid leaks, 1, 2 and 3 megohms (with one set of clips) (L. McMichael, Ltd.).

Three fixed condensers, .0005, .001 and .002 (with one set of clips) (L. McMichael, Ltd.).

One single-pole change-over switch, nickel plated (Wilkins and Wright, Ltd.).

One double-pole change-over switch, nickel-plated (Wilkins and Wright, Ltd.).

One Decko dial indicator (A. F. Bulgin and Co.).

Twelve nickel-plated terminals (Burne-Jones and Co., Ltd.).

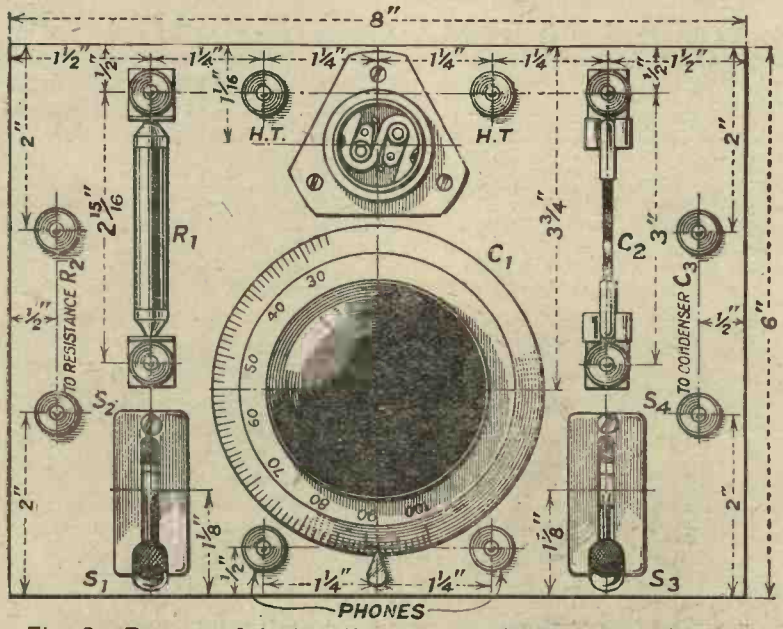
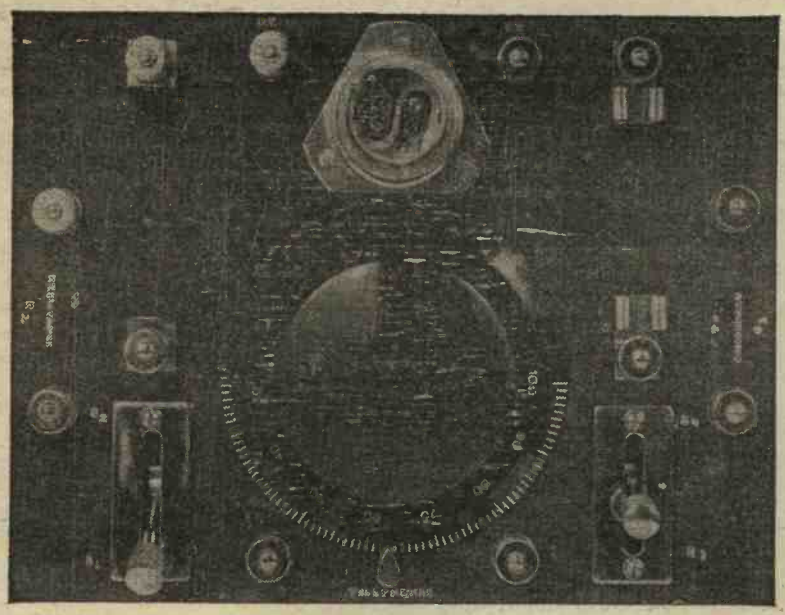


Fig. 3.—Pay careful attention to the dimensions given in this diagram when marking out the panel.

One batten-mounting lamp-holder.

One neon lamp (Osglim) 230-250 volts.



All the components are neatly and compactly arranged on the panel.

(These last two items can be secured from any local electricians.)

Quantity of Glazite and three small screws.

Panel Details

Reference to Fig. 3 must be made for details of the panel layout, and having drilled the necessary holes the terminals and components can be mounted in position. The flanged bottom of the lamp-holder has been cut in a triangular fashion so that it can be fixed on the panel without fouling the condenser dial. Since all the components on the panel had a nickel-plated finish except the lamp holder a pleasing appearance was brought about by having the holder nickel-plated as well, although in many cases it can be bought in this form.

Wiring

An examination of the wiring diagram of Fig. 4 shows that little difficulty will be encountered during the operation of wiring. The leads must be kept short and straight, and those nearest to the back of the panel must be soldered first. Make sure that the moving plates of the variable condenser do not lodge against the lead joining one of the telephone terminals and one of the H.T. terminals.

Calibration

A calibration curve for the variable condenser must now be obtained by comparison with some known standard, although many of the manufacturers will supply this chart on application.

The resistance of one of the grid leaks must also be carefully determined, the fixed condensers and remaining grid leaks being calibrated by the unit itself in the manner to be indicated. These spare components can be stored at the bottom of the cabinet, which has been made of sufficient depth for this purpose.

Having made sure that the wiring has been correctly carried out, it is possible to proceed now with the desired measurements.

Capacity Measurements

Connect about 180 volts across the H.T. terminals, the positive and negative connections being immaterial, the telephones to the terminals so marked and the condenser to be measured across the terminals for C_3. Insert a grid leak of about 3 megohms in the clips provided, and with the clip-in condenser C_2 removed and with the switches in positions S_2 and S_4 a note of a particular frequency will be heard depending upon the setting of C_1. If a note is not heard then the wiring should be checked or the H.T. raised to a higher value.

Small Condensers

When the condenser to be tested is less than ·001 all that is necessary is to move the double-pole switch to position S_3, listen to the note, and then move to position S_4 and alter condenser C_1 until no change of note frequency is heard when the double-pole switch is moved rapidly to and fro. Since the same grid leak is in circuit for both cases a reference to the calibration curve of C_1 will give the value of C_3 at once. Judging the same tone for the musical note presents no difficulty, especially after a little practice, so that great accuracy is possible.

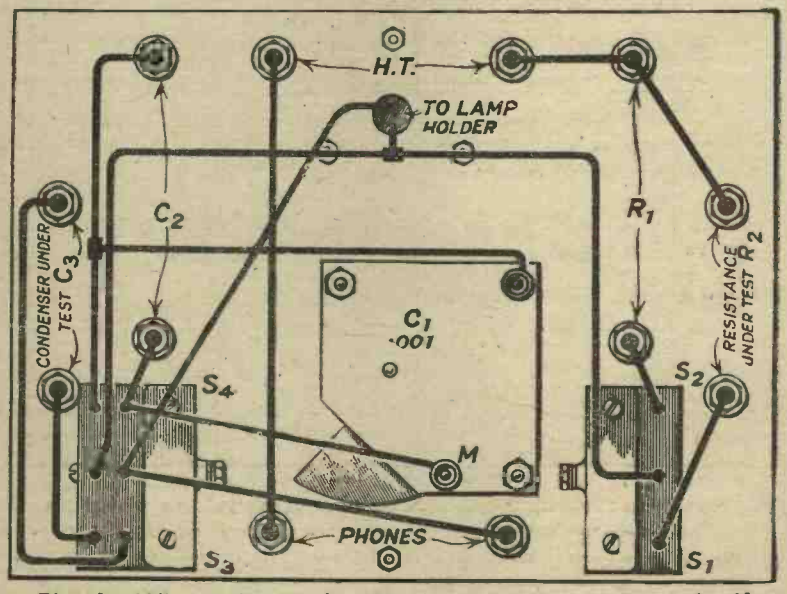


Fig. 4.—Wiring the unit may be accomplished easily if this diagram is carefully followed.

Sub-standard Condensers

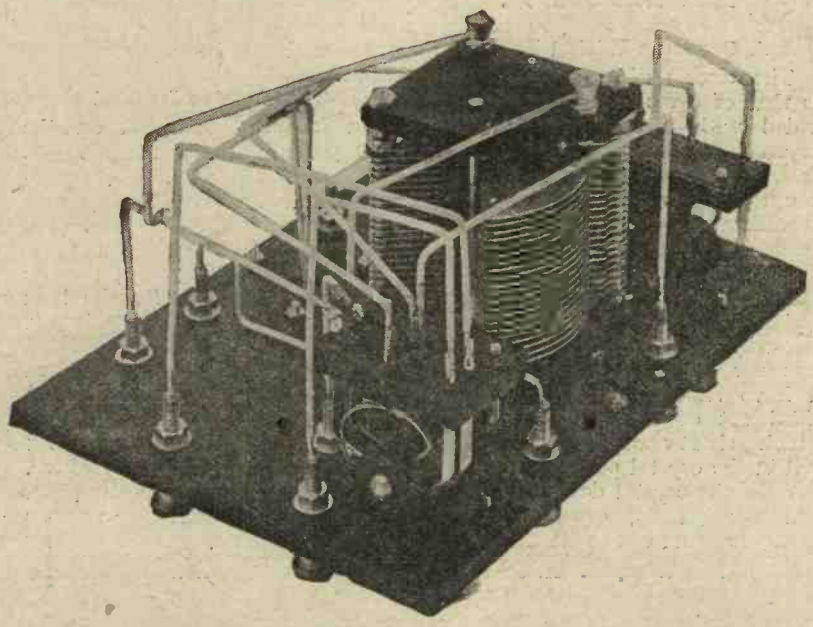
For condenser values above ·00: the clip-in condenser C_2 must be inserted and the same procedure adopted, the value of C_2 being added

to that of C_1 to give the capacity of C_3. Three clip-in condensers are suggested, the values ·0005 and ·001 being first verified against the standard C_1, and then with the ·001 in parallel with C_1 the exact value of the ·002 can be determined.

If clip-in condensers are not available the terminals holding the clips in position enable any other condensers to be joined across the position C_2 when once calibrated, thus giving a very flexible arrangement.

Large Condensers

It will be found that when a large condenser such as a 2 microfarad is placed in position C_3 and tested, the current pulses are so



Connections to the double-pole change-over switch can be followed from this photograph.

low that they are countable as the flashes of the lamp will be visible. In order to make the known capacity of sufficient magnitude for comparison purposes one or two intermediate sub-standards for C_2 may be required, and they may be connected across the clips by the terminals provided. To get the flashes of the same number per minute the aid of a good watch is necessary, and in addition as a double check the 'phones will give an indication of the flash by a strong click.

Resistances

We will next deal with the measurement of the resistances. One resistance must be carefully calibrated from some outside source and this will then be used as a standard. Place this leak in the clips of position R_1 and the unknown resistance across the terminals marked R_2. With the switches in positions S_2 and S_4 listen to the pitch of the note for a given setting of C_1. Now change the single-pole switch to position S_1 and rapidly adjust C_1 until the same pitch note is heard. This process should be repeated three or four times to ensure a correct result and the two readings of C_1 should be noted. Calling C_x the value of C_1 when R_1 is in circuit and C_y when R_2 is in circuit, then since the current pulses are proportional to the product of R and C we have

T proportional to $R_1 C_x$

and T proportional to $R_2 C_y$

Hence

$$C_x R_1 = C_y R_2$$

Therefore

$$R_2 = \frac{C_x}{C_y} R_1$$

and the value of R_2 is thus determined. Note that if R_2 is greater than R_1 then C_x will be greater than C_y and conversely when R_2 is less than R_1 then C_x will be less than C_y. It will depend on the value of the resistance under test whether the added parallel condenser C_2 will be necessary.

Continuity

To test the continuity of a circuit, or, in other words to see if a break exists in a particular coil winding, etc., it is only necessary to insert this circuit in series with one terminal of the H.T. battery and one of the H.T. terminals of the unit. If no sound is heard in the telephones then a break is present. Again, if a particular grid leak is faulty and does not make contact the fact will be evidenced by the absence of a note in the 'phones when this particular leak is placed across the terminals R_2 with the switches in positions S_1 S_4.

A Noteworthy Feature

A point which is worthy of note in connection with the testing unit is that the actual musical notes, while depending on the supply voltage and the values of resistance and capacity in circuit, do not enter into the calculation, since the only requirement is notes of equal pitch, irrespective of what the frequency of that note may be, and thus many possible discrepancies in the measurements are automatically ruled out.

Many other uses for this testing unit will no doubt suggest themselves to the reader, and much interesting information will be gained by experiments made with it.

A Precaution

When the ballast resistance has been removed from the lamp, care must be taken to ensure that the lamp is not used across the ordinary mains again, or it will not subsequently function satisfactorily in the unit.

The Melody Three.

SIR,—I wish to thank you for the circuit of "The Melody Three," described in the March, 1926, issue of MODERN WIRELESS. The reaction adjustment is particularly good, and I am writing to tell you of an alteration that I have made in this circuit which I think is well worth while. I have substituted for coils L_3 and L_4 an ordinary McMichael broadcast H.F. transformer treating one winding as the tuned anode coil and the other as fixed reaction coil with a Marconi resistance across it. The magnetic fields are considerably reduced, much less space is taken up on base board, while the reaction control is positively delightful. I have never had an H.F. valve working as efficiently as this, and I have tried very many circuits.—Yours truly,

J. A. TURNER, M.P.S.

New Barnet.

An Analysis of Some Common Switching Faults

By JOHN UNDERDOWN.

Very often the trouble in a receiving set can be traced to the switches, and Mr. Underdown has drawn on his experience to indicate possible faults from this source.

"TO switch or not to switch?" is a question, judging from the correspondence I receive, which is generally answered in the affirmative. Now, although certain systems of switching are very convenient, in practice the wiring necessitated thereby is not always easy to carry out, and where the beginner, and often the experienced constructor, goes astray is in translating a theoretical diagram into practical wiring.

Wrong Connections

I have come into contact with a large number of switching faults recently, and in the majority of cases trouble has been due to a wrong connection rather than to faulty contacts in the switches.

A Common Wiring Fault

The circuit diagram of Fig. 1 is that of a receiver which is provided with a switch to give a crystal detector followed by a transformer and two resistance-coupled note magnifiers for loud-speaker work on the local station, while for distant reception a valve detector with reaction on to the aerial coil is followed by two resistance stages only. A three-pole two-way switch is incorporated, but for convenience in drawing I have shown only two of the third set of contacts, 7 and 8, which short-circuit the reaction coil in the crystal position S_1.

With the crystal detector in use *i.e.*, position S_1, excellent loud-speaker results were obtained from the local station, but on switching over to the valve-detector position S_2 even the local transmission could not be heard, despite the most careful searching, and on placing a hand near the aerial coil L_1 this was found to be unaccountably warm.

The Trouble Located

An independent check on the wiring revealed the fault to be quite a simple one. The grid-condenser C_2 was of the type in which the grid-leak clips are arranged to form integral parts of the two soldering tags, so that the normal position for the leak is in parallel with the condenser. The grid-leak R_4 had been placed in the clips and the right-hand clip had been joined to contact 4 of the switch, whilst the left-hand clip had been joined to contact 1 and also to low tension positive. In the valve position (S_2), therefore, the aerial coil was connected across the L.T. battery. On rectifying this wiring error the receiver functioned in the normal manner, and is in fact giving excellent results at present.

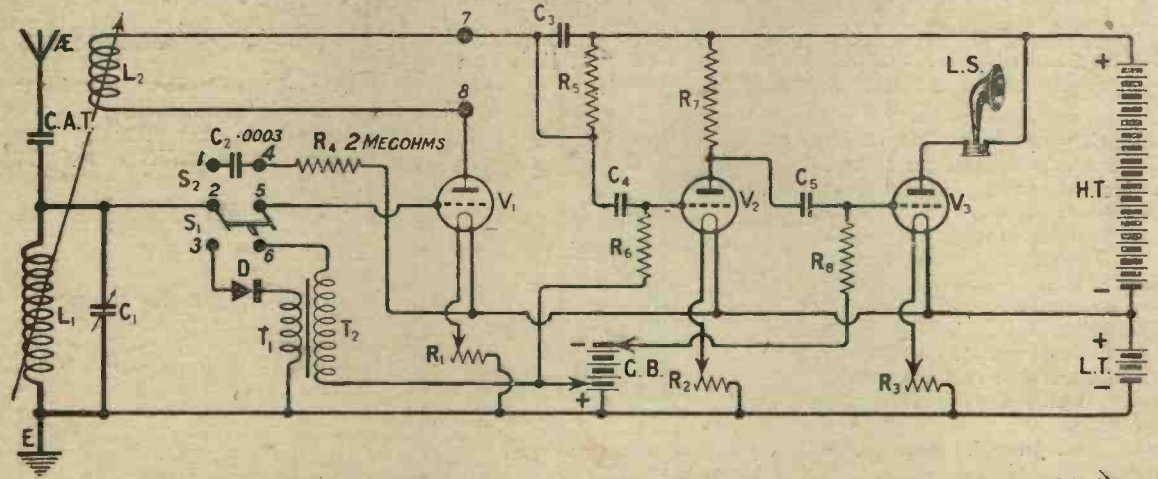


Fig. 1.—The switch S_1 S_2 enables crystal or valve rectification to be employed at will.

Other Causes

The employment of the grid-

leak in parallel with the grid-condenser constitutes a fault in a number of circuit arrangements, such as tuned-anode circuits, and inability to make a receiver of the H.F. and detector type with tuned-anode coupling oscillate may often be traced to this cause. In such a case the grid-condenser is rendered inoperative as a direct current " stopping " condenser and considerable positive bias is communicated to the grid of the detector, which may even in some cases practically render the set inoperative, if the " saturation " point on the rectifying valve's characteristic curve is passed.

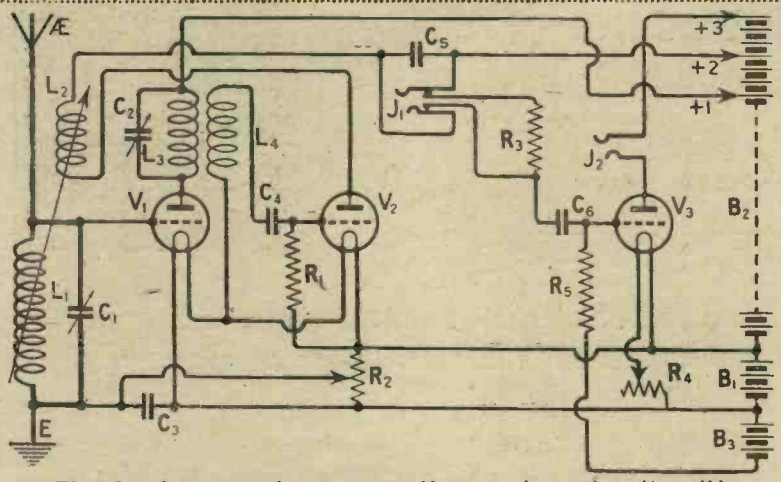


Fig. 2.—A general purpose three-valve circuit with jacks for using two or three valves as desired.

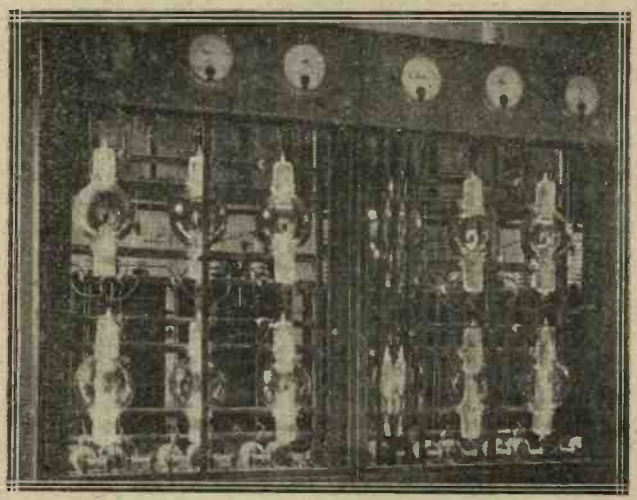
An Annoying Phenomenon

The Fig. 2 circuit arrangement is one employed in a general purpose type three-valve receiver. The set consists of a transformer-coupled high-frequency stage, a valve detector with reaction on to the aerial coil and one resistance-coupled note magnifier, jack switching permitting two or three valves to be used at will. The difficulty experienced in this case was that when a transmission requiring critical tuning was obtained at good strength with the telephones in jack 1 (in the anode circuit of the detector valve), on transferring the telephones to jack 2, or plugging a loud-speaker in this position, the signal which was previously strong was scarcely amplified at all. On switching in V_3 it was always found necessary either to increase the coupling between aerial and reaction coils or to bring the slider of the potentiometer over to full negative.

