MODERN WIRELESS

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HOW TO MAKE A SELECTIVE FOUR-VALVE SET

By E. J. Marriott

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A CHOKE-COUPLED TWO-VALVE SET. *By D. J. S. Hartt, B.Sc.*
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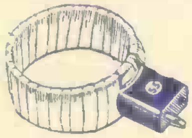
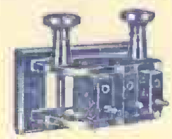
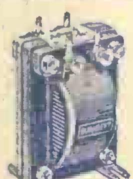
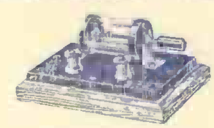
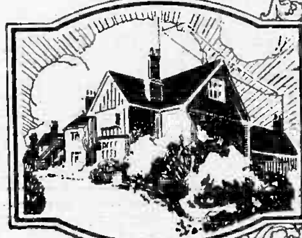
TWO-VALVE CIRCUITS WORTH TRYING. CHOOSING A RADIO SET.











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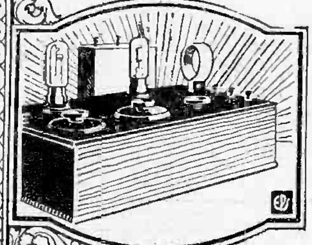
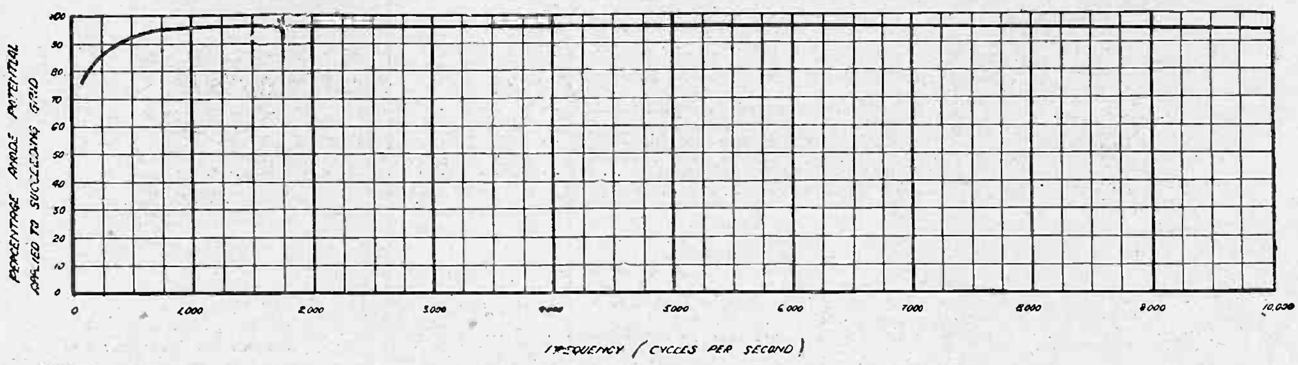


Radio Press, Ltd.,
Publishers of "Wireless Weekly" and "The Wireless Constructor,"
Bush House, Strand, W.C.2.
Telephone.—City 9911.

All correspondence relating to contributions is to be addressed to the Editor of "Modern Wireless."

Resistance-Capacity Coupling and its merits

RESPONSE OF POLAR R.C.C. UNIT
AT VARIOUS AUDIO FREQUENCIES.



THE performance of R.C.C. Units, at all frequencies audible to the human ear, has already been described (April, May and June issues of "Modern Wireless").

It has been shown that the degree of response given by the Units is so nearly the same at all frequencies that amplification of speech and music can be carried out with very little distortion indeed.

If you are interested in the technique of Broadcast amplification you may have seen the earlier notes to which we refer, and you may have appreciated our arguments.

If you are not interested in this technique you are probably, at any rate, desirous of making your Loud Speaker sound as clear and realistic as possible.

It is surprising to find how frequently this or that device is advertised as giving "perfect results" or "complete freedom from distortion"—this is all nonsense, and merely induces a feeling of contempt for the advertiser on the part of discerning readers.

Only when we have reached the ideal are we entitled to say that we have attained perfection.

If our ideal is a true one, we find that the harder we strive the nearer we approach to it without actually getting there.

It is therefore not strictly possible to claim that any method of amplification is "*free* from distortion," but it can be claimed that when R.C.C. Units are properly used, the distortion in the amplifier is very very small—so small in fact, that it is quite negligible compared with that taking place in other parts of the installation (*e.g.*, Valves, Telephones and Loud Speaker)

If you use R.C.C. Units in your amplifier you can have real confidence in that part of your equipment.

It is a good insurance for the future to use R.C.C. Units, because, in the event of better valves, telephones or a more aperiodic Loud Speaker being brought into use, the distortion in your amplifier will not even then be apparent, and hence it will not be necessary to face the expense of a new amplifier.

It is feasible to obtain bad service even from a Rolls-Royce, if it is badly driven—therefore, when using R.C.C. Units do not employ unsuitable circuits or valves.

A circuit diagram is enclosed in the carton of each R.C.C. Unit.

R.C.C. Units are inexpensive—they cost less even than poor transformers.

Norman Lea

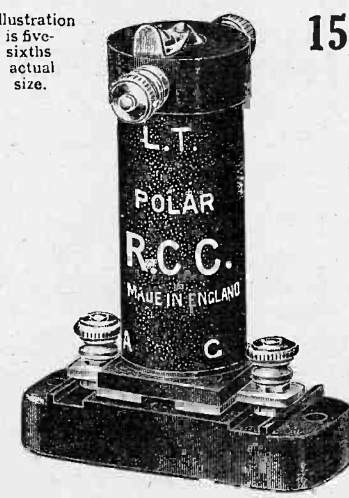
Chief Engineer,
Radio Communication Co., Ltd., London, W.C.2.

Polar RCC Unit

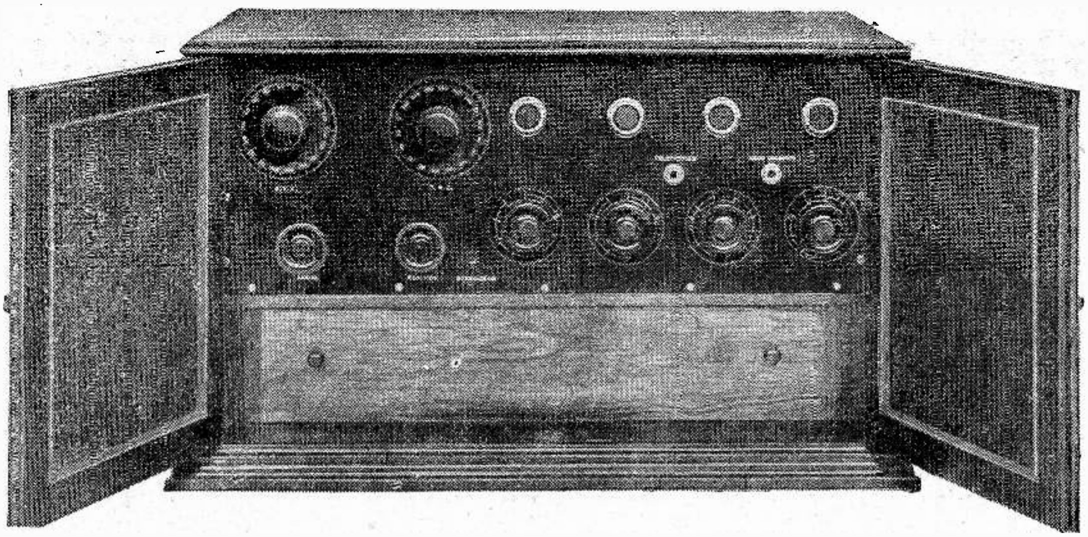
The Polar R.C.C. Unit consists of wire-wound anode resistance, grid leak and specially built Dubilier condenser. It is perfectly self-contained, with four clearly marked terminals correctly positioned for easy wiring.

Illustration is five-sixths actual size.

15/-



Radio Communication Co., Ltd., 34-35, NORFOLK STREET, STRAND, LONDON, W.C.2



A Selective Loud-Speaker Receiver

By E. J. Marriott.

Full constructional details are here given for building a four-valve loud speaker set, which incorporates the well-known neutrodyne method of stabilizing the high-frequency valve. Semi-aperiodic aerial coupling, which is so popular in America, is also used for obtaining selectivity, thus enabling the more distant stations to be received during the hours of operation of the local station.

FOR the satisfactory reception of several broadcasting stations it is a generally accepted fact that the use of at least one H.F. amplifying stage is desirable, and although several stages will enable extremely distant transmissions to be tuned in, where it is desired to keep the number of tuning controls as low as possible, only one stage, coupled to the detector valve by the tuned anode method and neutrodyned to prevent self-oscillation, will give very fine results. At the same time its manipulation will necessitate no unusual skill on the part of the operator.

Considerations in Design

In designing the set to be described, it was desired to obtain satisfactory loud-speaker reception from at least three or four B.B.C. stations, together with selectivity, and it was essential that the number of tuning controls should not be too great. For these reasons, only one stage of H.F. amplification is used, thus adding but one more tuning control. Selectivity, of course, is in many districts a necessity, and in order to obtain this, an optional aperiodic aerial connection is incorporated. Constant aerial tuning is also made possible for those who desire it, by the addition of a third aerial terminal and a condenser of ·0001 μF

The Circuit

A theoretical diagram of the circuit used will be seen in Fig. 1. Tuned anode coupling is employed, and the inherent tendency to oscillate is eliminated by the use of the now well-known neutrodyne arrangement, which neutralises the effects of the inter-electrode capacity of the valve, and other causes of self-oscillation.

Selectivity is obtained to quite a good degree by using an "aperiodic" aerial circuit coupled to the grid coil as in the Reinartz circuit, and if ordinary single circuit tuning or C.A.T. is preferred, both of these arrangements are obtainable by merely connecting the aerial to a different terminal, the earth remaining connected to the terminal so marked.

Referring to the circuit diagram Fig. 1, it will be seen that the two L.F. amplifying valves V_3 and V_4 are coupled by the resistance capacity method, whilst transformer coupling is used between the detector V_2 and V_3. This combination has been found to give very fine results, both from the view-point of volume and purity.

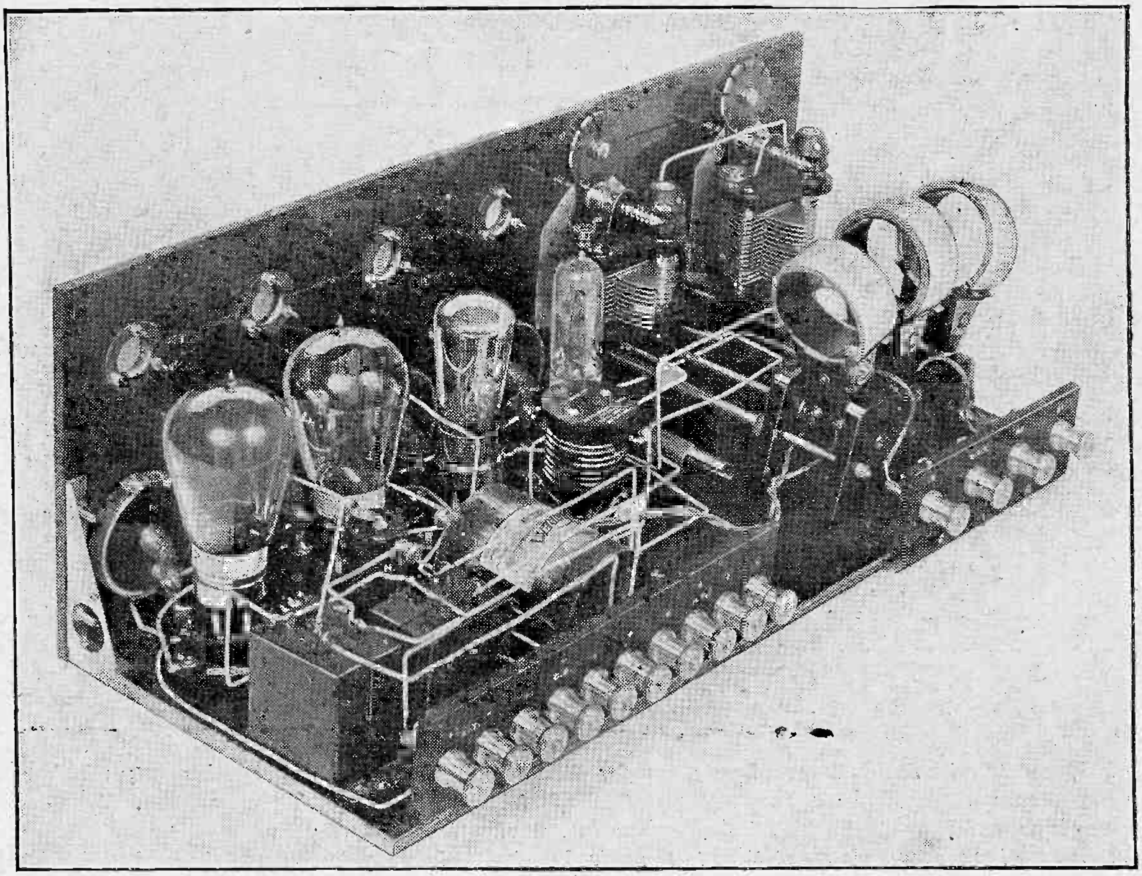
For connecting up telephones or loud-speaker, plugs and jacks are used, and no terminals or loose wires whatsoever appear on the panel.

It was not thought necessary to connect a jack between V_3 and V_4, and, in any case, this would have involved extra complications in the wiring in order to vary the H.T. applied to V_3 when replacing the high anode resistance by telephones or loud-speaker of only about 2,000 ohms resistance. If signals are too loud on four valves they can easily be reduced to the desired strength by merely detuning.

Batteries

Generally, the H.T. blocking condensers are regarded as part of the H.T. equipment, but in this case the H.T. and G.B. batteries may, if desired, be accommodated in the space beneath the baseboard, and therefore the condensers have been incorporated in the set itself.

In order to construct this set you will require the following components, and for the information of those who wish to duplicate the instrument exactly, the names of the actual manufacturers are given.



The three-coil holder is fitted to the baseboard, the controlling handles being extended through the panel.

It should be noted here that the components employed leave very little unused space, and so, if the use of components other than those below is contemplated, first make sure that they will fit in the space available.

One mahogany finished panel, 20 in. by 7 in. by ¼ in. (Paragon).

Cabinet (mahogany with baseboard) to take panel, with front doors and lifting top.

(This cabinet was obtained from the Carrington Manufacturing Co., Ltd., and reference to this article

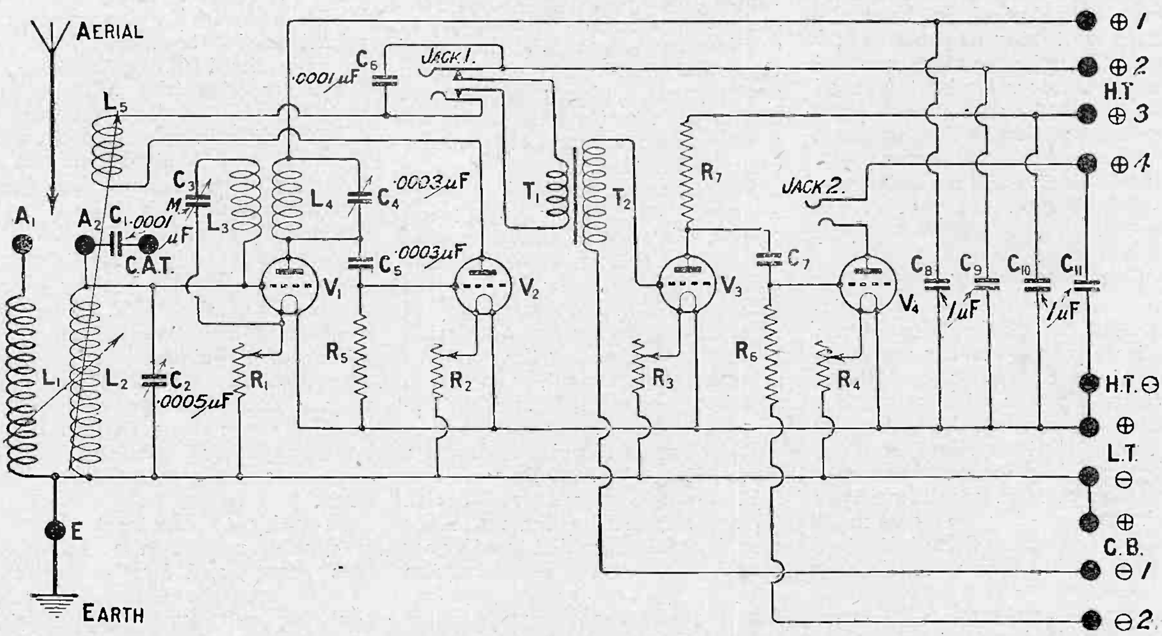
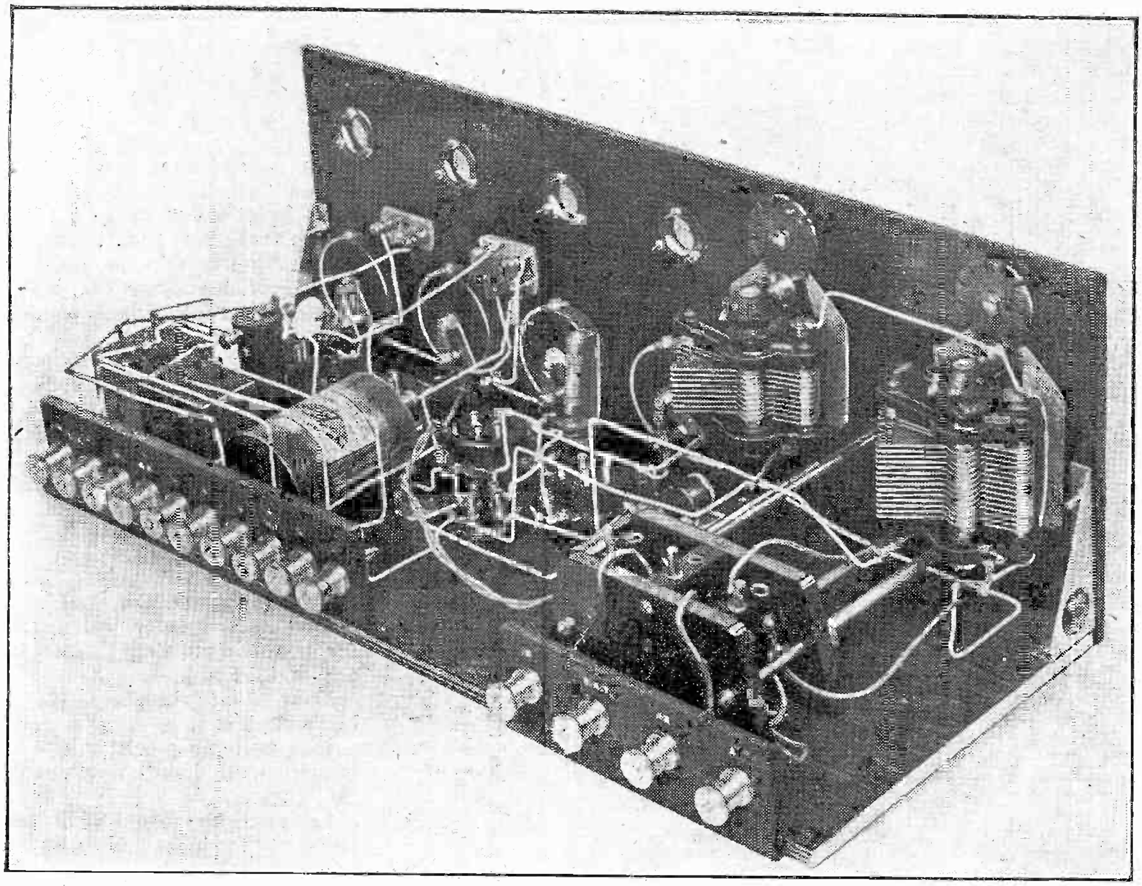
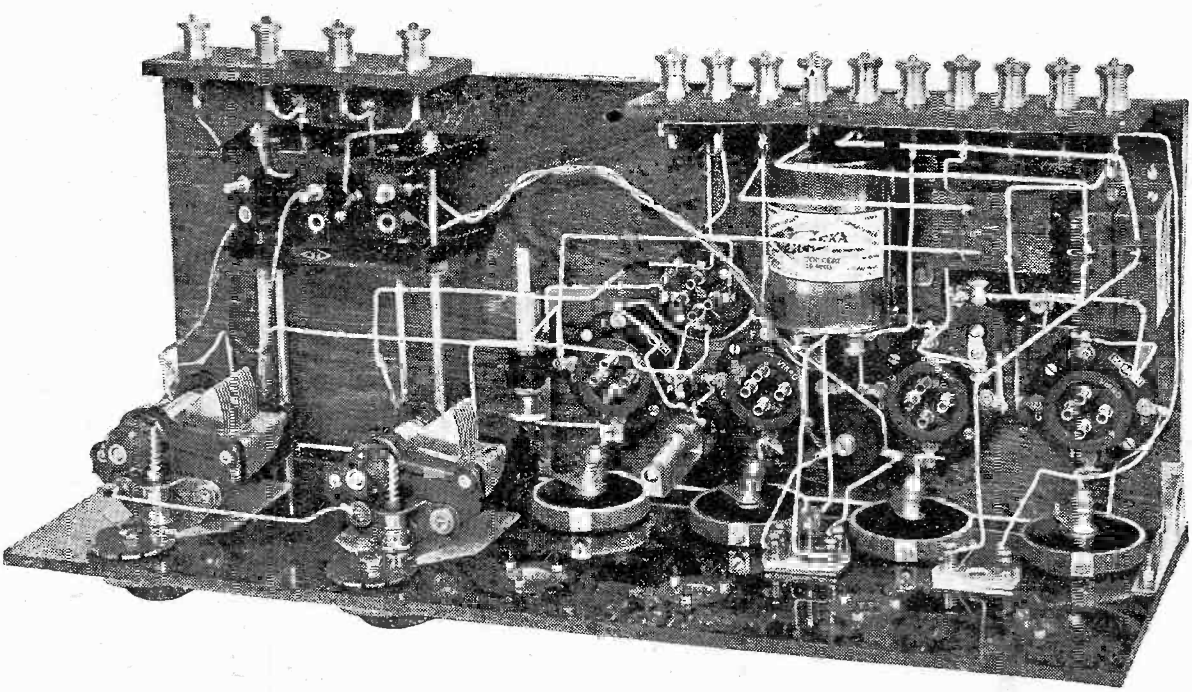


Fig. 1.—The theoretical circuit of the receiver. The jacks permit either two or four valves to be used.



The terminals for the various external connections are fitted to ebonite strips which in turn are secured to the baseboard in the manner shown.



Valve holders, L.F. transformer, etc., are all secured to the baseboard, thus relieving the panel of quite a considerable weight. The two flex leads which are twisted together go to the reaction coil.

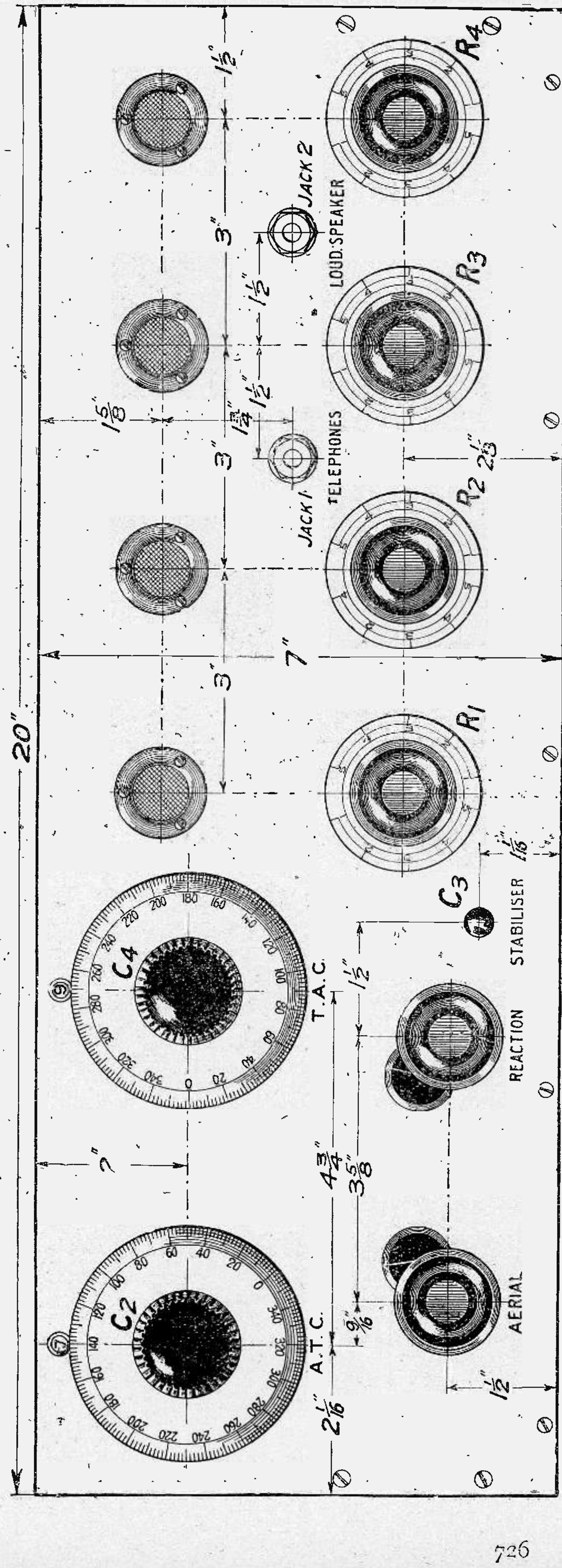


Fig 2. When drilling the panel the dimensions given should be respected, otherwise oscillation difficulties may result when the receiver is tested. A full-size blue print of this drawing may be obtained upon quoting No. 123A. (Price 1/3 post free).

will be sufficient specification when ordering).

One piece of ebonite 9 in. by 2 in. by ¼ in. (Paragon).

One piece of ebonite, 6 in. by 2 in. by ¼ in. (Paragon).

One variable square law condenser "Selector" ·0005 μF (Collinson's Precision Screw Co., Ltd.).

One variable square law condenser "Selector" ·0003 μF (Collinson's Precision Screw Co., Ltd.).

One ·0001 μF fixed condenser (Peter Curtis, Ltd.).

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

One ·0001 μF fixed condenser, (Herbert Bowyer and Co.).

One grid leak, 2 megohms (Dubilier).

Four 1μF condensers (Telegraph Condenser Co., Ltd.).

Four "Vibro" valve holders (Burne-Jones and Co., Ltd.).

One anti-capacity valve holder for board mounting (Burne-Jones and Co., Ltd.).

Four dual rheostats, (L. McMichael, Ltd.).

One variable 3-coil holder with long control handles (Peto-Scott Co., Ltd.).

One first stage Eureka L.F. transformer (Portable Utilities Co., Ltd.).

One new type "Polar" micrometer condenser (Radio Communication Co., Ltd.).

One "Polar" resistance capacity coupling unit (Radio Communication Co., Ltd.).

Two telephone plugs (General Radio Co.).

One double contact short type jack (General Radio Co.).

One single contact short type jack (General Radio Co.).

Fourteen large brass terminals (Burne-Jones and Co., Ltd.).

Four oxidized copper valve windows (Grafton Electric Co.).

Two angle brackets (Richard Melhuish and Co.).

Eight wander plugs for H.T. and G.B., various colours.

Quantity of Glazite (3 ten-foot lengths will be found ample) and short lengths of rubber flex. Screws etc., and Radio Press transfers.

Marking-out and Drilling the Panel

Reference to the diagram Fig. 2 will show that few components are carried by the panel relatively; consequently the marking out and drilling of this is a simple matter and should present no difficulty. The holes for the valve windows, if a sufficiently large drill is not available, may be very easily cut out, by the use of an ordinary long fret-saw, which can be purchased very cheaply in any tool shop.

It is essential that the positions for fixing the two "Selector" condensers and the variable coil-holder controls be very accurately marked out and drilled, as the clearance between these components is quite small.

The neutrodyne condenser has been mounted on a small length of brass fixed to the baseboard, in order that when it is adjusted to maximum capacity, its control handle shall not project out far enough in front of the panel to foul the doors of the cabinet when shut.

When you have completed the panel drilling, fix the components on to it, and temporarily attach it to the baseboard. Those components to be carried on the baseboard may now be screwed down, and although the various diagrams and photographs will give practically all the information necessary for this, there are a few points which must be carefully observed.

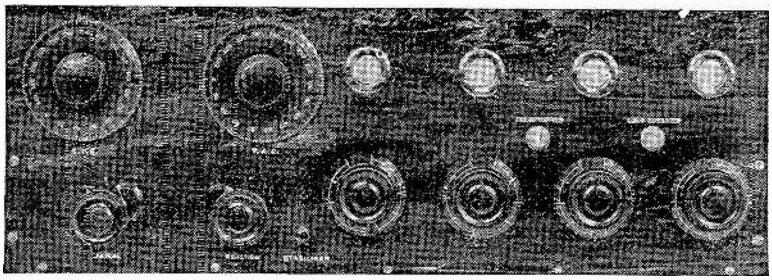
shanks of two of the battery terminals in order to allow clearance between them and the "Eureka" transformer. If a smaller transformer or terminals are used this may be found unnecessary.

The ebonite strip carrying the battery terminals is not mounted against the back edge of the baseboard, as is the aerial and earth terminal strip, but on top, thus leaving a space between it and the back of the cabinet in order that, when H.T. and G.B. batteries are accommodated in the cabinet base the leads to these may go straight down from the terminals to the compartment below.