The Cause

This annoying phenomenon was due to the fact that when the anode resistance R_3 replaced the telephones in the anode circuit of the detector valve a considerable voltage drop took place across the former so that the voltage actually applied to the anode of the detector was considerably decreased.

The valve panels at the Radio-Paris station are indicated in the photograph. These panels have special sliding doors to protect them.



When the detector valve is adjusted to function just below the oscillating condition the drop in voltage experienced will render the valve far from this condition, necessitating alteration of reaction or potentiometer setting.

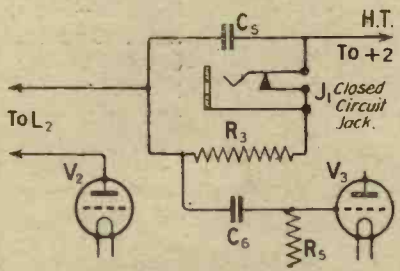


Fig. 3.—To place the anode resistance in series with the telephones a closed circuit jack is utilised.

Overcoming the Difficulty

The difficulty is best overcome by keeping the anode resistance R_3 in series with the telephones when tuning in on two valves, and this may be done if the connections indicated in Fig. 3 are followed. Here only the revelant parts of the circuit are shown. The double-circuit jack of Fig. 2 is here replaced by a closed-circuit jack which is wired in series with the anode resistance. Normally jack 1 forms a continuous connection, but when the telephones are inserted the circuit is broken so that the 'phones are in series with R_3.

It should be observed that the fixed by-pass condenser C_5 is arranged to be in parallel with both the anode resistance and the closed-circuit jack, which connection is necessary so that the condenser performs its by-passing function whether the telephones are or are not inserted into the closed-circuit jack.

A Matter of Interest

Before passing on from the Fig. 2 circuit it should be observed, as a matter of interest, that the two first valves V_1 and V_2 are wired in series. This is a very convenient arrangement where a 6-volt accumulator is employed and it is desired to use two 3-volt valves for the H.F. and detector positions followed by a 6-volt power valve.

Aerial and Earth Switching

When an outside aerial is used it is desirable, when the set is not in use, to earth the aerial, at the same time totally disconnecting the receiver therefrom. A good

(*Continued on page* 987.)

Local Reception on a Frame Aerial

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

Readers so situated that an outside aerial is impracticable will find the information concerning frame aerial circuits contained in this article of extreme value.

ONE often meets cases where people living in flats, and others similarly situated, are under the impression that wireless is out of the question for them, even to the enjoyment of the programmes from their local station, unless they provide themselves with elaborate and costly equipment. It is true, of course, that if you are

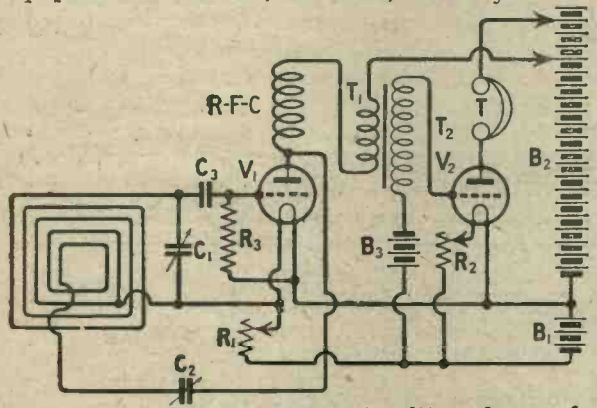


Fig. 1.—A frame aerial circuit with a form of Reinartz reaction.

so situated that you have no facilities for the erection of a good outdoor aerial and you want to receive the more distant stations at good strength, you are generally limited in your choice of a receiver either to an elaborate multi-valve set or a superheterodyne.

Local Reception

However, the question of local reception is different, and even if it is not possible or convenient to fix up an efficient indoor aerial, there is still the frame aerial to be considered.

Experiments recently carried out by the author have shown that, provided a suitable circuit is chosen, two or three valves will, under normal conditions, be adequate for most purposes when used with a frame aerial of average size at distances up to about 10 miles from a main broadcasting station. Even with two valves adequate loud-speaker results of good quality were possible at about 10 miles from the London station.

Screening

It must be remembered, of course, that a frame aerial is particularly susceptible to screening effects such as are produced, for instance, by the iron girder work of a building, and since local conditions vary to a considerable extent it is not possible to tell beforehand what sort of results will be obtained in any given location. However, the results mentioned subsequently in this article show what is possible under average conditions. The circuits were tried out at about 10 miles from 2LO, using a frame aerial with two-foot sides.

A Precaution

A large outdoor aerial leading into a room on the first floor, in which the frame was situated, was completely lowered so as to avoid any pick-up from this source, but it was found that, provided the lead from the lead-in insulator at the top of the room was removed, the presence of the outdoor aerial had little effect on the strength of signals received on the frame.

Reaction Control

The simplest arrangement of two valves is that of detector followed by a stage of low-frequency amplification; but it must be remembered that with a detector valve using the usual grid-leak and condenser rectification, there is a heavy damping in its grid circuit, and for this reason signals received on a frame aerial are somewhat weak.

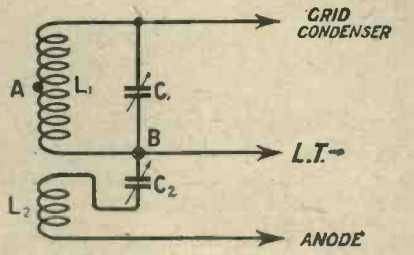


Fig. 2. — The hand capacity effects of the Fig. 1 circuit are reduced by this arrangement.

Introducing Reaction

By introducing reaction into the grid circuit, *i.e.*, on to the frame, the effects of this damping can be counteracted with a consequent improvement in signal strength. It is essential, however, that the reaction adjustment should be gradual

and easily controllable, so that it may be easily brought up to such a point as to give the desired increase in signal strength without any detriment to the quality of reproduction.

A Simple Circuit

This condition is fulfilled by the reaction arrangement shown in the circuit of Fig. 1. It will be seen that the reaction is of the Reinartz type,

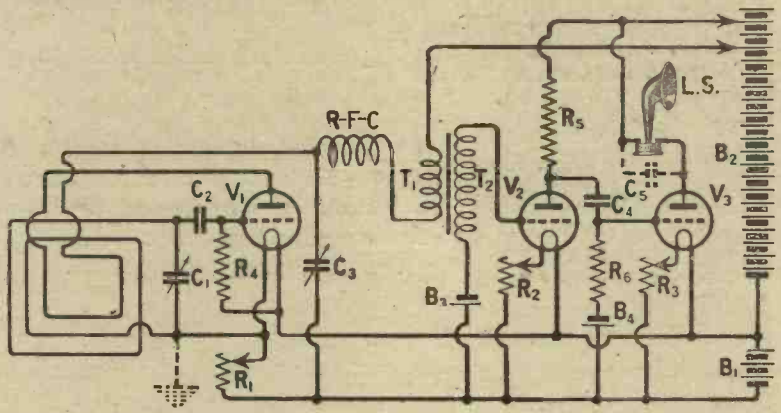


Fig. 3.—Greater volume is secured with the circuit indicated in this diagram.

obtained by inserting a radio-frequency choke in the anode circuit of the detector valve and providing a control condenser C_2, connected to a fixed reaction winding wound continuously with the frame aerial. The frame aerial used was of the square type, having two-foot sides, and wound in solenoid fashion with twelve turns of No. 18 enamel insulated wire, spaced at half an inch.

The Reaction Winding

The reaction winding consisted of two turns of No. 20 D.C.C., wound in the same direction as the aerial winding at the end of the frame connected to the filament. With a .0003 condenser having a single plate vernier for C_2 good reaction control was obtained. C_1 was also a .0003 condenser with vernier attachment, a reading of about 50 degrees (100 degree dial) being obtained on 2LO.

Here it may be mentioned that it is advisable to have as large a number of turns on the frame aerial as possible and to keep the parallel tuning capacity small, so that for lower frequencies on the broadcast band more turns could advantageously be added to such a frame.

Necessary Details

The detector valve V_1 is preferably of the high impedance type with a high amplification ratio, followed by a first-class transformer of 2.5 to 1 ratio, with a valve of the D.E.5 type for V_2. The grid leak R_3 and grid condenser C_3 have the conventional values of 2 megohms and .0003.

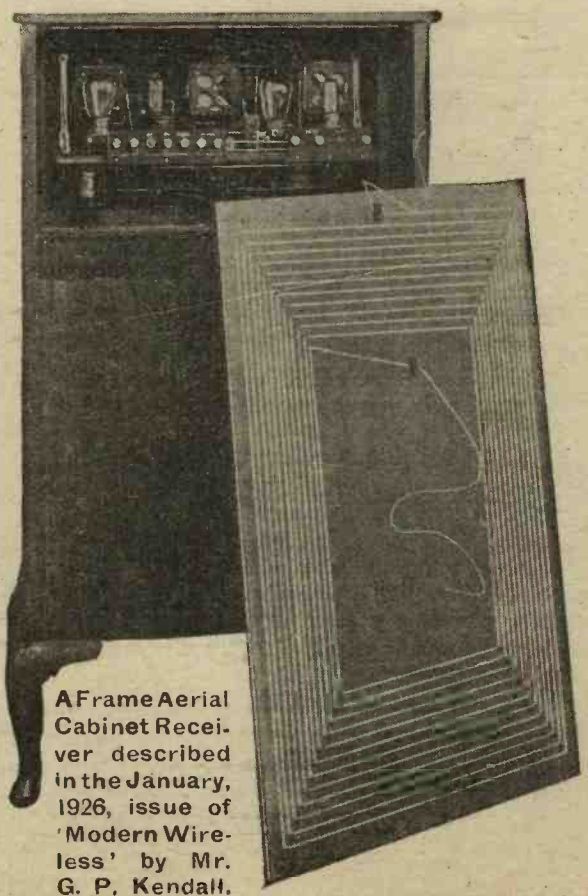
Hand Capacity Effects

Hand capacity effects are to a certain extent troublesome with this arrangement, and it is preferable to connect the reaction condenser in the manner shown at C_2 in Fig. 2, where L_1 represents the frame aerial and L_2 the reaction turns. The effect of earthing the centre point A of the frame was tried; while this considerably reduced the capacity effects on the frame, they were much more pronounced on the batteries' loud-speaker and battery leads, and the better practical arrangement was to make the earth connection to B.

There were then no body capacity effects on the batteries, etc., and they were not serious on the frame aerial, which could be rotated into the position for maximum signals and left; then, providing no part of the body came nearer than about 6 inches to any part of the frame winding, no effect on the tuning was noticed.

Sharp Tuning

With this circuit, using D.E.8 H.F. and D.E.5 valves for V_1 and V_2 with 60 volts and 120 volts H.T. respectively, 2LO could be tuned in



A Frame Aerial Cabinet Receiver described in the January, 1926, issue of 'Modern Wireless' by Mr. G. P. Kendall.

at good quality loud-speaker strength adequate for an ordinary room. The frame tuning is very sharp, and either a geared condenser or some form of "vernier" is desirable.

Greater Volume

Fig. 3 shows a circuit suitable for use where greater volume is required, a stage of resistance-capacity amplification being added. The reaction arrangements in this case are provided by the "throttle" control method, in which a fixed reaction winding is connected as shown and a variable by-pass condenser C_3 provided between the anode end of the radio choke and low-tension negative. This scheme also gives exceedingly good control; as the value of C_3 is gradually made larger so the reaction is smoothly increased. The reaction winding consisted of two separate turns wound on the filament end of the frame and C_3 was a geared .0003 condenser.

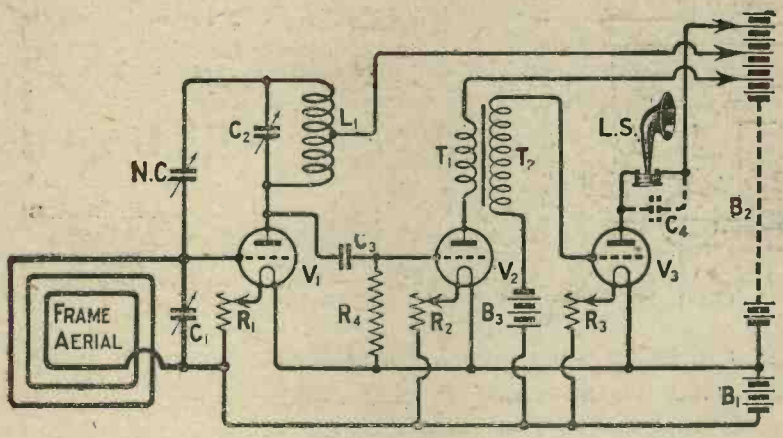


Fig. 4.—With this circuit great care should be exercised to ensure no coupling exists between the frame aerial and coil L_1.

Practical Details

Suitable valves, amongst others, are D.E.5 b., D.F.A. 4, D.E. 8 H.F. for V_1, D.E. 5 b, D.F.A. 4 for V_2, and a D.E. 5 B 4, or D.F.A. 1 for V_3, these references indicating the types to be preferred. The anode resistance R_5 is preferably wire-wound, and of 100,000 ohms, suitable values for C_4 and R_4 being .1 microfarad and .25 megohm respectively. Satisfactory anode voltages are about 60 volts for V_1 and 120 volts for the tapping supplying V_2 and V_3. An earth connection should be provided where indicated by the dotted lines.

High-frequency Amplification

Another practical circuit, employing three valves, is shown in Fig. 4. In this case a neutralised stage of high-frequency amplification, using a centre-tapped anode coil, precedes the detector valve, which is followed by a transformer-coupled note magnifier. The centre point of the anode coil L_1 is connected to H.T. positive and a neutralising condenser N.C. connected between the grid and the end of the coil remote from the anode provides for neutralisation.

Stability

It will be found that there is one adjustment for the neutralising condenser for which the circuit is perfectly stable when the anode circuit L_1 C_2 is brought into tune with the frame circuit tuned by C_1. On either side of this adjustment the circuit will oscillate when this condition obtains; but it is only a matter of a few moments to obtain the correct adjustment. Care should be taken to see that the coil L_1 is remote from the frame aerial and preferably at right angles to it, otherwise difficulty might be experienced in the neutralisation.

Full Loud-speaker Strength

Without an earth connection the circuit was found quite a practical arrangement from the point of view of hand and body capacity effects, but an earth connection to low-tension negative is an advantage. For the coil L_1 a Gambrell centre-tapped B was used, but the "Dimic" and the centre-tapped Lissen coils may also be employed. A high-impedance valve should be used for V_1, while valves for V_2 and V_3 may be as suggested for the circuit of Fig. 1. With this arrangement excellent loud-speaker results were obtained from 2LO.

Some of the aerial coupler equipment at the Radio Paris station, Boulevard Haussmann.

A Multiple Circuit Single-Valve : Receiver :

by E. J. MARRIOTT.

A receiver designed to enable several types of aerial and reaction coupling arrangements to be tried is described in this article.

THE degree of selectivity which may be obtained with a receiving set can be made quite considerable if a suitable type of aerial coupling is incorporated, but it should be noted here that an arrangement which might give the most effective results with one aerial-earth system, will not necessarily be the most efficient with other types of aerial and earth systems.

Therefore, in order to obtain the greatest selectivity on different aerials, this coupling should be of a more or less variable nature.

Flexibility

In designing the receiver to be described here, these particular features have been borne in mind, and a simple scheme involving the use of spring clips has been incorporated, in order that any of several aerial-coupling and reaction-coupling arrangements can be tried at will.

The Circuit Adopted

Fig. 1 shows the theoretical arrangements of this receiver. L_1 is a plug-in coil of any of the usual makes whilst L_2 and L_3 together constitute one of the "Universal" transformers manufactured by Messrs. Peto-Scott Co., Ltd., and L_4 is a radio-frequency choke.

The "Universal" transformer is constructed in the form of two separate but similar coils wound on a common ebonite former, one of the coils being centre tapped, as shown at E in Fig. 1.

Various Aerial Coupling and Reaction Arrangements

Both the aerial and the earth leads terminate in spring clips, indicated by arrow heads, as do also the leads from the tuning and reaction condensers C_1 and C_2. It will be seen then, that by clipping the flex leads on to the various points marked A, B, C, D, E and F, the desired aerial coupling and reaction flexibility is obtained.

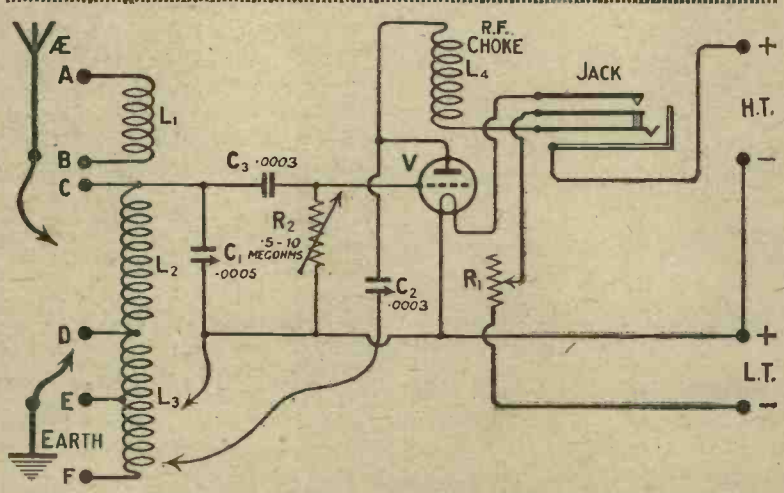


Fig. 1.—Various aerial and reaction coupling arrangements can be tried with this circuit.

An Example

For instance, by clipping the aerial lead and the lead from C_2 on to the point marked E, and the earth lead together with the lead from C_1 on to the point marked D, we have one of the well-known and effective Reinartz arrangements.

A Further Refinement

The variable grid-leak is shown as R_2, and as a further refinement, a four-contact telephone jack has been incorporated, in order that when the telephone plug is withdrawn from the jack, the filament circuit is automatically broken, and thus, once the best filament rheostat adjustment has been found, it is only necessary to withdraw the telephone plug in order to put the set out of use, and on again inserting the plug this adjustment does not require alteration.

Components Required

In order to build a receiver similar to the one described, you will need the components set out below.

Other makes of good quality may be substituted in most cases if desired, but in the case of the "Universal" transformer, a substitute is not desirable.

In all cases, however, strict attention should be paid to the layout, which should conform as nearly as possible to that shown in the diagrams and photographs.

One Radion panel, 12 ins. by 7 ins. by $\frac{3}{16}$ in. (American Hard Rubber Co., Ltd.)

One cabinet to take above panel. (The Artcraft Co.)

One baseboard, 12 ins. by 8 ins. by $\frac{1}{2}$ in. (The Artcraft Co.)

Two ebonite strips, 2 ins. by 2 ins. by $\frac{1}{4}$ in. and 4 ins. by 2 ins. by $\frac{1}{4}$ in.

Six indicating terminals, "A" "E," "HT+" "HT−" "LT+" "LT−" (Belling and Lee, Ltd.)

One single coil baseboard mount. (Burne-Jones and Co., Ltd.)

Two "Universal" transformers, one to cover the normal broadcast band, and one for the higher. (Peto-Scott Co., Ltd.)

One mount for above.

Four "Lico" spring clips. (Peto-Scott Co., Ltd.)

One cam-vernier square-law ·0005 variable condenser. (Radio Communication Co., Ltd.)

One cam-vernier square-law ·0003 variable condenser. (Radio Communication Co., Ltd.)

One grid-condenser and variable grid-leak, combined. (Bretwood, Ltd.)

One "Clearer Tone" valve holder. (Benjamin Electric Ltd.)

One-Radio-frequency choke. (Lissen, Ltd.)

One 30-ohm filament rheostat. (C. A. Vandervell and Co., Ltd.)

One four contact single filament telephone jack. (Igranic Electric Co., Ltd.)