L.T. Supply

The batteries may of course, if desired, be placed somewhere outside the set, in which case connections to the terminals may be simply made through the aperture in the back of the cabinet. The L.T. accumulator will be more or less frequently disconnected for charging, and for this reason no accommodation for it is provided. The H.T. and G.B. batteries, however, will, once adjusted, remain untouched for quite long periods, and it will be found that the ordinary type of 60 volt H.T. battery (of which one or more may be used) will lie on its side in the space provided, leaving room for various leads to pass above it, and allow of easy adjustment from the front of the receiver when the lower door is removed. In order that each valve may be used with maximum efficiency a separate H.T. voltage can be applied to each anode.

The aerial and earth terminals have also been mounted at the back, so that the set may be closed up when not in use without having to disconnect any leads whatever. In this manner also, the general appearance of the receiver is enhanced by the absence of any loose wires on the panel.



The face of the panel presents a symmetrical layout with only necessary controls appearing.

The neutrodyne condenser and anti-capacity valve holder (for the neutrodyne unit) must be placed as nearly as possible where shown. The best method to employ is, first to fix the variable coil holder in position, plug a quite large coil in the reaction socket and adjust it to a position of, say, 60 or 70 deg. from the vertical. Now place the components on the baseboard and in this way any mistake in position with regard to the coil will be made more unlikely.

Coupling

It will be observed that the adjustment of loose coupling between the aperiodic aerial coil L_1 and L_2 is limited somewhat by the side of the cabinet, but the adjustment obtained will be found sufficient generally, and if looser coupling is desired L_1 may always be replaced by a coil possessing a smaller number of turns.

I have cut about ¼ in. off the

Wiring

Except where flexible connections are necessary, "Glazite" has been used throughout for wiring up this receiver, and is found extremely useful, where the risk of shorting through wires running very close together is eliminated by the insulated covering.

The actual wiring should present no difficulty to the constructor so long as careful attention is given to the following points. When everything is ready for wiring, remove the panel from the baseboard. Now solder all the connections possible on the baseboard alone, taking care that the wire follows the paths shown in the photographs as nearly as possible. After this is done take the panel and solder the L.T. negative lead to the four rheostats as shown. To each of the moving arm soldering tags on these rheostats a small piece of glazite should be soldered, so that, when the panel is again fixed to the baseboard the free ends of these pieces will lie conveniently above the L.T. negative tag of each of the valve holders. The connections to the variable condensers and coil-holder may now be soldered, and both the 'phone and loud-speaker jacks connected up. If the above instructions are carried out, the wiring up process will not be found at all difficult.

In regard to the grid condenser and grid leak, a small leaflet is included with each condenser showing the correct method of connecting up. The series method is in use here.

Stabilizing

Having completed the wiring, the H.F. valve must now be "neutrodyned" before testing the receiver. To do this, the following procedure should be carefully adhered to. Connect up all the batteries to their respective terminals, place the four valves to be used in their correct holders, and after shorting the reaction socket (L_5) with a shorting plug or a piece of wire, place a coil of, say, 75 turns in the centre socket (L_2) and a neutrodyne unit to cover the broadcast band in the anti-capacity holder provided for that purpose. The neutrodyne condenser must be adjusted to its minimum position and aerial and earth disconnected. Now light the valves to their correct brilliancy by means of the rheostats, plug in the loud-speaker and adjust condenser C_2 to a low arbitrary value, say, about one-third of its maximum capacity. If the anode condenser

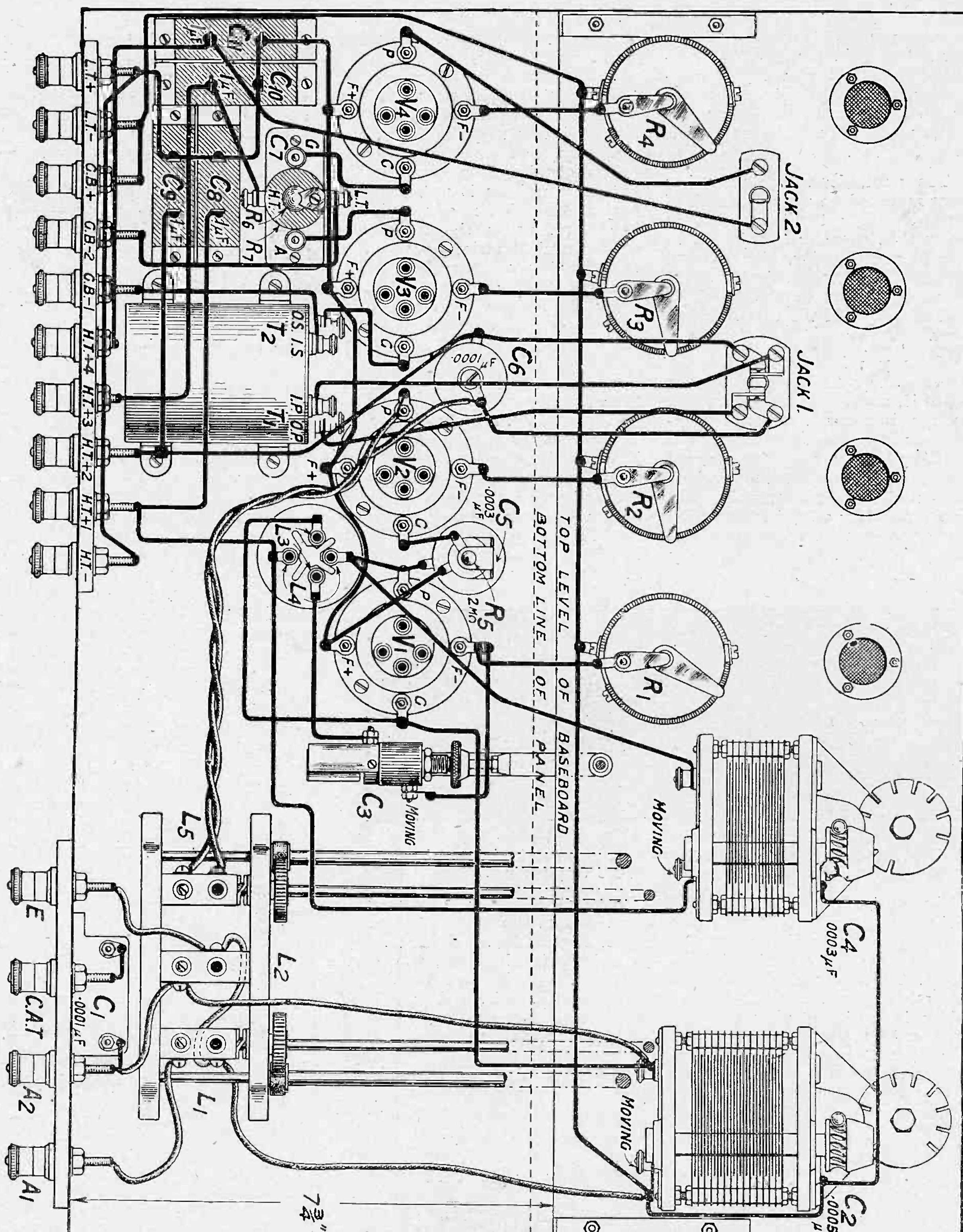
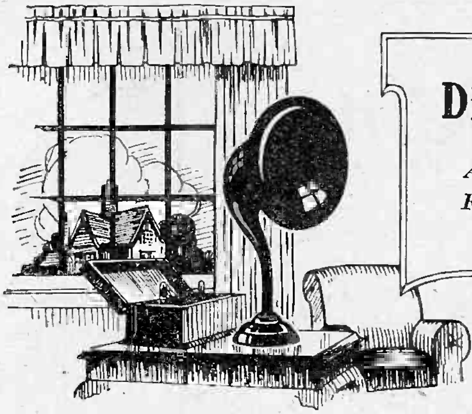


Fig. 3. The wiring of the receiver may easily be followed from this diagram of which a blue print may be obtained upon quoting No. 123B. (Price 1/6 post free.)

C_4 is now adjusted from minimum to maximum, it will be found that oscillation will occur over a certain band of its readings, and the limits of this band should be noted.

The presence of oscillation can be confirmed by tapping the terminal A_2 with a wet finger, when a loud-plonk will be heard from the loud-speaker. It will be found that a slight alteration of the neutrodyne condenser will narrow down this oscillation band, until, with very little patience, an adjustment on

(*Continued on page 754.*)



Director of Research of Radio Press, Ltd.

Appointment of Major James Robinson, D.Sc., Ph.D., F.Inst.P., Council P.S.L., Chief of the Wireless Research and Design Laboratories of the Royal Air Force.

WITH reference to the great new laboratories which Radio Press Limited (the proprietors of MODERN WIRELESS, *The Wireless Constructor*, *Wireless Weekly*, *The Wireless Dealer*, and a large number of wireless handbooks) are establishing at Elstree, 12 miles north of London, readers of this journal will have noticed that two highly-important posts have been advertised. The post of Director of Research and Chief Engineer carries with it a salary of £2,500 per annum, while the second, that of Deputy-Director of Research, carries a salary of £1,700.

An Announcement

The first position, taking into consideration the extra remuneration in the nature of royalties, payment for publications, etc., etc., will be the highest paid wireless staff appointment in this country. We are happy to be able to announce in this issue that this important post has been filled by the appointment of Major James Robinson, D.Sc., Ph.D., F.Inst.P., Council P.S.L. Dr. Robinson is at the present moment the Technical Wireless Head of the Royal Air Force, a position of unusual responsibility; he has handed in his resignation to the Air Ministry and is joining Radio Press Limited on the 15th August. Just before his appointment he was offered a very high administrative post at the Air Ministry in London, a tribute to the very successful manner in which he has carried out his work at the Royal Air Force Wireless Laboratories at Farnborough, where the research and design work is carried out. We are happy to say that in spite of this additional inducement for him to remain in a career in which he has achieved such success he has chosen to take up the new post created by the Radio Press.

It has been a matter of surprise to many that a publishing firm should acquire the freehold of seven acres of land for the purpose of building laboratories on it, and also that it should engage a staff of such high qualifications. The reason is that we intend to ensure that in the years to come our periodicals and publications will remain pre-eminent in their respective fields. We feel that when

Major James Robinson, D.Sc., Ph.D., F.Inst.P.

the readers of this paper and our other publications realise the great sum of money which is being spent in order to give the very best in our papers, they will in turn support us by reading regularly our journals and recommending them to their friends and, what is equally important, buying the goods advertised in these papers.

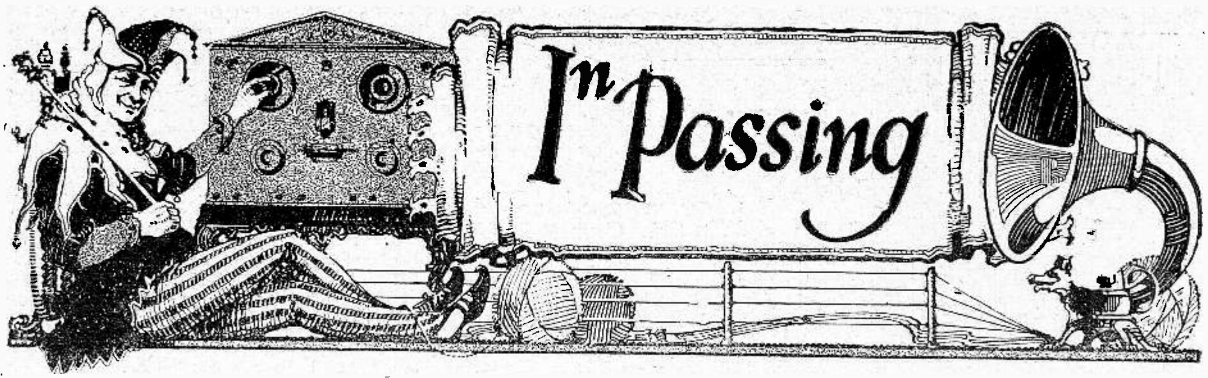
Test Department

Already the Radio Press has in existence a Test Department which carries out the testing of readers' sets. We have just received figures which indicate that the giving of a service to our readers is by no means a profitable undertaking. It may surprise readers to learn that on every set we test and repair we lose an average of £2, while it costs us 8s. 6d. to answer every written inquiry addressed to the company. Even on the present limited service we are losing, in this department, at the rate of £3,000 per annum, and it may well be asked on what commercial or other grounds we are justified in carrying out work which no other wireless papers are attempting. The reply is that sooner or later the readers of our papers will appreciate that the technical articles, constructional designs and the information generally in our papers is produced by the most qualified staff obtainable. It is extremely difficult, particularly for the beginner, to tell the difference between a good design and a bad design, between a sound technical article and one by a novice.

Radio Press Aims

Leading experimenters will give their views on our work, and we are content with their opinion. In the case of the broader public, it is our aim and object to do what we can to enlighten them regarding what is behind every Radio Press publication. It is no use our merely stating facts which any other organisation can state. We have to prove our contentions and the easiest way, in the case of set designs or, in fact, any other technical information, is to offer to prove to our readers the accuracy of our information and the efficiency of our sets and circuits. A very big step towards doing this was to offer to put right at a nominal fee any sets made from Radio Press designs which did not give the results expected. It is always possible for a man who has made

(*Continued on page* 803.)



Glad Summer

MY head is buzzing owing to the ravages of hay fever whilst my workshop is buzzing with bumble bees. A family of these no doubt interesting insects decided some time ago to make its home in a crevice of the wall beneath my table. Since their first coming they have shown so much of that commendable industry that one is taught to associate with their kind that there now appears to be more nest than wall. They have also increased and multiplied exceedingly. I would not in the least object to sharing my workshop with them; but they on the other hand do not see the point of sharing it with me; in fact, they do their best to chase me out whenever I put in an appearance. Having been skilfully centre-punched by them on one or two occasions I have decided to give up wireless construction for the present. Truly the summer is a glad and joyous season.

Buzzing with bumble bees.

A Dilemma

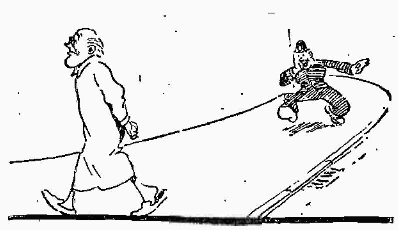
But it is not so much of my own sorrows that I want to tell you this month. I want to ask you to spare a little of your sympathy for my poor friend Professor Goop, upon whom a blow has fallen which to any ordinary man would have been well nigh crushing. The Professor is bearing up wonderfully, though he is not at the moment quite the man that he was. He is, as you possibly realise, a person who is always capable of conquering adversity. This was strikingly shown in an adventure that befell him the other night. Being awakened not long after midnight by the sound of distant thunder, the Professor recollected that he had forgotten to earth his aerial. He therefore sprang out of bed, and as the weather was warm descended to the garden in his natty nightwear. Having performed the necessary safeguarding process the Professor, who is given to absent-mindedness, forgot to return to bed, but went instead for a little stroll. He was musing upon many things as he walked when his thoughts were rudely interrupted by a loud and scandalised shout of "Hi!" from somewhere behind him. Turning round, he dimly discerned the form of P. C. Bottlesworth advancing upon him. The shock brought the Professor immediately to earth, and he realised that he must not be caught running about the High Street in his nightshirt.

Safe!

A long stern chase ensued, the Professor always managing to keep so far ahead that he was not recognised. He led Bottlesworth on by devious ways until they were in the neighbourhood of Poddleby's villa. Then he bolted in through the front gate, down through the garden and out of the back one. Owing to the Professor's cleverness, our local arm of the Law at once jumped to the conclusion that Poddleby was the culprit, and he had some difficulty in proving his innocence when he appeared before the Little Puddleton bench next morning. This just shows you what sort of man the Professor is when he is roused or when he has to face a crisis.

An Opportunity

But the latest swat from fortune's wand of which I am about to tell you has been a very shrewd one indeed. Many weeks ago, as you may remember, there appeared an announcement of considerable interest; a chief engineer was required for the new Radio Press research laboratory. The notice stated that the salary was to be £2,500 per annum, which should at any rate be sufficient to keep one in cigarettes. So far everything was satisfactory. It was also stated that applications would not be considered unless they came from those possessed of the highest qualifications. Satisfactory again, for who could possess better qualifications for such a post than Professor Goop? Ever since his earliest days his life has been devoted to science. As a child he would pour ink into the milk jug, not, as is the case with other children, from sheer mischief, but in an earnest endeavour to discover a pale blue dye. Again, when he pulled the cat's tail he was not teasing the animal. He was merely studying the way in which its nerves reacted to an applied stimulus. It was not greediness that



A scandalised shout of "Hi!"

caused him to eat too many green apples; he was experimenting upon the human works, moved by the same spirit as that which makes a bacteriologist inoculate himself with some horrid disease just for the pleasure of curing it later on. His career at school was not so brilliant as it might have been, since in his young days science was not taught at schools. His whole being revolted against learning about such hateful things as the "Ablative Absolute," or the "Constitutions of Clarendon." He wanted to be manufacturing chlorine or sulphuretted hydrogen in the laboratory, but he was baulked of his desire since there was no laboratory.

Well Qualified

It was only when he left school that he was able to develop his abilities properly. He argued very soundly that since degrees are obtainable by post from Trans-Atlantic institutions, it was a mere waste of time to immure himself for three or four years in a university. Examination papers again merely serve to cramp a man's style instead of bringing out his

Not teasing the animal.

real knowledge. When I tell you that Professor Goop without having done a single examination paper in his life is a Doctor of Science, a Master of Astrology, Meteorology, Carpet-laying, Psycho-analysis and Metaphysics, a Bachelor of Palmistry, Poultry-breeding and Plumbing, and that he holds diplomas for Horticulture, Barratry, Numismatics, Pestology, and Cyclosophy (the art of arguing in circles), you will see that no man could possibly be better qualified than he for any post, no matter what its nature.

A "Sitter"

As soon, therefore, as he had seen the announcement to which I have referred, the Professor realised that he had what the vulgar call a "sitter." He let it be known at the club that he was considering the matter, and we all understood that, of course, he had only to send in his application to receive the appointment. We regarded the final selection as so much of a foregone conclusion that other members took to calling him "C.E." whilst I endeavoured on several occasions to borrow a fiver, pointing out that no man could possibly miss the five-hundredth part of his salary. I asked the Professor nearly every day whether he had sent in his formal application. For some time he merely replied, "Plenty of time, my dear fellow, plenty of time." Then one evening he asked me to go round to have a little talk with him.

A Proud Moment

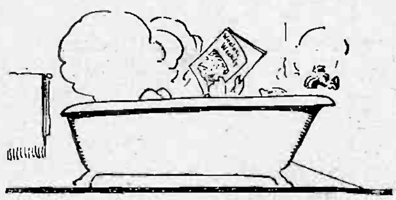
As we sat in his little study he opened his heart to me, and I suddenly realised how close were the bonds that bind us together. "My friend," he said, "I would send in my application and secure the post but for one little fly in the ointment. Can you imagine Marshall parted from Snelgrove?" "No." I replied firmly. "A thousand times no." "Can you envisage," he went on, "Damon without his Pythias, Orestes minus his Pylades, or Pope severed from his Bradley?" "Certainly not." I said, wondering what he was leading up to. "Then," cried the Professor, "Can you possibly entertain the idea of Goop parting from his Listener-in? Such a thing is unthinkable, impossible. That is the one and only reason why I hesitate about taking this post." I seized his hand and wrung it until his fingers creaked. "Professor," I said in a broken voice, "This is the proudest moment of my life. I have longed to see you as Chief Engineer, and never would I have put anything in your way. Yet the sorrow of parting brass rags, so to speak, would, I think, be just a little more than I could bear."

The Deputy C.E.

"But," I continued, "do not forget that it is always darkest before the dawn breaks. You have not seen, I take it, to-day's *Wireless Weekly*. They are announcing now that they want a deputy chief engineer, and, if I may say so, what better chief could I have or what better right hand man could you? Let us examine the terms of the appointment." We did so. The applicant was required in the first place to possess a degree not lower than M.Sc. Nothing wrong here, since I am an honorary Doctor of Divinity of the Catwhisker University, Wis. U.S.A. Secondly, he must have not less than ten years' experience of wireless work. Easy. Thirdly, for not less than five years he must have held an executive position involving the originating of radio inventions and their development. I need only refer you to the back files of *In Passing*, which contain not a few radio inventions that I may, perhaps, class as notable without undue immodesty. In any case I was the first man to claim the reception of KDKA on a crystal, and if that is not a radio invention *I* do not know what is. Fourthly, the candidate must possess an extensive engineering experience, and a thorough knowledge of mechanical and electrical design of radio instruments. This, I think, requires no comment. There is a fifth condition about his being familiar with modern radio developments, which, of course, presents no difficulties in my case. The salary, of course, is not quite what the chief engineer will get, still £1,700 a year, if one is careful, should at all events help towards scaring the wolf should he happen to call at the door. We decided then that if the senior post was a gift for the Professor the other was mine for the asking. With two such people as ourselves in command, radio research would have received a real fillip, as you, readers, will at once agree. Before we parted on that evening we had jotted down many ideas which we proposed to develop as soon as we were in the saddle. Though we should be both of us comparatively poor men we felt that we could face such poverty for the sake of wireless. We would sacrifice everything. We would put our backs into the business. We would show them.

A Sad Shock

And the next morning fate let out. I do not mind so much for myself since, thanks to my proficiency at tiddlywinks and shove-ha'penny, my income is assured; but my heart bleeds for the Professor. That morning as I lay reading *Wireless Weekly* in my bath I came across the horrid announcement that, having waited in vain for Professor Goop's application,



Reading "Wireless Weekly" in my bath.

they had appointed with much sorrow the next-best man that they could find for the post of chief engineer. Think of the inventions that might have been produced had Professor Goop not been too late in sending in his application. . .

THE LISTENER-IN.

Which is the better aerial—the one depicted above, or that on the opposite page?

Large or Small Aerials?

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

Summary

THE points to be considered in the design of a receiving aerial are shown to be as follows :—

(1) In order to obtain the maximum reception from a given signal, the aerial should be designed so that the working wavelength is not more than three times the natural wavelength.

(2) In order to obtain adequate selectivity and sharp tuning, the aerial should be somewhat smaller than is required by Condition 1. The selectivity remains about the same over a band of wavelengths ranging from three times the natural wavelength of the aerial up to ten or twelve times.

(3) These two conflicting conditions may be combined to give an efficient aerial system, in which case the condition required is that the ratio of the working wavelength to the natural wavelength should be from three to three and a half. Numerical values are given illustrating the applications of this principle.

(4) While a small aerial may satisfactorily be employed for longer wavelengths and will continue in such circumstances to give adequate selectivity, the converse is not true, and a long wavelength aerial will not prove satisfactory for short waves.

(5) It is important that the ratio of horizontal length to vertical height should be small. The most efficient aerial system possible would be a single vertical wire. This, however, is not practicable in the majority of cases, but it is preferable to sacrifice some of the length in order to obtain a preponderance of vertical height over horizontal length.

General Considerations

The aerial is one of the most important factors in any receiving system and may make all the difference between success and failure. Apart from the details of actual construction, such as the necessity for good insulation, or the avoidance of undue screening, the size has a very considerable effect upon the results obtained. Transmitting aerials, somewhat naturally, fall in a class by themselves, and it is proposed in this article to consider only aerials used for receiving purposes.

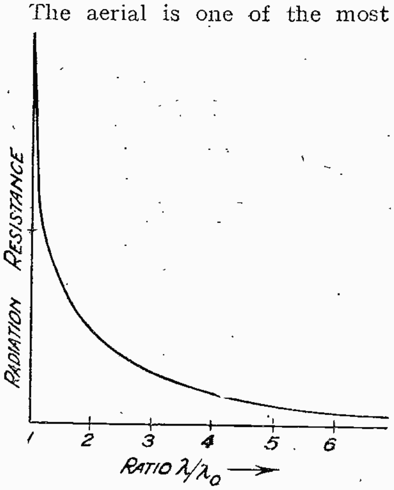


Fig. 1. Showing the variation of radiation resistance with wavelength.

We may summarise the points to be considered as follows. There are three essential conditions for a good receiving aerial system. In the first place the tuning of the aerial should be sharp. This requires, primarily, that the resistance of the aerial shall be low. Secondly, it is desirable that the receptive properties of the aerial shall be as high as possible. Finally, the aerial should be capable of being selectively tuned. This is to some extent bound up with the considerations of resistance, the first of the three essentials.

Resistance

We will consider these several points in detail. The first point is that of the resistance of the aerial. Now, quite apart from the resistance of such tuning coils as may be necessary, the aerial itself has considerable inherent resistance. This resistance may be analysed into several components. There is, of course, the resistance of the wire of the aerial itself, and of the earth.

Secondly, there is a very fruitful source of loss, known as the "dielectric loss."

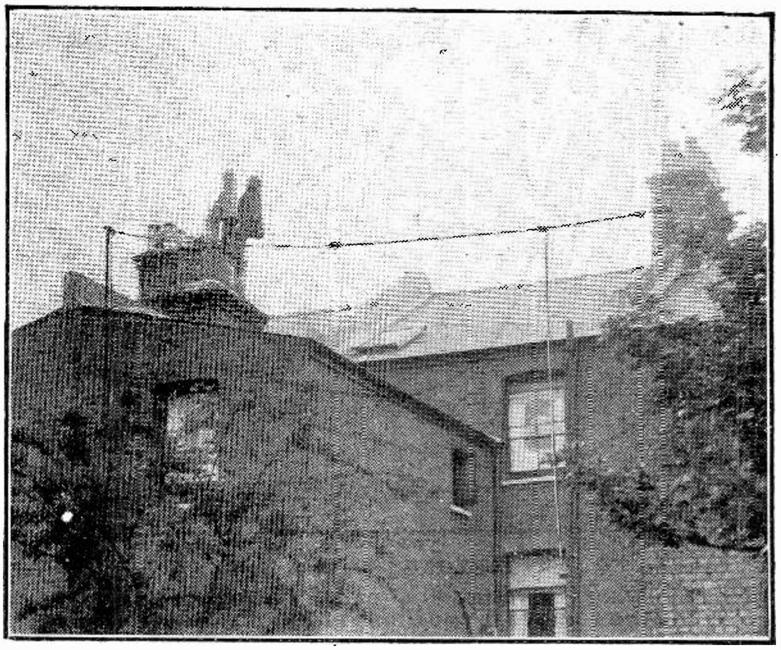
The currents which are set up in the receiving aerial give rise to secondary currents in the insulators, the walls of the building and the ground underneath the aerial.

Such currents will, of course, absorb energy from the aerial and will thus prevent the full signal strength from being developed.

Radiation Resistance

The third component of the resistance of the aerial is the quantity known as the "radiation resistance." In a transmitting aerial there is a certain expenditure

In this article the author discusses the question of the size of the aerial system and shows that there is little to be gained by employing a large aerial for broadcast reception. The effect of size on the signal strength received and the selectivity of the system is discussed, and details are given to enable the best results to be obtained under any given conditions. For the convenience of readers a short summary of the article has been given.



This aerial, comprising a vertical wire with a very short horizontal top, is better than that shown opposite. The portion on the left of the lead-in is merely an insulated "tail."

of power in overcoming the resistance of the aerial and the losses associated therewith. The remainder of the power is effective in producing radiation. This may be measured by considering the aerial to have a certain fictitious "radiation resistance," which requires the expenditure of power in order to overcome it. The radiation resistance is thus a measure of the amount of power actually radiated.

In an exactly similar manner, the radiation resistance of a receiving aerial is a measure of the amount of power abstracted from the passing ether waves, and it is therefore important to ensure that the radiation resistance shall be a large proportion of the total resistance.

Natural Wavelength

It is well known that an aerial is capable of receiving or transmitting signals without any additional inductance or capacity. This is due to the fact that the aerial itself possesses a certain inherent inductance and capacity, and consequently if the aerial is set in oscillation it will radiate a certain definite wavelength.

This wavelength is termed the *natural wavelength* of the aerial, and the radiation resistance of an aerial is a maximum when the aerial is operated at this natural wavelength. As the working wavelength is increased so the radiation resistance falls off somewhat rapidly. It is found experimentally that the radiation resistance is inversely proportional to the square of the wavelength. This point is illustrated in Fig. 1, which shows the variation of the radiation resistance in terms of the ratio

$$\frac{\text{working wavelength}}{\text{natural wavelength}} = \frac{\lambda}{\lambda_0}$$

Variation of Loss Resistance with Wavelength

We may now consider the other resistances, which may be called *loss resistances* because they militate against good reception. It is well known that the resistance of a conductor carrying alternating current increases with the frequency of that current. This is because at high frequencies the current only flows in the skin of the conductor. Consequently the effective area of the conductor is less, and the resistance will increase in proportion. This effect is found to

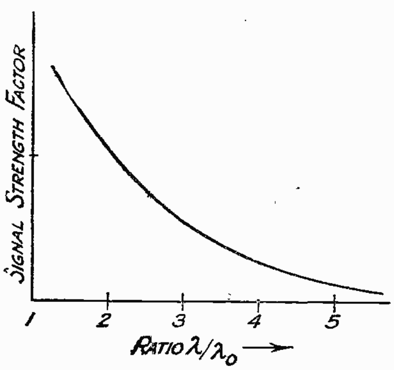


Fig. 2. Showing how the ratio of radiation resistance to total resistance varies with the wavelength.

vary inversely as the square root of the wavelength, that is to say, the shorter the wavelength the higher will be the resistance of the conductor.

Finally, the dielectric resistance is found to increase directly as the wavelength increases, being greater for long wavelengths than for short.

Aerial Resistance

It is possible therefore to draw a curve showing the variation of these component resistances for any given aerial circuit. This has been done in Fig. 3, and the three dotted line curves represent the three resistances which have just been considered. The full line curve is the sum of these three component curves, and represents the total resistance of the aerial. It will be seen that this total resistance varies very considerably with the wavelength at which the aerial is operated, and, moreover, that there is a fairly well-defined minimum point. This is the type of curve which is obtained in practice if the resistance of an actual aerial is measured. The minimum point is found to occur at a wavelength of two or three times the natural wavelength.

Conditions for Best Reception

Now it follows from what has previously been said, that in order to obtain the best reception from a given aerial, the proportion of radiation resistance to total resistance should be as large as possible. Reference to Fig. 3 will show that this condition is obtained by working the aerial as near as possible to the natural wavelength. The actual proportion of radiation resistance to total resistance can be worked out for a typical case, and this has been done in Fig. 2, which indicates quite clearly the

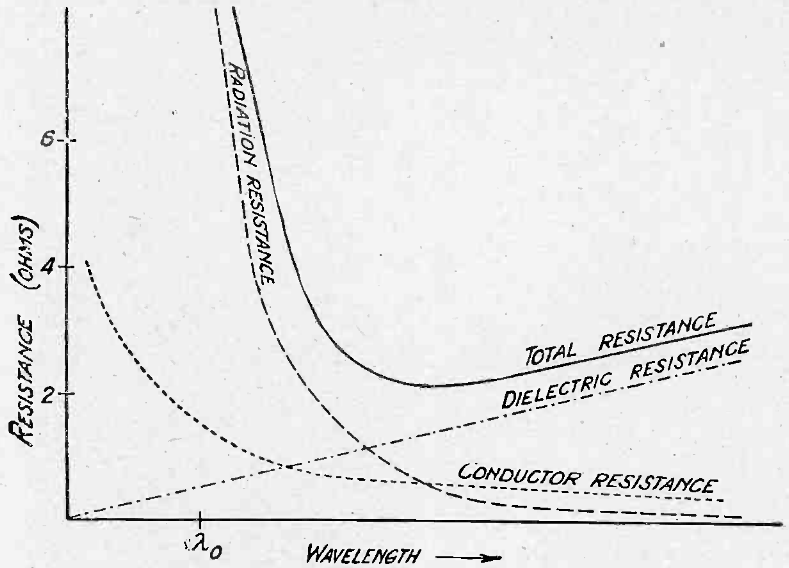


Fig. 3. Showing the variation of aerial resistance with wavelength and the relative proportions of the various component resistances.

increase in this ratio as the natural wavelength of the aerial is approached.

It will be seen from this curve, that the radiation resistance remains a fairly high proportion of the total as long as the wavelength at which the aerial is operated is not greater than two or three times the natural wavelength. This, therefore, is the condition required for good reception.

Selectivity

We have now, however, to consider the third factor in the case, that is to say, the question of the selectivity. In order to investigate this question, it is necessary to obtain some definition of selectivity. We may consider an aerial system tuned to a given station, in which case a certain current will be produced in the telephones. If now a second station transmits on a wavelength very slightly different from the first, a certain interfering signal will be obtained in the telephones. The selectivity is the ratio of the detected signal current to the detected interfering current. It may be shown that, other things being equal, this ratio is proportional to $\frac{L^2}{R^2}$, where L and R are the inductance and resistance in the aerial circuit.

This reasoning applies both to the direct tapped aerial circuit and to the loosely coupled type of aerial circuit.

It will be obvious, therefore, that there are several possible arrangements. We may provide a fairly large aerial with a small loading inductance (in order to tune the aerial to the wavelength being received), or we may have a smaller aerial with a larger inductance. Now, the ratio of $\frac{L}{R}$ for a coil remains approximately constant, provided the same type of winding is employed. If, however, a smaller aerial is used, the natural wavelength of such an aerial will be considerably smaller than if a large aerial were used. This means that the ratio of the working wavelength to the natural wavelength is larger, and, as has been seen in Fig. 3, this will have considerable effect upon the resistance of the aerial.

It is therefore necessary to take into account both the inherent resistance and inductance of the aerial, and the inductance and resistance of the loading coil which is employed. This has been done in Fig. 4, and it will be seen that the ratio of $\frac{L}{R}$ increases as the wavelength increases, up to a point where the working wavelength is about eight times the natural wavelength. At this point the curve begins to drop again, but the maximum extends over a considerable range of wavelength.

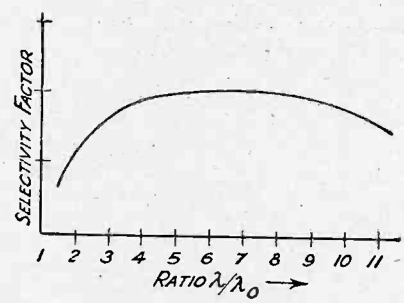
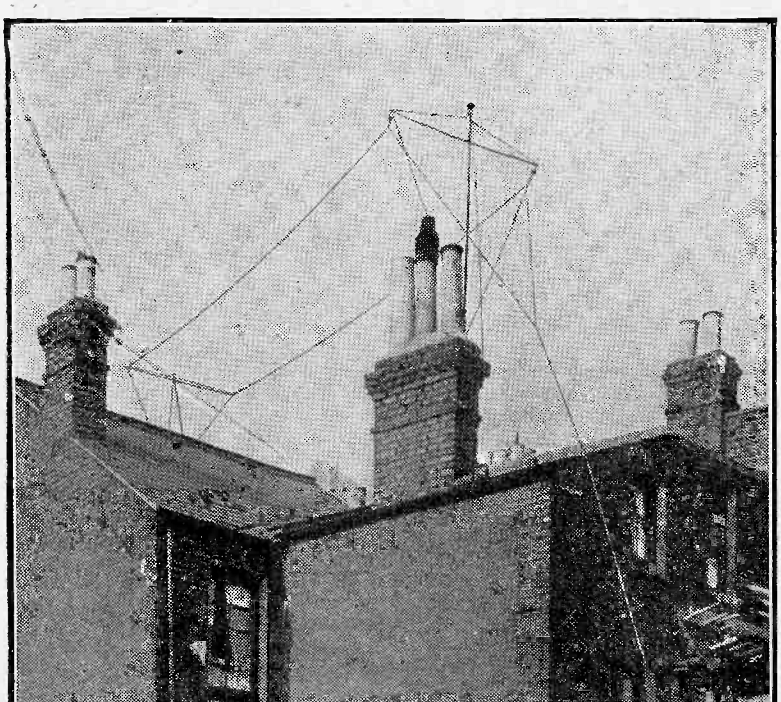


Fig. 4.—Variation of ratio $\frac{L}{R}$ with wavelength.



A typical receiving aerial. A single wire would give better selectivity.

Optimum Arrangement

We therefore have two sets of conditions. If receptivity is considered, the condition required is that the aerial shall be operated at a wavelength not greater than two or three times the natural wavelength.

If, on the other hand, selectivity is the criterion, it is necessary for the wavelength to be at least three or four times the natural wavelength.

These two conditions may be combined, and we may obtain a curve giving the best position from both points of view. This has been done in Fig. 5, which indicates to a very marked degree that the wavelength employed should be about three times the natural wavelength.

It will be obvious that this optimum position is really a compromise between two conflicting conditions. Fortunately, however, there are positions at which the reception conditions are good from both points of view, and to obtain the best results the aerial should be worked in this overlapping portion. From Fig. 5 it will be seen that this occurs at a wavelength of about three times the natural wavelength of the aerial.

Numerical Values

We may now translate these results into terms of actual length and type of aerial. The natural wavelength of an aerial is about four or five times the actual length of wire employed. This strictly applies only to single wire aerials, but serves as a rough guide if double wire aerials are employed. On a wavelength of four hundred metres, the natural wave-

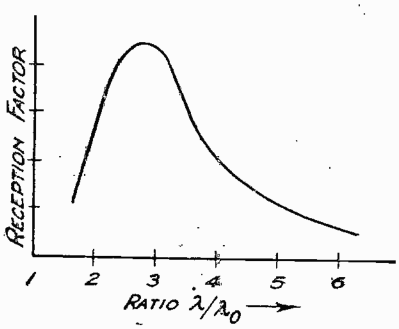


Fig. 5.—Indicating the marked effect of size upon the results obtained.

length, in order to comply with the conditions just given, should be about 130 metres.

This requires an aerial about 30 metres long, which will be seen to accord very closely with the figure of 100 feet which has become the standard among amateurs (1 metre = $3\frac{1}{4}$ ft. approximately).

This size of aerial, therefore, gives the best conditions both as regards receptivity and selectivity, and Fig. 5 indicates very clearly that an increase in this length is accompanied by a marked decrease in the resulting signals.

Loaded Aerials

In order to receive the longer wave broadcasting it is necessary to insert a fairly large loading coil in the aerial circuit. Now it will be obvious from what has been said, that it is not practicable to obtain an aerial which is equally effective both for short waves and long waves. In the majority of cases, however, the long wave stations are using rather more power than those on short waves, and therefore it is the selectivity factor which requires consideration.

A reference to Fig. 4 will show that the selectivity factor increases as the ratio of working wavelength to natural wavelength is increased, and that this ratio may be increased to as much as ten without any detrimental effects on the selectivity. That is to say, the 100 ft. aerial just considered, having a natural wavelength of about 130 metres, will give good selectivity on wavelengths up to 1,300 metres or even more.

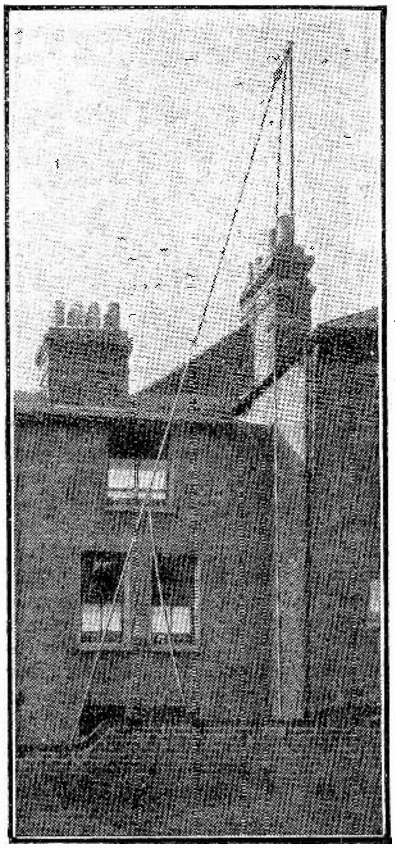
On the other hand, an aerial which was made efficient for the longer wavelengths would not be by any means efficient if used on the short waves, so that for general purposes a small aerial is preferable.

Ratio of Horizontal Length to Height

This is another aspect of the question, which has not yet been considered. There are, moreover, several interesting features which are brought to light in this connection, but it is not possible to discuss this point at any length in the present article.

Pending a more detailed investigation of this matter, it may be observed that the existing form of aerial, in which the length of the horizontal top is several times as great as the height, is decidedly inefficient.

The length of the flat top should not be more than about half the vertical height if the aerial is to possess good receptive properties. Actually the ideal aerial would be a simple vertical wire, 100 ft. high, which is not practicable in the majority of cases. It is better, however, to sacrifice a certain amount of actual length.



A good type of short wave aerial.

An aerial 30 ft. high and 30 ft. long would be a better receiver than one 30 ft. high and 70 ft. long.

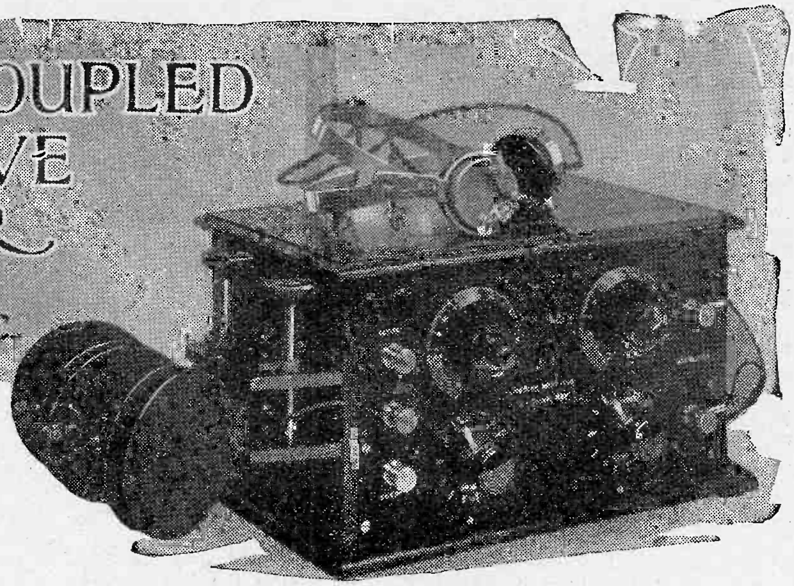
Short Wave Aerials

These results are particularly interesting in connection with short wave reception. They indicate very strongly that a considerable improvement in signal strength and selectivity could be obtained by reducing the size of the aerial, other things being equal. Unfortunately a small aerial is more subject to screening, and this point should not be lost sight of.

In the case of the reception from American stations, the selectivity factor is not of such great importance as the fact of good reception. It is probable, therefore, that in this case it would be better to construct an aerial having a natural wavelength of the order of one half that being received. If the wavelength being received is equal to or less than the natural wavelength of the aerial, certain undesirable secondary effects occur, which militate against good reception. Simple vertical wire aerials, 20 or 30 ft. in height, are more likely to give satisfactory results on wavelengths between 50 and 150 metres.

A CHOKE-COUPLED TWO-VALVE RECEIVER

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



FOR the circuit of the two-valve receiver to be described in this article, I have chosen what is probably one of the most popular in this country, namely, the detector and "one-step," that is, a detector-valve followed by one stage of low-frequency amplification. The reason for its popularity is only too apparent, for it is one of the easiest circuits to operate, and is one of the most useful "DX" circuits in good conditions and provides, in addition, a good general-purpose receiver.

Refinements

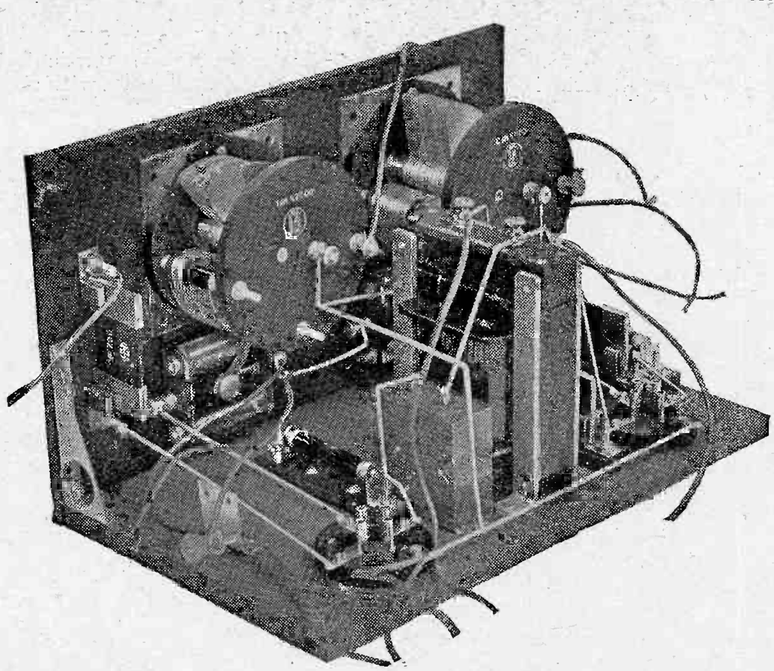
It will be seen from the circuit diagram that I have used choke-coupling, and have incorporated in the set one or two refinements which should render it an attractive proposition for the man who is situated quite near a main broadcasting station, and who desires to receive the latter on the loud speaker and yet be able to "reach out" occasionally in search of more distant stations without being troubled by interference from the nearby station.

To achieve this, an auto-coupled aerial circuit is used in conjunction with a type of wavetrap recently described by Mr. A. D. Cowper, in *Wireless Weekly* (Vol. 6, No. 7, May 20, 1925). This consists of a "series-acceptor" circuit L_2C_2, that is, an inductance in series with a condenser, shunted across the aerial turns of the auto-coupled circuit. Provided this "acceptor" circuit is of negligible H.F. resistance, then no appreciable H.F. potentials can be built up across these aerial turns for the particular frequency to which the "series-acceptor" circuit is tuned. If then, we keep down the H.F. resistance of this circuit by using a coil of good design, this arrangement forms a very effective wavetrap for the elimination of a powerful local transmission.

When the wavetrap is in operation, ordinary magnetic reaction on to the aerial from the plate circuit of the detector-valve is used, and the whole tuning arrangement is shown in Fig. 2.

Reinartz Reaction

The second feature of interest in the receiver lies in the fact that it is possible by merely changing a coil and altering the connection of a flexible lead, to use the Reinartz form of reaction. This is effected by simply connecting the flex lead marked X in the circuit diagram to the terminal Y and substituting a radio-choke for the reaction coil L_3, thus giving the arrangement shown in Fig. 3. The smooth control and ease of adjustment which this type of reaction gives can be fully appreciated only when it is used in conjunction with a really low-loss grid circuit, but, nevertheless, if a good type of plug-in coil is used this method gives a marked improvement over the ordinary swinging coil method, and a much finer adjustment is possible without an excessive tendency for the set to burst into oscillation suddenly.



This view of the rear of the receiver shows the general disposition of the components on the panel and baseboard. The clip seen close to the near edge of the baseboard holds the grid battery in position.

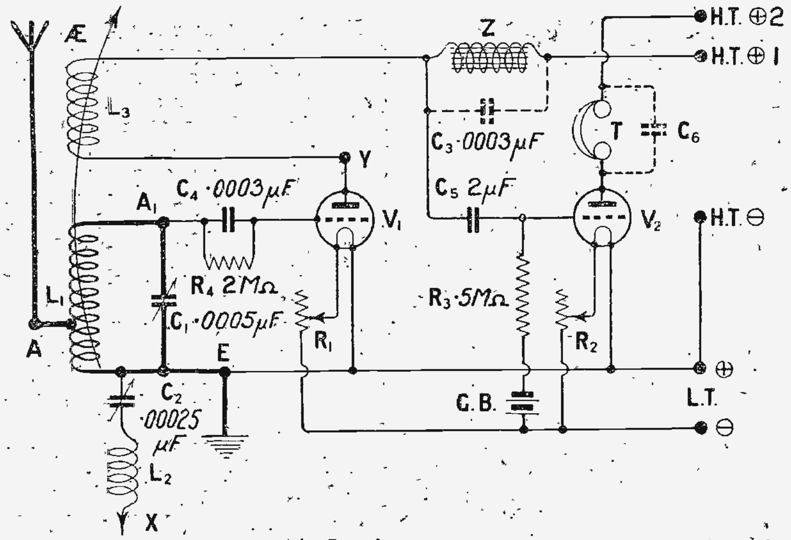


Fig. 1.—The theoretical diagram of the circuit employed. Reinartz reaction may be introduced with the aid of the coil L_2 and condenser C_2.

Although these refinements have been incorporated the set still retains the simplicity of an ordinary receiver using a more usual circuit, and even the beginner need have no doubt as to his ability to operate it.

Arrangement of Coils

A three-way coil holder is used to accommodate the coils, the central fixed socket taking the aerial coil with the coils L_2 and L_3 in the movable sockets on either side. When the wavetrap is in use the coil L_2 is kept at right angles to the aerial coil so as to minimise the coupling between them. Before describing the actual set, a few words on the low-frequency coupling may not be out of place.

With the circuit arrangement shown the amplification may not be as high as one is accustomed to obtain with transformer coupling, but, provided a good choke of sufficiently high impedance is used, and with proper conditions elsewhere, the quality of reproduction will show an improvement on that possible with many transformers. The value of the coupling condenser C_5 is not critical above a certain value, but for the best results it should not be less than about 0.01 μF. I have used a 2 μF condenser in the actual set but any value above 0.01 μF will prove quite satisfactory. The gridleak R_3 should have a low value, preferably from 0.25 to 0.5 MΩ; in the present set one of 0.5 MΩ is used.

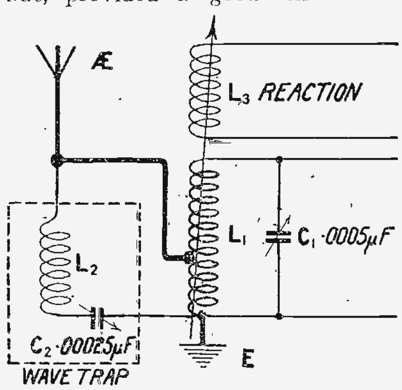
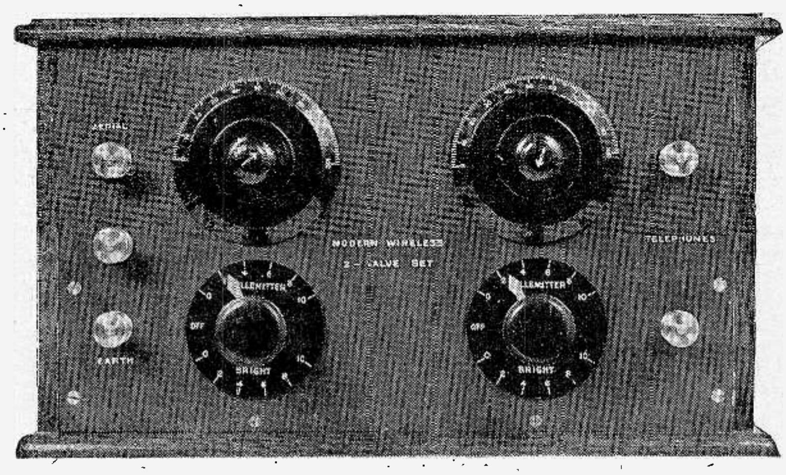


Fig. 2.—An efficient wave-trap circuit is obtained by connecting L_2 and C_2 in series across the aerial turns.



The adoption of the American scheme of mounting the fixed components on a baseboard at the rear results in extreme simplicity of panel layout.

Separate H.T. Tappings

Note that a separate H.T. tapping is provided for each valve. This is a desirable feature in any set employing low-frequency amplification, and in this particular set the correct voltages may be applied to each valve, and preferably a small power-valve with suitable grid bias used for the L.F. stage.

It is advisable, though not absolutely essential, that shunting condensers of 2 μF be connected between each positive H.T. tapping and H.T −, but these are not incorporated in the actual set, as a separate unit is preferable for this purpose. In *Wireless Weekly*, Vol. 6, No. 9, June 3, 1925, I described such a unit containing shunting condensers, grid bias batteries and tapping switch and also a filter circuit and loud-speaker shunting condenser, under the title of "A Useful Accessories Unit," and this should prove a useful adjunct to any experimenter's equipment.

By-Pass Condenser

When using the ordinary magnetic reaction, a condenser C_3,

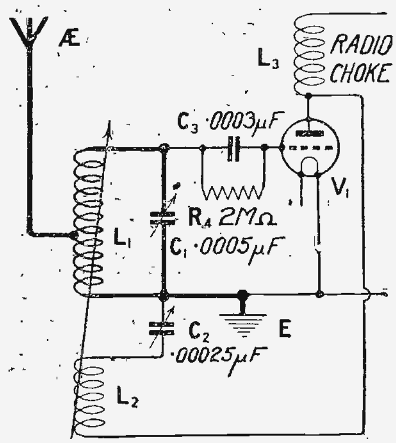
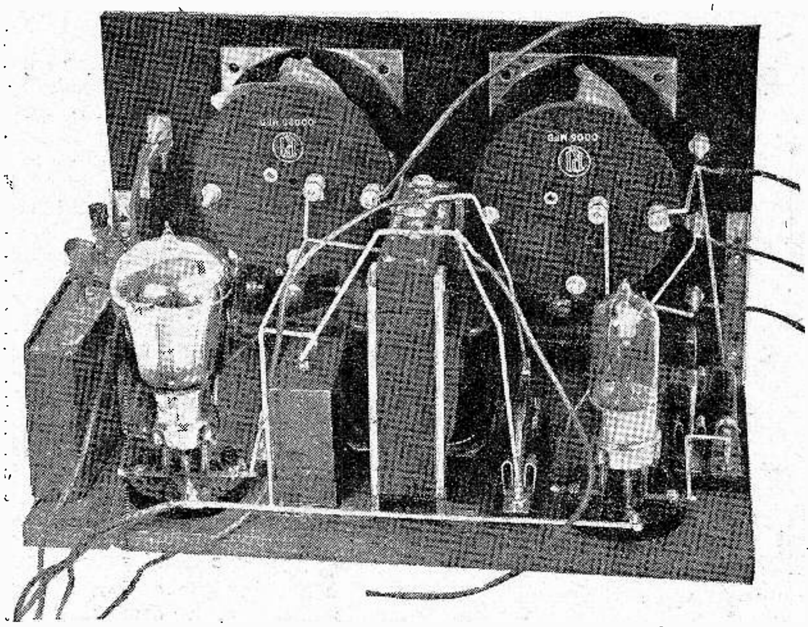


Fig. 3.—Reinartz reaction, as shown above, is obtained by connecting the free end of L_2 to the plate of the detector valve.



From the above photograph it will be observed that no space is wasted on the baseboard, and though appearing to be crowded easy access is given for making all necessary connections.

shunted across the choke Z, is desirable. The value of this fixed condenser should be kept as low as possible consistent with suitable reaction control, and a value of .0003 μF as specified is usually about right. Clips for the shunting of a fixed condenser across the telephone terminals have been provided in the set. This is for the purpose of tone control, should the set be used, say, up to distances of about 10 miles from a main station, for working a loud-speaker, and the best value of this condenser will depend on the type of loud-speaker used, and may be between .001 μF and .01μF.

The General Lay-out

The accompanying photographs should convey a fair idea of the appearance of the receiver. The American method of baseboard mounting with a vertical panel for the tuning controls has been adopted and allows of a neat and symmetrical panel lay-out. The three-way coil-holder is attached to the cabinet on the left-hand side. The front coil socket takes the Reinartz reaction or the wavetrap coil, whilst that at the back takes the H.F. choke or the ordinary reaction coil, according to which arrangement is being used. The top terminal on the left of the panel is for the aerial when direct coupling is used, whilst that at the bottom serves to make the earth connection. The centre terminal on the left corresponds to that marked Y in the circuit diagram. The condenser dial on the left at the top of the panel is the A.T.C., while that on the right controls the reaction or the wavetrap condenser. Terminals are provided for telephone connections but all battery connections are made with the aid of flexible leads brought out through a hole in the back of the cabinet. A tapped grid-bias battery is, however, included in the cabinet, and the necessary flexible connections and wander plugs provided. The anti-shock type of valve-holders and dual rheostats have been employed to render the set adaptable for use with dull-emitter valves.

Components Required

For the construction of the set the following is a complete list of the components and materials required; the makes actually specified and used in the set need not be strictly adhered to, and the discriminating constructor has a wide choice of suitable components. If the reader has any doubt, however, as to the suitability of any material he is advised to keep to the list given below:—

One suitable cabinet (Camco).

One ebonite panel, 12 in. by 7 in. by ¼ in. (Paragon).

One .0005 μF variable square law condenser.

One .00025 μF variable square law condenser. (Both by Radio Instruments, Ltd.).

One L.F. choke (Grafton Electric Co., Ltd.).

Two "Antipong" valve-holders (Bowyer-Lowe Co., Ltd.).

Two dual type rheostats (Radio Instruments, Ltd.).

One three-way coil-holder (Peto-Scott Co., Ltd.).

One grid-leak (2MΩ) and grid condenser (.0003 μF) unit.

One grid-leak (mounted) 0.5 MΩ.

One .0003 μF fixed condenser (mounted).

One fixed condenser with clips (tone control condenser; value determined by trial). (The last four items are by L. McMichael, Ltd.).

One fixed condenser, 2μF (Telegraph Condenser Co., Ltd.).

Five terminals (those used are by Burne-Jones & Co., Ltd.).

One grid-bias battery 9v., tapped (Siemens Bros. & Co., Ltd.).

Radio Press panel transfers.

Square wire, about 5 yards rubber covered flexible wire, brass wood screws, and two angle brackets.

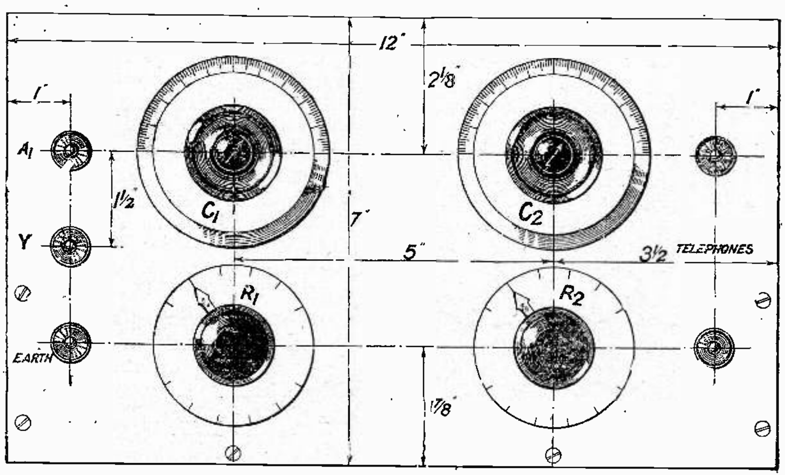


Fig. 4.—The positions for the few holes requiring to be drilled in the panel may be obtained from this diagram. Blueprint No. 124A may be obtained, price 1/6, post free.