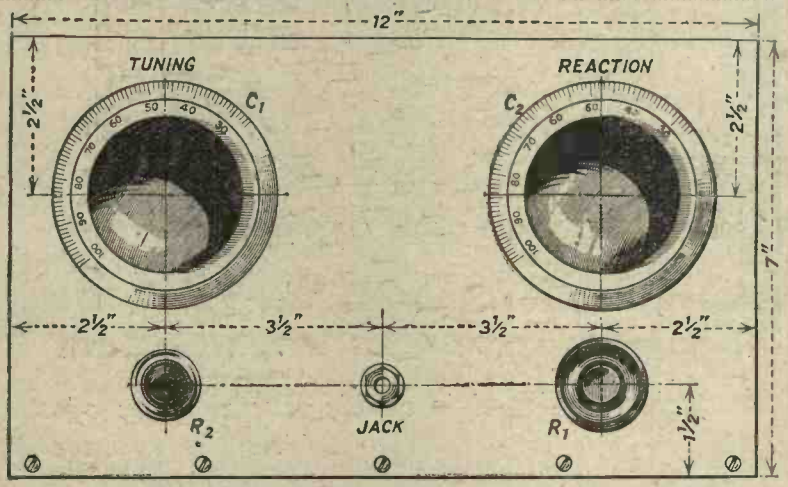


Fig. 2.—The panel details are very simple. Blueprint No. 156a is available at 1s. 6d., post free.

One telephone plug.

Length of rubber-covered flex (about 3 feet will be ample).

Glazite for wiring up.

Wood screws.

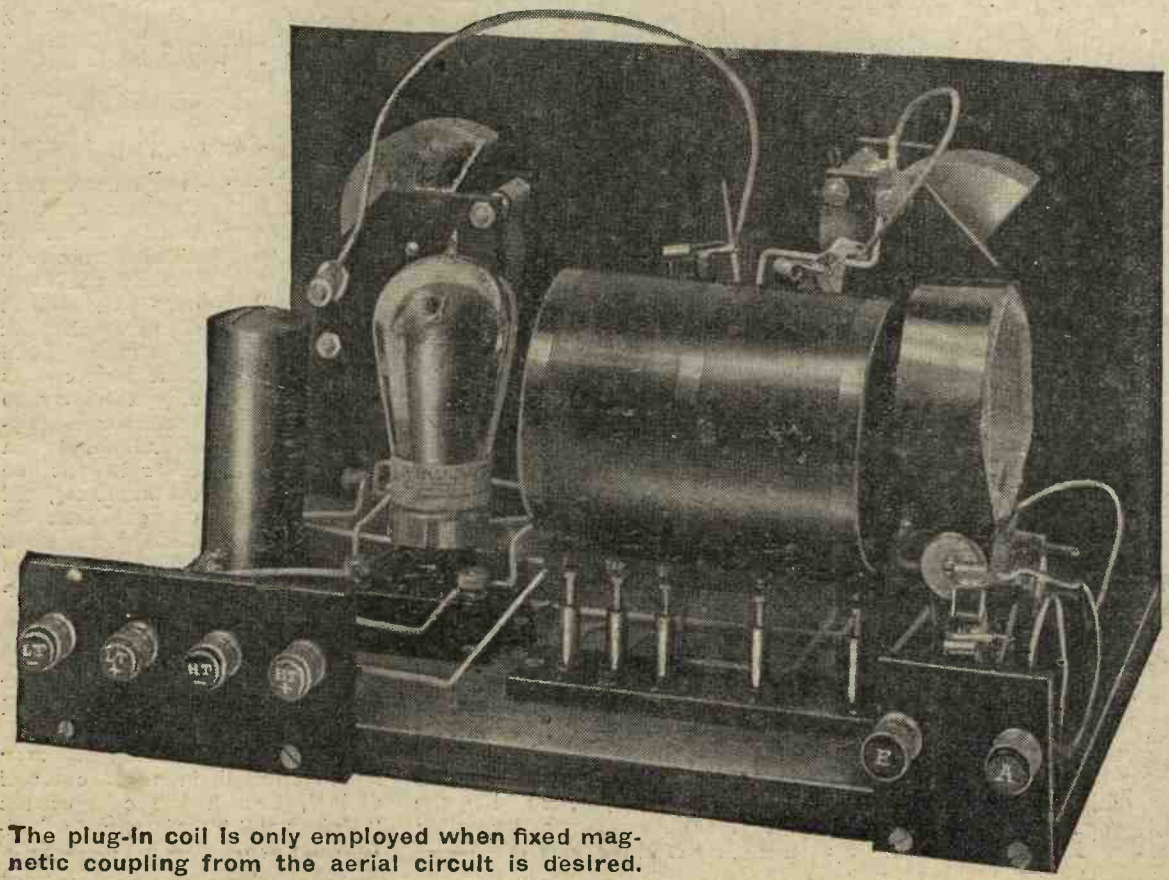
Radio Press transfers.

The Constructional Work

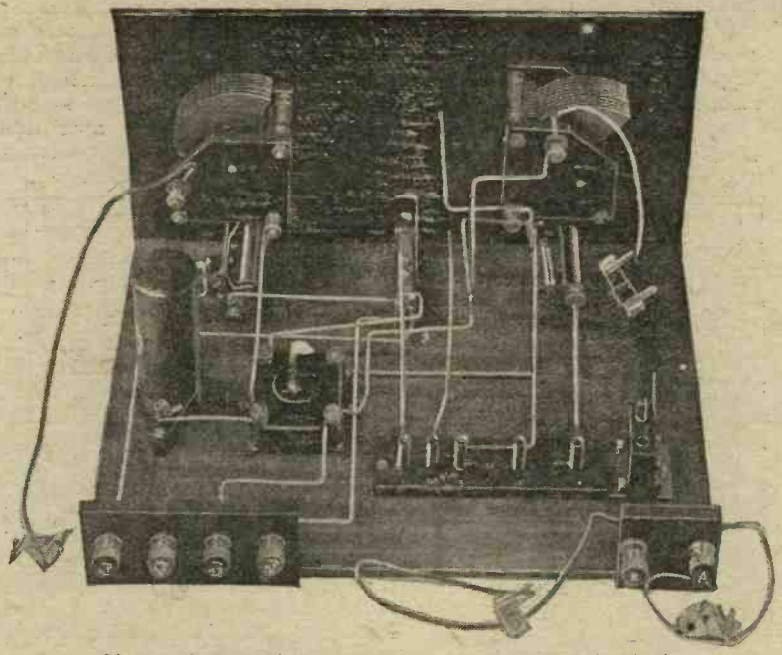
The first step in the actual constructional work is to prepare the panel, and if that used is not of a guaranteed brand, it should be rubbed down thoroughly on both sides with very fine glass-paper and finished off with a soft oily rag.

These remarks also apply to the two ebonite terminal strips.

The marking out and drilling can then be proceeded with, in



The plug-in coil is only employed when fixed magnetic coupling from the aerial circuit is desired.



Note the flexible lead connections with their terminating clips.

accordance with the measurements given in Fig. 2.

A Detail

The hole for the telephone jack will require to be slightly larger than those for the variable condensers, and several constructors will probably not possess a suitably sized drill for this. It is a simple matter, however, to drill a ⅜ in. hole first, and then use the tang of a file to reamer the hole out to the necessary diameter.

Fitting the Panel and Wiring

Having completed the drilling, the panel may now be screwed to the baseboard while the latter is in the cabinet, thus ensuring a good fit. At this stage, the two terminal strips with the terminals mounted in their correct order, as indicated in Fig. 3 may also be screwed to the baseboard.

Now withdraw the whole, and affix the various components to the panel and baseboard in approximately the same positions as those shown in the photographs and the wiring diagram of Fig. 3.

The next step is to prepare and wire up the set, and this should be done in the usual manner.

Facilitating Tapping

It will be seen by reference to the photographs that a length of Glazite has been soldered to each of the lettered tapping points, and bent upwards, in order that the clips may be attached easily to any one of them whilst the set is in the cabinet.

Testing Out

Having completed all the wiring and carefully checked over the connections against Fig. 3, the receiver can be tested for actual reception. Join up the H.T. and L.T. batteries, and aerial and earth to their respective terminals, plugging in the + H.T. wander plug at about 30 volts.

Turn the rheostat on slightly and note that on inserting the telephone plug into the jack the filament lights up.

Now set both the variable condensers to their minimum positions and adjust the filament current to its correct value.

A Useful Circuit

For general all-round reception the following arrangement will be found most useful, and it is suggested that the constructor tries it out first.

Attach both the aerial flex and the flex from C_2 to the point E and the earth lead and that from C_1 to the point D. A suitably sized "Universal" transformer must be

Extracts from the Elstree Laboratory Report

Stations heard

Hanover, Manchester, London, Bournemouth, Newcastle, Dublin, Radio Toulouse, Birmingham and several others were received with the coil intended to cover the broadcast wavelength. On the long-wave coil Daventry, Radio Paris and Hilversum were received.

Simplicity of Operation

Good. Various forms of tuning could be employed with ease, no difficulty being experienced in changing from one to another. No hand capacity was perceptible.

Selectivity

The selectivity of this receiver was found to be just about the average, Birmingham being received with a very faint background of London. On the long wave, however, Radio Paris was received entirely free of interference from Daventry.

Signal Strength

The signal strength obtainable with this receiver, using the auto-coupled circuit, was up to standard. Using the circuit recommended, both the signal strength and selectivity were not so good as obtained with the auto-coupled arrangement. This was no doubt due to the characteristics of the aerial employed. With tight coupling using a plug-in coil in the aerial, signal strength and selectivity were not so good as with the auto-coupled scheme.

Tuning Range

With the auto-coupled arrangement, connecting the aerial to D, earth and grid return to E and reaction condenser to F, the range covered was from 285 metres to somewhat over 600 metres. Using tight coupling with a No. 50 plug-in coil for the aerial, the range covered was from 190 to just over 600 metres. Using the circuit recommended the tuning range obtained was from 160 to 465 metres.

Valves Used

D.E.5b, D.E.5, D.E.R., bright emitter R and D.E.3. Best selectivity and oscillation control were obtained with the bright emitter R valve.

plugged into the mount provided. One to cover 200–500 metres in conjunction with a .0005 variable condenser will generally be quite suitable. Now tune in on C_1 in the usual manner, and if you are situated within a few miles of a main station, you should hear it at good strength in the 'phones. Increasing the value of C_2 towards maximum will increase the reaction effect obtained and consequently the strength of signals.

Care must be taken, however, not to increase unduly the value of C_2, otherwise the receiver will break into self-oscillation, and neighbouring listeners will have their reception spoiled.

The aim of each constructor should be to so adjust the H.T. and L.T. values that on increasing the reaction condenser C_2, the set will gradually slide into oscillation. Only in this manner can the best results be obtained.

Receiving Other Stations

In order to receive other stations, the condenser C_1 must be adjusted very slowly, and meanwhile the set kept in its most sensitive state (*i.e.*, just off the oscillation point) by means of the reaction condenser C_2.

If it is desired to secure a greater degree of selectivity than that already obtained, the aerial and earth leads may be moved from their present positions and affixed one to *A* and the other to *B*. The way round is not extremely critical. Other leads in the set should be left as before.

Now insert, say, a No. 30 or 35 coil in the coil holder and tune in again as before. It will probably be found that the selectivity has now considerably increased.

Receiving Daventry

For the reception of the long-wave station 5XX, it is merely necessary to plug in a "Universal" transformer which will cover this station's wavelength, and proceed to tune in the same manner as for the local station.

If it is desired to use aperiodic aerial coupling on these long waves, the plug-in coil L_1 might be either a No. 100, 150 or 200, according to the degree of selectivity required.

Extending the Wave Band

Each half of the "Universal" transformer is stated by the makers to tune over the given wavelength band. It will be a simple matter then to increase the maximum wavelength by clipping the flex lead from C_1 on to *E* instead of to *D*, or even on to *F*. In the latter case, the effect of joining the reaction flex lead to *D* or *E* might be tried.

The reaction condenser C_2 should always be turned to its minimum adjustment before changing any leads in order to lessen the likelihood of causing interference to neighbours by oscillating.

Test Report

This receiver was tested out on a poor aerial, about four miles west of 2LO, employing the circuit suggested previously as the best for general reception, very good telephone signals were received from that station. Also using the same circuit, Bournemouth was heard at fair strength and two German stations.

The selectivity was fair, although 2LO interfered considerably at this distance with Bournemouth.

The Daventry Station

Still using the same circuit with the longer wave "Universal" transformer, Daventry came in at comfortable headphone strength, and Radio Paris was easily understandable. Using a separate aerial coil (a No. 35 or 30 on the normal broadcast band, and a No. 150 on the long waves) increased the selectivity in the writer's case, although signal strength suffered somewhat.

This receiver was tested at our Elstree Laboratories, and it is interesting to note that the circuit which gave the best results on the writer's aerial was not the most effective on the laboratory aerial, and extracts from the report are given.

The enthusiastic experimenter should find in this set a means for obtaining useful information regarding the coupling with which his aerial will give the most efficient results.

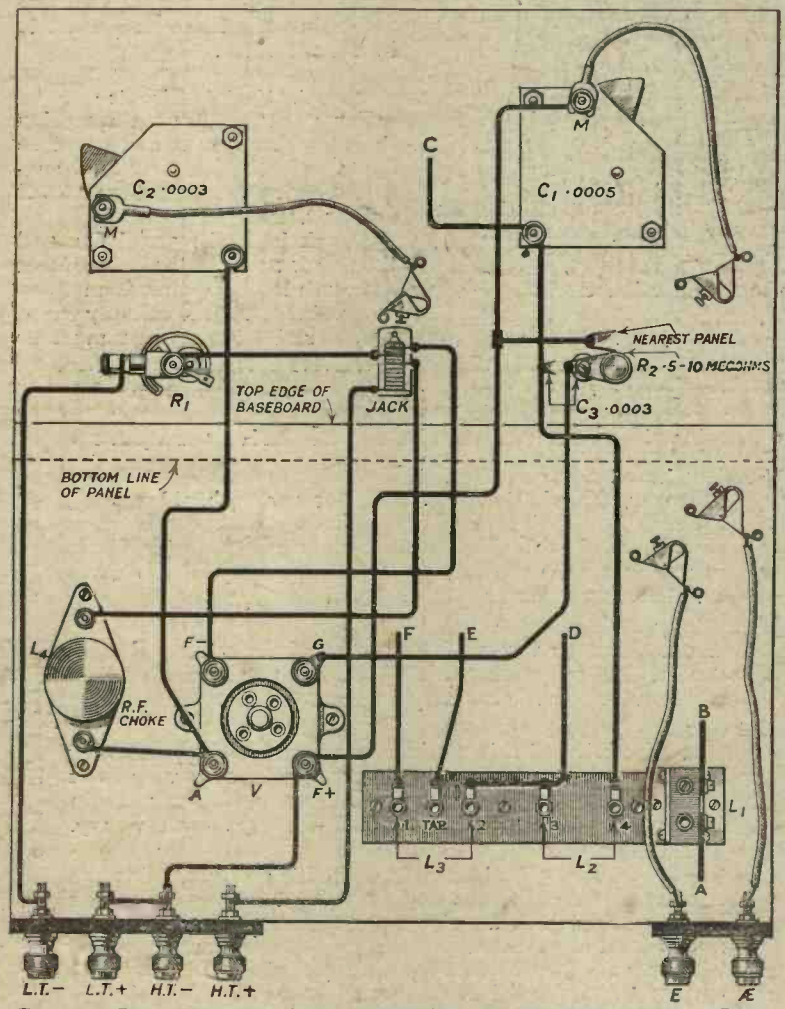
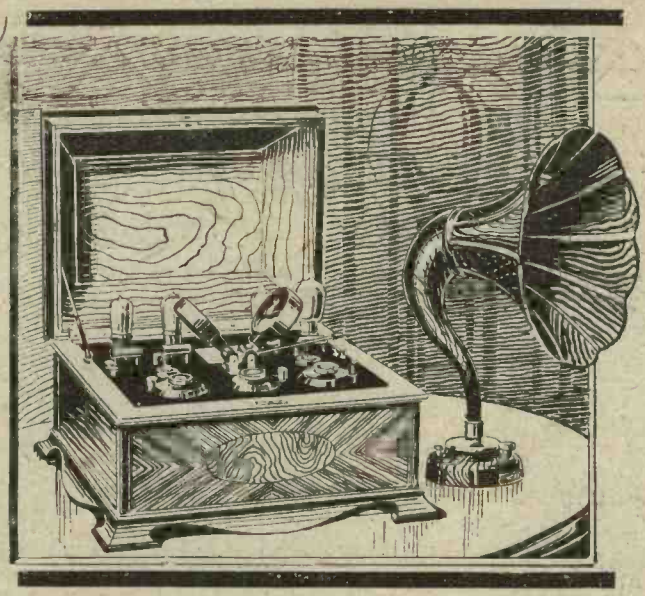


Fig. 3.—This diagram is a reduction of Blueprint No. 156b, which can be obtained for 1s. 6d., post free.



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The results were astonishingly good. During the morning, when conditions are not good, Cardiff was received at such a strength that it had to be 'toned down' before it was at all comfortable in a very large room.

Nottingham was also received in the morning, and was heard at good loud-speaker strength, whereas Stoke-on-Trent was also received at loud-speaker strength.

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The Neutrodyning is as perfect as could be desired.

The positions of the small neutrodyne condensers are marked, and if they are set in their correct position the set remains stable throughout the whole range of tuning; that is, from 200 metres to 550 metres.

The receiver can be brought a little further off the oscillation point by reducing the filament voltage without a very great decrease in signal strength.

THIRTY STATIONS IN FIFTEEN MINUTES.

The following stations were heard at night, all on the loud-speaker, during about 15 minutes' search. Bournemouth can be received without hearing London. Manchester and London were heard at about equal strength.

STATIONS AND WAVE-LENGTHS.

Station.	Wave-length. Metres.	Station.	Wave-length. Metres.
Stettin ...	241	Dublin ...	399.5
Norrkoping ...	260	Newcastle ...	408.7
Brussels ...	262	Munster ...	411.5
Bremen ...	277	Breslau ...	416
Dortmund ...	283	Glasgow ...	423
Hanover ...	297	Berne ...	436.5
Sheffield ...	301	Belfast ...	438.8
Stoke-on-Trent	305	Stuttgart ...	446
Bradford ...	308	Barcelona ...	460
Leeds ...	321	Birmingham ...	478.7
Nottingham ...	330	Swansea ...	492.5
Cardiff ...	353	Aberdeen ...	498
London ...	362	Berlin ...	503.5
Manchester ...	378	Vienna ...	538
Bournemouth	388	Budapest ...	552

NOTE.—This is the first night that some of the main stations changed wave-lengths—Bournemouth, Newcastle, Dublin.

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Developments in Single-Valve Reflexes

By W. S. PERCIVAL, B.Sc. (Hons.), A.R.C.S.

Reflexing valves provides material for many fascinating experiments, and the results indicated in this article prove that there is still a wide scope for ingenuity.

THE single valve reflex receiver has always proved a fascination to the amateur owing to its being the loudest single-valver for local reception. Results have, however, frequently been rather inconsistent because of the erratic damping introduced by the crystal detector.

Incorporating Crystachoke Arrangements

Recent developments as regards neutralising the valve capacity and employing a Crystachoke crystal circuit have enabled very much better results to be attained, while further advantages may also be secured by special arrangements. Crystachoke circuits have been described at length in recent issues of *Wireless*.

A Well-known Reflex Circuit

A well-known reflex circuit is shown in Fig. 1. This will be found to provide moderate loud-speaker reproduction at several miles from a main broadcasting station, provided a suitable transformer and a power valve are employed.

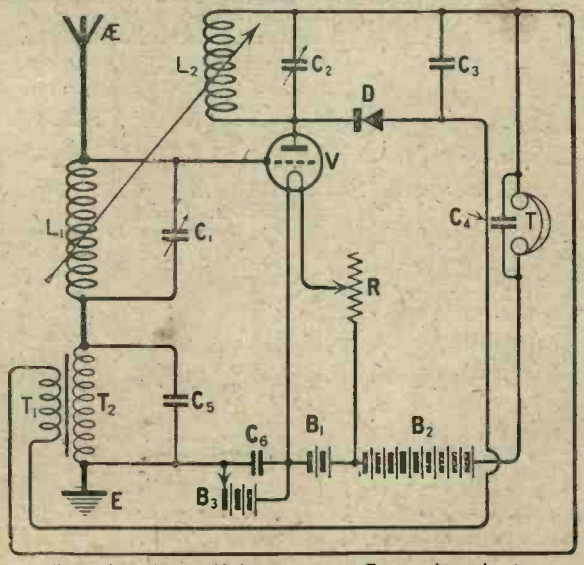

Fig. 1.—A well-known reflex circuit is indicated in this diagram.

It suffers, however, from a few drawbacks which can be removed largely by suitable alterations.

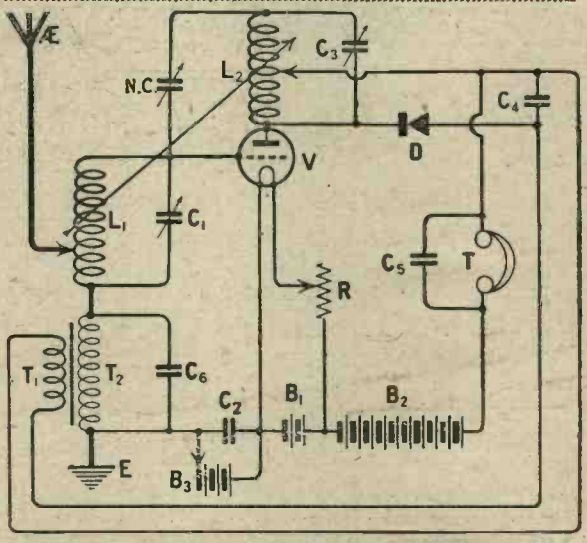

Fig. 2.—This neutralised arrangement possesses many advantages over the simpler circuit.

Certain Drawbacks

In the first place the crystal detector is placed across the whole of the anode tuning coil, thus conducing to a lack of selectivity and decreased signal strength.

Secondly, if a transformer of high step-up ratio is employed the circuit is liable to howl, which considerably restricts the range of suitable transformers. Further, although selectivity can be improved by tapping the aerial across part of the tuning coil, this will frequently result in instability. For the same reason tapping the crystal across part of the anode coil may cause uncontrollable oscillation. In the extreme case when the catswhisker is removed from the crystal the set will often howl violently owing to the removal of the crystal damping.

Other Disadvantages

Again, the reaction is not independent of tuning owing to the method employed for coupling two tuned circuits. This is especially troublesome

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when DX work is attempted. Another disadvantage which may be mentioned is that the removal of the anode coil results in the whole of the anode current passing through the crystal, thus upsetting the adjustment.

Stabilising

Various methods of stabilising reflex receivers have been proposed from time to time, one of these being to place a resistance of about 100,000 ohms between the grid and filament. Many important questions dealing with reflexing have been discussed by Mr. J. Scott-Taggart in *Wireless Weekly* and MODERN WIRELESS, the problems being of an intricate nature and meriting careful attention.

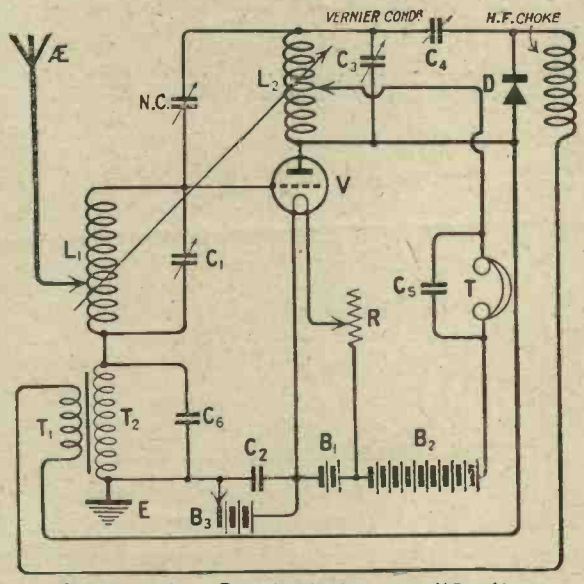


Fig. 3.—The Crystachoke modification enables the load on the tuned-anode circuit to be suitably adjusted.

A Neutralising Circuit

A suitable neutralising circuit is shown in Fig. 2, where it will be seen that a split anode coil is employed, the return to the telephones and H.T. being from the centre tap, while the two ends of the coil are connected respectively to anode and to the neutralising condenser.

A further refinement is the introduction of an aerial tap which improves selectivity in the tuned-grid circuit in the same way as tapping the crystal increases the selectivity of the tuned anode.

With this circuit it should be possible to remove both aerial and crystal without oscillation taking place. This makes it particularly suitable for frame aerial reception, and remarkably good results may be obtained in this manner.

Using a Crystachoke Arrangement

The next step after stability has been secured is to introduce some means for varying the crystal load. Clearly the provision of a number of tapping points is not conducive to simplicity, nor is it desirable owing to the necessity for changing over to Daventry.

It was therefore decided to employ a Crystachoke method. This consisted of placing a vernier condenser in series with the crystal in order to control the load imposed by it on the anode tuning circuit, a choke being provided to by-pass the low-frequency current.

Reducing the Load

The new circuit is shown in Fig. 3, where C_4 is a vernier condenser. By decreasing C_4 it is possible to reduce the load of the crystal on the tuned-anode circuit to the required extent, and thus enable the crystal to function under the best conditions.

An experimental set built with this circuit gave particularly good results, 2LO coming in at powerful loud-speaker strength at a distance of about twelve miles. It should be remembered, however, that careful layout is necessary in order to obtain the best working.

Other Advantages

A further advantage of the Crystachoke method is that it considerably reduces the tendency to howl, and enables a transformer of high step-up ratio, *e.g.*, 8:1, to be satisfactorily employed.

In addition this method of removing crystal damping prevents the possibility of the anode current passing through the crystal when the anode tuning coil is removed. This means that semi-permanent or even permanent crystal detectors may be used with safety.

Reaction Control

Reaction can be conveniently controlled in this circuit by coupling the anode and aerial coils to the necessary degree, and using the vernier condenser for fine control. If it is desired to employ a swinging-coil control of reaction, a coil placed in series with the tuned anode and coupled to the grid coil will be found satisfactory.

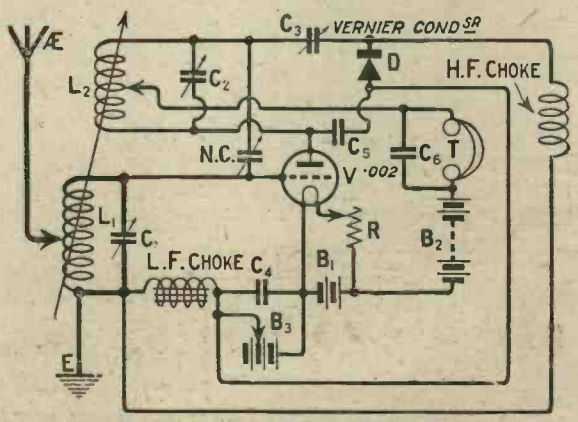


Fig. 4.—A suggested reflex circuit which has many novel features.

An Interesting Circuit

An interesting circuit is shown in Fig. 4, which incorporates several novel modifications. It will be seen that the rectified crystal current passes through an L.F. choke in the grid circuit. Low-frequency potentials are thus built up across this choke and thence applied to the grid of the

(*Continued on page* 990.)

Experimental Circuits Worth Trying

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

Modifying existing circuits and evolving new ones is perhaps one of the most popular features of wireless.

IN the course of some experiments on high-frequency amplification using the split-grid-coil system of neutralising shown in Fig. 1 it was found that if the lead shown dotted from the centre of the coil to L.T. negative was removed an increase in amplification was obtained. The circuit shows a stage of H.F. in which the grid coil L_1 (tuned by a variable condenser C_1) is connected so that one end goes to the grid of the H.F. valve, the other end being connected to one side of a neutralising condenser N.C. The other side of this condenser is connected to the anode of the valve, while the centre tap is connected to L.T. This gives a true bridge arrangement, and it is possible to balance this up with the valve turned out so as to result in no transfer of energy taking place between the grid and the anode circuits.

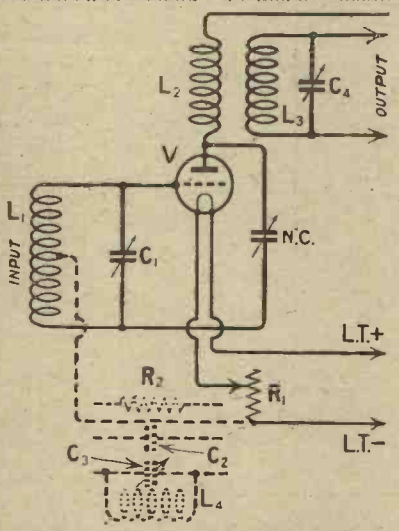


Fig. 1.—Certain peculiarities were noted with this circuit.

Increased Amplification

The effect noted above was found to occur equally when one or two stages of H.F. were used, and various experiments were made to see how this increase could be retained. A grid leak R_2 was placed between the centre tap of L_1 and L.T.—and this was found to cause no appreciable difference. Then fixed condensers, as shown at C_2, of various values, were tried, and finally a tuned circuit L_4 C_3. This latter was found to sustain the increased amplification obtained, as compared with the direct connection to L.T., only when the circuit was tuned, and the next step was to connect a H.F. choke in this position. This was satisfactory in that not only was the increased amplification retained, but it was possible to apply a negative bias to the grid by means of a small battery without any diminution in signal strength, and thus effect economy in anode current, a serious consideration when several H.F. stages are employed using valves with heavy H.T. current consumption.

Parasitic Oscillations

It was further found that this circuit was liable to generate short-wave oscillations at the lower settings of the tuning condenser C_1 with the direct connection, and the use of the choke was found to damp these out entirely with one stage, and with two or more stages it reduced them to a negligible quantity so that they occurred only at the absolute minimum of each tuning condenser. The final circuit using two stages of H.F. amplification is shown in Fig. 2, each stage being neutralised.

This formed a very efficient and

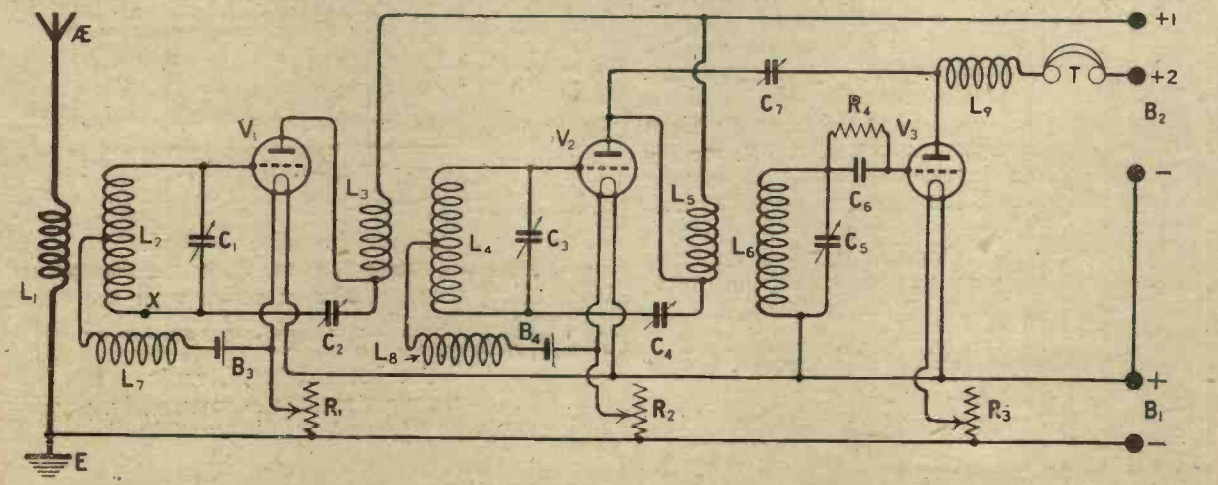
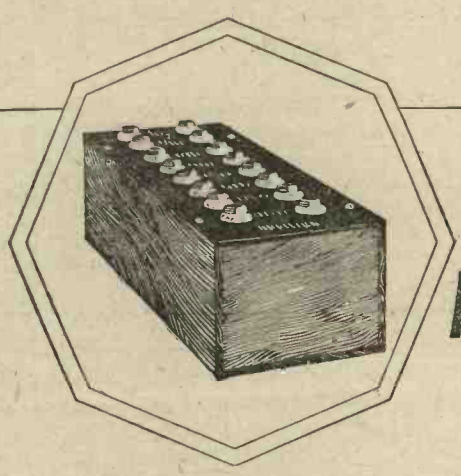


Fig. 2.—A very efficient and selective circuit. If the aerial lead was connected to X an increase in signal strength was observed on some distant stations.



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In connection with the Dubilicon, there is an interesting little problem. How many different capacities can be obtained by using it? For example, taking the first two units only, you get two values by using each separately, one by using them in parallel, and another when they are in series. Total 4. How many arrangements are possible by using the first five units, both separately and in various combinations?

To the purchaser of a Dubilicon who sends in a correct estimate, we will award a cash prize of £200.

If two or more competitors send in a correct solution, this prize will be divided equally among them, while if no correct solution is forthcoming, the prize will be awarded to the competitor furnishing a figure most closely approximating the correct estimate, or divided among them equally if more than one is included in this category.

By courtesy of the Trader Publishing Co., Ltd., the competition will be judged by the Editor of the "Wireless Trader," whose decision will be final.

All you have to do is to purchase a Dubilicon from your Wireless Dealer. It will be given to you in a sealed box containing a numbered entry form, and full particulars of the competition as well as instructions for the use of the Dubilicon.

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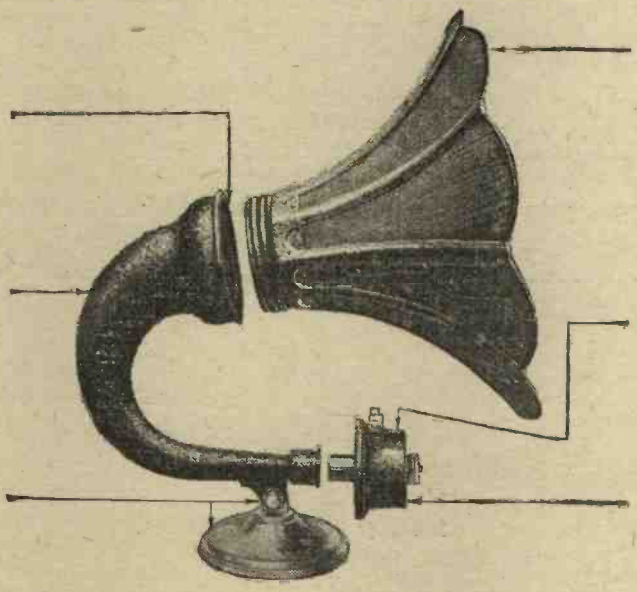
The conduit is hinged to the weighted electro-plated base, giving stability and freedom of movement, in order that the horn may be tilted to suit the acoustics of any apartment.



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selective circuit, while reaction was obtained from the anode of the detector valve after the manner of that used in a modified Reinartz circuit where the aerial coil is used also for the reaction coil.

Non-radiation

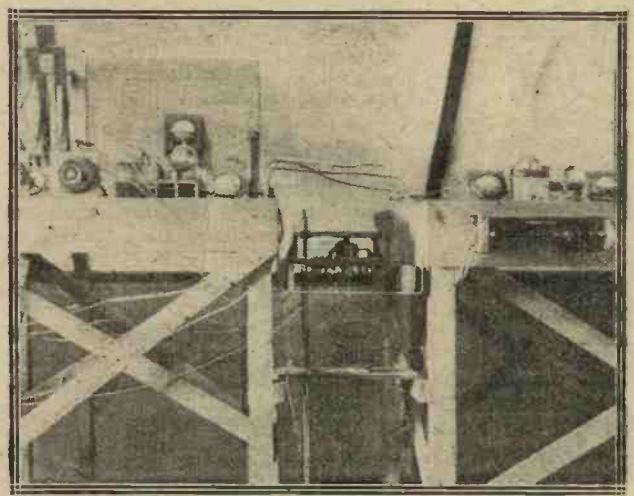
The reaction in this case was accomplished by employing the primary of the H.F. transformer L_5 which couples the second H.F. valve to the detector, as a reaction coil, a choke L_8 being placed in the anode circuit of the detector valve as shown. This gave a smooth control of reaction, and provided that the valve V_2 was correctly neutralised no interaction in the tuning between the circuits L_4 C_3 and L_6 C_5 resulted.

When the detector valve was made to oscillate both stages of H.F. remained perfectly stable, and owing to their being exactly balanced no radiation from the aerial took place, thus making it possible to search for distant stations with the detector oscillating and without fear of causing any disturbance to other listeners.

Obtaining Greatest Efficiency

Since the energy fed back by the neutralising condenser is in opposition to that fed back by the anode-grid capacity of the valve, as long as balance exists, the detector valve may oscillate quite strongly, but no feed back will occur. If, however, the value of the neutralising condenser is reduced slightly the feed back from anode to grid will be greater than that via the neutralising condenser, and by a suitable adjustment of this condenser's capacity the effect of increasing reaction from the detector can be made progressive so that all three circuits are brought up to the oscillation point together. This results in the maximum sensitivity and selectivity being obtained, and produces a marked increase in efficiency.

An interesting point that was discovered was that if the aerial lead was connected to the point X a decided increase in signal strength was observed in some cases on distant stations without in any way impairing the selectivity of the circuit.



Mr. J. D. Chisholm's transmitter with which he demonstrated to the Press his secret system of wireless communication.

One of the disadvantages sometimes experienced with this type of coupling is the initial adjustment necessary to obtain the maximum amplification and purity. It will be seen that if the potential on the grid of the first amplifying valve V_2 is varied slightly, this variation will be impressed on the grid of the last valve in an amplified form, in fact it may be sufficient to throw the grid potential off the working part of the characteristic curve of the valve. A further disadvantage is the number of batteries required, since the grid batteries may need to be each as high as 60 volts.

No Coupling Condensers used

It will be seen by reference to Fig. 3 that the circuit is shown in skeleton form, only the essential connections being given. The detector valve V_1 may employ either anode current or grid leak and condenser rectification, the latter being indicated. This valve has in its anode circuit a coupling resistance R_1 which is of the same type as that used for ordinary resistance-capacity coupling, a suitable value being 100,000 ohms. The anode is coupled conductively to the grid of the next valve by means of a battery B_1. This battery is required to establish the correct working potential on the grid, as the H.T. positive is connected through R_1 to the grid of V_2. It is therefore necessary that this battery be adjustable, that is, it must be provided with tappings. Since the grid of the first amplifying valve may be somewhat critical in adjustment a grid leak R_4, connected to the slider of a potentiometer through a small biasing battery, may be needed as shown, but this is a matter for individual experiment, much in the behaviour of this circuit depending on the valves employed.

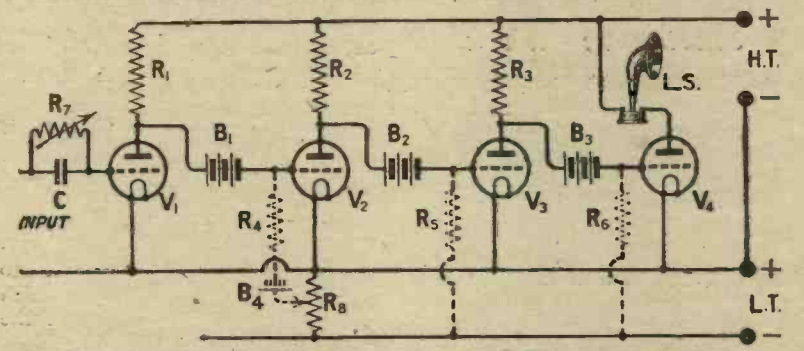


Fig. 3.—The simplified battery coupling possesses the advantage of producing a truly aperiodic system.

A Truly Aperiodic System

A form of L.F. coupling that has received but little attention is that employing battery coupling, and the circuit of Fig. 3 shows a battery-coupled amplifier which is entirely aperiodic. No chokes or condensers are employed, only resistances which do not vary with the frequency of the signal being amplified.

The remaining valves are coupled in a similar manner. In some cases the grid leaks R_5 and R_6 may be found of use as indicated by dotted lines, but these, if employed, should be of a high value or else a reduction in amplification may result.

Preliminary Adjustments

For the benefit of those wishing to carry out any experiments with this circuit some notes on adjustment may be of use, since this will be found extremely tricky if the

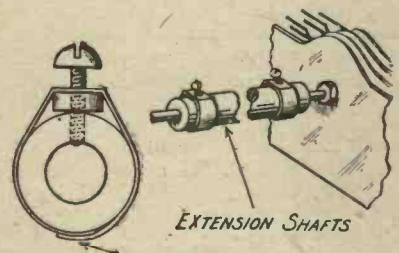
(*Continued on page* 989.)