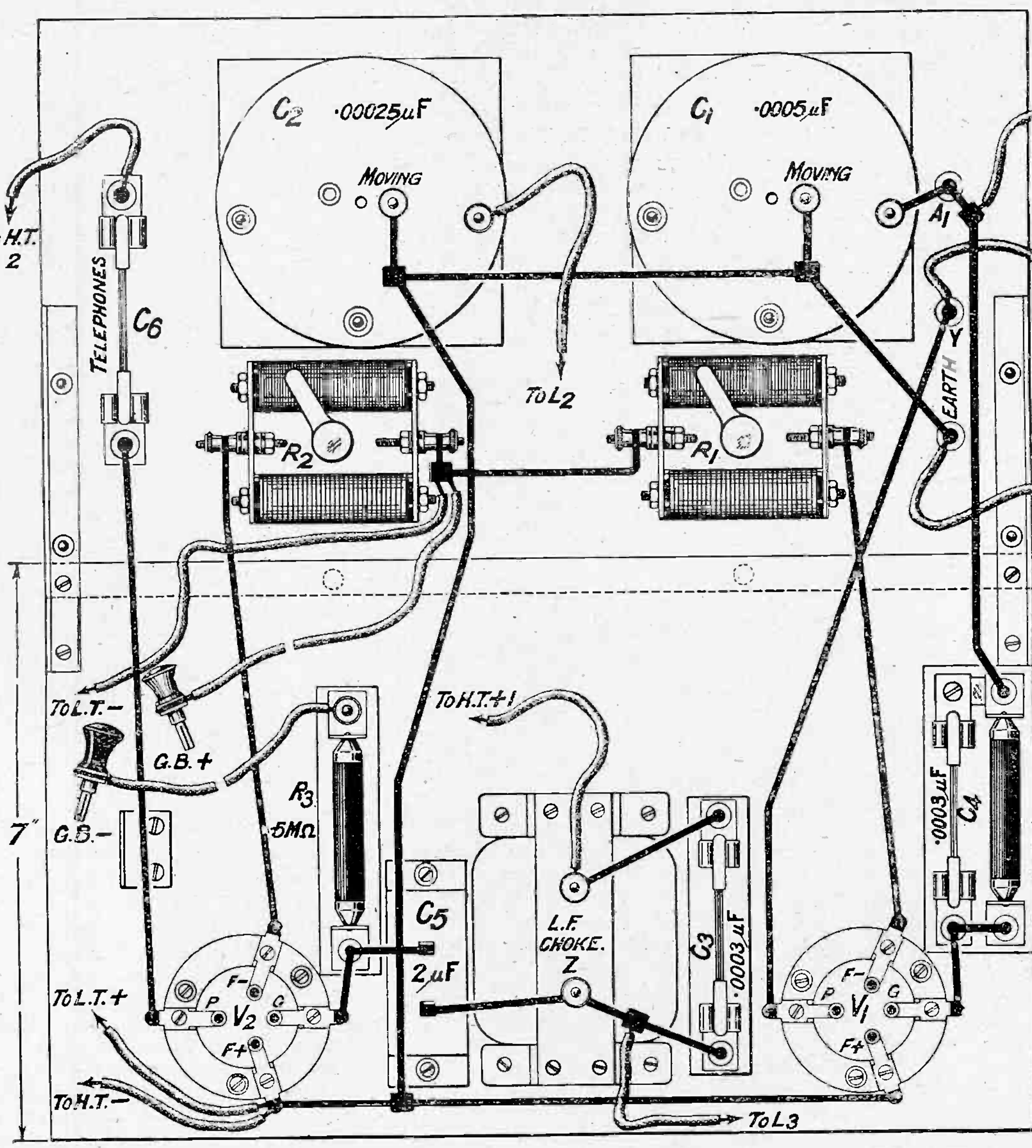


Fig. 5.—All the necessary connections are given in this diagram, a full size blueprint of which may be obtained for 1/6, post free. No. 124B should be quoted. Note the position of the clip which secures the grid battery against the side of the cabinet.

As the panel lay-out is quite simple there is little work to do here and the necessary drilling centres may be obtained from one of the accompanying diagrams. In addition, two holes to take 4 B.A. screws should be drilled on each side of the panel (these are for securing the angle brackets) and also two along the lower edge of the panel through which wood screws are inserted into the baseboard to provide additional support for the panel. When the latter has been drilled and cleaned, the condensers, rheostats and terminals may be mounted and the whole secured to the baseboard as indicated. Note that the clips for the tone control condenser are held behind the fixing nuts of the telephone terminals.

The remainder of the components should then be assembled on the baseboard, and screwed down in the positions indicated on the wiring diagram and shown in the back of panel photographs.

Mounting the Coil Holder

In fixing the coil holder to the side of the cabinet the positions for the four holes may be obtained by using the coil holder itself as a template. With these holes carefully drilled, the coil holder is placed in position and secured with washers and nuts inside the cabinet. In addition five small holes through which to pass the flex for connecting purposes will be required opposite the corresponding holes in the coil holder, and a further hole about ⅜ in. in diameter should be drilled in the back of the cabinet on the left (facing the back), through which the battery connections are to be taken.

The wiring may next be commenced, and this operation will be greatly facilitated if all the soldering points are previously tinned. For those who are unaccustomed to wiring a receiver from a circuit diagram, the wiring diagram will prove helpful. In making the flexible battery and coil-holder connections adequate lengths should be allowed in all cases. In making these connections do not hurry the procedure unduly, but clean and tin carefully the ends of each length of flex before the connections are made. Such connections if not well made are often a considerable source of trouble which may be easily avoided if only a little care is taken.

Before the set is completed ready for testing, mark clearly with a tag the purpose of each flexible battery connection.

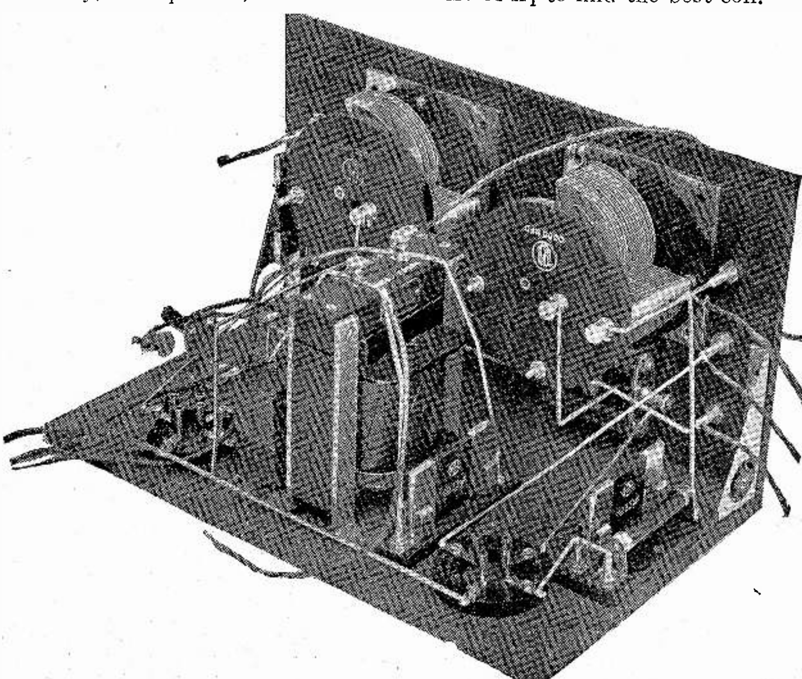
Note particularly that if Lissen X coils are used for the auto-coupled aerial circuit then the flex connection from the earth terminal to the centre coil mount should be connected to the plug.

Initial Tests

For a preliminary test insert the two valves into their sockets, connect up the accumulator and ascertain that the filament lighting circuit is wired correctly. Assuming this to be so, connect up the H.T. battery, telephones, aerial and earth. Then insert a shorting plug in the moving coil socket at the back of the coil holder, or if a shorting plug is not available use a short length of wire connected between the plug and the socket; insert a suitable coil, say, a No. 50 into the fixed socket and neglect for the moment the other socket. Rotation of the left-hand condenser should then enable you to hear the local station. Provided this is so insert a reaction coil into the appropriate socket (the one previously shorted) and try the effect of bringing it gradually nearer the aerial coil. You should find that signals increase in strength, especially if you retune on the A.T.C. If this effect is not observed, reverse the flexible leads to the reaction coil socket and try again. The reaction effect should now be quite in order.

Using the Wavetrap

Now, using a Lissen X coil (say No. 50 or 60) in the fixed socket and a suitable coil for L_2 (say, a No. 75) connect the free flexible lead from this socket to the aerial connection on one of the tappings on the Lissen coil, having previously tuned in the local station. Rotation of the right-hand condenser should then enable you to eliminate completely the local transmission. When using the wavetrap keep the coils L_1 and L_2 as far apart as possible, and experiment with the size of L_1 to find the best coil.



The back of the receiver, showing the position of the grid-leak and condenser. The wiring should be copied as exactly as possible.

Reinartz Reaction

Next remove the ordinary reaction coil, insert a No. 250 as radio-choke and keep it at right angles to L_1. Disconnect the flex connection from the aerial tap and connect its free end to the centre terminal on the left of the panel. With a coil (say, a No. 50 or 75) plugged in the L_2 socket and coupled to L_1, observe that the receiver oscillates when the capacity of the right-hand condenser is increased. If this does not happen, reverse the flex connections to the L_2 coil socket.

Valves

After a little further trial you will soon learn to manipulate the various controls successfully for the best results. For valves I suggest a general purpose bright emitter or .06 type for the detector and a valve of the B4, B6 or similar class for the low-frequency stage with an anode voltage of 100—120 volts and a suitable grid-bias as indicated by the makers' curves.

Suggested coil values for the broadcast range are No. 35 or 50 for L_1 and say, No. 50 for L_3, if magnetic reaction is used. A No. 75 will probably be suitable for the wavetrap and a No. 50 or 75 for Reinartz reaction. In all cases, however, the size of the reaction coil should be kept as small as possible.

For Radio Paris and 5XX use a No. 150 for L_1, or a No. 250 of the Lissen X type, and for Eiffel Tower a No. 200 will probably be correct. The same remarks as above apply with regard to the size of the reaction coils. The size of the wavetrap coil will in general be about the same as that used in the aerial circuit with a series condenser for tuning the particular station it is desired to eliminate.

Some Results

In the actual tests I used a .06 valve for the detector and a B6 for the L.F., but the set worked quite satisfactorily with two general-purpose valves, bright or dull emitters. Gambrell coils were used throughout with the exception of the auto-coupled aerial coils for which Lissen X coils were used with success. I have no hesitation in saying that the set in every way came up to expectations and proved delightfully easy to control.

At 9 miles S.W. of 2LO, on a fairly good outdoor aerial, both London and Chelmsford were received at fair strength on the loud-speaker, and the quality of reproduction was very commendable. The wavetrap proved very effective and the transmission from London could be completely eliminated and Bournemouth received without a trace of interference. Birmingham was received in daylight at good strength on the phones and subsequently Newcastle was heard quite well. Aberdeen was very faint and marred by excessive Morse interference.

Of the Continental stations Petit Parisien and Ecole Superieure came in well on the phones; Rome also was of good phone strength. Two German stations and two stations on wavelengths below 300 metres were also heard, the latter not being identified. Radio-Paris was also received at very good phone strength

A Selective Hartley-Reinartz Circuit for Broadcast Reception

A description of an interesting short-wave circuit modified by the author for reception on broadcast wavelengths

By A. D. COWPER, M.Sc., Staff Editor.

THE peculiar type of Hartley circuit developed for extremely short-wave work, having a series condenser inserted in the *middle* of the usual Hartley inductance (the latter being connected at its extremities to grid and plate respectively), results in an unusually selective receiving circuit when modified in its dimensions to tune to the ordinary broadcast wavelengths. The resulting receiver is more particularly suitable for the reception of fairly strong local transmissions through bad interference on a closely adjacent wavelength; in these conditions, by careful tuning the local station can be received at good strength with a nearly silent background, without the help of wave-traps.

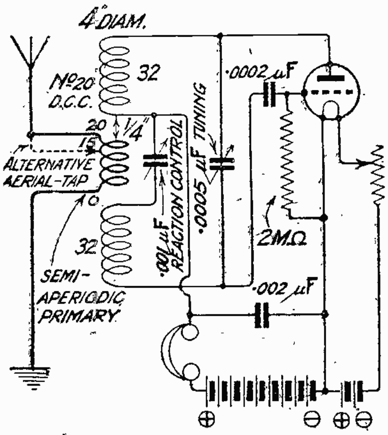


Fig. 1.—The theoretical scheme of connections.

As shown in the circuit diagram, the grid tuning inductance is divided into two equal parts, the semi-aperiodic aerial coil (with an alternative tapping for the short waves or for use with large aerials) being sandwiched in between them. The principal tuning condenser is put across grid and plate and across the whole of the inductance; considerably less than the maximum of an ordinary ·0005 µF tuning condenser covers the short-wave B.B.C. stations. A *large* variable condenser, of ·001 µF capacity, is put across the gap between the two halves of the tuning inductance, and serves to give an uncommonly smooth reaction-control effect, as well as affecting the tuning range to some extent. The aperiodic aerial coil is coupled to the secondary as in Fig. 1.

Radio-Chokes

The H.T. circuit is completed via the upper half of the tuning inductance, and a lead from the lower end of the upper half to 'phones and so to the battery. A ·002 µF blocking-condenser is put across the 'phones and H.T. battery, but can be omitted in some cases. Actually, the circuit will work without a separate grid-condenser, but it is preferable to use one, as usual, the grid-leak being taken directly to the positive filament leg. No radio-choke is required in this circuit for ordinary wavelengths. In the short-wave version, with which the writer was able to go as low as 2·4 m. wavelength recently, using a single-turn inductance and a tubular type of valve, radio-chokes were called for in both H.T. and filament connections, but on the broadcast waves the circuit appears to operate better without.

The Tuning Inductance

Since the effective tuning capacities are cut down by the series condenser, an unusually large inductance has to be used; this is wound in a fairly low-loss form with 64 (secondary) turns of No. 20 d.c.c. wire, in two halves, on a 4-in. dry cardboard former, 6 ins. long. The primary consists of 20 turns of the same wire (with an alternative tapping at the 15th turn) wound on the same former in between the other two half-coils and with a clear ¼ in. space on each side of it.

Whilst the operation of the circuit is fairly straightforward, it is a two-handed job; and the tuning is so sharp that even the local station may be missed at first. The reaction-control condenser is kept at a setting just below that which gives oscillation, and the main tuning condenser is *slowly* rotated, following up all the time with the reaction. When the station is found, the optimum setting of the two condensers is determined by successive *very small* adjustments of each, following up every time with the other, as there is a mutual effect on the tuning, similar to, but not quite so distressing as, the effect of a conventional swinging reaction-coil on the tuning of an ordinary receiver. For this latter reason, the circuit is not recommended for searching and for long distance work.

Results Obtainable

On practical trial, the circuit gave a modest degree of loud-speaking with a moderate aerial on the local B.B.C. station

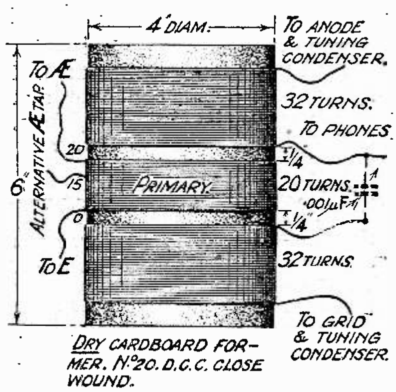


Fig. 2.—Constructional details of the tuning inductance.

at a dozen miles; and the latter could be tuned out within 3-5 degrees, depending on the height of the aerial used. One hundred mile station could be tuned in, but not with great ease; the background was, however, perfectly silent, in spite of close proximity to a powerful commercial station of notorious mush-producing tendencies. On account of the smooth and effective reaction obtainable, there is a temptation to operate the receiver rather too close to oscillation, producing harshness in the reproduction; this should be guarded against by relaxing the reaction considerably and retuning when it is observed.

The Alternative Tapping

The alternative aerial tap is necessary, because if by chance the aerial is actually tuned by the primary inductance in use to the wavelength of reception, the reaction demands will be so high that the circuit may not oscillate at all, so that sensitive reception is impossible. The lower tapping is available for use in such a case. The natural frequency of the (loaded) aerial should always be a little *above* that of reception, for smooth reaction control.

It is evident that the primary of an inter-valve L.F. transformer can be substituted for the 'phones, to provide one or more stages of note magnification in the usual way.

A Readers Experiences with a Three-Valve Reinartz Receiver

SIR,—I thought you might be interested in the results obtained with my Reinartz tuner. I am at present using the receiver described by Percy W. Harris in MODERN WIRELESS, March, 1924, viz. :—Det. and 2 L.F. The components are laid out on a board, each condenser and valve being in its own small box, and the following particulars may be pertinent :—

Location.—10 miles west of Manchester.

Aerial.—60 ft. of 7/22; average height, 30 ft.; lead-in, continuous with main aerial.

Earth.—6 ft. lead Electron wire to buried lead piping (3 ft.).

Results :—All main B.B.C. stations are received at good L.S. strength on an Amplion Junior de Luxe, with exception of Cardiff. London, Bournemouth and Newcastle, however, suffer interference from Manchester. Manchester has to be de-tuned, and can be received without an aerial. Of the relay stations Liverpool is almost as loud as Manchester. Others received are Hull, Leeds, Sheffield, and Edinburgh, all giving speech and music, which can be followed quite easily and enjoyed. Foreign stations received are :—

		Strength.
Petit-Parisien	..	L.S.
Zurich ..	..	L.S.
*Frankfurt	Fair	L.S. (fades)
*Breslau ..	,,	L.S.
*Stuttgart ..	,,	L.S.
*Madrid ..	,,	L.S.
Hamburg	..	L.S.
Ecole Sup.	..	L.S.

*Equal to British Relay Stations.

By L.S. I mean volume equal to that of a good gramophone.

Is not this list truly amazing! And the beauty of the business is that it can be done any and every night, which statement can be vouched for. The main B.B.C. stations I can also get in the afternoon at nearly the same strength as at night.

Features of the circuit I find are :—

1. Remarkable simplicity of tuning.
2. Delightful build-up of signal strength on increasing reaction condenser
3. Smooth and easy control of reaction.

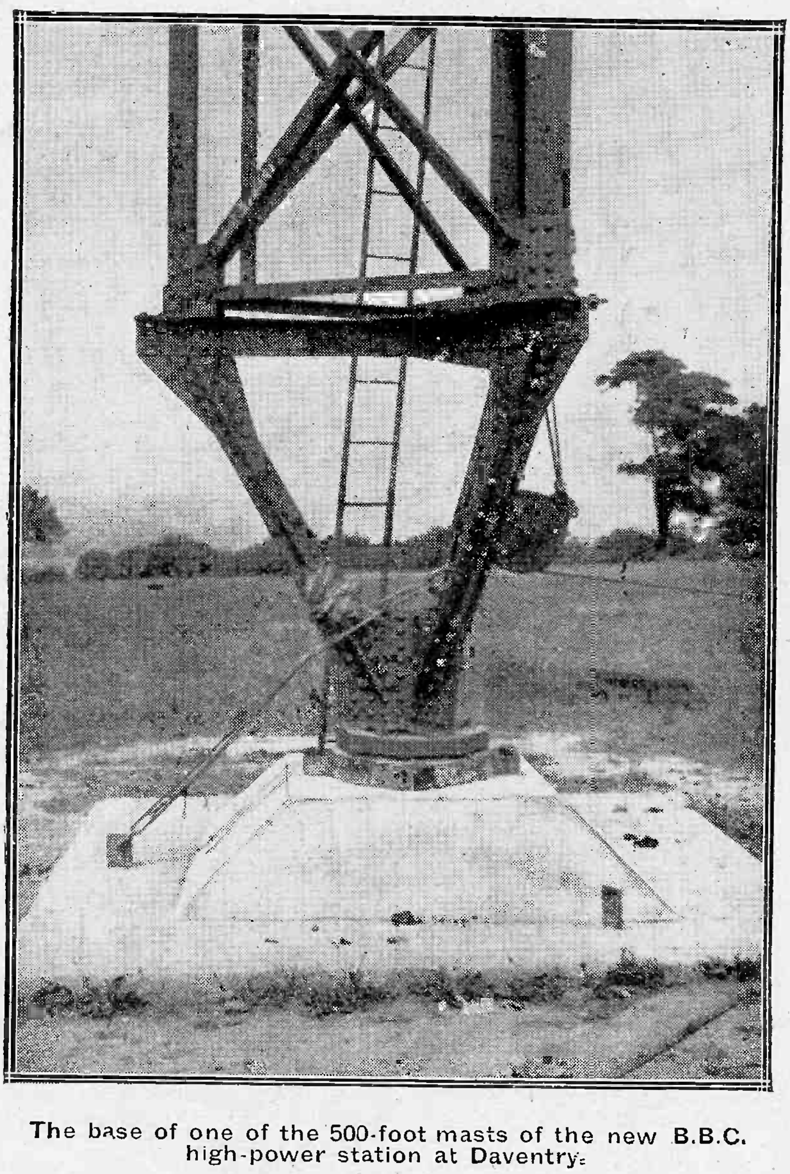
I might add that I find a radio choke (300 turns) between the plate of the first valve and the OP of the first L.F. transformer gives greater freedom of oscillation. I hope I have not wearied you, but when one comes across such a really excellent design one feels bound to thank the giver, and that can best be done, I think, by showing exactly what can be done with it.

Wishing you and your periodicals every prosperity.—Yours faithfully,

HAROLD FAIRHURST.

Manchester.

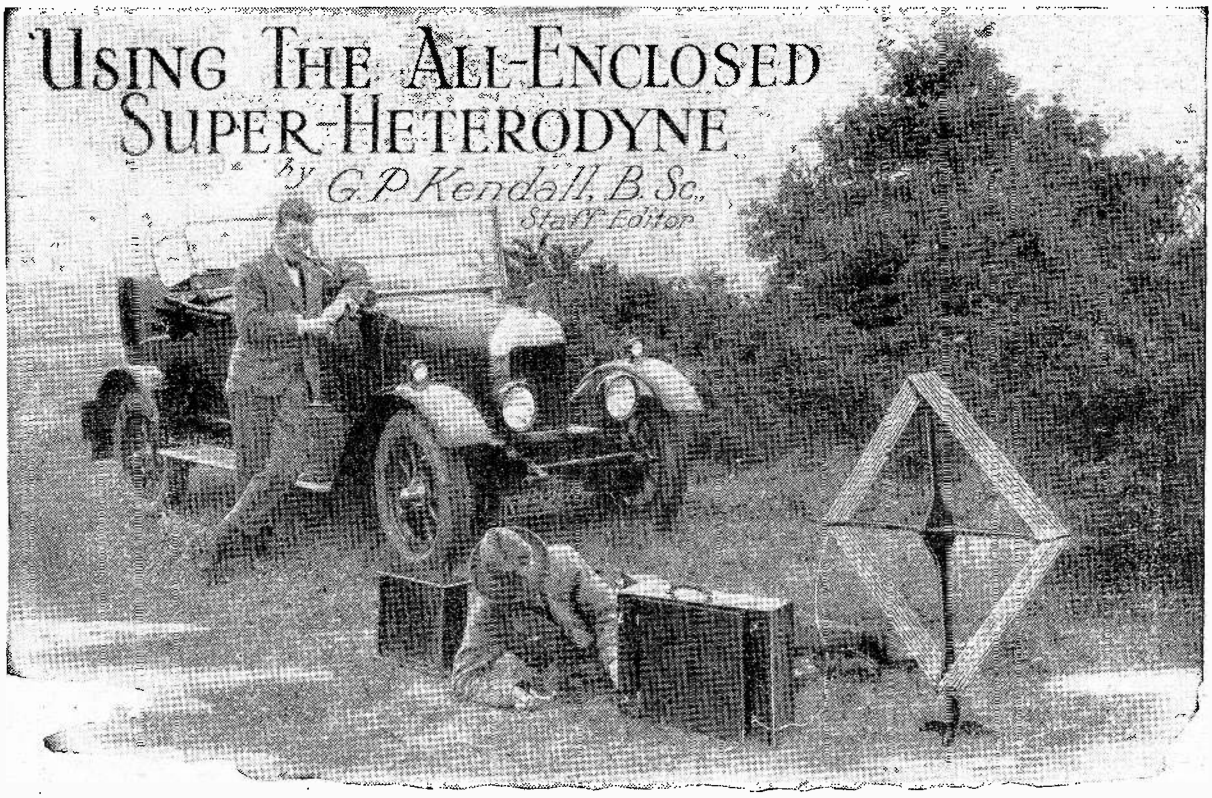
THE DAVENTRY STATION



The base of one of the 500-foot masts of the new B.B.C. high-power station at Daventry.

Using The All-Enclosed Super-Heterodyne

by G. P. Kendall, B.Sc., Staff Editor



THE question of the operation of the finished instrument had perforce to be dealt with in the briefest manner possible last month, and I propose in the concluding pages of this article to try to give a somewhat clearer idea of the best procedure to adopt. The working of a super-heterodyne, even of a simple one like the present instrument, is most emphatically a matter for practical experience rather than theoretical explanations, but some general rules for the guidance of those without previous experience of these receivers will perhaps be of assistance.

The Requirements

It is to be understood that before the desired station can be heard the settings of both the dials must be correct to something like a degree or less upon their scales, and therefore the ordinary methods of rough-and-ready searching, such as may be adopted in the case of a receiver with two controls of which one is the condenser of the aerial circuit and the other that of the tuned anode circuit, will no longer suffice. With practice it will be found possible to manipulate the two controls simultaneously, increasing or decreasing the capacity of the two condensers in sympathy, and keeping them in step with each other by noting and following round the faint crackling of atmospherics which comes through when the two circuits are correctly adjusted with respect to each other. In this way it is possible to carry out quite rapid searching, but a good deal of skill is needed, and at the start the more tedious method of the advance of a few degrees at a time of one of the dials, accompanied by wide sweeps of the other, is to be preferred.

A Good Method

The best method is probably to set the frame condenser first of all to zero, swing the oscillator condenser very slowly over its whole range, then advance the frame condenser a few degrees, again swing the oscillator condenser slowly, and so on until the whole scale of the frame condenser has been covered. In this way any but the weakest signals will be picked up with due patience. When a signal has been picked up, the first thing to do is to decide whether the long-wave side is functioning at its highest efficiency as regards filament current and grid potential. To do this, carefully readjust the potentiometer for loudest signals, and at the same time check the adjustment of the oscillator condenser, which will need to be altered every time that the potentiometer is moved, and then try the effect of brightening the valve filaments slightly.

This will probably cause the signal to vanish altogether, but if the potentiometer is now revolved towards the negative end so that the long-wave side is once more on the verge of self-oscillation, and the oscillator condenser is readjusted, it will probably be heard once more, and quite possibly at greater strength. If it is no better than before, try reducing the valve filaments somewhat below the original point, again adjusting the potentiometer and the condenser. In this way you will soon discover how critical the long-wave side adjustments are if the very best results are to be obtained.

Purity Control

Of course, when actually receiving a distant station from the entertainment point of view, it is not desirable to work with the potentiometer adjusted so that the intermediate amplifiers are hanging on the edge of self-oscillation, for then quality will not be of the best. If the potentiometer is withdrawn slightly from the point at which oscillation begins and the tuning of the oscillator condenser checked, very nearly as loud signals will be obtained and with a considerably greater degree of purity.

When you are satisfied that the set is giving the best results of which it is capable so far as the adjustments which we have been considering are concerned, try the effect of swinging the frame aerial, which may make a great difference to the signals. When used indoors with electric light wiring, gas-pipes and so on in the neighbourhood, the directional effects of the frame may be only very slight; but out in the open they are usually quite pronounced, and it is sometimes possible to discover that a distant station cannot be picked up at all until the frame is set more or less to the correct direction.

H.T. Values

I gave last month the values of 102, 30, 54 and 108 volts as the correct figures for high tension terminals Nos 1, 2, 3 and 4, and it may be assumed that these voltages will suit the great majority of valves. They are dependent, of course, upon the use of a battery of 108 volts total.

These voltages were chosen when using a particular collection of valves, these being the ones employed in the first tests with the finished set, and it may be of interest to give the names of these valves and their functions, since to do so will give a good idea of the varied types which can be used successfully in this set. For the oscillator valve I used a Cossor Wuncell; for the first high-frequency valve a B. 5; for the first and second detectors Mullard D. 06's; for the intermediate frequency amplifiers D.E. 3 B's, and for the low-frequency amplifier a B. 6. This varied collection was all run from a 4-volt accumulator, and gave perfectly satisfactory results, so that no hesitation should be felt in using any such mixed arrangement, so long as due care is taken to see that they run from roughly similar filament voltages.

Final Adjustments

These values will be found suitable for the majority of general purpose valves, and can be adopted for the first tests, to be improved upon by careful adjustment once the set has been got into working order.

The value of 102 volts suggested for terminal No. 1 (the oscillator H.T. terminal) proved most suitable for several of the valves tried, but it is to be observed that when a dull emitter of the .06 ampere type is used as the oscillator little advantage (if any) may be derived from the use of more than about 45 volts upon this terminal.

Having succeeded in tuning in some distant station by the use of the methods which I have given, the final adjustment of the voltages applied to the H.T. terminals may be performed. Take first that of the oscillator voltage (*i.e.*, the voltage applied to terminal No. 1), and adjust this in steps of perhaps 6 volts at a time, carefully readjusting the oscillator condenser (C_2) as this is done. With many dull emitter valves little or no alteration in signal strength will be observed so long as the oscillator voltage is above about 45 volts, but it is as well to carry out the adjustment in order to make sure that the valve being used does not happen to be an exception to the rule.

Oscillation of Long Wave Amplifier

The voltages applied to terminals Nos. 2 and 3 are best adjusted together, since they are in a way related. For example, if the lead from terminal No. 3 is transferred from the 54 volt socket to the one supplying 66 volts the long wave amplifier will probably oscillate, and it will be necessary to turn the potentiometer round some distance towards the positive end to stop it.