Some Constructional Hints

A page of information which will prove useful to the experimenter and home-constructor.

Extension Shafts for Short-wave Work

ANYONE who has tried it knows the difficulty to be encountered in making extension shafts of insulating tubing for short-wave work. Usually a piece of brass rod, the same size as the instrument shaft, is inserted in the front-panel dial, and the two shafts are inserted in the ends of a



A method for connecting an extension shaft to a condenser.

length of tubing made from some insulating material, being held by set screws.

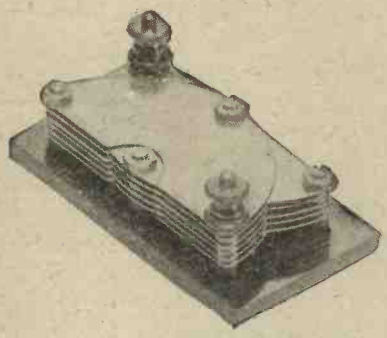
But when the set screws are tightened enough to keep the shaft from slipping, the tubing is apt to split. The trouble may be overcome in the manner shown in the accompanying diagram. Procure two pieces of strip brass, about three-quarters of an inch longer than the diameter of the tubing to be used, and two square brass nuts, with short screws to fit. Tin both sides of the brass strips and one side of each nut. Drill a hole in the centre of each strip, large enough to pass the screws. Drill a hole of the same diameter near each end of the tube. Then solder the nuts to the strips, keeping two edges perpendicular to the length of the strips, and centring the holes in the strips carefully over the holes in the nuts. Bend the ends around the tube and solder them together, forming a complete collar at each end. The extension shaft may then be fitted to the regular shafts, and the screws tightened. It will be seen that by this method all strain on the tube itself is removed, yet the collars form a very firm and permanent means of holding the extension shaft rigidly.

A. R. H.

A Use for Old Condenser Plates

ONE of the writer's variable condensers came to grief recently, and after surveying the wreck, it was decided to make use of the fixed vanes, which had almost escaped injury, in the manner depicted herewith.

A piece of ebonite was trued up, drilled and tapped to take six screws, one vane being used as a template. One of the spacing-washers was threaded on to each of the screws projecting from the ebonite, and the first plate placed in position. The three remaining screws were then each fitted with a spacer which had been filed down to half-thickness, in addition to that already in position. The second



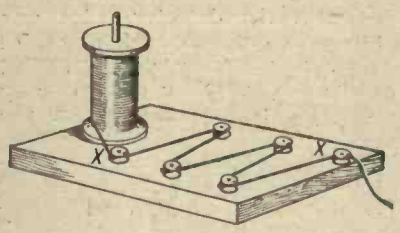
A fixed condenser can be made from old condenser plates.

plate was slipped into place on the screws and was thus raised off the first plate by one half the space distance of the fixed plates of the original condenser. Thereafter a vane and a washer were applied alternately.

In this manner the plates are arranged in two piles, dovetailing but insulated from one another and separated by air as shown in the photograph. One pile should have a plate in excess of the other, and in estimating the total capacity the lesser number should be taken into consideration.

The spacing can of course be varied according to the thickness of the spacers used. The result is quite a firm job and there is very little area wasted. The terminals shown can if desired be replaced by copper lugs for making soldered connections.

G. L. A.



A device for removing the kinks in wires when winding coils.

When Winding Coils

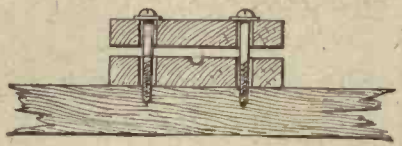
WHEN winding coils and using silk or cotton covered wire which has been bought on reels, it will often be found that it is not an easy matter to stop the wire from kinking, and also make it run smoothly on to the former with an even tension.

A Simple Device

The little device shown in the accompanying sketch makes matters easy, however, and a very neat result can be obtained.

The porcelain pulleys are of the ordinary type obtainable from any wireless dealer.

The pulleys are fixed on to a board 2 ft. long by 9 ins. wide, each pulley being 6 ins. apart, while



A small wooden clamp for holding the wire down.

leaving plenty of room for the wire reel. It will be found in practice that a small wooden clamp at each end to hold the wire taut will be useful when finer wires are being used.

L. W. R.

Will Low-Frequency Amplification Increase Your Range?

By THE RADIO PRESS LABORATORIES.

The question is often raised as to whether H.F. or L.F. is necessary for distant working, so that the results indicated here make interesting reading.

IT is now generally accepted that for long distance work high - frequency valves are necessary; while for obtaining the loudest results from the local station it is essential to have one or more low-frequency amplifiers. Further, if loud-speaker results are required from distant stations, then both high-frequency and low-frequency amplifiers are required.

Many experimenters will probably have noticed that a really efficient high-frequency valve will considerably increase the strength of the local station sometimes to the extent of giving good loud-speaker results, while a stage or so of low-frequency amplification will materially increase the range of a detector valve.

A Fallacy

A very popular fallacy with regard to detecting is that there is a certain more or less definite value of applied high-frequency potential which is insufficient to cause a detector such as a crystal or detector valve to rectify. Now theory indicates that this is not so, but that except under rather unusual conditions the output of the detector valve will be roughly proportional to the square of the input.

An Interesting Experiment

In order to test this practically an experimental receiver was constructed consisting of a crystal detector followed by four stages of low-frequency amplification. The first two of these were transformer-coupled, followed by a stage of resistance-coupled amplification, while in the final stage another transformer-coupled valve was employed.

Reception on a Loop

It was, of course, impracticable to use this receiver for DX work, while the local station was transmitting, owing to the flat tuning of the crystal receiver. In order to simulate conditions applying for distant reception, therefore, an attempt was made to receive London on a loop. It was known from previous experiments that at a distance of 12 miles from 2LO at which the receiver was employed it was just possible to receive London on a loop used in conjunction with a particularly efficient crystal receiver.

No provisions were made in the present instance to adapt the crystal receiver to loop reception, and it was therefore found that no signals at all could be heard from 2LO either when telephones were placed in series with the crystal, or in the anode circuit of the succeeding low-frequency valve. On the other hand, when all the stages of low-frequency were employed rather weak loud-speaker reception could be obtained from the local station.

A Definite Result

This experiment therefore shows quite definitely that a crystal detector will rectify satisfactorily below the point at which signals become audible. Further, it afforded an indication that a certain amount of DX work is possible on a crystal followed by a sufficient number of low-frequency valves.

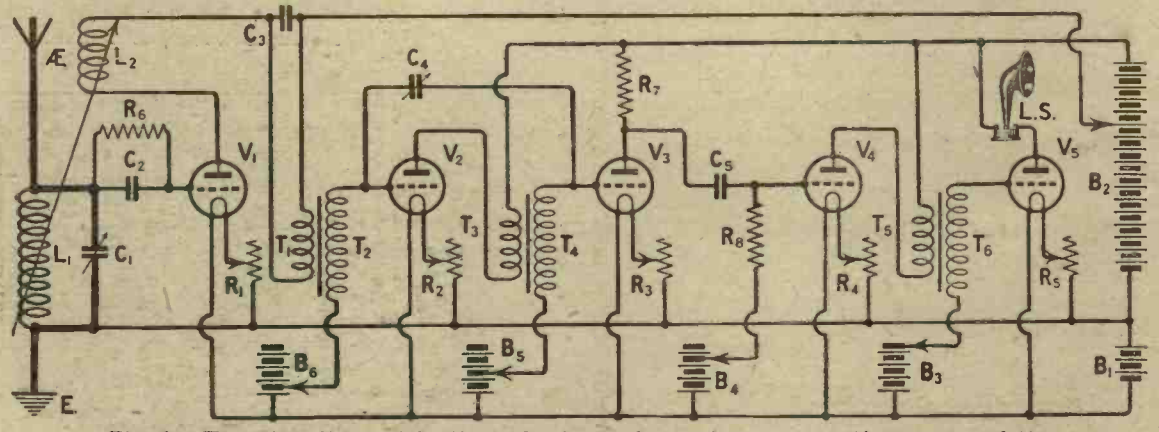


Fig. 1.—The circuit used in the actual receiver when conducting some of the tests at the laboratories.

In order to test this it was necessary to wait until 2LO had closed down, when the receiver was connected to an outside aerial. Immediately this was done, music (unfortunately unidentified) was heard rather weakly on the loud-speaker; but although audible about 20 or 30 feet away, it could hardly be described as loud-speaker

strength. This gives a clear indication that low-frequency valves serve to increase range, as no distant stations could be received on this particular aerial with a crystal alone, or with a crystal and a single stage of note amplification.

Another Test

On another occasion, under more favourable conditions, a crystal and two stages of low-frequency were found to give faint signals from both Birmingham and Bournemouth at a distance of about four miles from 2LO.

The next step was to substitute the detector valve for the crystal receiver and listen with the telephones. It was then found possible to obtain Madrid at fairly good telephone strength without any reaction on the detector; while one or two other stations came in when using very slight reaction. By removing the four-stage amplifier, no station other than the local could be obtained without full reaction, and then only Madrid was audible. This was primarily due to bad atmospheric conditions, although it was also probable that the detector was not very efficient.

A Practical Point

The actual receiver is shown in Fig. 1. It will be seen that a neutralising condenser C_4 is placed between the grids of the second and third valves. In the particular receiver employed this was found necessary in order to ensure stability. Its action appeared to be rather that of negative reaction than of true neutralising; but it served to stabilise the amplifier without weakening the signal strength.

Atmospherics

Amateurs who attempt distant work on the telephones with a detector followed by two stages of low-frequency amplification will know how painfully loud atmospherics and other parasitic noises become. It was particularly noticeable with the detector and four stages of low-frequency. In fact, it was sufficient to render DX work exceedingly painful to the ear when full reaction was employed. Possibly some limiting device on the last stage of the low-frequency would assist to some extent, although the use of a very selective single valve for the detector is generally found to decrease parasitic noises.

Seven Stages of L.F.

The next step was to find how many stages of low-frequency could be added without introducing oscillation or uncontrollable distortion. The first step in this direction was to add three stages of choke-coupled amplification to the detector and the four stages of low-frequency previously described. The result of this was to decrease the strength of the local station to moderate telephone strength, even this suffering from considerable distortion. The whole amplifier was very difficult to control, and it is quite possible that the lack of volume was due to low-frequency oscillations above the limit of audibility.

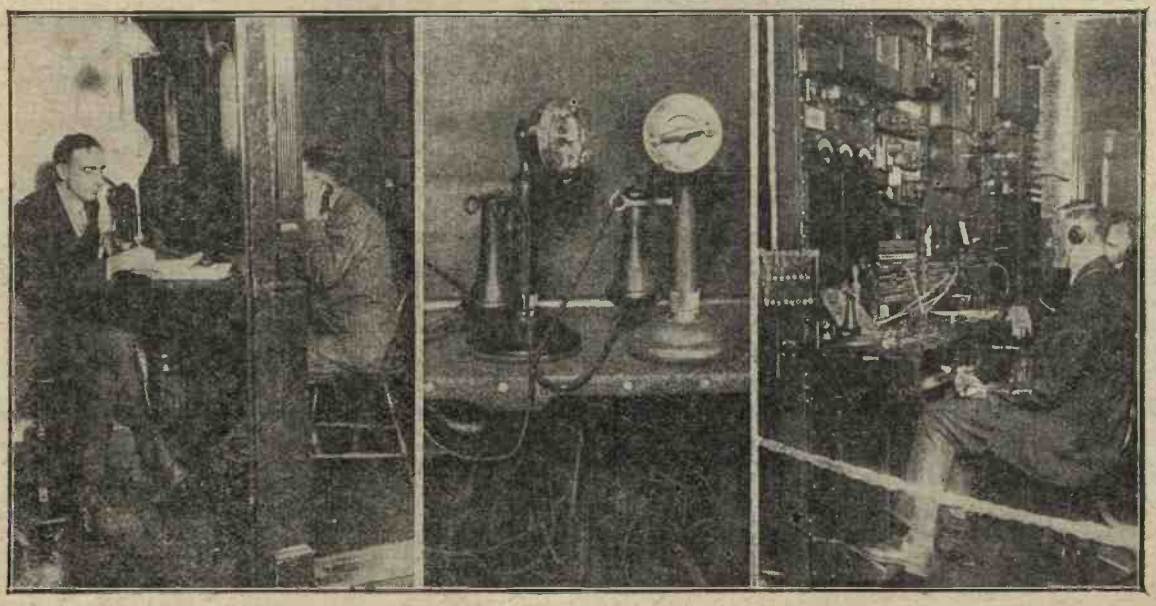
It should not be concluded from this that it is impossible to make up a low-frequency amplifier of this type; but simply that the inexperienced amateur would probably find it extremely difficult.

Resistance Coupling

It was next decided to eliminate the transformers and simply employ a six-stage resistance-coupled arrangement. This was found to oscillate at an audible frequency, and also, when this was overcome, to distort, but after carefully choosing the values of the resistances it was possible to obtain good reproduction. Quite remarkable results were obtained with this receiver, and it was possible to obtain Cardiff at very strong loud-speaker strength during daylight. Quite a number of foreign stations were also obtained at powerful loud-speaker strength during the evening. If we take Cardiff's strength during daylight as a criterion it is probable that on the particular aerial employed at least two high-frequency stages before a detector followed by two stages of low-frequency would be necessary to enable equal results to be obtained.

Disadvantages

Naturally in a set of the type described it is quite impracticable to work on headphones, and even with a loud-speaker the process of tuning in was rather painful owing to the colossal amplification of atmospherics and heterodyne whistles. When a station was obtained, however, it came in with



A recent epoch-making event was the radio telephonic conversation held between New York and London. Some of the principal features are indicated above.

quite satisfactory quality, and it was possible to listen in comfort.

The most important drawback is the lack of selectivity on the single-valve detector. This can be cured to a great extent by the use of two or even more tuned circuits; but when doing this it should be remembered that the coupling must be very loose or the circuits will interact, rendering the process of tuning very difficult.

Conclusions

From the experiments described above it is possible to draw the following conclusions. In the first place low-frequency amplification does increase range, while it enables tuning controls to be very considerably simplified.

Secondly, it is necessary to design the low-frequency amplifier very carefully. This applies especially where transformers are employed, and it may be necessary to use a neutralising arrangement to control any tendency to oscillate. Further, if serious work is to be done it is necessary to use at least two tuned stages in the detector to obtain the requisite selectivity.

The "Experimenter's Tuner."

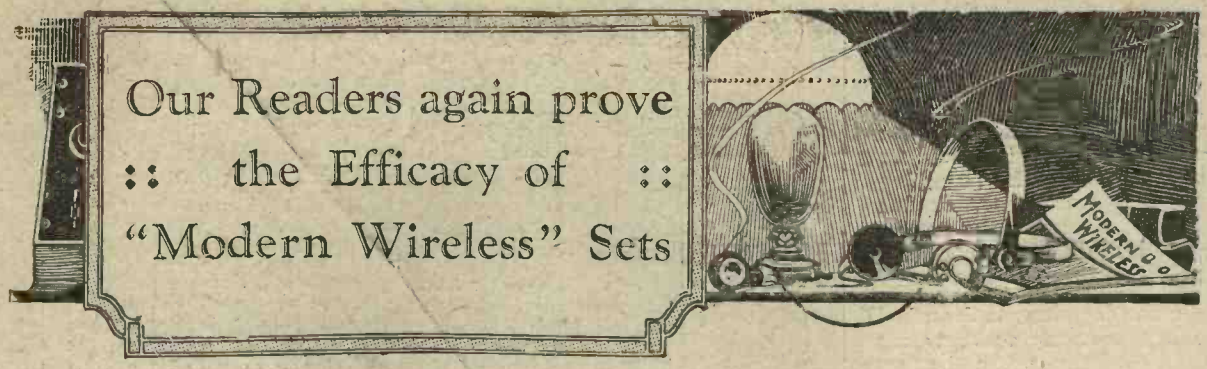
SIR,—I was interested to see in the April issue of MODERN WIRELESS a mention of the "Experimenter's Tuner," in the article entitled "Is the Separate Tuner Obsolete?" I made up this tuner to Mr. Kendall's specification soon after the description of it appeared in MODERN WIRELESS for September, 1924, and was delighted with its performance and usefulness. Though it has now lost some of its original smart appearance, this is due to hard and continuous use and not at all to neglect. I find it an invaluable unit for experimental work, and I have attached it to any number of receivers.

The convenience of such an instrument needs to be tried to be fully appreciated, and in my opinion a tuner of this type should form part of the equipment of every experimenter.

All success to MODERN WIRELESS, of which I have been a regular reader since No. 1.—Yours truly,

F. DICKSON.

Dollis Hill, N.W. 10.



"Full Volume with Three Valves."

SIR,—Since writing you a short time ago giving my results with the "Three Valve Dual" circuit, I have built the set described in the July, 1925, issue of MODERN WIRELESS under the heading, "Full Volume with Three Valves," by Mr. A. Johnson-Randall, and again feel I must let you know the wonderful results I am obtaining.

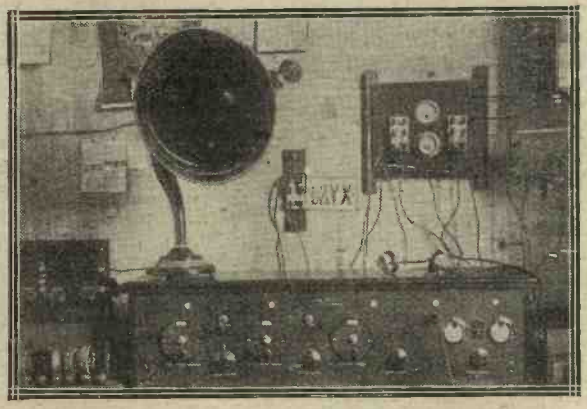
I have followed the design very closely, the only alterations being that instead of the series-parallel arrangement, I have wired the receiver for parallel tuning only with the addition of a C.A.T. condenser. The transformers used are first stage, Fullers "Ironclad," and second stage Radio Instruments "R.I."

The aerial tuning coil is similar to that given in the March, 1925, issue of your paper by Mr. G. P. Kendall, together with the same type of coil for reaction.

This arrangement proves very selective and the coils tune from well below 300 metres to about 580 metres with the aerial on one of the tapping points.

And now for the results: Daventry at about 100 miles is at times overpowering and the set has to be detuned for comfortable loud-speaker strength; Manchester at 76 miles is all that one could wish for in a small room, as is also Birmingham at approximately 60 miles, the tonal quality being extremely good. All the B.B.C. main stations are received at good 'phone strength, and several come in quite well on the 'speaker on a favourable evening.

On completing the set I decided to ascertain how many stations it was possible to receive, and up to the present the following have been logged: Stoke-on-Trent.* Liverpool, Berne, Plymouth, San Sebastian,* Cardiff, Le Petit Parisien, London,* Madrid,* Manchester,* Bournemouth, Dublin,* Hamburg,* Newcastle, Munster, Glasgow, Rome, Belfast, Radio Toulouse,* Stuttgart, L'Ecole Sup., Barcelona,* Frankfort, Birmingham,* Aberdeen, Berlin (Vox Haus), Hilversum, Konigswusterhausen,* Radio Paris* and Daventry.*



Mr. A. E. Clipstone's "Special Five" receiver with special vernier dials and meters incorporated.

The stations marked * were all received on the loud-speaker at various strengths.

The above is, I think you will agree, a very formidable list of stations to the credit of a three-valver, and the set, in my opinion, does more than the author claims for it, and is easily the best all-round receiver I have yet handled.

Thanking Mr. Johnson-Randall for such a clear description, and hoping the above will be of interest to you.—Yours truly,

OWEN H. OWEN.

Oswestry.

"The Special Five."

SIR,—About one month ago I made the "Special Five" Receiver as described in the November, 1925, issue of MODERN WIRELESS. I compliment Mr. Harris on his excellent set and it is by far the best I have ever made. It is particularly selective and I have had to fit vernier dials in order to tune in the stations satisfactorily. I live only one and a half miles from 5NG, but I can cut this station right out in two degrees on the condenser scale. I have nearly all the B.B.C. main stations at good loud-speaker strength. Up to the time of writing I have also received 20 Continental stations at good loud-speaker strength. I enclose a photograph of this set which I hope will prove of interest. In conclusion I must say the purity of tone of this set leaves little to be desired. I am a regular reader of all your valuable publications and wish you every success.—Yours truly,

ALBERT E. CLIPSTONE.

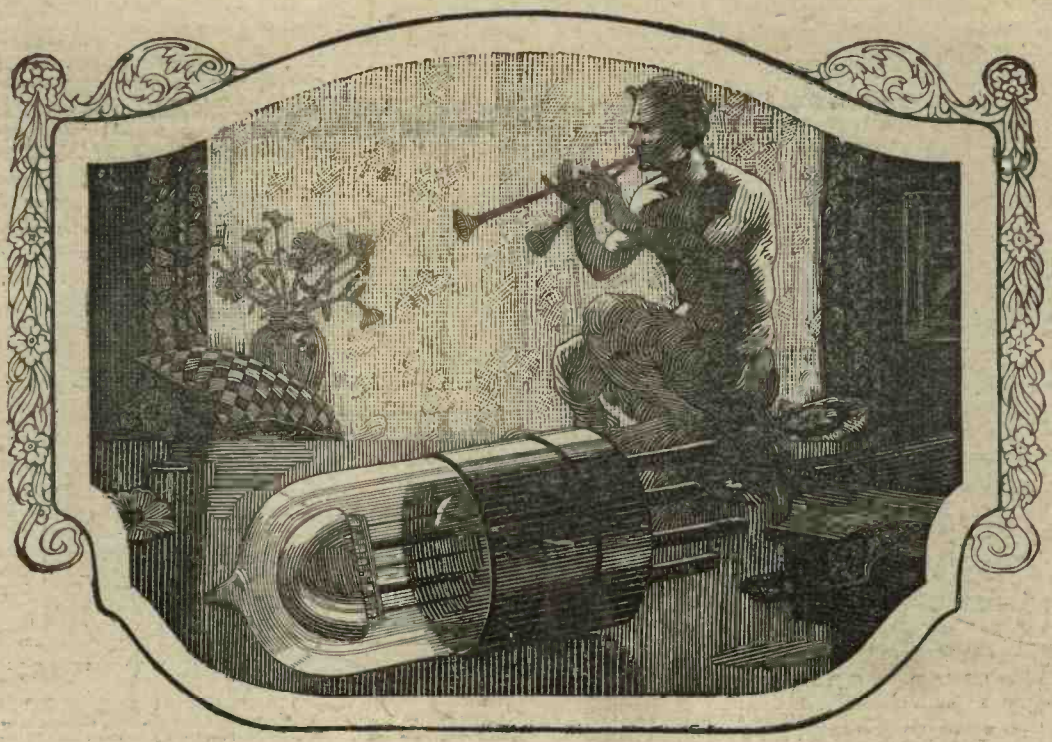
West Bridgford.

Flexibility with the Reinartz Circuit.

SIR,—Under the heading of "Flexibility with the Reinartz Circuit," in the February 1926 issue of MODERN WIRELESS, Mr. A. Johnson-Randall described a two-valve receiver, and I am writing to say that I have had great success with this receiver. The Continental stations come in particularly well on the telephones, while the simplicity of working leaves nothing to be desired. My heartiest thanks for this constructional article.—Yours truly,

T. J. WHEELER.

Watford.



The Dull Emitter which defies old age

LISZT'S beautiful Rhapsody Hongroise—full of dramatic fire and brilliantly contrasted passages—was being broadcast. Away in the Studio, the artiste's fingers tripped lightly over the ivory keys. At home, the family sat enthralled—captivated by the richness and emotion of the masterpiece which won for its composer a niche in the Hall of Fame.

And then suddenly . . . dead silence. A valve in the Receiving Set had burnt out.

What causes a valve to burn out prematurely? Excessive heat—nothing else—is the devastating influence. All metals when heated expand—when cool, they contract. A valve filament constantly expands or contracts as the current is turned on or off. The higher the temperature, in fact, the greater the expansion. Such treatment, in course of time, produces brittleness and inevitably renders the filament very susceptible to fracture.

This was the problem Cossor set out to solve—and so successfully unriddled—by the invention of the triple-coated filament used only in the Wuncell Dull Emitter Valve.

Whereas in most dull emitters, low current consumption has been obtained by the use of extremely fine filaments operating at temperatures as high as 2000°, the Wuncell ensures economy by entirely different methods. Its special filament is *triple-coated* to ensure a prolific electron stream at only 800°—practically the temperature of the embers of a dying match.

Further, its filament is practically as stout as that used in any bright emitter. Because of this, and the fact that its working temperature is so much lower than hitherto thought possible, heat has little or no effect upon it.

As a result the Wuncell has already won a great reputation throughout this country and abroad among broadcast listeners as the one dull emitter "which really defies old age."

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*W.1. For Detector and L.F. use. 1·8 Volts. Consumption: ·3 amps.	14/-
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W.3. The Loud Speaker Valve. 1·8 Volts. Consumption ·5 amps.	18/6
*Also in special base with resistance to suit 2, ·· or 6-volt Accumulator	16/-

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Gilbert Ad.

An Analysis of Some Common Switching Faults.

(Concluded from page 960)

arrangement by which this may be effected is shown in Fig. 4.

To be really effective the aerial and earth switch should be placed outside the house, but some provision should be made to protect it from the effects of the weather, and the blades should be periodically cleaned, it being ascertained that they make good contact with their respective clips.

Switch Contacts

In a case which recently came to my notice this was not done, and the transmission being received was heard intermittently. On retuning on the aerial con-

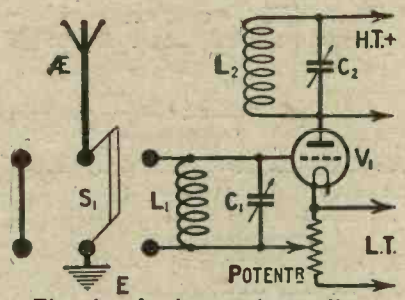

Fig. 4.—A simple but effective aerial - earth switch arrangement.

denser C_1 the station could be heard at greatly reduced strength and only at a considerably higher condenser reading than previously. This condition of affairs generally only existed for a short time, when the transmission would come back to full strength at the original condenser setting. After suspecting an intermittent break in the earth lead, which was replaced, the trouble was finally located to the switch contacts. These only made properly on one side and the strain of the down lead, due to wind pressure, was sufficient to cause discontinuity between the aerial switch arm and its clip.

A Superheterodyne for the Open Air

By G. P. KENDALL, B.Sc.

(Concluded from page 921.)

At a certain point it should be found that the long-wave side passes fairly smoothly into oscillation, and a continual rustling is then heard.

Now revolve the condenser dial of the oscillator between its mid-scale reading and its maximum, noting whether what appear to be carrier waves are then heard, with their characteristic whistle. If nothing is heard it indicates that the oscillator valve is not functioning and the little rotor in the oscillator-coupler should be turned through 180 degrees, which, of course, is equivalent to reversing the connections of the reaction coil. The oscillator will now be found to be oscillating correctly, and whistles will be heard when the oscillator is tuned with the long-wave side and also in the oscillating condition.

Finding the Centre Point

Now bring the long-wave side just off the oscillation point, set the oscillator condenser to its mid-scale reading and turn the frame aerial tuning condenser. You will probably find that loud clicks are heard at a certain point, indicating that the frame aerial has come into resonance with the oscillator tuned circuit, whence energy from the incorrectly located centre point is being transferred back into the frame.

Now pull off a few turns from one half or the other of the oscillator coupler winding, noting whether the effects become less troublesome, that is to say, whether the clicks now occur closer together upon the condenser dial. (Two clicks will be heard, separated by a few degrees on the oscillator dial, and the closer together these clicks are the more correctly has the centre point been located.)

A Useful Indication

A little careful adjustment of this sort usually removes the click effect altogether and will at any rate reduce it until it is no longer troublesome. If you only hear a slight click at practically one point upon the dial, you may cease to trouble about this effect, which may rather be regarded as a convenient guide to a condition of resonance between the frame aerial and the oscillator circuit.

This condition of resonance, it should be noted, does not indicate that a station will be heard when the two circuits are both so set, but rather that when the frame aerial is set to a given tuning, by varying the oscillator dial upon each side of the "click-point," the correct adjustments will be found at which the desired station will be heard.

This condition may be found to render searching somewhat easier than with a more perfectly adjusted set in which no clicks whatever are heard, and therefore this month I am only describing a simple oscillator-coupler with which the click phenomenon is rather prone to take place. Later we shall be considering methods of removing it completely and also of various special oscillator-couplers intended for particular purposes, such as short-wave reception, use in close proximity to a powerful station, and so on.

Valves

The choice of valves to use in a circuit of this nature is a highly important point, and I would strongly urge the reader who intends to use the set seriously, that is to say, for both portable and other purposes, to consider the question of purchasing a special set of valves of a particularly suitable type. The type of valve which I have found most successful is the high-impedance high amplification ratio type in the first five sockets, and one of the usual low-impedance power valves in the last socket.

For example, I have obtained particularly good results with the D.E. 8 type of valve, using the H.F. variety in the first five sockets and the L.F. in the last socket. On occasion, also, a D.E. 8 L.F. valve had proved somewhat more advantageous than the H.F. type in the first socket, more particularly when any difficulty had been experienced in getting the first valve to oscillate, as sometimes happens when working on the higher frequencies in the neighbourhood of Brussels, depending, of course, upon the exact number of turns put upon the windings of the aperiodic H.F. transformer.

H.T. Voltages

With these valves, of course, a 6-volt accumulator is necessary and the H.T. voltages found suitable are as follows. The H.T.+1 lead supplies the first H.F. valve and the second detector, a suitable common voltage for these two being usually found in the neighbourhood of 45 volts. The H.T.+2 lead supplies the intermediate frequency amplifiers and the oscillator-detector, a common voltage here again being found perfectly suitable with most valves. About 80 or 90 volts is desirable here; while H.T.+3, which feeds the L.F. valve, should be given the maximum available voltage, up to about 120 volts.

I have tested the set with .06 ampere valves in use, but I did not find them quite so suitable as various other types, although perfectly good results could still be obtained. In particular, it was not found very easy to make sure that the best results were obtained from the first valve in the set, which it is essential shall be of the fairly freely oscillating type. It will be understood that this valve is intended to be capable of oscillating when the potentiometer controlling it is brought down towards the negative end, in order that the desired reaction effect into the frame aerial circuit may be obtained.

Searching

In practice, of course, one adjusts this potentiometer so that the valve is not quite oscillating, when the maximum signal strength and selectivity is desired. Incidentally, this potentiometer provides a very good volume control; but these points of refinement in operation must be dealt with in greater detail at a later date. At the moment I must content myself with pointing out that both the potentiometers should be set so that the valves which they control are a little way off the oscillation point.

Other Valves

As regards alternative valves, I would suggest that the D.E.2 type, using the H.F. and L.F. variety in the appropriate circuits, as previously explained, will be found convenient from the point of view of portability, since they only require a 2-volt accumulator, and the total consumption would be only in the neighbourhood of .7 of an ampere, the Mullard P.M.3 and P.M.4 valves also being suitable. Those types which I have mentioned, of course, are not the only ones which will give good results in the set, and are merely intended as a general guide to the type of a valve for each particular function.

Experimental Circuits Worth Trying

(Concluded from page 977.)

correct procedure is not followed. I will assume that no grid leaks are being used. First obtain the static characteristic curves of the valves being employed and find from them the correct H.T. current and grid-bias voltage to bring the working point on to the centre of the straight line portion of the characteristic. With the valves switched on and the H.T. battery connected, disconnect B_3 from the grid of V_4, connecting instead a small bias-battery between the grid of this valve and L.T. negative.

Apply the bias indicated by the characteristic curve of the valve and with a milliammeter in the anode circuit of V_4 note the current. Suppose this is 6 milliamps. We may also assume that since high resistances are connected in the anode circuits of V_3 and V_2 the effective anode voltage applied will be low and that therefore a small negative potential of about 1½ to 3 volts only need be applied to the grids of these valves.

Intermediate Steps

Connect B_3 to the grid of V_4 and connect the grid of V_3 to L.T. negative through the 1½- or 3-volt battery and adjust the potential applied to the grid of V_4 by B_3 until the anode current is once again 6 milliamps. Now connect the grid of V_3 to B_2 and place the bias-battery between the grid of V_2 and L.T.—, B_1 being disconnected. Adjust B_2 till the anode current of V_4 again reads 6 milliamps. Now connect the grid of V_2 to B_1 and readjust again. The use of the grid leak and potentiometer as previously mentioned may be found useful here, while a further fine adjustment is provided by means of a variable grid leak for the detector valve. The needle of the milliammeter should be stationary when signals are being received, any movement showing the presence of distortion.

A Warning

The intending experimenter is warned, however, that this circuit is by no means a simple one to work, but once its intricacies have been mastered, the purity of reproduction obtained is of a very high order, while the degree of amplification obtainable is generally somewhat greater than that given by straight resistance-capacity coupling.

Developments in Single-Valve Reflexes

(Concluded from page 973.)

valve. It will be noted how a Crystachoke method is employed to enable the rectified current to be applied to the grid of the valve without shorting the H.T. battery. For this purpose a fixed condenser C_5 is inserted in the position shown. The exact value of this is not important, .002 being suitable.

An Untuned-anode Reflex

It is not generally known that a reflex will work quite satisfactorily even if the anode coil is entirely untuned. It is, however, necessary to employ a coil of suitable size, *e.g.*, a No. 75 or a No. 100. A circuit of this type is shown in Fig. 5, where it will be seen that neither neutralising nor the Crystachoke method is employed. This is because the circuit is quite stable without neutralising, while the employment of Crystachoke arrangement was found to result in a loss in efficiency. Tapping the crystal across part of the anode coil was also found to give weaker signals.

Simple Operation

While this circuit does not give quite such loud signals as the tuned anode arrangement, it has the advantage that it is almost as simple to operate as the single-valve detector. Its action is, however, not altogether clear. An obvious suggestion is that the anode coil acts as a choke across which the H.F. potential is built up. Against this there must be placed the fact that there is a definite optimum inductance for the coil, which is much less than that of an ordinary H.F. choke.

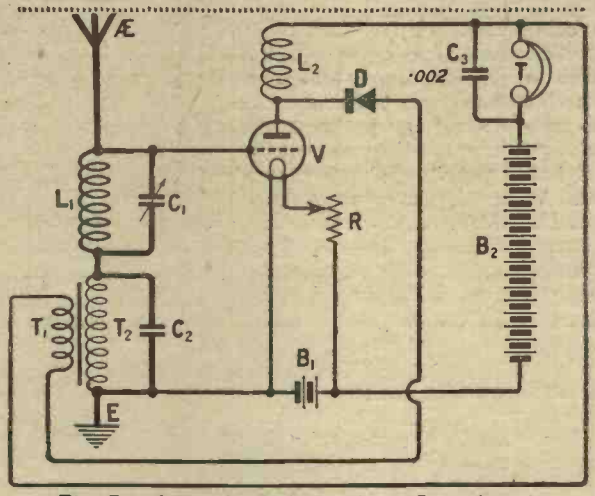

Fig. 5.—An untuned-anode reflex circuit is very simple to operate.

Another possibility is that reaction involves sufficient coupling between the tuned grid coil and the anode coil partially to tune the latter by what is known as trap tuning.

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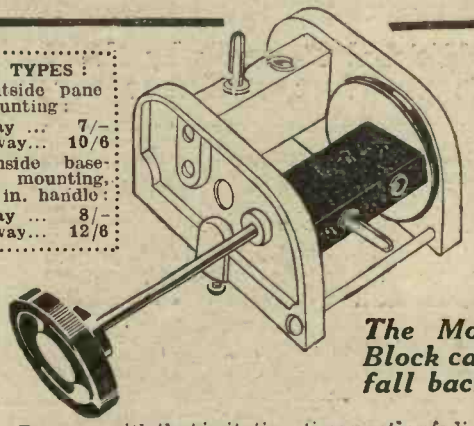

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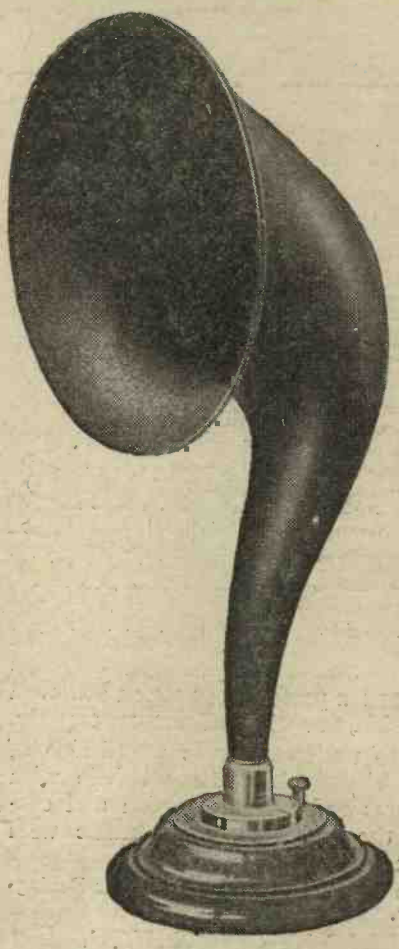

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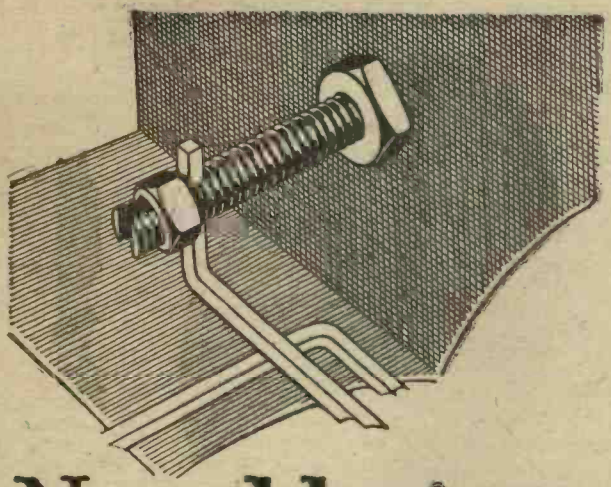
Table-Talker	*Audio Transformers*	*Matched Tone Headphones*
30/-	17/6	20/-

45/563.A SERVICE ADVERTISING



No soldering needed here!!

The stem of a Belling-Lee Terminal is slotted as shown. The wire is clamped tight by means of the nut and a perfect connection achieved without trouble, or risk of future trouble. You begin to understand the popularity of Belling-Lee Terminals! They bristle with unique features and they give finish and distinction to the set. They are made with twenty-eight engravings.

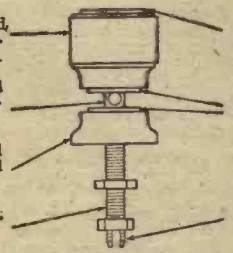
Moral: If you're proud of your set, give it Belling-Lee Terminals.

BELLING-LEE PRODUCTS.

Terminals, Plugs and Sockets, Couplers, Double Sockets, Sub-connectors, Dial Indicators, Air Space Wire, Coil Holders, Variometers, Detectors, Distribution Boards, Crystal Sets.

Illustrated Catalogue post free on request.

Standard (Bakelite-insulated) (*Type B*) . . . 9d. each.
Popular (Non-Insulated) (*Type M*) . . . . . 6d. each.



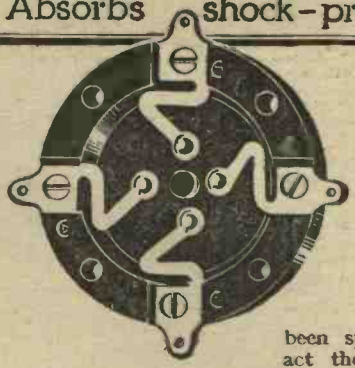
Patent Application No. 5954/25.

BELLING-LEE

PANEL FITTINGS

QUEENSWAY WORKS PONDERS END, MIDDLESEX.
Telephone: Enfield 498 E.P.S.2

Absorbs shock—protects the valves



Valve sockets and springs are locked together by a mechanical process, making a definite and permanent connection. Bakelite mouldings, nickel silver springs and phosphor bronze valve sockets. Nickel plated.

You know it's good because of the name "LOTUS"

Don't have your valves spoiled by shock. The Lotus Valve Holder has been specially designed to counteract the microphonic elements that are so injurious to the delicate valve filaments.

The unique and original springs of the Lotus Valve Holder absorb any shock and eliminate all microphonic noises. Protect YOUR valves by fitting the Lotus Holder.