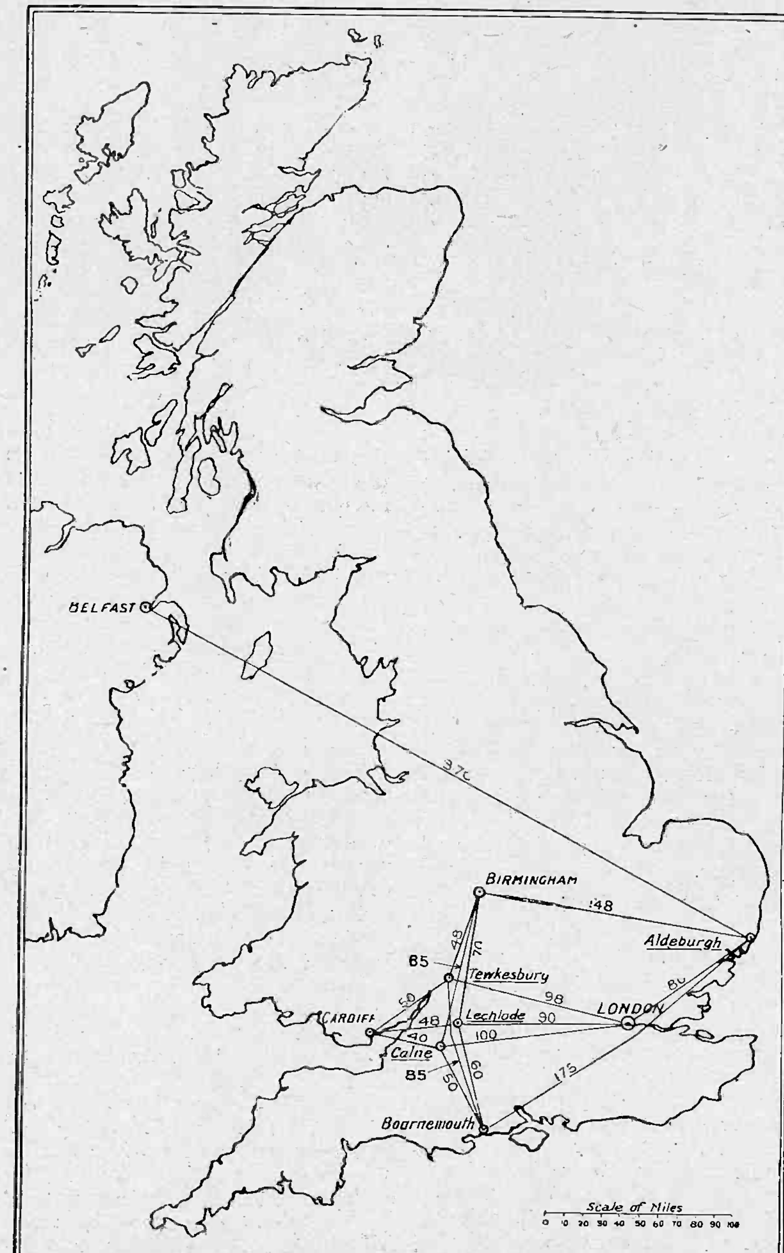


Fig. 1.—The instrument has been tested by Mr. Kendall at the four places whose names are underlined on this map. The numbers indicate the distances in miles to certain of the stations heard.

Results will probably then be no better than before, unless attention is devoted to the adjustment of the voltage applied to terminal No. 2 (supplying the first and second detectors). If the voltage is reduced somewhat (say, from 30 to 24 volts in the case of .06 ampere valves) it may be found that the long wave side oscillates no more readily than before, but that signals have greatly improved.

What will actually be observed, of course, depends upon the kind of valves being used, and I can merely indicate the particular points which call for careful adjustment, and leave the operator to find out for himself the exact voltages which best suit his own valves. Carry out the adjustment when receiving fairly weak signals, to be obtained by slightly detuning the frame circuit if necessary, so that the signals of some strong station are sufficiently reduced to serve, and you will experience little difficulty.

A final point about the high-tension battery to be used. I have found it desirable with every type of super-heterodyne receiver yet tested to use a fairly new and good high-tension battery, and this applies to the receiver under consideration. It will be observed that no reservoir condensers are provided across the high-tension terminals, and I have not found them to give any improvement when used, provided that the high-tension battery is in reasonably good condition.

Those who wish their high-tension batteries to last a little longer, however, can, of course, add such a reservoir condenser, and it may be mounted upon the under side of the baseboard behind the ebonite panel carrying the filament rheostats, and may be of 2 μF capacity. It should be connected directly between high-tension negative, that is to say, any point on the positive side of the filament circuit and the H.T. +3 terminal. It was omitted in the original receiver because it adds to the weight, and so long as the battery is reasonably new it does not seem to give any improvement in results.

The value of grid bias used will depend upon the type of valve in use and the amount of high-tension supplied, and it may be taken that with a 72-volt battery 3 volts will generally be ample, while with the 108-volt battery $4\frac{1}{2}$ or 6 volts will be adequate, remembering that a certain amount of grid bias is provided by the drop across the filament rheostat.

Small Faults

It will perhaps be as well at this point to consider some of the small faults which may develop in a set of this type during use. If the set is regarded as a portable one and is used for motoring and travelling generally, by far the most likely one is a broken connection, for it is quite suprising how really sound a joint must be to stand up to prolonged vibration.

To anyone who wishes to use the set in a similar way I would suggest that whenever a "T" joint is made, one of the wires should be twisted several times round the other, and the whole joint should then be soldered over. In this way alone have I succeeded in producing a really sound and permanent joint which I can depend upon to be proof against prolonged vibration.

The First H.F. Valve

A brief mention was made last month of possible difficulties with the first high-frequency valve; it was pointed out that since there is a slight tendency towards self-oscillation on the part of this valve it is possible that certain types of valve might produce actual oscillation. As a matter of fact, I do not possess any general purpose valve which does this, but it is quite possible to produce the effect with valves of other types which oscillate extremely easily. It is not likely that anyone will use one of these valves for this purpose, but it is perhaps useful to give a certain remedy if by any chance anyone is compelled to use such a valve.

The obvious remedy is to apply a small positive bias to the grid of this first valve, and this may be done by breaking the connection between the upper frame terminal and the filament circuit, and taking a lead instead from this upper frame terminal to the slider of the potentiometer. The result will be to apply a considerable positive bias to the grid of the first valve and self-oscillation will thereby be prevented. The positive bias which is applied is, or was in the cases which I investigated, somewhat excessive for the purpose, and, of course, the best results could not be obtained when it was employed.

Much the best remedy is to replace the valve which is found to give this trouble with one of a normal general purpose type, with which self-oscillation is extremely unlikely with any usual values of filament temperature and anode voltage. It will be remembered, of course, that to reduce the tendency to self-oscillation upon the part of this valve the high-tension voltage should be reduced somewhat upon the terminal which supplies the group of valves of which the one under consideration

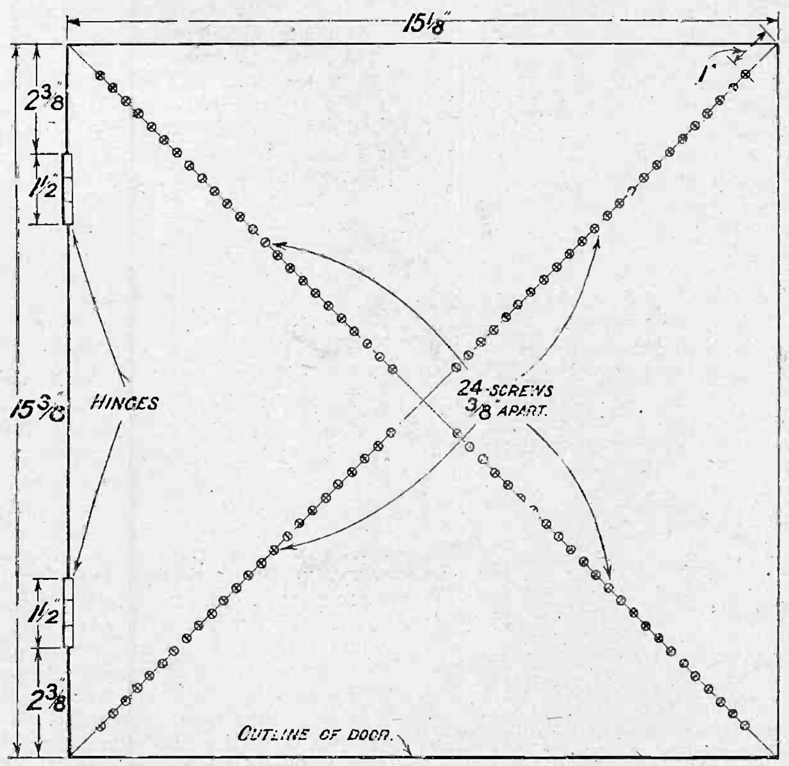


Fig. 2.—The arrangement of the screws upon the lid, round which the aerial turns are wound.

is a member, and the filament should perhaps be brightened by a suitable adjustment of the middle filament resistance.

The Oscillator Coupler

Practically the only other possible trouble with this set, other than faults in components, is to be found in the arrangement of the circuits of the oscillator valve. The oscillator coupler which I have used in this set is so designed that it will produce self-oscillation over the entire range of the condenser with any general purpose type of valve with a reasonable amount of high-tension voltage, the exact voltage depending upon the particular type of valve in use. As a matter of fact I think I do not possess a valve which will not oscillate conveniently in this arrangement with about 60 volts on the plate, some of them giving louder signals when the voltage is increased somewhat, others giving uniformly good results with any voltage from 30 volts upwards. Should any difficulty be experienced here, the effect should be tried of reversing the connections to terminals 3 and 4 on the coupler, and if this produces no improvement, similar reversals should be made to terminals 5 and 6.

I have also tried successfully in this set one of the interchangeable plug-in couplers produced by Messrs. Burne-Jones and Co. Ltd., and similar results were observed as regards voltages, etc., with this component.

Tests

The set has been very thoroughly tried out in different localities during daylight conditions, and some account of these tests may perhaps prove of interest, besides showing what results may be expected from this instrument.

If reference is made to the map which is reproduced upon one of these pages it will be found that upon the East Coast the name Aldeburgh is marked, and it was here that the first tests were conducted after the set had received its preliminary try-out in London. Aldeburgh is a small watering-place with fairly flat surroundings and the reception conditions which obtain there appear to be fairly good.

The set was put into use at about seven o'clock one evening and within a very short time a German station, later identified as Hamburg, was picked up at good strength on the loud-speaker. A little later this was followed by fair loud-speaker signals from Ecole Superieure, Paris, and attention was then turned to the British stations, which had by then commenced their evening musical programmes. London gave signals of only moderate loud-speaker strength and required a certain amount of critical adjustment for satisfactory results. Bournemouth, on the other hand, was something like twice as loud as London and was quite easy to pick up. This seems a somewhat extraordinary result, when the respective distances of the two stations are borne in mind (see Fig. 1). Birmingham only gave rather poor loud-speaker results until darkness fell, while Belfast was practically equal in strength to London.

No other stations could be obtained at anything like loud-speaker strength during daylight, and I believe that the presence of a bank of overhead wires outside the window of the room in which the set was being used must have been responsible for the somewhat freakish results obtained. This seems the more probable since the only frame setting at which good signals could be obtained from any of these stations was parallel to the wires. After darkness fell on this same evening the usual rise in signal strength was noticed, and the following stations were received upon the loud-speaker :—Newcastle, Glasgow, Manchester, Birmingham, London, Bournemouth, Madrid and Rome. The Nottingham and Hull relay stations were also heard, giving only fair loud-speaker signals. Cardiff could not be heard at all, while Aberdeen was heard at only rather poor strength.

These results, it is to be understood, were all obtained using the small folding frame aerial of 26 in. side to which I referred last month.

At Bury St. Edmunds

As confirmation of these results, the next night the set was taken inland a distance of some thirty miles, to Bury St. Edmunds, in a position entirely surrounded by buildings, somewhere near the centre of the town. Here it was found that under daylight conditions London and Bournemouth alone gave really satisfactory results upon the small frame aerial, Birmingham being somewhat below the strength required properly to fill a moderate-sized room. The position was undoubtedly very badly screened, since the amount of spark traffic heard upon 600 metres was much below the normal.

After dark it was found that Bournemouth was very much stronger than London, giving really good loud-speaker results, very much louder, in fact, than those of Birmingham. No relay stations were heard in this locality, but the following British main stations gave fairly good loud-speaker signals :—Newcastle, Manchester, Birmingham, London, Bournemouth. Again Cardiff could not be picked up, while Belfast was heard only upon phones.

Further Results

The receiver was next taken to an entirely different type of locality, tests being carried out at various places in the west. These will be found to be marked upon the map, and the first to be visited was Calne, in Wiltshire, where an evening was spent in investigating the possibilities of the receiver in such a situation. There were a number of main stations at reasonably short distances, and these were found to give dependable loud-speaker results in daylight, even when the set was used indoors with buildings on all sides. Bournemouth was loud, London gave moderate loud-speaker results, and Birmingham was very strong indeed. Cardiff, on the other hand, was quite weak in spite of its short distance, and could only be heard on the loud-speaker to advantage after dark. When darkness had fallen the usual list of main stations was received, the only exceptions being Belfast and Aberdeen, which were heard upon phones only. Numerous foreign stations were also picked up, including Petit Parisien, Madrid, Brussels, Münster and Hamburg. These also gave loud-speaker results.

A good deal of difficulty was experienced here from the interference produced by the proximity of the Post Office station at Devizes, whose harmonics were heard very strongly at various points upon the broadcast band.

Tests in the Severn Valley

The next night the set was tested at Tewkesbury (in the Severn valley), under somewhat unfavourable conditions. The set was located in a room outside of which were several overhead wires carrying lighting currents, and these proved extremely noisy. It was found necessary to place the frame in a certain definite direction to minimise this noise, which otherwise drowned all signals, and therefore only a small number of stations could be picked up, being merely those which happened to

(Continued on page 804.)

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Any Date

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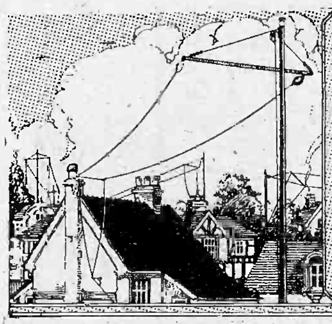
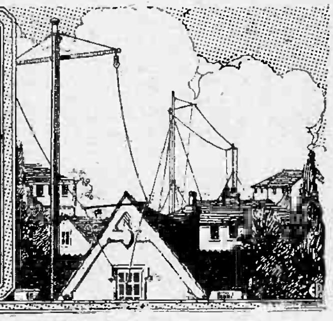


Some Two-Valve Circuits Worth Trying

by

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



An interesting discussion on some of the most popular arrangements possible with two valves.

BROADCAST receivers which make use of one of the many possible combinations of two valves have much to recommend them to those who do not wish to make a large initial outlay nor to be burdened with heavy maintenance expenses. They are economical in battery current consumption, while they can be relied on to give good reception of the local broadcast programme ; a suitable two-valve set should be capable of producing moderate strength from a loud-speaker when not too far distant from the transmitting station, while comfortable reception on the telephones may be looked for from several British and, in many localities, a number of Continental stations. It is not intended to convey the impression that any given two-valve set will necessarily give all the above results ; the circuit must be chosen to suit the needs and situation of the individual. From the circuits to be described it should not be a difficult matter for anyone to select the type which is best suited to his requirements.

The Local Station

Studying first the needs of those who live within a radius of ten miles or so from a broadcasting station, and who wish to obtain comfortable reception from a loud-speaker in a small room, the circuits shown in Figs. 1 and 2 will be found adequate for the purpose. Both of these circuits comprise a detector valve followed by a single stage of low frequency amplification, the circuit of Fig. 1 using transformer coupling and that of Fig. 2 choke-capacity coupling. The operation of the circuit of Fig. 1 may be briefly summarised as follows ; The incoming oscillations present in the aerial circuit set up varying potentials across the tuned circuit L_1 C_1, and these are applied between the grid and filament of the valve V_1, which acts as a detector, the usual grid condenser C_2 and leak R_3 being provided. The rectified currents in the anode circuit of V_1 cause variations of potential across the primary winding T_1 of the iron-core transformer T_1 T_2, and are transferred via this transformer to the grid and filament of V_2. The amplified energy in the anode circuit of V_2 actuates the telephones or loud-speaker. Reaction is provided by coupling the coil L_2, in the anode circuit of V_1, to the aerial coil ; this control must be handled with care, because of the risk of causing interference to other listeners if the coils are brought so close together that V_1 oscillates. For the broadcast band of wavelengths, L_1 may be a No. 35 or 50 coil, and L_2 a 35, 50 or 75 ; for C_1 a value of ·0005 μF is suitable, C_3 may be ·001 μF, while ·0003 μF and 2 megohms will serve for the grid condenser C_2 and the leak R_3 respectively.

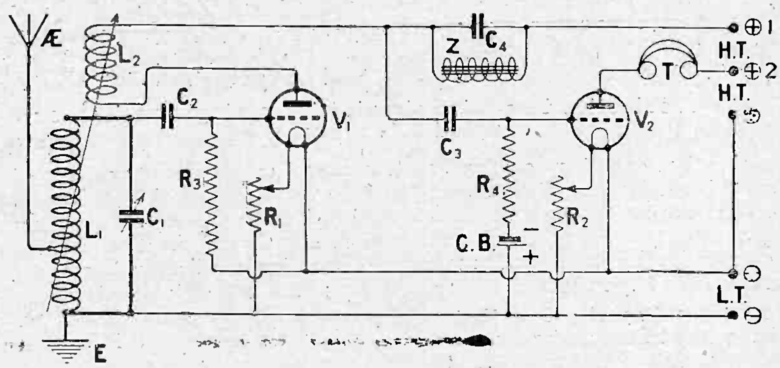


Fig. 2.—Another popular circuit wherein the low frequency valve is choke coupled.

Auto-Coupling

The circuit given in Fig. 2 provides rather improved selectivity over that of Fig. 1 by making use of an auto-coupled aerial circuit. Here L_1 may be a tapped " X " coil of about 60 turns for the broadcast wavelengths, the best tapping for the aerial being found by trial. The choke-capacity coupling shown will provide slightly less amplification than transformer coupling, but the loss in strength may be compensated for by a slight improvement in the quality of reproduction. In this circuit the components performing similar functions to those shown in Fig. 1 may have the same values as those given for that circuit ; in

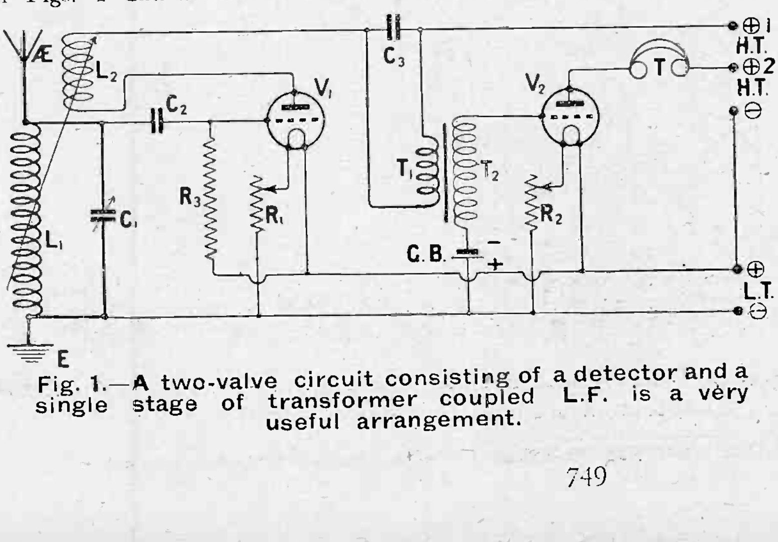


Fig. 1.—A two-valve circuit consisting of a detector and a single stage of transformer coupled L.F. is a very useful arrangement.

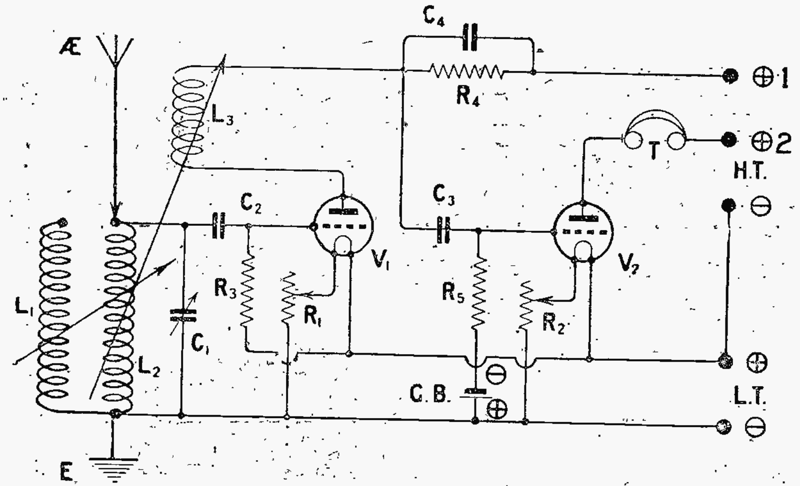


Fig. 3.—A selective two-valve circuit with a single resistance coupled L.F. stage.

addition, the coupling condenser C_3 should not be less than about 0·01, while the leak R_4, whose function is to maintain the grid of V_2 at the correct working potential, may have a value of .5 megohm.

Resistance-Capacity Coupling

Fig. 3 illustrates a similar combination of valves to those already described, but here the resistance-capacity method of coupling the second valve is chosen: this is to be recommended when good quality is the prime consideration, but a circuit of this type can hardly be expected to operate a loud-speaker satisfactorily at more than a short distance from the transmitting station. It will be noted that two points are provided for the attachment of the aerial. If reception of the local station is desired, the aerial is connected direct to the coil L_2, which may be a No. 35 or 50; if the programme from a more distant station is to be picked up, the aerial lead is connected to the aperiodic coil L_1, which may be a No. 35 or 50, L_2 being a No. 75 coil. By suitable adjustment of the coupling between L_1 and L_2, and judicious use of the reaction coil L_3, it should then be possible to hear the more remote transmissions with considerably reduced interference from the local station. In this circuit the by-pass condenser C_4 may be one of ·0005 μF shunted across the coupling resistance R_4 of 100,000 ohms; the coupling condenser C_3 is ·25 μF, and the leak R_5 half a megohm. The H.T. voltage applied across H.T. and H.T.+1 must be higher than the normal, in order to make up for the voltage drop across the resistance R_4. The size of the reaction coil will be as before.

In the three preceding circuits magnetic reaction control is provided. The circuit of Fig. 4 employs the now familiar Reinartz form of reaction coupling, which combines magnetic and capacitative coupling by means of the reaction coil L_3 and reaction condenser C_2 respectively; the second valve is again used as a low frequency amplifier. L_1 is here an aperiodic coil coupled to the grid coil L_2; a practical form of receiver using this circuit may be conveniently constructed to use a three-coil holder for the coils L_1, L_2 and L_3. L_1 may then be a No. 25 coil, L_2 a No. 50, and L_3 a No. 50 or 75, C_1 and C_2 being each of .0005 μF capacity.

Air-Core Choke

It should be noted that no by-pass condenser is placed across the primary T_1 of the L.F. transformer T_1, T_2. It may happen that the winding T_1 possesses sufficient self-capacity to by-pass the H.F. currents and so upset the proper working of the circuit; in this case an air-core choke coil, which may consist of a No. 200 or 250 plug-in coil, should be inserted at the point marked X in the diagram. The same precautions with regard to the control of reaction should be observed with this circuit as with any others using reaction coupled direct to the aerial circuit.

H.F. Amplification

The circuits outlined so far are mainly suitable for use within a few miles of a broadcasting station; if greater range of reception is required, it is advisable to employ a stage of H.F. amplification preceding the detector valve; such arrangements cannot be expected to provide sufficient energy to operate a loud-speaker satisfactorily, but they are excellent for the reception on the head-telephones of a number of British and Continental stations, the actual stations within range depending, of course, on the situation of the receiver, while the additional tuned circuit included in this type of receiver tends to improve selectivity slightly.

Tuned Anode

Three different methods of coupling the H.F. valve to the detector are shown. Fig. 5 illustrates the popular "tuned anode" method of coupling. Here the varying potentials applied to the grid of the H.F. valve V_1 by the incoming oscillations present in L_1 C_1 produce amplified oscillations in L_2C_2 which circuit is also tuned to the desired frequency. The consequent varying potentials across L_2 C_2 are applied between the grid and filament of V_2, which functions as a detector. Reaction effects are obtained by coupling the coil L_3 in the anode circuit of V_2 to L_2; this method of obtaining reaction is to be recommended as one which is unlikely to cause serious interference to other listeners, so long as due care is exercised. If only an inefficient aerial system is available, better results

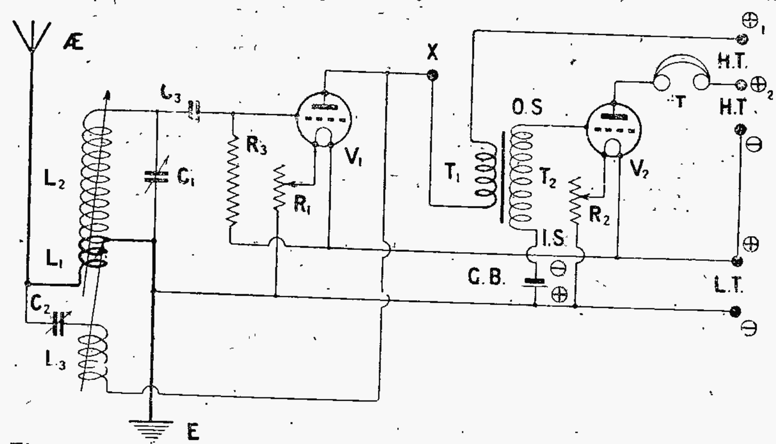


Fig. 4.—The Reinartz circuit is extremely popular among experimenters and may be used with plug-in coils.

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The difficulty of designing a wire-wound resistance with a sufficiently high resistance, except at a prohibitive price, has resulted in a compromise between efficiency and cost, and the majority available have a resistance of only 40,000 or 50,000 ohms. This is far too low for use in the anode circuit of a valve.

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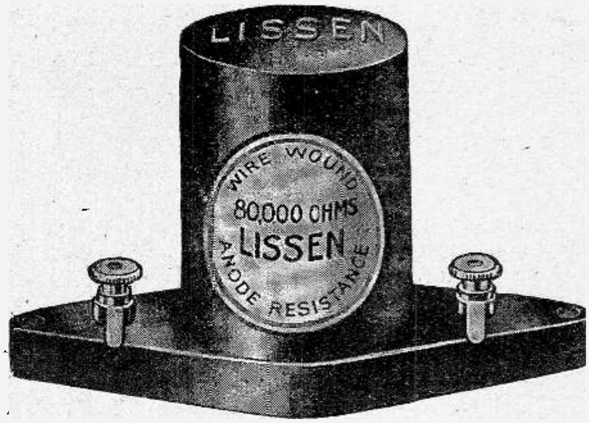

THE LISSEN WIRE-WOUND ANODE RESISTANCE is wound in sections which inductively neutralise each other; it is consequently also particularly suitable for use in H.F. circuits. The method of winding also results in a very low self-capacity.

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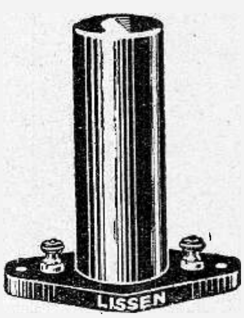

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may be obtained by coupling L_3 to the aerial coil L_1 instead of to L_2; as shown by the dotted lines but in this case the control must be handled with greater caution to avoid causing annoyance to other listeners.

Self-oscillation of V_1 may occur when the circuits $L_1 C_1$ and $L_2 C_2$ are tuned to the same frequency; to prevent this undesirable condition, the earthed side of the circuit $L_1 C_1$ may be connected to the positive terminal of the filament battery. Suitable sizes of coils for this circuit are a No. 35 or 50 for L_1, a No. 50 or 75 for L_2, and a No. 50 for L_3; C_1 may be .0005 μF and C_2 .0003μF. The by-pass condenser C_4 across the telephone terminals has a value of .002μF. Other values as before.

The circuit shown in Fig. 6 is generally similar in operation, but tuned transformer coupling is substituted for the tuned anode method.

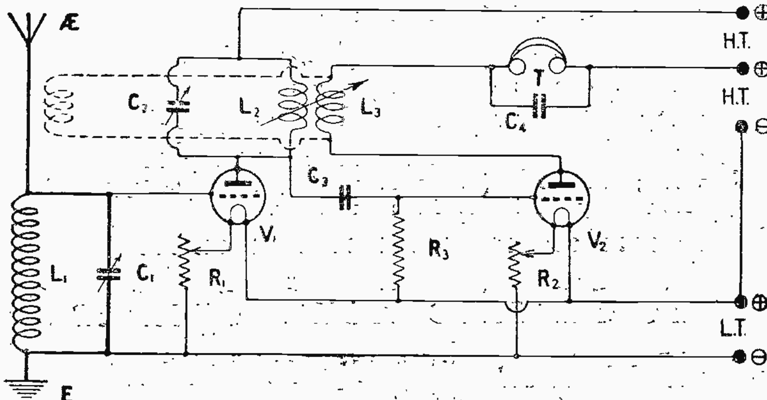


Fig. 5.—The tuned anode method of coupling is probably one of the most popular methods used in this country.

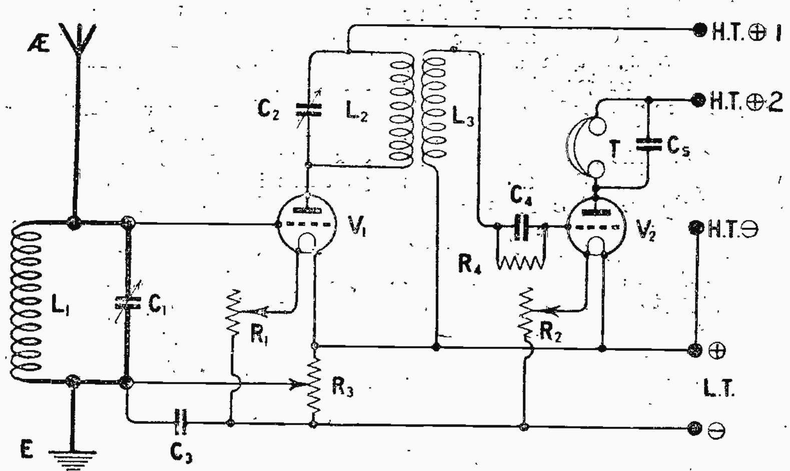


Fig. 6.—In this circuit stability is maintained by adjusting the potentiometer R3.