LOTUS
BUOYANCY
VALVE HOLDER
ANTI-MICROPHONIC

2/3
With Terminals 2/6

From all Reliable Radio Dealers.

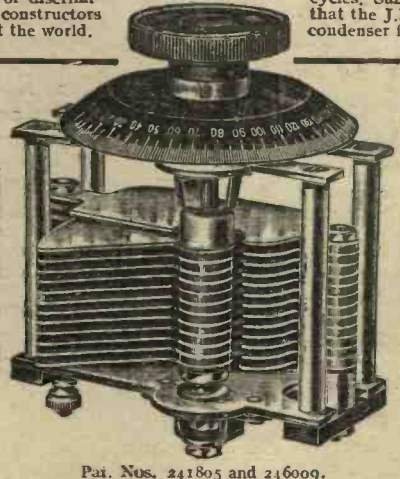
GARNETT, WHITELEY & Co., Ltd.,
Broadgreen Road, Liverpool.

Makers of the famous LOTUS Coil Holder

An Additional Reason why the J.B. is the best condenser for you

THE J.B. has always been synonymous with the best condenser efficiency. Pre-eminent in design, construction and performance since broadcasting began; for these reasons alone the J.B. has continued to be the choice of discriminating constructors throughout the world.

And now the J.B. claims a further point of superiority in that it has the lowest losses yet measured in a radio condenser. By an N.P.L. Test the '0005 Model J.B. was found to have a total loss of only '02 ohms at a million cycles. Sufficient proof that the J.B. is the best condenser for you.



J.B. LOW LOSS GEARED VERNIER (60 to 1).

·001	17/6
·00075	16/3
·0005	15/-
·0003	13/6
.00025	13/3
·0002	13/-
·0001	12/-

[Pat. No. 246009].

J. B. LOW LOSS.

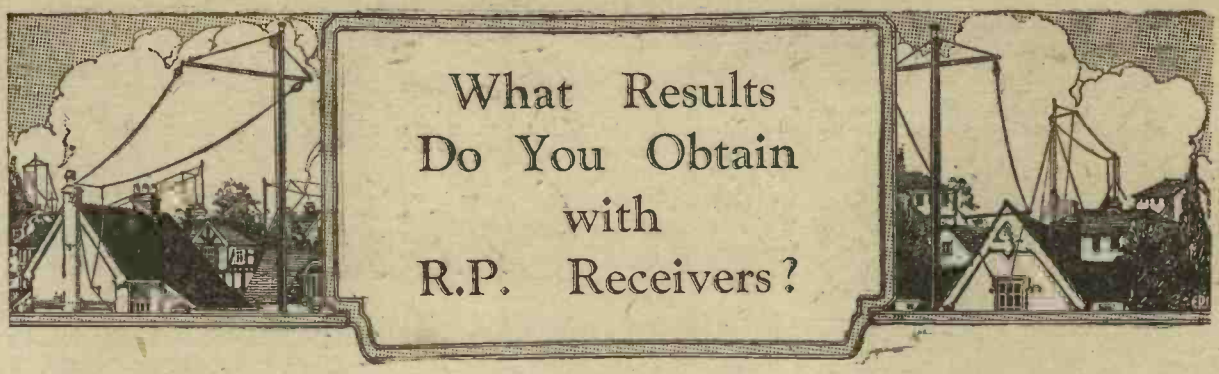
·001	13/-
·00075	11/9
·0005	10/6
.0003	9/-
·00025	8/9
·0002	8/6
·0001	8/3

Pat. Nos. 241805 and 246009.

JACKSON BROS.

8, POLAND ST—OXFORD ST
LONDON—W.1
(First Floor)

Telephone:—
GER. 7414



"The Seven-Valve T.A.T." Receiver.

SIR,—Some time ago I constructed the T.A.T. 7-valver, the details of which I found in MODERN WIRELESS, January, 1925. As you asked for reports, I have much pleasure in forwarding mine.

First, the set was wired most carelessly, a part by myself and the rest by one of my workmen, who had the first chance to see a wireless set in his life! Consequently several mistakes occurred and much trouble was experienced, which was quite natural. Anyhow the set was put into order and since it began to work it has been giving splendid results. I have made the following few changes in the set :—

(1) Three-terminal arrangement for series—parallel tuning.

(2) Provided a separate H.T. positive terminal for detector valve.

(3) Also a separate L.T. negative terminal for power valves.

(4) Five 30-ohm rheostats were inserted instead of the usual 5-ohm ones, as most of my stock of valves consists of Marconi Osram D.E. 3's.

(5) The fixed condensers used were Dubilier's, and the variable ones those manufactured by Falk Stadelmann, while the last L.F. transformer is a Marconi Ideal 6 : 1 instead of U.S. Super 5 : 1.

I used D.E. 3 valves in all H.F. and detector stages and an L.S. 5 on the L.F. side, and find no difficulty in tuning to NSS Annapolis quite clear and loud with only a detector and two L.F. stages. Besides this I regularly listen to press news from all countries of the world and enjoy regular broadcasting from nearly all the B.B.C. stations and from the European and American stations.

Having a good deal of experience in wireless, scores of sets having passed through my hands since 1919, I can say with confidence that this set is better than any other seven-valve receiver I have tried.

I forgot to mention that I provided a stud switch for cutting off the last L.F. stage, the idea being taken from the Radio Press series "Twelve Tested Wireless Sets."

Wishing you good luck in all your excellent publications,—Yours truly,

B. D. VIRMANI.

Dera Ismail Khan,
India.

The Three-Valve "Prince" Receiver.

SIR,—I am so well pleased with my three-valve "Prince" receiver, constructed from Mr. A. S. Clark's description in MODERN WIRELESS for January, 1926, that I feel bound to write and thank you and express my appreciation of this set. Until I had actually heard this set working properly on our local transmission I should never have believed that such good quality of reproduction was possible.

I had some trouble, when the set was first completed, in finding the right high-tension and grid-bias. For a while, in fact, I feared that I was in for a disappointment, but I soon found that the poor results were simply due to my lack of familiarity with the operation of the set. I am using valves which I happen to have by me, a D.F.A.4 and 2 B.T.H. B.4's, and these give excellent loud-speaker volume and truly wonderful quality.

My aerial is nothing much, being the usual type that can be seen in most small back gardens, about 15 ft. high and 60 ft. long from the free end to the aerial terminal of the set.

This set has now been adopted for regular use on the local station, so that I cannot experiment with it further. I am intending to make up the three-valve receiver described by Mr. C. P. Allinson in MODERN WIRELESS for February, 1926, so as to be able to do some more distant work on my own account. My best wishes to MODERN WIRELESS,—Yours truly,

JAMES OVERTON.

Bournemouth.

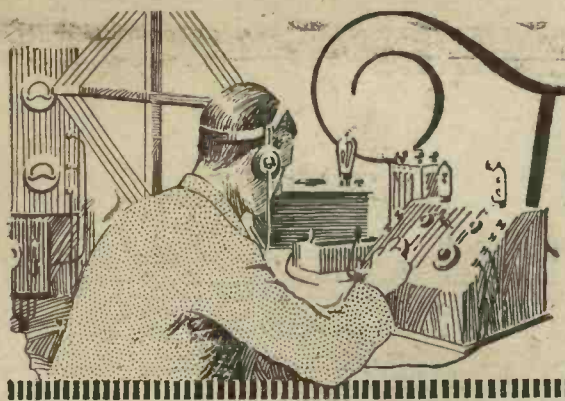
"The Special Five."

SIR,—I should like to congratulate Mr. Percy W. Harris on his very fine set, "The Special Five." I built this set to the published design immediately after it was published in MODERN WIRELESS, November, 1925. My first results were very pleasing, but these disappeared afterwards and I was confined mostly to my local station (Belfast), and Daventry, London, Glasgow and Dublin. A friend of mine, who had also constructed this set, was complaining that it did not come up to his expectations (we had both used valves and components as recommended by you), when, after experimenting for some time with the set, he discovered that the neutrodyne condensers required nearly maximum capacity for the reception of distant stations, and recommended me to try this. On adopting his suggestion I was agreeably surprised to find that reception was immensely improved, in fact, the distant stations now come in at full loud-speaker strength, almost equally as well as the local station.

Thanking you for publishing such a finely designed set, and wishing your wireless magazines every success.—Yours truly,

MALCOLM MCQUIGG.

Aghadowey,
Co. Londonderry.



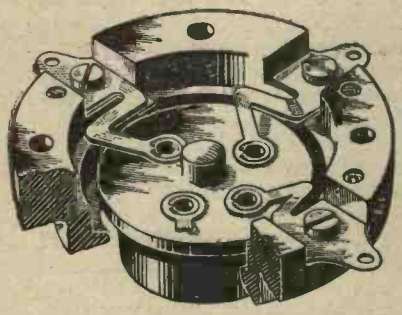
Tested by Ourselves

Valve Holder

MESSRS. Garnett, Whiteley and Co., Ltd., have submitted to us for test and report a sample of their Lotus anti-microphonic valve-holder.

Description of Component

The two main features of this valve-holder are, apart from its actual appearance, that it is anti-microphonic and that it is impossible to injure the valve when inserting it into the holder. The latter quality is assured by the valve sockets being sunk into the insulation material. The anti-microphonic quality of this valve-holder is ensured by the use of thin bent strips of metal which serve to support the insulating material containing the sockets, and also to connect the sockets to the respective soldering tags.



The particularly satisfactory valve-holder of Messrs. Garnett, Whiteley & Co., Ltd.

Laboratory Tests

On test it was found that this valve-holder provided an excellent fit for several makes of valves, and that it was impossible to burn out the filament by attempting to insert the valve the wrong way. On testing-out in a set with dull emitter valves it was found to insulate the valve satisfactorily from shock and vibration. The insulation resistance of this valve-holder was infinite.

General Remarks

This valve-holder is of excellent material and workmanship. The soldering tags with advantage might be made slightly longer, but this is not a serious matter, and the valve-holder can therefore be recommended with every confidence.

Vernier Knob

WE have received an Atlas vernier knob for test and report from Messrs. H. Clarke and Co. (Manchester), Ltd. This consists of a 4 in. moulded dial carrying a large knurled knob for coarse adjustment, in the centre of which, slightly smaller in diameter, is the vernier knob. Inside the vernier knob is an ingenious arrangement of rollers which drives a screwed gear carrying a small rubber roller on its end positioned close to the circumference of the main dial.

The dial is adjusted so that this roller is in contact with the surface of the panel, and as the fine adjustment knob is turned, this small rubber roller rotates and rotates the main dial. In actual practice this rubber roller passes over a fibre disc which is supplied to protect the surface of the panel.

An approximate reduction of 80 to 1 is obtained, and the dial can be fitted to condensers with either $\frac{1}{4}$ in. or $\frac{3}{16}$ in. spindles. It was noted, however, that the length of spindle projecting from the panel must not exceed $\frac{3}{4}$ in. or be less than $\frac{1}{2}$ in., otherwise the dial cannot be fitted.

The component is well finished, the graduations being clearly marked.

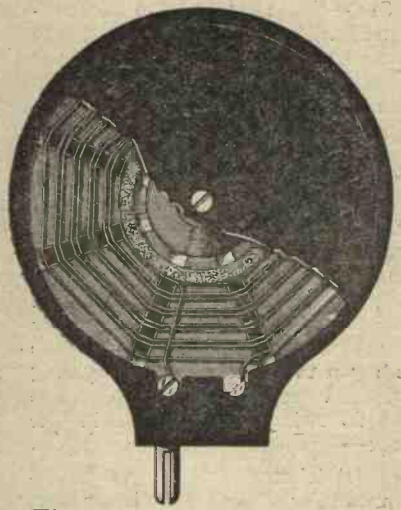
Plug-in Coil

MESSRS. The Automatic Coil Winder and Electrical Equipment Co., Ltd., have submitted to us for test and report a sample of their "Slektun" inductance coils.

A special point is made that this coil has an extremely low self-capacity.

Description of Component

This coil is contained in a solidly made case of insulating material



The "Slektun" coil is a solidly made component.

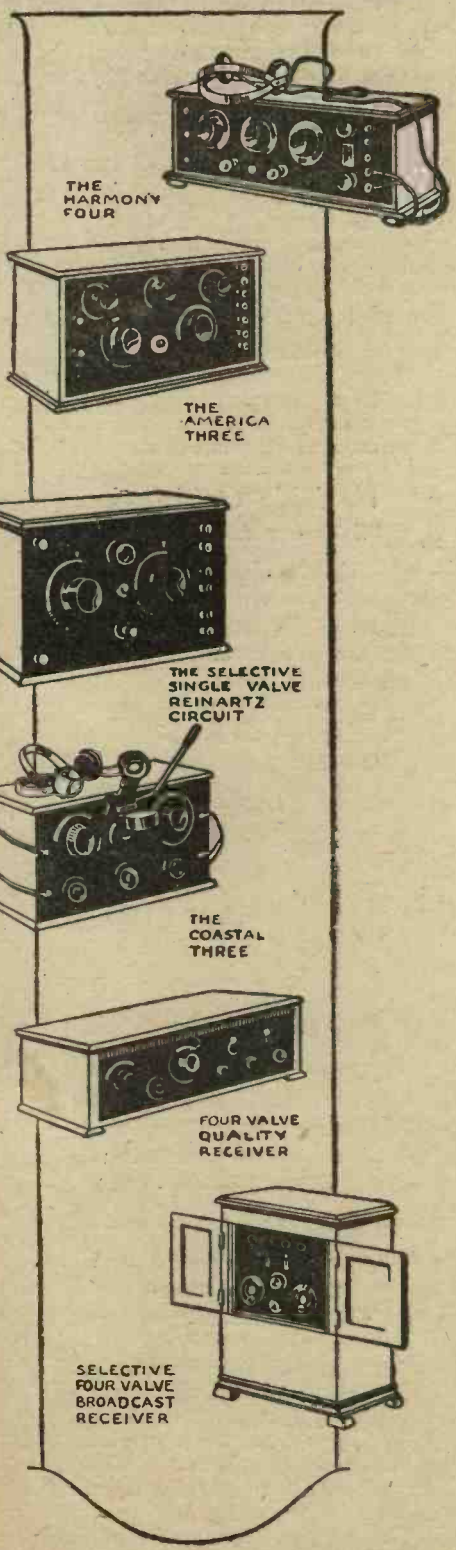
about 3 ins. diameter and 1 in. thick. It is a multi-layer coil, ebonite separating strips being employed, and a special feature is that these ebonite separating strips are thinner at one end than the other. This is for the purpose of securing the maximum separation between those turns which are at the maximum high-frequency potential difference.

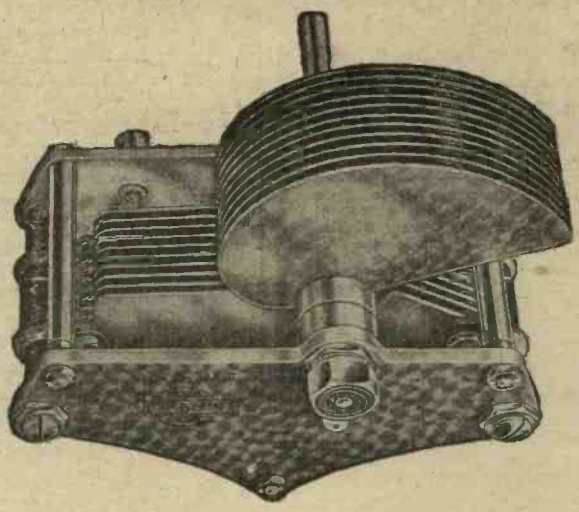
Laboratory Tests

On test it was found that the constants of the No. 200 coil submitted were as follows: Inductance, 2000 microhenries; resistance, 46 ohms, giving an $\frac{R}{L}$ ratio of .023 ohm. per microhenry. The natural wavelength of this coil was found to be of the surprisingly low figure of 220 metres.

The fit of this coil was tried in several makes of coil-holders, and it was found to be perfectly satisfactory, and its performance is satisfactorily good.

The Igranic Low Loss Square Law Variable Condenser is specified by the Authors of these and many other circuits.





IGRANIC Low Loss Square Law Variable Condenser. Patent No. 220312.

Experts specify it—— Constructors prefer it

even Transmitters build it into their apparatus. Undoubtedly the Square Law Variable Condenser success of 1925 was the Igranic Low Loss model—and it has no equal yet. Refer to past issues of your wireless publications and you will find that those circuits giving extreme range, volume, sensitivity and super-selectivity have invariably the Igranic Low Loss Square Law Variable Condenser built into them. Follow the experts' choice—build with the Igranic Low Loss Square Law Variable Condenser.

Prices:

.0005 .. .. .. **24/-** .0003 .. .. .. **21/-**

With 4 inch knob and dial.

Write for List J.23, which illustrates the entire range of Igranic Radio Devices

RADIO IGRANIC DEVICES

include: XLLOS and Honeycomb Duolateral Coils, Variable Condensers, Fixed Condensers, Filament Rheostats, Inter-valve Transformers, Variable Grid Leaks, Variometers, Vario-couplers, Coil Holders, Potentiometers, Combined Instruments, Vernier Tuning Devices, Switches, Anti-microphonic Valve Holders, Stand-off Insulators, Knobs, Dials, etc., and also the Igranic Supersonic-Heterodyne Receiver Outfit.

All carry the IGRANIC guarantee.

IGRANIC ELECTRIC CO., LTD.,
Exclusive Manufacturing Licensees of Patent Radio Essentials
149, Queen Victoria Street, London.
Works: BEDFORD.
BRANCHES:
Birmingham, Bristol, Cardiff, Glasgow, Leeds, Manchester, Newcastle.

The IGRANIC Supersonic Instructional Carton

for constructing a six-valve Supersonic Heterodyne Receiver according to the Igranic design, contains a comprehensive, fully illustrated descriptive hand-book, full-size general arrangement drawings, wiring diagrams and drilling template. Obtain a copy from your dealer.

PRICE 2/6

A Non-spillable Accumulator

WE have received a new-type non-spillable accumulator from Messrs. Rowland, Edwards & Co. The container of this accumulator is constructed with an ingenious trap arrangement to prevent any acid being spilt in the event of the accumulator being upset. A vent is provided for allowing the egress of any gas liberated while in use, while a

Showing the construction of the upper portion of the Rowland, Edwards accumulator.

screw in the stopper is provided for filling the accumulator with acid.

When turned violently on its side, this accumulator showed not the slightest sign of allowing any of the acid to escape, and could be turned upside down and held thus for some considerable period without a drop of the acid coming out. Before any of the acid could be got out of this accumulator it had to be held upside down and shaken violently, a form of treatment to which it would not be normally subjected.

Discharge

Rated at 50 ampere-hours, on a continuous discharge test it was found to give an actual maximum of 53 ampere-hours, after which the accumulator was completely run down.

This accumulator should prove of great use where it is necessary to keep the battery in a living-room and where it is desired to obviate all risk of damage to carpets, etc., through acid being spilt.

Mansbridge Condensers

MESSRS. The Camden Electrical Co. have submitted to us for test samples of their Mansbridge fixed condensers.

Manufacturers' Claims

It is claimed that these condensers, which are taken at random out of stock, have been tested up to 500 volts and are guaranteed to be within 5 per cent. of their rated capacity.

Description of Component

These condensers are of the usual rather large size, and have a metal case provided with two holes for base-board mounting, being sealed at the top with a black insulating material. Two soldering tags project from the centre of this, but no terminals are provided.

Laboratory Tests

On test the insulation resistance of these condensers was found to be infinite. The soldering tags were also well spaced from each other and from the metal case. They were also of adequate length for soldering purposes.

Their rated and actual capacities are given below:—

Rated capacity in microfarads	Actual capacity in microfarads
·0025	·0029
·005	·0042
2·0	2·0

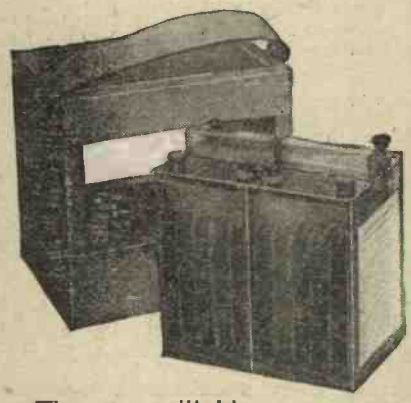
All these condensers stood up satisfactorily to a voltage of 500.

General Remarks

These Mansbridge condensers appear to be good specimens of their class, although in two cases their capacities are not correct.

Variable Grid-leak

WE have received a variable grid-leak for test and report from Messrs. Igranic Electric Co., Ltd. This is constructed on similar lines to the high-resistance potentiometer made by the same firm, except for the fact that the carbon track on which a



The non-spillable accumulator of Messrs. Rowland, Edwards & Co.

brass brush slides is specially prepared to have a high resistance.

Laboratory Tests

On test this grid-leak was found to have a resistance variation between 10,000 ohms and 9 megohms, while the form of construction is such that the reading on the dial will be approximately proportional to its resistance. When tried in a set, it was found to give a satisfactorily silent control.

This component, which is of the one-hole fixing type, is well constructed and nicely finished and can be recommended.

"Going to make a set?
Don't forget to use
GLAZITE
BRITISH MADE REGD.

COLOURED CONNECTING WIRE
Red, Yellow, Blue *and* Black

10 foot COILS	2 foot LENGTHS
Be sure to see the LEW seal	Four assorted colours in an envelope
Per 1/2 *Coil*	*Per* 1/- *Pkt.*

Obtainable from all dealers

Write for interesting descriptive leaflet.

THE LONDON ELECTRIC WIRE CO. AND SMITHS LTD.

(Makers of Electric Wire for over 40 years.)

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

This mark LEW *guarantees quality.*

JUDD

Why the Best is the Cheapest

When results are disappointing, change that "cheap" transformer for a "Powquip" Orchestral. For the best is the cheapest in the long run—and undoubtedly the "Orchestral" is the finest transformer that money can buy. It reproduces music, song, and speech without the slightest suspicion of distortion, and the quality of the workmanship is without equal. The "Orchestral" is remarkable for its flat amplification curve characteristic, over normal frequencies. Voltage amplification at: 250 cycles = 29 2,000 cycles = 29

- POWQUIP -
ORCHESTRAL TRANSFORMERS

The case is stamped out of high grade electrolitic copper and is polished, buffed and lacquered, giving an attractive appearance to an extremely efficient instrument. **Price 31/6**

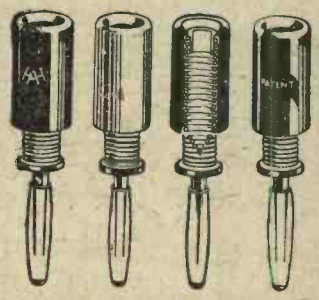
Send a postcard for curve and booklet giving full particulars.

The POWER EQUIPMENT CO., Ltd.,
Kingsbury Works, The Hyde, Hendon, N.W.9.
Telephone: Colindale 6196 & 7. Telegrams: Powquip, Hyde, London.

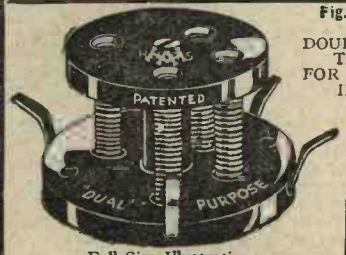
"YOU'LL CONVERT YOUR RIGID HOLDERS NOW"

JUST PLUG THEM IN.

HUNT'S "WOBBLERS" (Fig. 975.) PRICE **1/6** PER SET. (3 black and 1 red)



Full Size Illustration.

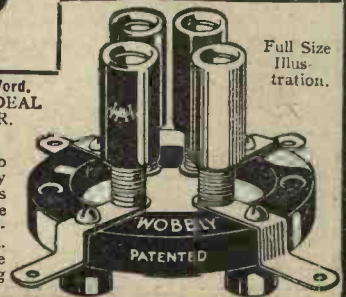


Full Size Illustration.

Fig. 976. Code "DUAL" Word. PURPOSE.
DOUBLE-ENDED. PRICE 1/9 each.
THE FOOL-PROOF HOLDER.
FOR BASE OR PANEL FITTING OR IN ANY OTHER POSITION.
The smallest and neatest combined holder on the market.
No joints because the soldering tag is the same piece of wire as the spring. Show cards and display cards free.

Fig. 974. Code "WOBBLY" Word.
PRICE 2/3 each. THE IDEAL EXPERIMENTER'S HOLDER.
TOO SIMPLE TO IMPROVE.

For the genuine experimenter who must have a holder without capacity and perfectly sprung, Hunt's "WOBBLY" is ideal. It is impossible to have fewer parts, or to better insulate, separate or spring them. Separately sprung legs are far more effective than a closed-in solid spring top.



Full Size Illustration.

Made under patents 242057/24, pro. pats. 30670/25 and 40/26, by
A. H. HUNT Ltd. (Dept. 5), Croydon, Surrey.

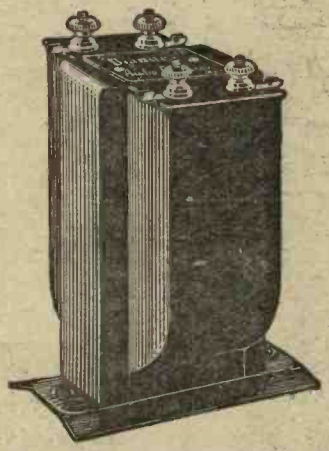
L.T. Accumulator

WE have received from the Tungstone Accumulator Co., Ltd., one of their 12-volt 50 ampere-hour (actual) accumulators. The accumulator was filled with acid and charged at the maker's rating until gassing occurred freely. It was short circuited several times and then put on a load. The load test was carried out at 3 amps for about 6 hours, the current then being raised to 6 amps. In completely running down the accumulator a total capacity of 90 ampere-hours was obtained as against the 50 ampere-hour rating.

After this treatment the plates were taken out for examination, and although it was found that the paste had loosened a little on some of the negative plates, the positive plates were in perfect condition. In view of the severe test applied, this undoubtedly speaks well for the accumulator.

A Particular Feature

A feature of the construction of this battery is the allowance for any single plate to be renewed, and we understand that the makers provide as well a further scheme under which, should any of the plates become damaged within a short period, a free replacement will be made. This accumulator marks a distinct step forward, being exceedingly robust in construction and can be thoroughly recommended to stand up to heavy work.



The L.F. transformer of Messrs. Brandes Ltd. can be thoroughly recommended.

L.F. Transformer

WE have received one of their 5 to 1 ratio L.F. transformers from Messrs. Brandes Ltd., for test and report. This transformer, which is of the shrouded type, is about 2¼ ins. by 1¾ in., and just over 3 ins. high. Four terminals are provided, together with soldering tags for making the necessary connections, while the terminals are marked with the actual connections to be employed instead of the more usual marking of inner and outer of the primary and secondary.

When placed on our standard transformer test panel it was found to give a degree of amplification somewhat above the average for the first stage, the quality of reproduction being very good. In the second stage the amplification obtained was equal to that given by the standard transformer, which is actually of higher step-up ratio than the transformer under test. The quality of the second stage was also very good. The insulation resistance between the primary and secondary was found to be infinity, and this transformer can be well recommended.

Silverex Crystal

MESSRS. Sylvex, Limited, have submitted to us for test and report one of their Silverex crystals. This is packed in cotton wool in a small card-

board box, and is provided with a special catswhisker. It is blue-grey in colour, and of medium fine crystalline structure, showing numerous small reflecting surfaces.

When tested in a receiving set, a large number of spots were found with a very satisfactory degree of sensitivity. The size of the crystal supplied was further found to be suitable for mounting conveniently in most crystal cups.

A Multi-switch

MESSRS. The Burner Insulator Co. have forwarded to us for test and report one of their "Bico" Multi-Valve Switches.

These switches are made in three types. They are intended for controlling the switching of the valves in multi-valve receivers, and can be obtained for controlling two, three or four valves when the first of these is a detector, the following valves being used for low-frequency amplification.

Description of Component

The switch submitted to us was suitable for use with a detector and two stages of low-frequency amplification.

The complete switch is mounted on a small piece of ebonite. The spindle which actuates the contact passes through a metal bush, and these contacts are operated by a small piece of brass mounted on the spindle, whilst other sets are caused to make and break, as the case may be, by a rheostat action on the spindle. The switch is provided with a substantial knob and a brass pointer, together with a scale for fixing on the panel to indicate the number of valves in use.

The "Bico" Multi-valve Switch submitted by Messrs. The Burner Insulator Co.

Laboratory Tests

On test the insulation resistance of the switch was found to be infinity, and the resistance across the contact points negligible. This switch presents an easy and convenient method of regulating the number of valves in a set. It enables one, two or three valves of the receiver to be used at will, while a valuable feature is that the voltage applied to the detector valve remains the same, whatever the number of valves in use. A leaflet is enclosed with the switch giving a list of connections to the various contacts of the switch, which are numbered to correspond with the numbers on the list. The switch, however, can be put to a number of other uses and can be thoroughly recommended.

Two-Coil Holder

WE have received a fine adjustment two-coil holder from Messrs. The London Electric Stores for test and report.

This consists of a two-coil holder constructed of black insulating material in which the coarse adjustment is secured with the usual

moving coil-holder, fine adjustment being obtained with what is generally the fixed socket. The moving socket is directly controlled by a large knob on the end of a spindle, while the other socket carries on its side a wedge-shaped piece of insulating material. This is kept in contact with a metal sphere by means of a spring attached to the lower edge of the coil holder. The sphere is tapped, a screwed spindle being passed through it.

As this spindle is rotated, the sphere moves up or down the rod, and thus, according to its position on the wedge attached to the coil-holder, this moves nearer to or further from the other coil socket. A very fine adjustment is obtainable by this means, the tensioning spring being strong enough to ensure positive control. This component is well finished and robust, while standard makes of plug-in coils were found to be a good fit. The insulation resistance between plug and socket was found to be infinity.

Neutrodyne Condenser

WE have received a sample of their baseboard mounting Neutrodyne Condenser from Messrs. A. F. Bulgin & Co. for test and report.

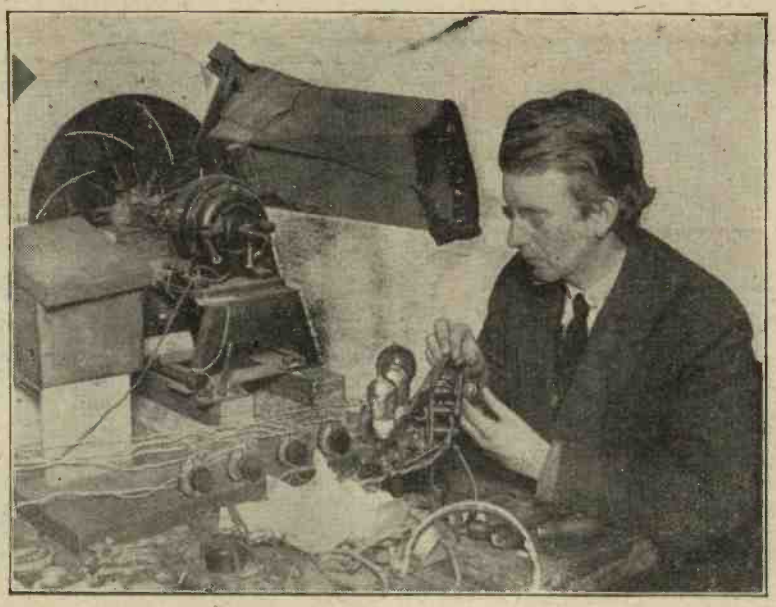
A circular ebonite base 1½ ins. in diameter carries a small cylinder of insulating material, from the top of which projects a slotted screwed metal rod. This may be adjusted by means of a special insulated handle supplied by the maker, and may be locked in position with the aid of a knurled nut. Two soldering tags allow connections to be made to the component, which is very neat and compact.

On test the maximum value of this condenser was found to be 2.6 micro-microfarads, while its minimum was somewhat less than 0.3 micro-microfarad, both very low values. Its insulation resistance was found to be infinity.

This is a useful component which might prove satisfactory in a neutrodyned H.F. amplifier, where valves having a very low internal capacity, such as .06 amp. type, are used.

Correction.

In the April issue of MODERN WIRELESS, a test report appeared of a repaired valve sent in by Messrs. "Radion Valves Co., Ltd." This should have read "Radio Valves, Ltd."



Television and the Future

by HUGO GERNSBACK, F.R.S.

A discourse on developments in "seeing at a distance."

Mr. John L. Baird with some of his television apparatus.

I AM frequently asked the question: "What, in your opinion, will be the next great development in wireless?" and to this question I always answer that, in my opinion, the next and most logical step will be the establishment of "Television," or the power to see objects at any distance, through the same medium by which we are now enabled to hear sounds by radio from all over the world.

Receiver Development

Wireless receiving sets have been developed to such a high degree that we need not expect any revolutionary improvements to be made in them for some years to come. The receiver is now at the stage of development such as the automobile reached ten years ago. The improvements made since then in the automobile have been only in the refinement of its various parts; and it will prove exactly so with wireless.

So, when I speak of television, I do not predict a novel type of radio set, but rather the creation of a device which can be attached to the existing receiver. It will be similar, in its relation to the present wireless set, to the loud-speaker, which can be connected regardless of whether the receiver is of the vintage of 1923, or the latest 1926 model.

An Analogy

This may seem to be a rash, off-hand statement, but a moment's consideration will show that it is not. For instance, you can listen to a full orchestra with your wireless set and (providing you have good transformers and your loud-speaker will take both the upper and lower ranges) you will find no trouble in distinguishing the notes of the bass drum from those of the piccolo, even though both are playing at the same time. In other words, you hear simultaneously a number of different instruments without their interfering with each other.

Through the future application of television, it is quite logical that while a station is broadcasting a song, you will be able to see the face of the singer at the same time, through a transmission on the same wave to which you are tuned in, for the following simple reason.

The Acoustical Frequencies

The range of acoustical frequencies is really very narrow, and does not take in a wide band; the human ear responds to no vibrations above a frequency of 23,000 per second. That is the reason why the so-called radio "carrier" is inaudible. To the non-technical reader it may be explained that the "carrier" is the fundamental wave emitted by the transmitting station, which is in space at all times when the station is transmitting. When no one is speaking or singing at the broadcasting station studio, you hear nothing but a faint rushing sound in your receiving instrument. The vibrations of this carrier run into millions per second, and that is why we cannot hear them directly.

No Interference

If however, television is perfected (as it almost surely will be during the next two years, or perhaps sooner) it will be possible to impress the television impulses upon this same "carrier" which brings the sound impulses to your set. These television impulses, being of a frequency too high to be audible, will not interfere with your loud-speaker; and the television picture, for the same reason, will not be mixed up with the speech, any more than a violin or a piano, both of which you can readily distinguish with your ear.

This is an inadequate comparison, because the separation between the acoustical band or audio frequencies and the radio-frequency band is enormously wider than that between any two audible notes of music; and it will, therefore, be practically impossible for the "sight" waves and sound waves to interfere with each other.

A Television Attachment

I have pointed this out to bring home the point that, when television is finally brought about, it is quite probable that to-day's wireless sets will be adapted to this new purpose; and that it will be possible to connect a television attachment right to your present set and thereby see what is going on all over the country while you are enjoying the programme. Not only will it be possible to see the entertainers at the broadcasting station to which you tune in, but everything that is broadcast for sound only, to-day, will be broadcast by "remote control" for television as well.

Nearer than we Realise

Wireless television, it must be said, is nearer at hand than most of us realise. The inventors of the entire world are racing frantically for the goal, because they realise

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that in television they will have created a great new emancipator, much greater than the telephone or radio communication itself.

In America, Mr. C. Francis Jenkins has been in the foreground in television experiments; and he has achieved success in making it possible to transmit and receive the outlines of moving objects by wireless at the present time. In this country, Mr. John L. Baird, who has been on the same track, has accomplished a great deal; in France Professor Edouard Belin has also produced results, and similar work has been done in many other countries. Television is now "in the air" and I shall be very much surprised if this great new art does not step out of the laboratory into every-day use, some time in the next two years or less.

Light-sensitive Cells

Back in 1915, and again in 1918, I wrote a series of articles on television which were the first, I believe, published in the technical Press. At that time we had only the selenium cell as a "photo-electric" or light-sensitive substance; but it is sluggish and does not follow changes of light with sufficient rapidity.

It has been superseded recently by some very excellent light-sensitive cells, which react to changes in less than one ten-thousandth of a second; and this improvement makes television an assured possibility to-day.

Simple Apparatus

We should not be surprised, also, when the final apparatus is evolved, to note with what simple instruments television can be accomplished. It is my belief that the successful device will be simpler and of fewer parts than our radio receivers are to-day, and it is quite possible that within the next ten years less than £15 will purchase a complete television attachment which will perform well.

Of course, for a long time to come, transmission will be only in black and white, giving an effect similar to that seen in motion pictures now, but colour transmission will come later.

An Erroneous Idea

At this point I desire also to correct an erroneous idea about television, which is much in vogue now. Many people think of it as "radio motion pictures." Of course there will be no motion picture equipment of any kind in the wireless television apparatus. Television does not concern itself with such methods at all. *In reality you will see at a distance*, just as if you had a telescope through which you could observe anything going on in any part of the country.

A Popular Development

Television between broadcast stations and the broadcast public will become very popular. If the telephone companies wish, they can make simple attachments for the present-day telephone, so that you can see the person at the other end with whom you are conversing. A lot of people will throw up their hands in horror at this idea, because the idea of television added to the telephone will suggest a reduction of their privacy to the minimum enjoyed by a gold fish.

This need not be feared, however, because a pushbutton in the telephone mounting will insure that the person calling cannot see you unless you wish it. This is a very simple detail.

In Time to Come

As to wireless television between private parties, I must admit that this lies much further in the future, perhaps twenty-five years or more, for there are not enough wave-bands available to make it possible for thousands to talk to each other at the same time. On the other hand, two wireless amateurs can converse by wireless telephony even to-day; and if, in the next two years, they are enabled to place television attachments on their receiving sets, it will result in a situation of tremendous interest. But the individual application of television to every one's personal convenience will not be practicable for many more years.

Index to Advertisers

	PAGE
"A.J.S."	969
Ashley Wireless Telephone Co.	980
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Electradix Radios	1003
Electron Co., Ltd.	1004
Fada Radio, Ltd.	970
Ferranti, Ltd.	997
Finchett (C. A.)	1008
Finston Mfg. Co., Ltd.	1002
Formo Co.	1002
Garnett, Whiteley and Co., Ltd.	991, 992
Graham (A.) and Co.	976
Hunt (A. H.), Ltd.	998
Igranic Electric Co., Ltd.	995
Jackson Bros.	992
Lissen, Ltd.	1003
London Electric Wire Co.	998
M. and A. W.	996
Metro-Vick Supplies, Ltd.	972, 986, 1000
M.A.P. Co.	1003
Miller, J. W.	1008
Mullard Radio Valve Co., Ltd.	Cover ii
Oldham Accumulators	987
Ormond Engineering Co., Ltd.	999
Pearson Bros.	1008
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Picketts	996
Portable Utilities Co., Ltd.	983
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Radiax, Ltd	996, 1003
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Radio Instruments, Ltd.	Cover iv
Radions, Ltd.	1008
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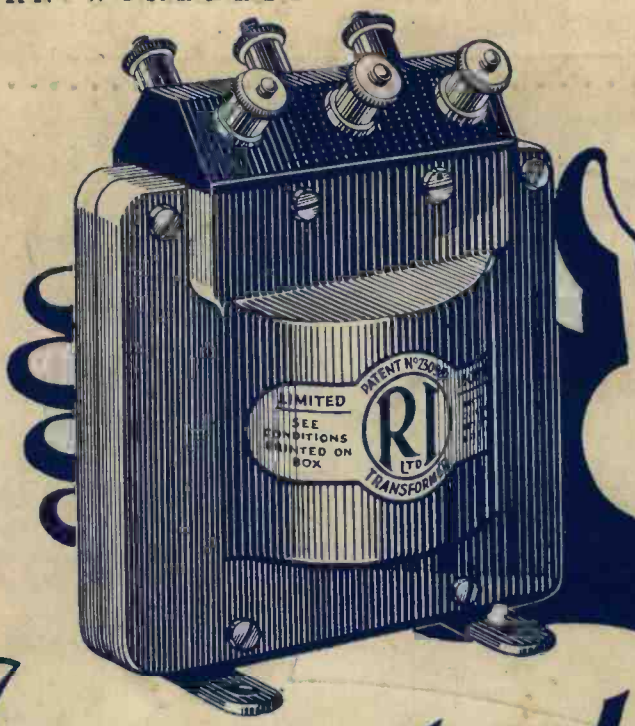

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	60,000
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