Transformer Coupling

Since the primary and secondary windings L_2 and L_3 of the H.F. transformer are in a position of fixed close coupling, the variable condenser C_2 in effect tunes both windings to the desired frequency. The leak R_4 in the grid circuit of the detector valve V_2 may here be placed direct across the grid condenser, since the other end of L_3 is connected to the positive side of the filament battery, this being the best arrangement for the types of valves in common use in this country. To prevent self-oscillation of V_1, stabilising potentials may be applied to its grid by adjustment of the potentiometer R_3, whose resistance may be 400 ohms; this provides a finer control than the method described in connection with the circuit of Fig. 5. A condenser C_3, of .01 μF capacity, is connected between the earth terminal and the L.T. — end of the potentiometer to by-pass the H.F. currents flowing in this portion of the circuit. $L_2 L_3$ is a H.F. transformer suitable for the wavelength band to be covered.

The tendency for the H.F. valve to oscillate is one of the principal troubles encountered in operating these circuits. While the methods of stabilisation described do achieve their object, the damping introduced tends to decrease the sensitivity and selectivity of the H.F. stage.

The Neutrodyne Method

The neutrodyne method of stabilising the H.F. valve, given in the circuit of Fig. 7, obtains the desired result without reducing so much the efficiency obtainable. Here the tuning components of the aerial circuit $L_1 C_1$ have their usual values; $L_2 L_3$ is a neutrodyne unit, tuned by the condenser C_2 of .0003 μF capacity, while NC is the small neutrodyne condenser which is used to balance out the effects of the capacity present between the electrodes of V_1 and elsewhere. When this latter condenser is correctly adjusted, the circuit will be found stable in oper-

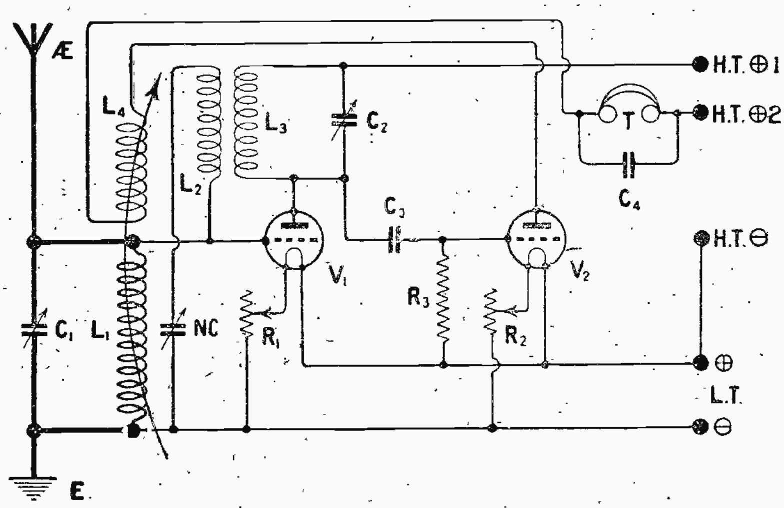


Fig. 7.—Illustrating the neutrodyne method of coupling which is noted for its stability.

ation, and reaction effects are obtainable in the ordinary way by coupling the coil L_4, included in the anode circuit of the detector valve V_2, to the aerial coil L_1.

In all the circuits described, separate terminals are shown to provide for the application of the most suitable anode potential to each valve; though quite good results are usually obtainable if the same potential is applied to both anodes, a considerable improvement may be expected from the employment of separate tapping points on the high tension battery; the two valves are performing different functions, and they may well be of types specially designed to operate most efficiently in the positions which they occupy in the receiver.

A Selective Loud Speaker Receiver

By E. J. Marriott

(*Concluded from page* 728.)

it will be found which totally eliminates oscillation, whatever the positions of C_2 and C_4. The receiver is now stabilized and will not oscillate without use of reaction. This adjustment will remain correct for any given valve and neutrodyne unit, provided the H.T. on the anode of V_1 is not altered to a very large extent. These instructions, whilst looking perhaps rather formidable in print, will be found in practice not very difficult to carry out.

Operating the Set

Having stabilized the receiver, it may now be tested out. Change the 75 turn coil for a 35 or 50 and connect up your aerial and earth to A_2 and E respectively. On adjusting the two condensers C_2 and C_4, the local station, if it is transmitting, should be heard on the loud-speaker. For the local broadcast, a reaction coil will not be found necessary, but for more distant reception it will be found extremely useful, and when used great care should be exercised in order that oscillation is not caused, with consequent annoyance to local listeners. Its size is best found by experiment, say a No. 35.

If interference is experienced it may be minimised by the use of aperiodic aerial coupling. To use this, a 35 turn or even smaller coil must be plugged into the first socket and the centre coil changed for a 75. It will be found now that tuning is distinctly sharper, and if the interfering station is not too strong it may be totally cut out by the judicious adjustment of the coils and condensers.

Under these conditions, however, reaction must be very carefully used, as oscillation will occur much more easily.

Test Report

Tested on a moderate aerial about four miles west of 2LO during the Radio-Paris transmission, that station on four valves, with direct aerial coupling and a 150 turn aerial coil, was received at good loud-speaker strength, music and speech being rendered without any noticeable distortion. The actual valves used were V_1-DE 3, V_2-DER, V_3-DE 5B and V_4-DE 4. The reaction coil was a No. 100.

Later on 2LO was tuned in, and on this station it was necessary to detune the anode tuning condenser slightly in order to prevent the loud-speaker being overloaded. Chelmsford was received at the same strength as 2LO.

With the aerial and earth disconnected and taken some distance from the set, it was found possible with the reaction coil shorted to tune in 2LO on the loud-speaker at a strength sufficient for a small room, using a 75 turn coil in the centre socket of the coil holder.

On test one night after 2LO closed down Radio-Toulouse was received loudly on the speaker, and a number of foreign stations, one of which was identified as German, came in very well indeed, without extreme use of reaction.

Aperiodic Aerial Coupling

Throughout these latter receptions, aperiodic aerial coupling was employed, a home-made coil of 30 turns being used in the aerial circuit 75 in the grid circuit and a 25 for reaction. Once the slow movement of the condensers was appreciated, tuning, even on distant stations, was found to be very simple, the condenser gearing allowing an exact adjustment with very great ease. Hand capacity effects, owing to the screening plates and the condenser mechanism being earthed, were non-existent.

Whilst 2LO was working, it was found impossible to cut it out, even using aperiodic aerial coupling, unless the circuits were tuned to a very different wavelength, *e.g.*, 600 metres. This, however, in view of the nearness to 2LO, was only to be expected, but on distant transmissions this form of coupling was found extremely useful.

Further Tests

During a further short daylight test it was found possible to receive both Bournemouth and Birmingham on the loud-speaker, at quite good strength. Unless loose aperiodic aerial coupling was employed, however, 2LO interfered considerably with the reception of 6BM, but with judicious adjustment of both aerial coupling and reaction, London was cut right out, Bournemouth being now received at weak loudspeaker strength.

Birmingham was not in any way jammed by 2LO when the aperiodic coupling was used, with a coil of 30 turns in the aerial socket.

In view of the fact that the writer, as previously mentioned, is able to receive 2LO at good loud-speaker strength without aerial or earth, the above results justify the incorporation of aperiodic coupling and indicate that at further distances from a main station it will be appreciated to a much greater degree.

I shall be interested to hear from anybody who constructs this set with regard to the results obtained in different districts.

Dr. W. H. Eccles.

The Wireless Engineer and His Work

By W. H. Eccles, D.Sc., F.R.S.

An interesting talk upon the variety of things which the wireless engineer is called upon to deal with during his daily work.

PERHAPS the most striking feature of a wireless man's work is the contrast in size between the various things he deals with. At one moment he may be designing a tower weighing 300 tons, and at the next moment a cat-whisker for tickling a crystal. I believe few other subjects furnish these great contrasts. They arise because wireless is now used to transmit messages across the greatest distances, and therefore the transmitting stations must be very powerful and the receiving apparatus exceedingly delicate.

I suppose everyone has had considerable experience of apparatus for the reception of wireless messages, so I propose to say little about the receiving side and to concentrate on the transmitting side. I propose, in fact, to tell you about two or three of the great wireless transmitting stations I have visited in recent years.

The Bordeaux Station

One of the most interesting of the great stations of the world is that one on the south-west coast of France near Bordeaux. It was built by the Americans when they came into the war so that their army could communicate direct with Washington, nearly 4,000 miles away. After the war it was bought by the French Government. To-day a visitor approaching the station from the direction of Bordeaux passes first through a countryside full of vineyards and then enters a region of pine woods covering a level plain extending to the sea. Long before he reaches the station he catches glimpses of its lofty towers. When he comes nearer he can see that the station is in the middle of a clearing about two miles in diameter, and that the towers are eight in number, and that they are arranged to form a stately avenue pointing straight across the Atlantic Ocean to Washington. The towers resemble the Eiffel Tower in Paris, but they stand on three legs instead of four, and are more graceful and airy. The first time I saw them was on a rather dull morning, and their tops were now and again hidden in the clouds; which all helped one to realise their great height. Actually they are about 800 feet high, which is only 180 feet short of the Eiffel Tower. Their purpose is to hold up a network of aerial wires, which on the morning of my first visit were quite invisible.

1,300 Horse-Power

Down on the ground, at the end of the avenue of towers, is the building containing the machinery; and from this long wires can be seen ascending to the aerial wires aloft. The building looks tiny compared with the towers, but as the visitor draws near to it he finds that it is an imposing structure about 60 yards long. The principal room in it is the machinery hall; in this is a group of roaring motors and dynamos, which deliver electric current to a magnetic arc seen in the background. The magnetic arc is one of the best forms of apparatus for making the powerful high frequency currents which are sent into the aerial wires. The one at work here is about 1,300 horse power. In external dimensions it is the size of a large elephant. There are in fact two of these elephants, one of which works while the other rests and is cleaned. They are the largest arcs ever built.

Seventy-eight Transmitting Keys

For sending dots and dashes a morse key is necessary; but as the current to be controlled is enormous it is divided among a row of 78 large morse keys all rising and falling together. They are operated automatically by a tiny electric current which has come on the telegraph lines from Paris, where a telegraphist sits at a table and taps a small morse key. It is fascinating to see and hear the 78 big keys moving all together like well-drilled soldiers at the bidding of an operator hundreds of miles away. It is difficult to realise that the clatter of these keys will be heard by wireless receiving operators in America and written down as a message.

St. Assise

Besides the station just described, France possesses three other magnificent wireless stations, of which the largest is at St. Assise, near Paris, and is the largest in the world. This station has 16 steel masts, each 820 feet high, forming an avenue nearly two miles long. These masts hold up aerial wires of which the total length is 30 miles. The masts do not stand on feet like the Bordeaux towers, but are held upright by slanting guy wires fixed to the ground. The station building has a frontage of 250 feet and contains two palatial machinery halls. Here the high frequency currents are made, not by magnetic arcs, but by machines called Latour alternators, named after their inventor. The power employed is about 2,000 horse power, and is controlled by a telegraphy key in Paris.

Towers or Masts?

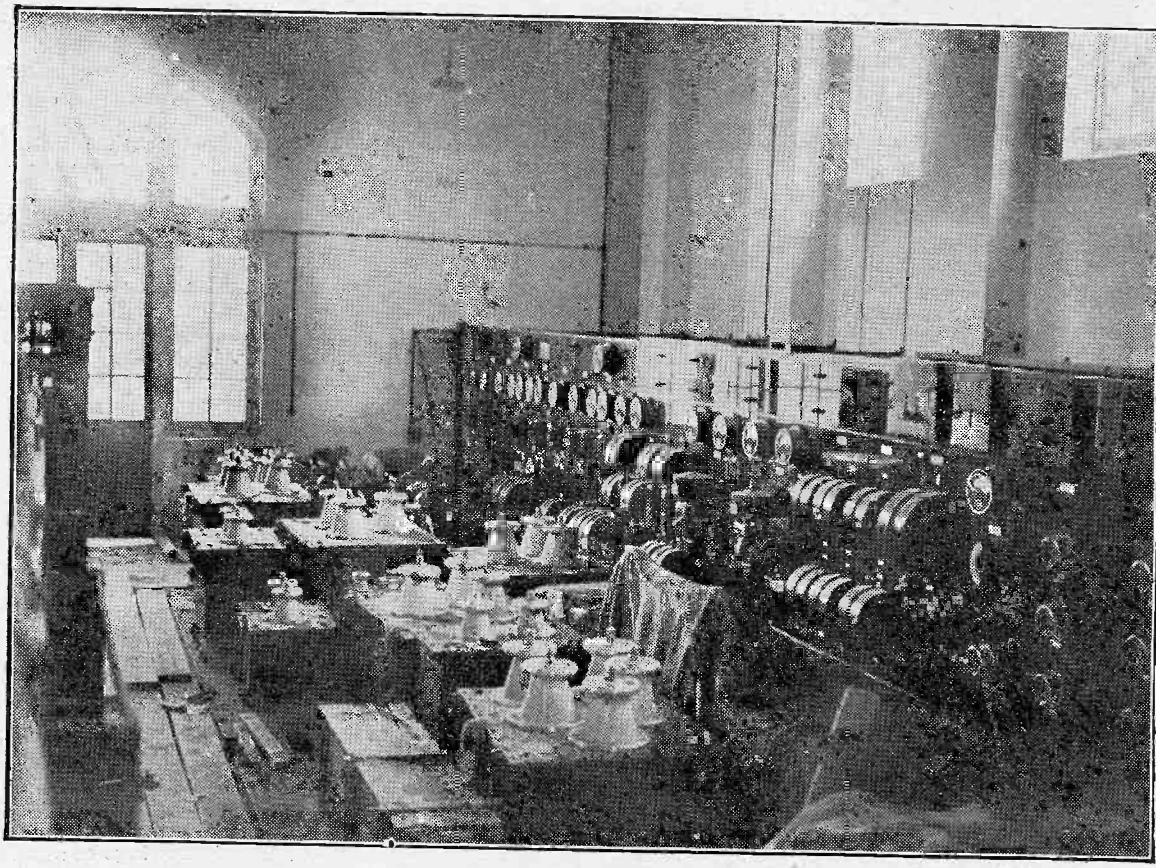
A visit to these two great French stations makes one ask, which is the better construction, towers standing on their own legs, or masts held up by guy ropes? Either of them will serve the purpose of the wireless engineer, who uses them merely to hold up as much aerial wire as possible as high as possible. Masts are usually less costly than towers, but the question arises, which of them is safer in a storm? Experience in Europe indicates that towers are stronger than masts. At any rate I do not remember having heard of a big tower being blown down, though I know of several high masts being wrecked. On the other hand, masts have sometimes proved unexpectedly tough. For instance, a few years ago a seaplane flew straight into a mast at Portsmouth 450 ft. high, and wedged its nose so firmly into the lattice work that it stuck there like a nail in a post. At the impact the pilot was shot from his cockpit against the mast and fell stunned on one of the wings of the plane, thus narrowly escaping a fall of 300 feet. He remained in this precarious condition until a courageous Marine climbed up the bent mast and rescued him. Later the wrecked plane was lowered in pieces, and the mast repaired and straightened.

Rugby

Among the great wireless stations of the world the new Imperial station at Rugby, which is now being erected by the Post Office Engineering Department, must be given an important place. It is situated about three miles from Rugby on a site about a mile and a half long by a mile wide and comprising nine hundred acres. There is room for sixteen masts, of which twelve are now nearly finished. These masts are 825 feet high and are supported by steel guy ropes fastened to the ground. Railway travellers passing through Rugby and looking at these masts do not usually realise their great height. There is nothing near enough to them to serve as a standard, and the few tall trees in the neighbourhood are so dwarfed by comparison that they look like gooseberry bushes. If the Nelson Column could be put near one of the masts it would be seen to be only one-sixth as high; or if St. Paul's Cathedral were placed alongside a mast the cross on the dome would not reach halfway. Inside each mast is a lift worked by an electric motor; this can carry four or five men to the top in about a quarter of an hour. There is also a ladder up which nimble people can climb in about half an hour. The whole mast is supported on porcelain insulators and can rock slightly on a joint at the bottom; in a high wind the top of the mast sways gently to and fro about eight feet.

An Exciting Moment

These twelve masts are the tallest structures in the British Empire. They have been erected without a single serious accident, a feat greatly to the credit of the contractors and the workmen. There have been exciting incidents, of course, I recall that on one occasion the lift was at its highest stopping place just beneath the platform which caps the mast, and a number of workmen got into the cage in order to descend. An extra man climbed on to the top of the cage, as there was no room inside. The signal to lower away was given, but instead of descending the lift started rising, with the result that the man standing on the cage was in danger of being crushed underneath the top platform. To save himself he made a flying leap into empty space, caught at a hanging



The building of the high-power station at Hillmorton, near Rugby, is nearing completion, and the photograph reproduced above shows the condenser banks ready for installing. The switchboards which will be used at the station are also seen.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rope and held on. I need not say that he was speedily hauled back into safety.

Thirty Miles of Wire

The masts are for the purpose of holding up the aerial wires. These are slung between the tops of the masts in festoons each a quarter-mile long. Altogether, about 30 miles of thick wire, that is, as much as would reach from London to Guildford, are suspended at the giddy height of 800 feet. From these aerial wires other wires descend to the station building far below.

The building contains three great halls; a machinery hall measuring 185 feet by 47 feet, a valve room 103 feet by 40 feet, and a high frequency room as big as the valve room but 52 feet in height. In this room the girders supporting the roof are of pine wood, because steel girders can be made red-hot by having near them the enormous high frequency currents present in the coils and condensers installed there. The coils are for tuning the circuits, just as my readers tune their receiving sets, but the Rugby coils are monstrous things weighing five tons, whereas yours probably weigh a few ounces; and the cable used in making them contains 6,561 strands of wire. As for the condensers, they are exactly like the mica condensers in your receiving set, except that they weigh ten tons.

Valves

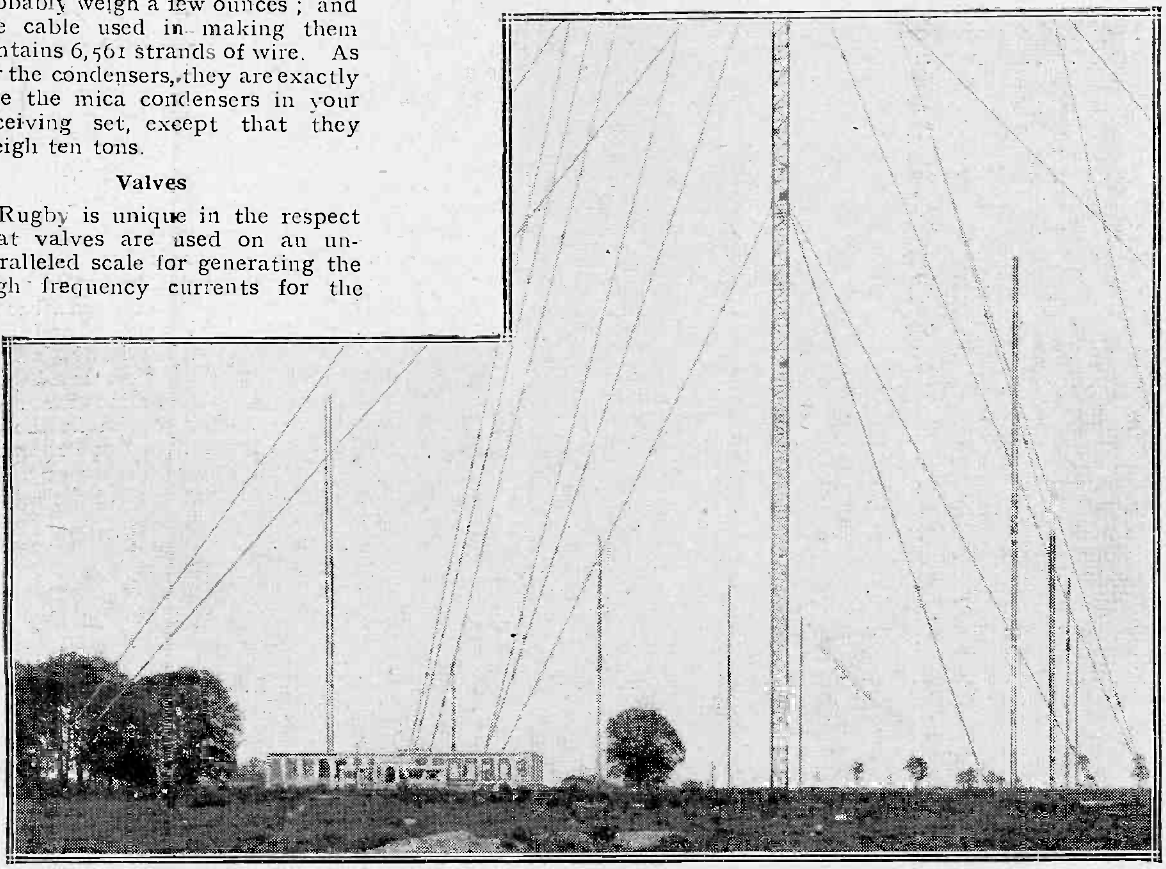
Rugby is unique in the respect that valves are used on an unparalleled scale for generating the high frequency currents for the aerial wires. 84 big valves are being installed. The valves are very like those you may use in your receiving set, but each Rugby valve consumes about one thousand times the energy taken by a receiving valve. The valves would get very hot unless cooled, so a reservoir containing half a million gallons of water with the necessary pumping machinery has been excavated for cooling them.

Flexibility

The Rugby station is the first high-power station ever equipped solely with valves. This form of equipment was decided upon by the Government because the valve method is very adaptable. A valve station with high masts can do more things than can a station employing arcs as generators. For instance, a valve station can transmit short waves as easily as long waves, and thus any wavelength, from the shortest to the longest, say from 10 metres to 20,000 metres, can be radiated if desired. Moreover, the masts at Rugby are so arranged that, if desired, reflectors can be erected for projecting short waves in useful directions in the form of beams. Again, the valve method is the fastest of all methods; speeds of a thousand words a minute have been reached experimentally in this country. In addition, a valve station can transmit messages by the voice as well as by the Morse code; in other words a valve station is a telephone as well as a telegraph station.

Transatlantic Telephony

The Postmaster-General has announced that telephone trials across the Atlantic will start during the coming winter. If the tests are successful anyone who can be connected on the trunk telephone line to Rugby will be heard at the corresponding New York Station, and his voice will be sent over the American trunk lines to any subscriber. As there are already a number of trunk lines connecting certain Continental countries to London and Rugby, the new station will enable a large area of Europe to be connected by telephone to the North American Continent. Later it may be found possible to extend these facilities to more distant parts of the world.



The giant towers which carry the aerial system at the St. Assise station form a landmark for many miles round.

A Chat on Good Reproduction

By

A. Johnson-Randall

Staff Editor.

In this interesting article the author points out the more important effects which tend to spoil reproduction and gives some useful advice upon how to eliminate them.

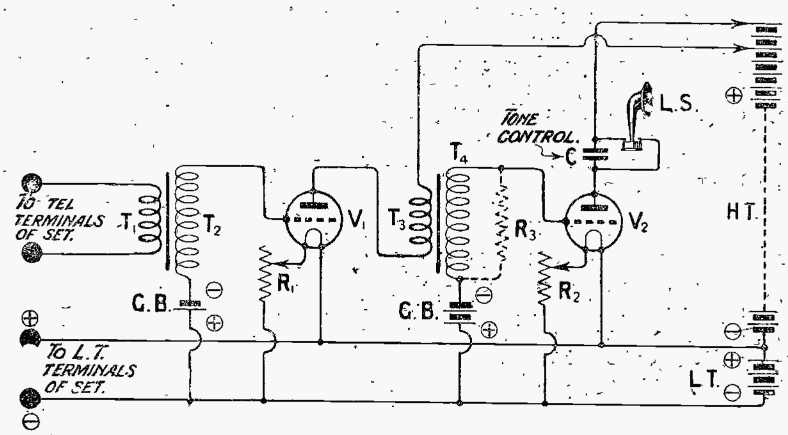


Fig. 1. A typical two-valve transformer-coupled low-frequency amplifier. The resistance R3 connected as shown will often improve results.

As the popularity of broadcasting as a means of entertainment increases and the time draws near when the wireless set may be regarded as part of the ordinary domestic equipment, so the broadcast listener is becoming more critical regarding reproduction generally. That which gave him pleasure but a few years ago when broadcasting was regarded somewhat as an experiment and as a novelty is now apt to bore him, and he asks himself how can those effects which are so harmful to perfect reception be wholly or partly eliminated.

Distortion

In many cases much of the distortion in existing receivers is due to instability on the high-frequency side, and listeners would be well advised to attend to this portion of their apparatus first. Probably one of the most popular methods of stabilising the conventional tuned anode or tuned transformer-coupled receiver is by means of a potentiometer. In this method stability is effected by the application of a small positive bias to the grid of the H.F. valve. In a really well designed set in which all stray couplings have been minimised this positive potential will not be very large, but if on the other hand the wiring has been badly carried out and unsuitable valves and valve mountings have been employed it is quite possible that the application of a much greater positive potential may be necessary to prevent self-oscillation.

The constructor should therefore first of all make sure that his wiring is well spaced, that he is using low-capacity valve-holders, and that his H.F. valve or valves are of a suitable type. He will then find, provided he is carrying out the maker's instructions in regard to H.T. and L.T. values, that the potentiometer can be worked very near to the negative end. In those sets not incorporating some efficient method of control a good plan is to reverse the leads to the reaction coil, and by placing a small sized coil in the reaction socket to render the receiver stable by the application of the required amount of reverse reaction. This will need a little practice at first, but once the correct sized coil has been discovered and the knack of handling acquired, no difficulty will be found in applying just the right amount for the best results. It is as well to mention that in some cases instability may be due to the earth connection becoming disconnected.

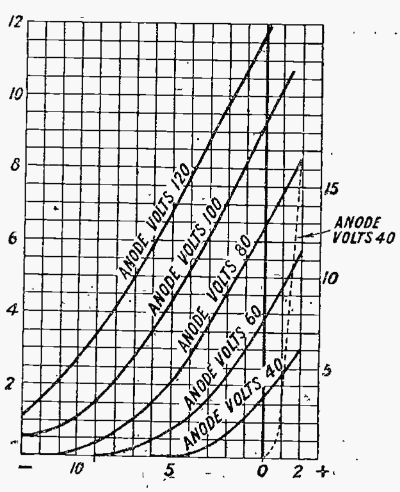


Fig. 2. Typical characteristic curves of a power valve for reading the correct grid bias for different anode voltages.

Reaction

These cases, however, are not common. Apart from inherent instability, distorted results can easily be caused by the excessive use of reaction. The reaction coil should be kept well away from the coil which it is reacting upon. Listeners will have noticed that, when the set is brought to its most sensitive state and is on the point of oscillation signals become distorted and woolly, and that all internal noises in the set become amplified, thus making the resulting reproduction most unpleasant. Moderation in the use of reaction will improve reception from the point of view of purity enormously, although of course some decrease in volume must be expected. The neutrodyne method of H.F. amplification has much to recommend it, since in this case stability is not the result of introducing deliberate losses.

L.F. Amplification

The causes of poor reproduction on the L.F. side are more numerous than those just dealt with in the high-frequency portion, and since the most common form of L.F. amplification is by means of transformer-coupling, I shall deal with this method first. In the majority of sets some form of general pur-

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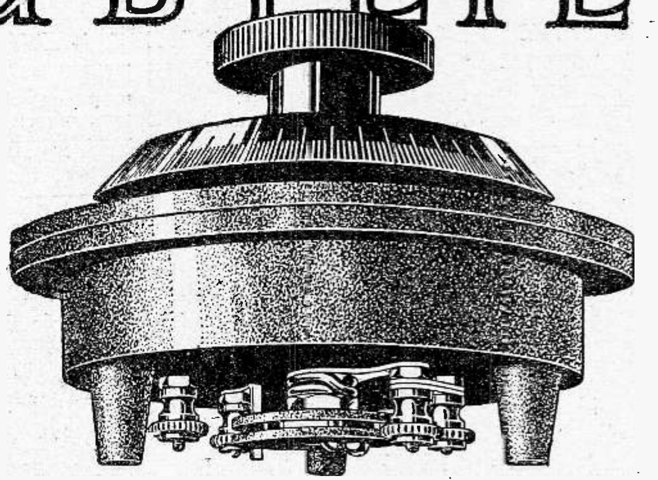

MANSBRIDGE VARIOMETER

12/6

FOR those occasions where it is more suitable, and for those people who prefer it, the Dubilier Condenser Company are now producing a Variometer. It was designed by C. F. Mansbridge, Esq., the originator of the Mansbridge Paper Condenser. It will thus be seen that the usual guarantee implied by the name of Dubilier is in this case re-inforced by the well-known name of Mansbridge.

The Dubilier Mansbridge Variometer is remarkably compact; it is 4¾ inches in diameter, and the overall depth is only 3 inches. It is equipped with three feet which enable it to be used standing on the experimenter's table, while it can easily be mounted on a panel if required. The Variometer consists of two pairs of D shaped coils, one pair being fixed, while the other is rotated by means of the knob. Connection to the moving coils is made through a phosphor-bronze spiral wound on a bobbin made of insulating material—a device which is also incorporated in the Dubilier Vanicon range of Variable Condensers.

The induction ratio is unusually high at 20:1, and the Variometer will cover all the broadcasting wave lengths up to 1800 metres. Full particulars are given with each instrument.

Suitable for experimental use or panel mounting, the Dubilier Mansbridge Variometer is sold at the low price of 12/6.

When purchasing, be sure that you safeguard yourself and specify—

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pose valve is used for detecting. It may be a bright emitter of the "R" type or it may be one of the dull emitter types now so popular, but in any case it is essential that the transformer immediately following this valve should be of good quality and that the impedance of the primary winding should be suitable for the type of detector valve employed. It is impossible to give definite figures regarding the impedance of this winding, since the impedance of practically every type of valve varies. One of a particular make will quite likely have a different impedance to a similar type of valve of some other make, but we can compromise and obtain good quality if we employ a first stage transformer made by a reputable manufacturer.

These instruments are suitable for use after a detector valve, and the makers have in most cases based their design upon the assumption that a valve of high impedance will be used as a rectifier. Provided that only one stage of transformer coupling is used there should be little difficulty in obtaining good quality, but careful design is necessary if two stages are employed.

L.F. Oscillation

Very often on coupling up the second stage a loud continuous howl is heard. No adjustment of controls will vary the note, and the constructor is faced with the problem of low-frequency oscillation. In other cases reproduction is entirely spoiled, but no audible note is heard. The low-frequency side may still be oscillating, but at a frequency above audibility. The remedy in these cases is to employ suitable transformers in both stages and to mount them in such a manner as to minimise any interaction. A pair of first-class first and second stage transformers, well spaced and with the axes through their cores at right angles, should give no trouble. In the event of L.F. oscillation occurring, the first thing is to try the effect of reversing the I.P. and O.P. of the second transformer.

It is sometimes advisable to earth both the cores, and in many cases a great improvement will be noticed if a resistance is connected across the secondary winding of the last transformer. The value of this resistance may be between half a megohm and a hundred thousand ohms. The lower the value of the resistance the greater is the effect upon signal strength, for although the quality may be vastly improved by the lower value, at the same time the volume obtained will be less, and so it is wise to try different values until the desired results are obtained. When two stages are used it is a good plan to purchase an H.T. battery containing units of large size, since this type of battery is more suited to supply the needs of valves of the low impedance type used in this class of work. With the smaller cells used in the popular type of battery the resistance may become very appreciable after a time and a "back coupling" effect may be produced which may result in a loud howl at low-frequency. Each tapping should be shunted by a Mansbridge type condenser of 2 μF or above, which should be joined between the H.T. +2 tapping and the common H.T. negative lead.

or resistance-capacity coupling, as in many of the sets described from time to time in this journal. Very good quality is obtainable by this method, and the chief points to be noted are that the chokes must be of good quality and of suitable impedance. If the choke is placed in the first stage it must have a high impedance of between 60 and 100 henries for good quality, the actual impedance, of course, depending upon the type of valve chosen for detecting. The above values are suitable for most valves of the general purpose type, and although the listener will not in all probability be in a position to determine the value of the choke he chooses, he should make sure that it has a core of substantial cross section and that the winding consists of a very large number of turns, preferably section wound as in the case of good transformers. It is worth while to experiment with defective transformers in which the primary windings have developed a fault, leaving the secondary winding intact. In this way some instruments which would otherwise be useless may be utilised as very effective chokes by making use of the secondary windings and ignoring the two primary terminals.

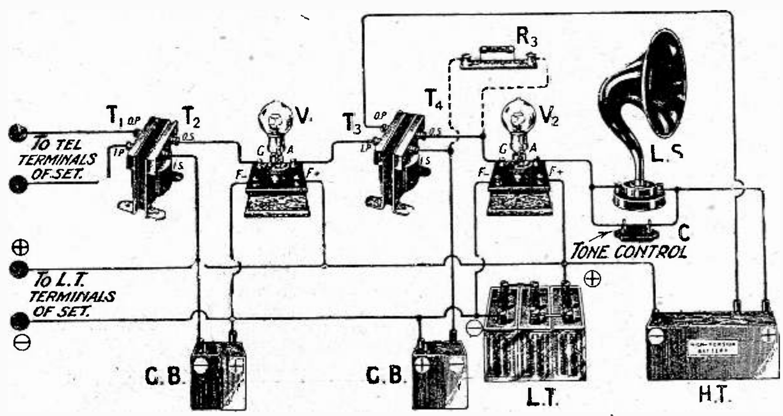


Fig. 3.—The arrangement of Fig. 1. shown in pictorial form.

Valves

Regarding the valves to use I always prefer to use two low-impedance valves of the loud-speaker type for two-stage work, but good results can also be obtained by using an "R" general purpose valve in the first stage with a small power valve in the second. It is, of course, essential to use the correct grid bias as specified by the makers of the valve for the particular H.T. voltage employed. Sometimes a characteristic curve only is obtainable, and in those cases the proper grid bias may be read off by dropping a vertical from a point half way along the straight portion of the curve to the left of the zero ordinate, the point where the vertical cuts the negative grid volts scale shows the correct grid bias value for that particular H.T. voltage. This is shown in Fig. 2, in which the correct grid bias is 6 volts for an anode voltage of 120.

Choke-Coupling

A good combination is one stage of transformer and one stage of choke

Resistance Coupling

When the choke is used in the second stage it is possible to employ one having a lower impedance, provided the valve in whose plate circuit it is connected is also of reasonably low impedance. If the constructor is prepared to use a fairly high anode voltage, or alternatively one of the special valves designed for resistance capacity coupling, he can obtain very nearly the same amplification as he would obtain if he employed choke coupling by replacing the choke itself by a resistance. One of the disadvantages of the latter method is that when ordinary valves are used an increase in anode voltage is necessary to make up for the drop in voltage across the resistance. This drop in voltage depends upon the value of the resistance itself and the steady plate current, and will of course vary with different valves.

Anode Voltage

In consequence of this drop in voltage the anode voltage must be increased correspondingly. It is well known that the higher the value of the anode resistance the greater is the amplification obtained, but at the same time the voltage drop across the resistance will be greater also, and so for ordinary valves it is usual to sacrifice a little amplification by employing resistances of about 50,000 ohms, thus cutting down the high anode voltage which would be essential for efficient working. By using specially designed valves such as those of the D.E.3 B or D.E.5 B type it is possible to obtain really good amplification and to use anode resistances of 100,000-120,000 ohms without increasing the anode voltage beyond 120, and so in this way recent research has practically eliminated the disadvantages of resistance coupling. For the best results the anode resistances must be of good quality and not subject to any variations in working. Any slight changes in their value will tend to make the receiver noisy, the resulting reproduction being accompanied by a background of crackling and frying. By purchasing the best components and by carefully following a good sound design the enthusiast and music-lover can obtain results which are at all times a pleasure to listen to. He may sacrifice a little volume in his search for purity, but, after all, surely it is worth while.

Long-Distance Reception with the Three-Valve Dual Receiver.

SIR,—I thought I would like to write and let you know some of the results I have had since I built the "Three-Valve Dual Receiver" (by Mr. John Scott-Taggart) which first appeared in MODERN WIRELESS, April, 1924. I built the receiver with the various terminals on the panel for use as a three-valve dual, two-valve dual, etc., and am more than astonished at the results I have been getting. I get all the main B.B.C. stations on the loud-speaker, and Chelmsford and Birmingham at good loud-speaker strength on the two-valve dual. Recently I received Dundee on the loud-speaker on the two-valve dual. The receiver is surprisingly easy to handle, and as stable as a rock, and can be switched off at night on any station and then be certain of that station being heard when next used without having to alter anything. I regularly get Hamburg on the loud-speaker, also Radio-Paris and many other Continental stations, at good loud speaker strength, which I am unable to identify. My aerial is a single one of thick copper wire about 30 ft. high at the far end and about 15 ft. high at the receiver end, and is well exposed on a slight hill.

Thanking Mr. Scott-Taggart for a most excellent circuit through MODERN WIRELESS.—Yours faithfully,

J. H. W. DOUGLASS.

Market Harborough.

A BRILLIANT DOUBLE NUMBER

OUR readers will be pleased to learn that the September issue of MODERN WIRELESS will be a Special Double Number. Regular readers will already be familiar with the demand created by our double numbers, which have in the past necessitated Radio Press buying back a number of sold copies in order that those who were late ordering should not be disappointed.

The size of the September issue will be much enlarged, and the price will be increased to 1/6 for this special number only.

This brilliant double number will contain complete articles from the pens of :—

John Scott-Taggart, F.Inst.P., A.M.I.E.E.,
Major James Robinson, D.Sc., Ph.D., F.Inst.P.,
Percy W. Harris, M.I.R.E.,
A. D. Cowper, M.Sc.,
R. W. Hallows, M.A.,
G. P. Kendall, B.Sc.,
A. Johnson-Randall,
Stanley G. Rattee, M.I.R.E., and
J. H. Reyner, B.Sc., A.C.G.I., D.I.C.,

as well as a very large number of other items, all of great interest to the wireless public.

A special article will appear by Mr. Scott-Taggart, which will be enthusiastically welcomed by all radio experimenters, who will also appreciate the inclusion in this issue of a complete and up-to-date list of amateur call-signs.

Major James Robinson, D.Sc., Ph.D., F. Inst.P., who has recently been appointed to the position of Chief Engineer and Director of Research to the Radio Press, Ltd., will also contribute to this number an article entitled, "New Developments in Wireless Receiving Circuits." Dr. Robinson, has been associated with wireless research of the most interesting kind for many years past, and his disclosures will be of the greatest importance to all interested in wireless reception.

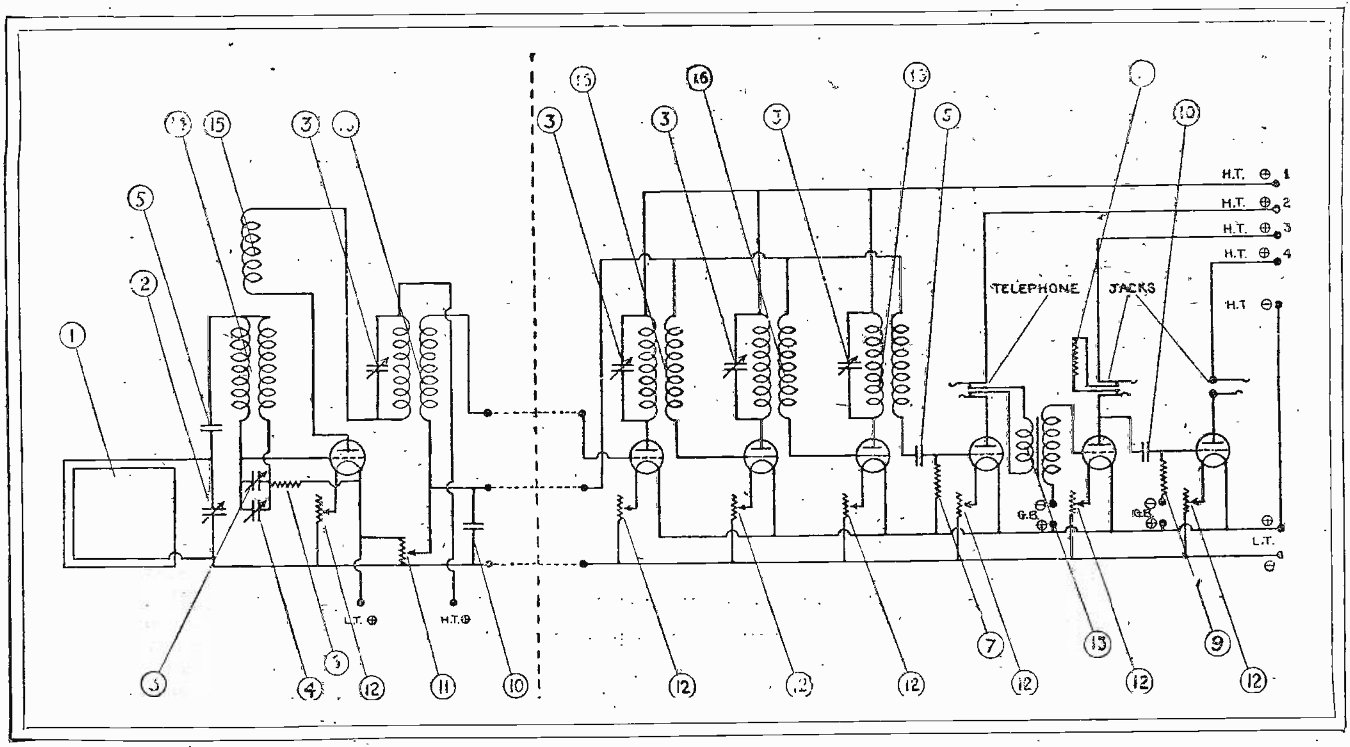
Other pages will contain full constructional details for building a complete range of sets from a small crystal receiver to one using four valves, besides which a receiver intended for the reception on the loud-speaker of the transmissions from KDKA, will also be fully described.

"Getting the Most from H.F. Valves" is a subject which will keenly interest all those anxious for distance, and this will be discussed at length by J. H. Reyner, B.Sc., A.C.G.I., D.I.C., whose article on aerials upon another page of this issue makes fascinating reading.

A comprehensive list of amateur call-signs is invaluable to the experimenter for constant reference, and the list which will appear in our double number will be the latest and most complete ever published.

In addition to those indicated above there are many other good things to be included in the September issue, which will contain a wealth of information that could nowhere else be obtained.

ORDER YOUR COPY IN ADVANCE. - - PRICE 1/6.



Conversion of existing H.F. Amplifiers to the Supersonic System

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THE Supersonic Set has come to stay, and although for the "Home Receiver" it will never supplant one or two stages of H.F., Detector and note magnification in conjunction with an aerial, the progressive experimenter and home constructor will feel that he must have one. Expense is the stumbling block.

MH Products in the form of the **A.7 Transformer, the Reactor,** and the **neutral point Autodyne,** enable those in possession of "straight H.F. Receivers" to convert them at a modest outlay, the minimum of trouble and with the certainty of superlative results.

The diagram above shows on the right a conventional 6 valve receiver; should you possess one following the general arrangement shown it need not conform with it in detail. To allow of its conversion, MH A.7 Transformers are substituted for those normally used.

To the left of the diagram is shown an additional Valve "with the so-called filter transformer" (the MH A.7), the Autodyne Coil, (the MH Neutral Point Autodyne) reacted on by the MH Reactor. This unit can be made up easily and inexpensively to precede your existing H.F. Amplifier, and you will then have both systems of reception at your command. The remaining details are self-explanatory.

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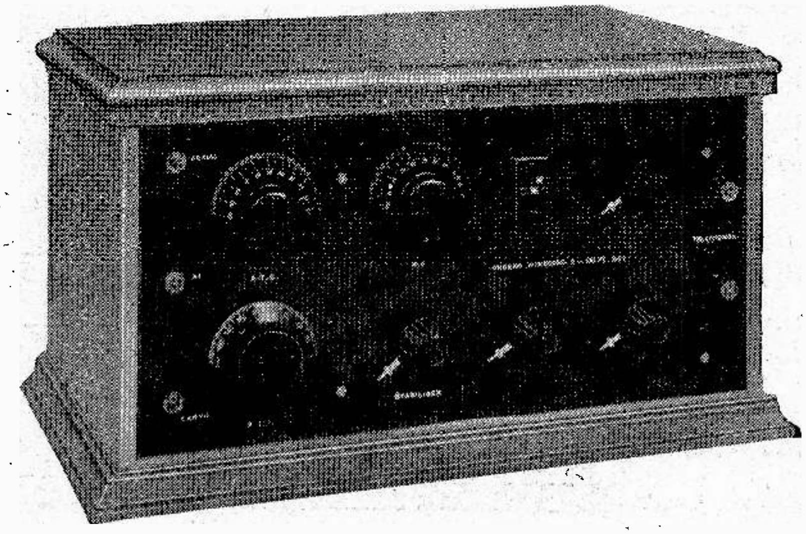


Fig. 1.—The coils, valves, batteries, etc., are all contained within the cabinet, thus giving the receiver a most neat appearance.

A Self-contained Three-Valve Receiver

By JOHN UNDERDOWN

THE set about to be described is one which will essentially appeal to many broadcast listeners. Valves, batteries and coils may all be enclosed within the cabinet, this being made possible by employing dull emitter valves of the ·06 ampere type, which can be successfully worked off dry batteries, and by incorporating certain components which take up but little space.

The set has been used for some time with two 36-volt batteries joined in series for high tension, and a 4½-volt dry battery for filament lighting purposes. These batteries are readily accommodated within the cabinet and have proved perfectly satisfactory for running three valves of the D.E. 3 type. Where, however, it is desired to use a small type of power valve for the note magnifying stage, in order to handle better really strong signals on the loud-speaker, one of the types requiring a filament voltage of 3 to 4 and taking .12 to .3 amperes may readily be used; but in this case it is advisable to employ a small 4-volt accumulator. There are several makes available which will readily fit into a cabinet such as is shown in the photograph and still leave room for a suitable high tension battery.

The Circuit

A most excellent all-round circuit for general purpose work is undoubtedly one in which the three valves function as a high frequency amplifier, as a detector, and as a note magnifier respectively. A circuit of this type is employed, and the theoretical diagram will be seen in Fig. 2. This is a purely straightforward conventional circuit. Dealing with it in detail, it will be seen that either constant aerial tuning, which gives a greater range with a given coil and condenser and allows the aerial coil to be predicted with a fair degree of accuracy for aerials varying considerably in characteristics, or plain parallel tuning may be used. Potentiometer stabilisation is adopted and the potentiometer is shown as R_4. The high frequency valve is coupled to the detector by means of a high frequency transformer, of which the primary winding is tuned. This particular method of coupling was incorporated since an H.F. transformer takes up less space than the usual coil as in the tuned anode method. It is also slightly more stable, owing to the somewhat higher damping, than that in the tuned anode system, and this feature is desirable with a set which is semi-portable in nature and may be used on various aerial systems. Rectification is by the leaky grid condenser method, and direct magnetic reaction is obtained by coupling the coil L4 in the plate circuit of the detector valve to the aerial coil. The low frequency stage is transformer coupled, since this type of coupling usually gives a greater step-up in signal strength than either choke or resistance coupling. Separate high tension is provided for each valve, and a grid bias battery for the note magnifier is also used. An "On and Off" switch allows the set to be put in

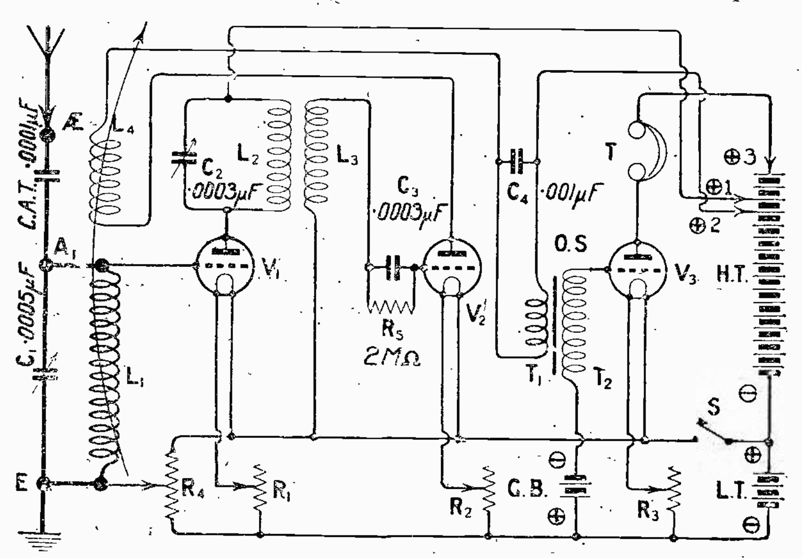


Fig. 2.—The theoretical circuit of the receiver shows that it contains one H.F. valve, detector and note-magnifier.

This handsome receiver is so designed as to enable the batteries, valves, coils, etc., all to be contained within the cabinet, making therefore a compact arrangement for family use.

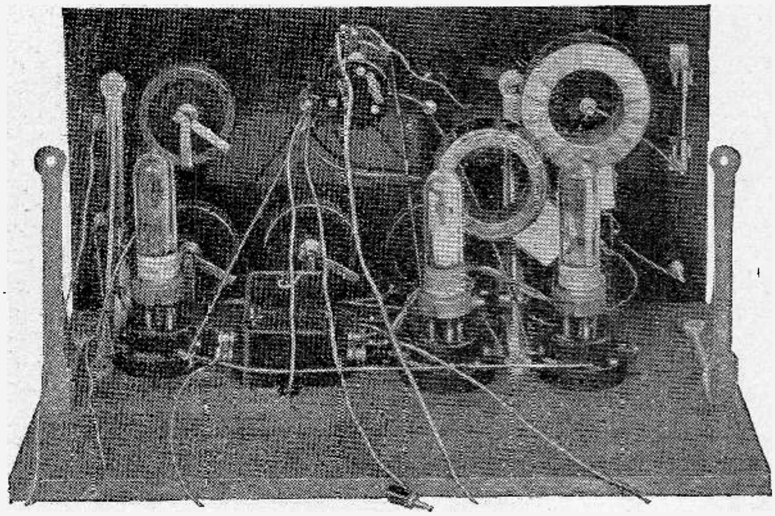


Fig 4.—The wiring at the back of the panel is extremely simple. The flexible leads seen in the foreground are for the connections to the batteries.

and out of operation when once tuned to a given station, a very desirable feature when a set is for family use. The values of the various condensers appear in the circuit diagram.

The General Layout

Reference to the photographs will show the neat and symmetrical layout of the panel. The three terminals on the left-hand side are, reading from the top to the bottom, for constant aerial tuning, for parallel tuning, and for the earth connection. The two terminals to the right of the panel are for the telephones or loud-speaker, that at the top being the positive terminal. The variable condensers tuning the aerial and the primary of the H.F. transformer are at the top left-hand side of the panel, whilst below the aerial condenser will be seen the dial of the two-coil holder. Below the H.F. tuning condenser is the potentiometer; whilst the other three knobs are for the three filament resistances. The filament "On and Off" switch is located above the high frequency valve rheostat.

The Back of the Panel

Since the set is compact in nature, care is needed in the disposition of the components behind the panel and the design should be followed closely. The panel itself is held in position by two large aluminium brackets. On it are mounted the constant aerial tuning condenser, the two variable condensers, the valve holder taking the H.F. transformer, the filament resistances and also the potentiometer. The valve holders, L.F. transformer, the grid condenser, and that across the primary of the L.F. transformer are mounted on the wooden sub-base. The dimensions of this latter are 16 in. by 9 in. by ⅜ in. thick. If desired, of course, the width may be increased if larger batteries than those shown in the photograph are used. A partition has been placed near the back of the cabinet to prevent the batteries from falling over and injuring the valves. This may or may not be necessary according to the types of batteries chosen. In the present receiver the distance between this platform and the back edge of the wooden sub-base is 3 in., but this may be increased to 3½ in. by slightly shifting the partition without altering the size of the wooden sub-base. Two brackets have been used, of similar type to those supporting the panel, to hold the partition in place.

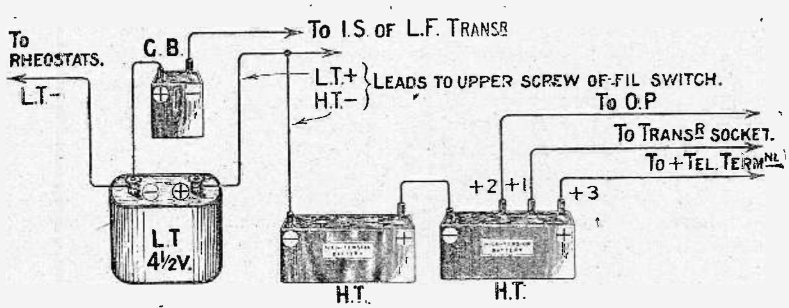


Fig. 3.—Illustrating the manner in which the batteries are connected.

Components

To duplicate the receiver exactly as seen in the photographs the following components will be required, and makers' names have been given for the convenience of those who desire them. Although it is not absolutely essential to adhere strictly to those used, provided the quality is good, considerations of space should be borne in mind if any change is made.

One black Radion panel 16 in. by 8 in. by 3/16th in. thick (American Hard Rubber Co., Ltd.)

One cabinet with lift-up lid to take a panel of the above size and to accommodate a baseboard of minimum width, 9 in. (W. H. Agar.)

One Dial-o-denser of .0005μF capacity and one of .0003μF (Portable Utilities Co., Ltd.)

One Success behind panel mounting two coil holder (Beard and Fitch, Ltd.)

Three 35 ohm Bakelite rheostats (R. A. Rothermel, Ltd.)

One Bakelite potentiometer, 400 ohms (R. A. Rothermel, Ltd.)

One Connecticut "On and Off" filament switch (R. A. Rothermel, Ltd.)

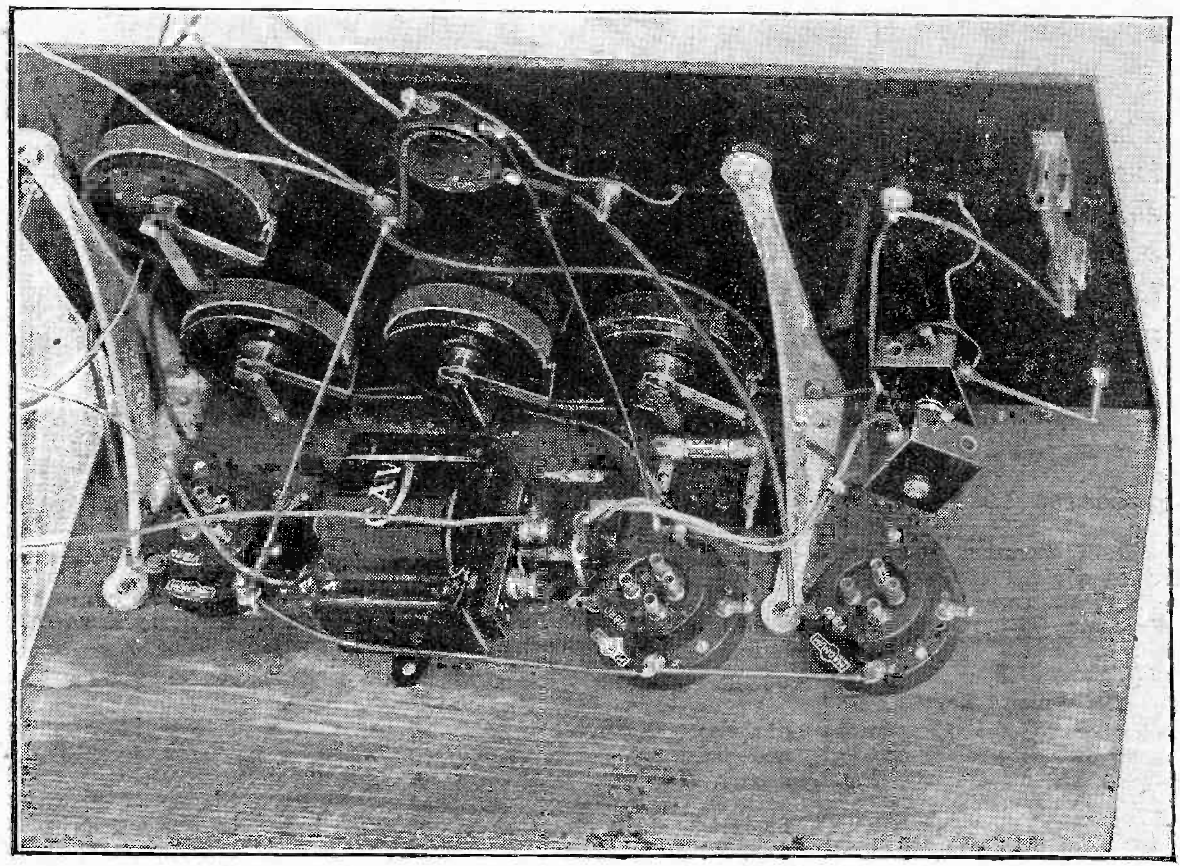


Fig. 5.—The holder for the H.F. transformer is fitted to the panel, the valve holders being secured to the baseboard.

Five W.O. type nickel plated terminals (Burne-Jones and Co., Ltd.)

Two aluminium brackets, or four if a partition is erected to keep the batteries in position (Burne-Jones and Co., Ltd.)

One first stage low frequency transformer (C. A. Vandervell and Co., Ltd.)

Three Magnum "Vibro" anti-capacity valve holders (Burne-Jones and Co., Ltd.)

One .0003 μF grid condenser (Dubilier Condenser Co., Ltd.)

One .001μF fixed condenser (Dubilier Condenser Co., Ltd.)

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

One .0001μF fixed condenser (clip-in type) (L. McMichael, Ltd.)

One Bretwood valve holder (Bretwood, Ltd.)

One packet of Radio Press Panel Transfers.

Quantity of V.I.R. covered flex.

Quantity of 20 gauge tinned copper wire and insulating sleeving or Glazite wire.

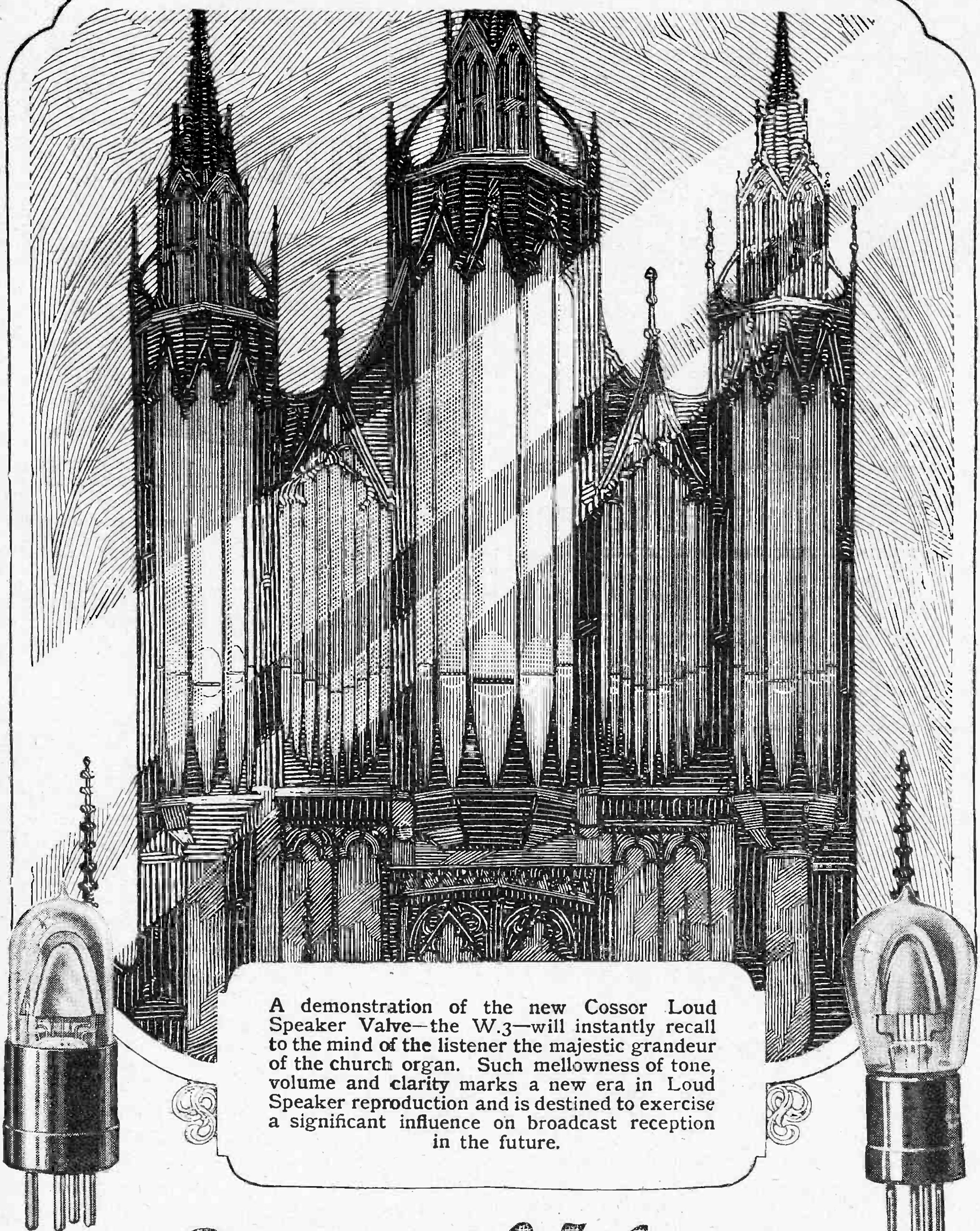
One strip of mahogany or oak 16 in. by 2 in. to 3 in. and 3/16 in. thick. This is only necessary if a partition is employed, as shown in the photograph, Fig. 8.

Constructional Work

The constructional work in building the receiver is quite simple in nature, it being merely necessary to drill the requisite holes for the components on the panel and to mount these, and then those on the baseboard. Drilling is best carried out from a full size blue print if possible, since the spacing is somewhat close to accommodate the various components. The Dial-o-densers are very simply mounted. One hole is required to take the spindle and another smaller hole the flexible lead. The aerial Dial-o-denser should have its spindle filed off fairly close to the panel in order to allow more space for the aerial coil. The most suitable length will, of course, be found when the coil-holder is in place. This latter is mounted by the one-hole fixing method and no difficulty should be experienced here. The valve socket taking the H.F. transformer is mounted by means of a 6 BA screw, the hole for which has been tapped. It is, however, not essential to tap the hole, since a 6BA screw and nut may be used. The rheostats and potentiometer are of the one-hole fixing type and are quite easily mounted. The only hole which may give any trouble is that for the Connecticut "On and Off" switch. This is best made with a Clark's Expansive Bit or an ordinary carpenter's bit of suitable size. A centre hole should first be made with a 4BA drill, and drilling carried out from either side of the panel in turn in order to obtain a clean hole. The constant aerial tuning condenser is held in position by the shanks and nuts of the two aerial terminals.

Spacing

Having mounted the components, including the brackets, on the panel, it is best to place the whole in position on the baseboard and to screw the panel and brackets into position with small wood screws. When the panel is fixed to the baseboard, the components to be mounted on the latter should be placed in position with coils and valves inserted so that appropriate spacing is obtained and should then be secured by means of small wood screws (¾ in. No. 4 being suitable in most cases). The brackets and partition at the back should not be



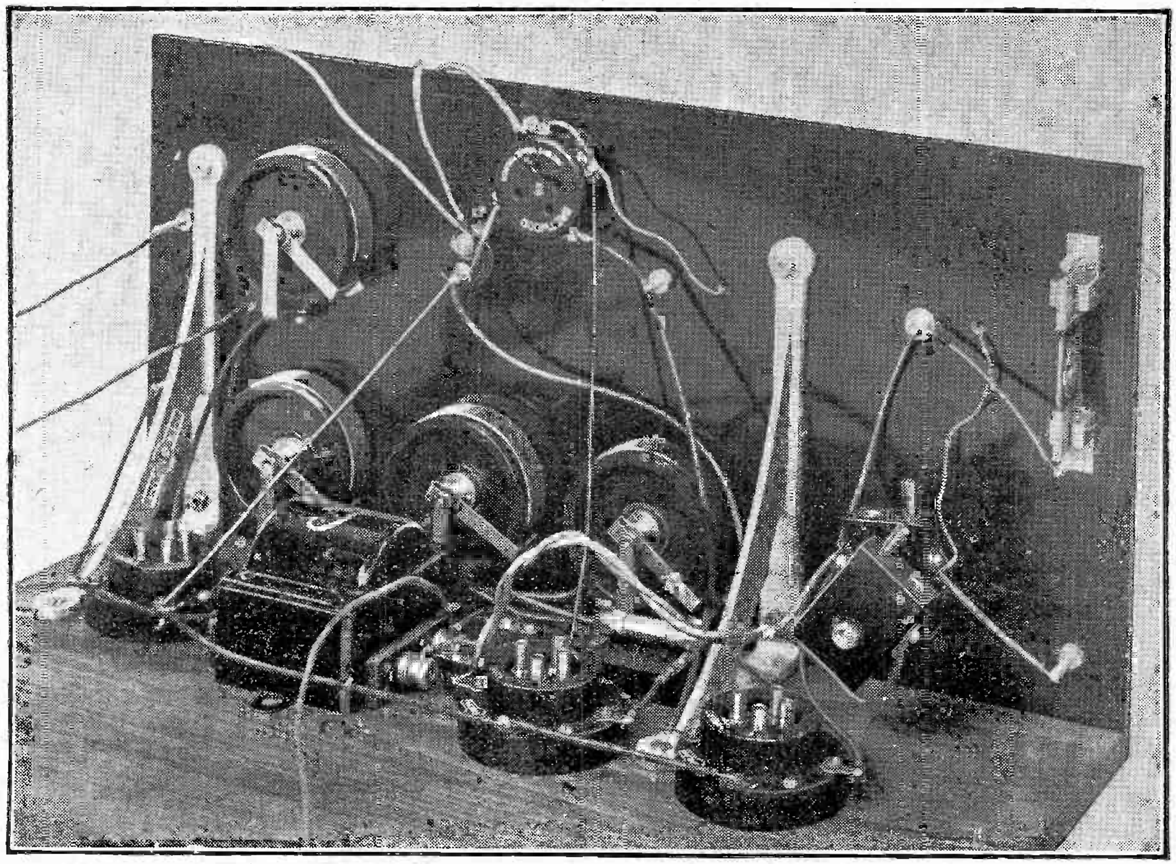


Fig. 6.—Care should be taken to see that adequate clearance is allowed for the moving coil.

affixed until the wiring has been completed.

The Wiring

For wiring purposes I would recommend that some fairly flexible wire, such as number 20 gauge tinned copper be used. This should be covered with insulating sleeving, since the leads are somewhat close together in certain places and some form of insulation is desirable. Terminals and contacts which are to be soldered should first be cleaned with a smooth file and then tinned with a really hot iron before wiring is commenced. It is as well also to give nuts half a turn after tinning, since the heat will often tend to loosen them. The best procedure to follow is to remove the panel from the baseboard, leaving the brackets in position on the former and to wire up on this as far as possible.

Leads from the moving contacts of the rheostats which are to go to the negative valve sockets on the baseboard should be attached to the terminals of the former, cut off at suitable lengths and left free temporarily, as it will otherwise be difficult to get at these terminals which come fairly close to the baseboard when the panel is in place. The components on the baseboard, *i.e.*, the L.F. transformer, the valve sockets and the grid and by-pass condensers, may also be wired, and then the panel should again be screwed into position, and the wiring completed. Before finally finishing this it is advisable to place the coils in position in order to see the best method of taking the remaining leads. It will be observed that the leads to the reaction coil are of V.I.R. flex twisted together. That from the plate of the detector valve goes to the plug of the moving coil block which takes the reaction coil.

Battery Leads

The necessary battery leads for both high and low tension are taken direct from certain points and not to the usual terminal strip, thus simplifying both construction and wiring. V.I.R. flex is used for all of these connections. Reference to the photographs will make this clear. The H.F. H.T.+ lead is taken direct from the upper contact of the H.F. transformer socket, the detector lead from O.P. of the L.F. transformer and that for the L.F valve from the positive telephone terminal. Leads for L.T.+ and H.T.— are taken direct from the upper screw of the "On and Off" switch. The connection to L.T.— is taken from the wire which goes to one terminal of each of the filament rheostats. The grid bias negative lead is taken from the I.S. terminal of the L.F. transformer. When the batteries are connected up a flex lead is taken direct from the negative terminal of the low tension battery to the positive end of the grid bias battery, so that no wire appears in the wiring diagram for this purpose.

Valves and Batteries

The photograph of Fig. 8 shows the batteries which I have used to supply three general purpose .06 ampere type valves, and which conveniently fit into the cabinet when arranged as seen. The L.T. is a 4½ volt Hellesen "GLATE" battery, and the other two are each of 36 volts, giving a total of 72 volts when joined in series. So that no difficulty should be experienced in connecting up, the sketch of Fig. 3 has been given.

Suitable voltages for the H.F.

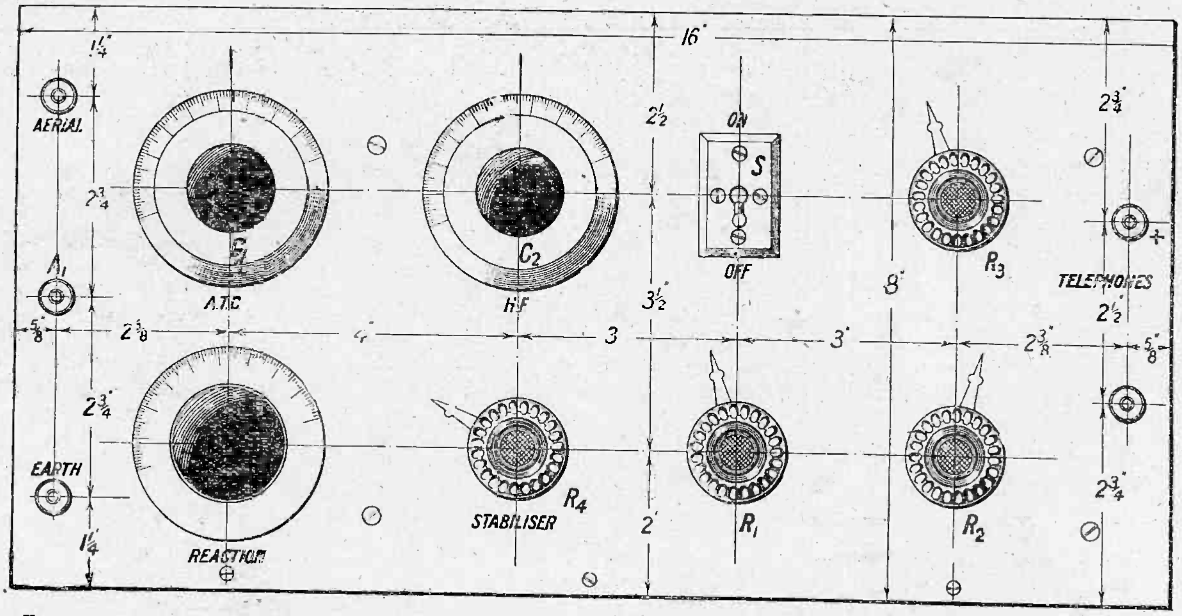


Fig. 7.—The layout of the panel and drilling dimensions. Blueprint No. 125A, Post Free 1/6.

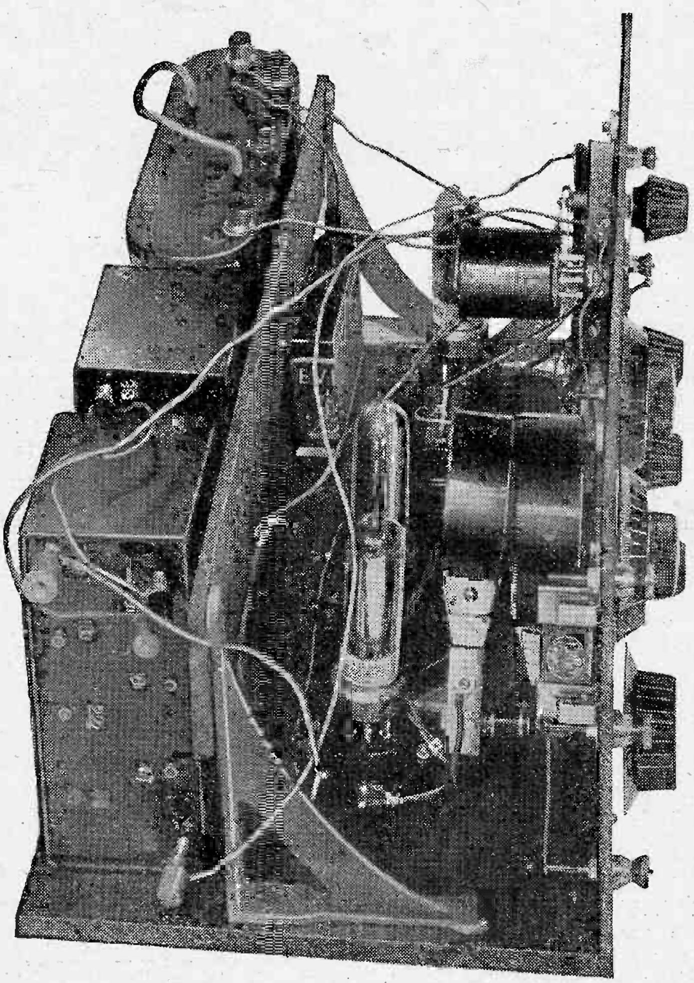


Fig. 8.—The batteries are situated along the back of the baseboard. Note the wooden partition.

and detector valves are between 40 and 60 volts, whilst on the L.F. valve the whole 72 volts should be used and a grid bias voltage of 3 to 4½ will be found correct with most ·06 valves.

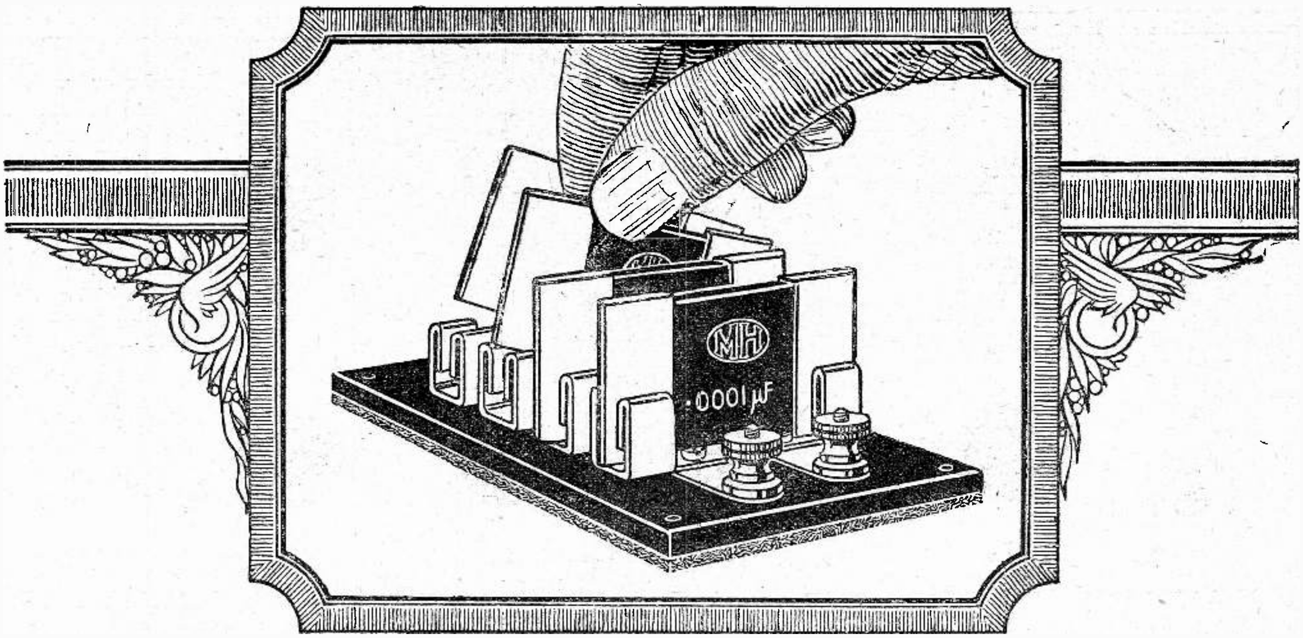
Testing

The wiring completed, it now remains to test the receiver. For the 300 to 500 metre band of wave-lengths a No. 35 and a No. 50 coil will be required when plain parallel tuning with the aerial connected to A_1 is employed. With C.A.T. Nos. 50 and 75 should be used. For reaction a comparatively small coil only will be necessary in both cases, and one of the order of a No. 35 should first be tried. The most suitable coil for reaction purposes is best determined by actual experiment. The wiring for the H.F. transformer is suited to a number of barrel-types, such as the Magnum, McMichael, Bowyer-Lowe, Peto-Scott and a number of other makes. One for the 300 to 500 metre wave band should be inserted when testing with the above coils.

First connect the low tension battery and see that a valve will light correctly when placed in each of the three valve holders in turn and then connect the high tension as shown in Fig. 3. It is best to try the set withdrawn from its cabinet and to adjust the H.T. and grid bias to give best results before the set and batteries are placed in the cabinet.

Tuning

Tuning is quite simple. The reaction coil, that is, the one in the moving coil block, should be as loosely coupled to the aerial coil as possible and the aerial condenser should be advanced by one or two degrees at a time, whilst that tuning the primary winding of the H.F. transformer should be taken gradually through the whole of its scale degrees. When a signal is heard



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Base Board only 5/-

FIXED CONDENSERS.

Two clips are supplied with each condenser.

0.0001 to 0.001µF.	1/9 each.
0.0015 to 0.01µF.	2/3 each.
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Mounted on ebonite bases, with terminals, any value.

0.0001 to 0.001µF.	2/9 each.
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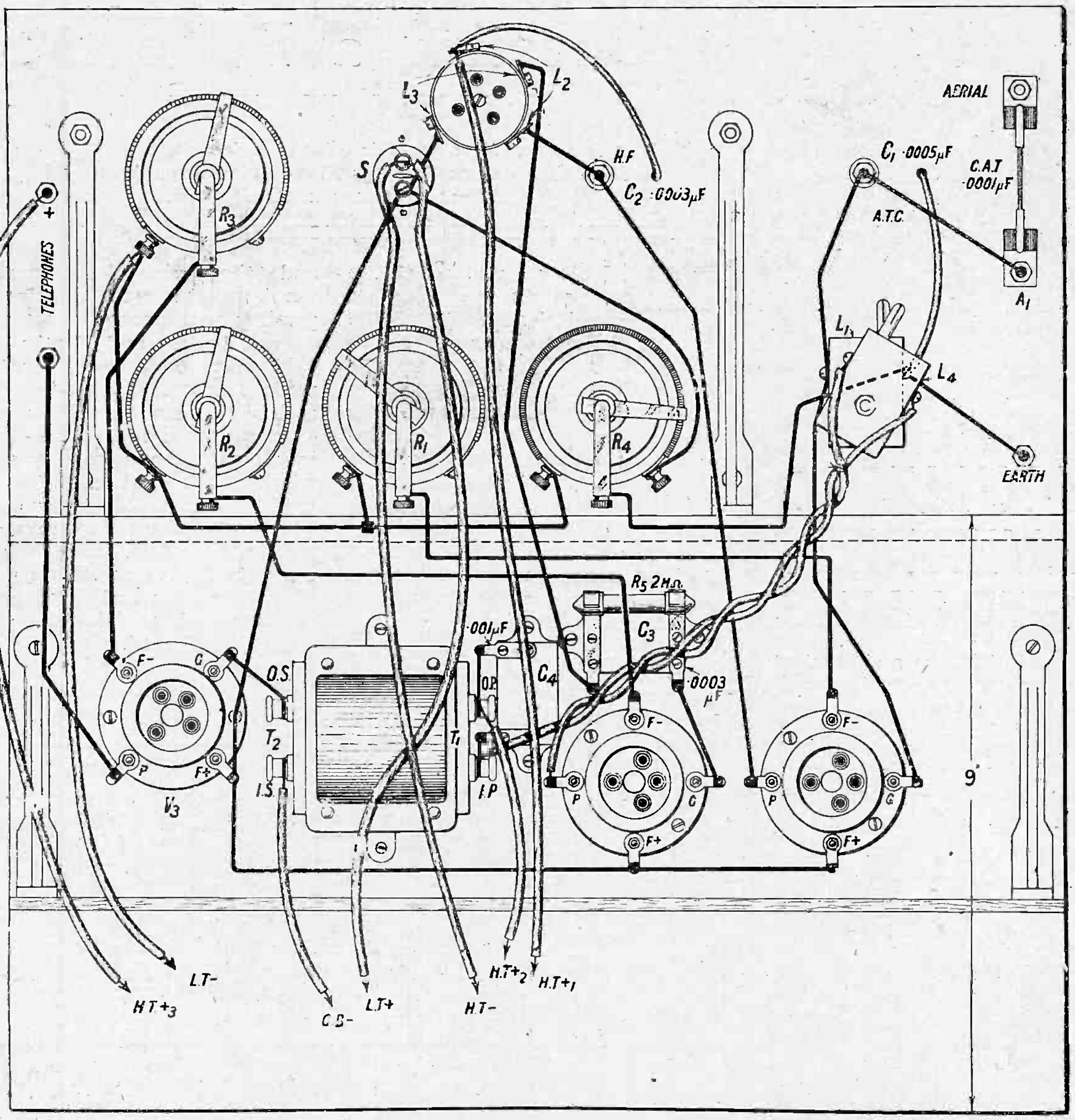


Fig. 9.—The wiring of the receiver may be easily followed from this working drawing. Blueprint No. 125B, Post Free, 1/6..

the reaction coil should be brought towards the aerial coil and slight retuning done on both variable condensers. It will be found best to work with the potentiometer towards the negative end, that is with the pointer over towards the right, and with as small a reaction coil as possible rather than with a bigger reaction coil and the potentiometer towards the positive end of the winding. Better results are usually obtained in this way.

For 5XX and Radio-Paris ordinary parallel tuning should be employed with a No. 150 for the aerial coil and a No. 100 or smaller coil for reaction. The H.F. transformer should be one for the 1,100 to 3,000 range.

Test Report

In practice the set has been used on an average aerial at Bexley Kent, roughly 12 miles south-east of the London station. The valves employed were of the D.E.3 type. Adequate loud-speaking was obtained from 2LO and 5XX during a preliminary test and on a 4 ft. frame the former station gave results sufficiently loud to be pleasant in a small room. On the detector and high frequency valves between 40 and 60 volts proved suitable, while on the L.F. 72 volt H.T. and 3 volt grid bias were used.

During other tests carried out in daylight, when reception conditions were far from favourable, Eiffel Tower was received at fair loud-speaker strength using a Gambrell "F" coil for the aerial and a "B" for reaction with a 2,500-7,000 metre McMichael H.F. transformer. Radio-Paris also gave fair loud-speaking, using the sizes of coils and transformer indicated previously.

Of the B.B.C. stations, Cardiff Newcastle and several others unidentified gave good telephone signals, although somewhat marred in quality by strong morse jamming and atmospherics. After dark Petit Parisien, and a number of German stations were received on the telephones at quite a pleasant strength.

Choosing a Radio Set

By JOHN W. BARBER.

The newcomer to wireless is often at a loss to know just how to choose his set, and in this contribution some indication of the most common needs is given.

MANY obstacles stand in the path of the man who has just decided to "put the wireless in," such as where to put the set, how to fix up the aerial, objections on the part of the landlord, and so on, hence the actual time taken over the installing is sometimes lengthy. On the subject of the latter difficulty, a case was recently brought to the writer's notice in which permission was only obtained from the landlord on condition that the aerial was lowered when the tenant was not actually listening!

Personal Needs

To come, however, to the subject of the present article, the would-be listener is faced with the problem of choosing the particular set to suit his own requirements, which are in all probability entirely different from those of his "wireless" friends. The capabilities of the proposed set must be taken into consideration, and whether it is desired to operate a loud speaker. The various forms of high-frequency and low-frequency amplification alone are a puzzle to the uninitiated, and the tyro may well turn to someone more experienced for advice.

It is the purpose of these notes to set forth briefly the type of receiver which will fill the most common needs, though it must be emphasized at the outset that it is clearly impossible to design receivers for every reader's particular circumstances, and thus wide departures from the form of set laid down may possibly be necessary.

Aerials and Earths

It must be assumed that the reader has erected the best possible aerial in his own situation, and this does not mean that the aerial will in all cases be a good one electrically, but that it is the best that circumstances will permit. The earth connection must also receive attention, and such important items as thorough insulation of the earth-lead as well as the aerial and lead-in, should not be overlooked.

The first case under consideration will be that of the man who lives within effective crystal range of a broadcasting station and who desires to operate a loud speaker upon that station, nothing in the way of distant music being required. The simplest possible receiver in this case will probably be that indicated in Fig. 1, which will be seen to consist of a crystal detector followed by two steps of transformer coupled- note magnification. Such a set is ideal from the point of view of the family, as, once the correct values of high tension and grid bias voltages have been applied, the crystal setting made, and the tuning condenser set to the correct adjustment, the only operation necessary to put the set into operation is to light the valves. The crystal detector may quite easily be one of the permanently adjusted variety.

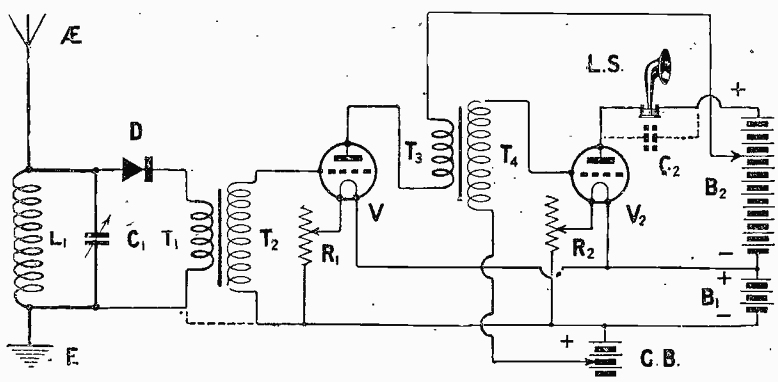


Fig. 1.—A simple yet effective circuit for loud speaker reception of the local station.

The wireless craze once having caught him, the average listener is seldom content for long with a set such as that outlined above, and will undoubtedly soon be wanting to hear other stations. Several problems at once occur. Firstly, there is the question of selectivity—can the local station be eliminated or must one have recourse to elaborate tuning systems? Are we to employ high-frequency amplification, and, if so, to what extent?

Aerial Coupling

In average circumstances, nearer than 10 miles from a main station, we shall require something more than a simple direct-coupled circuit, with parallel tuning condenser, in order to receive stations other than the nearest one, and the enthusiast has several forms at his disposal. Firstly, we may have a small coil in the aerial circuit, untuned, and loosely coupled to a tuned secondary circuit, such an arrangement being known as a semi-aperiodic circuit; the coil in the aerial may be wound over the secondary coil and so arranged that the coupling is fixed. Again, the aerial coil may be made a part of the grid coil by taking a tapping point at a given number of turns from the earth end of the grid coil, such an arrangement being known as auto-coupling.

Split Secondary Tuning

Cases may arise in which even greater selectivity than that given by these arrangements will be required, and we may use the split secondary method of tuning. This consists of a tuned aerial circuit coupled to a tuned secondary, the inductance of which is split into two portions, the larger being coupled to the aerial coil, while the reaction coil is coupled to the smaller portion. Very selective results are obtainable with such an arrangement, and although some practice is needed before skill in operation is attained, the final results will well repay the trouble.

Neutrodyne Coupling

The inclusion of stages of high-frequency amplification, where necessary, may increase the selectivity of a set, owing to the increase in the number of tuned circuits, it being assumed that either the tuned anode or tuned transformer systems will be used.

For distant reception in telephone receivers, at least one stage of radio frequency amplification should be employed, preferably stabilized by the neutrodyne system, in order that we do not have to work with a positive bias on the grid of the first valve, as this decreases selectivity as well as sensitivity. A valve detector, with reaction, should follow, and one stage of note-magnification, this forming a good all-round set for telephone work. In cases where loud-speaking is required, we shall need another stage of note magnification, transformer coupled, or more if resistance-capacity or choke coupling is employed. Power valves should preferably be employed for such work, and in the case of resistance coupled amplifiers, the special valves of the D.E.5B and D.F.A.4 type should be employed for best results.

For loud-speaker work at distances of 50 miles or so, such a cir-

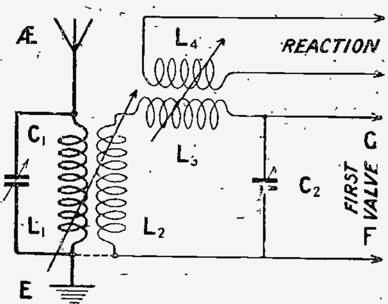


Fig. 2—Illustrating the tuning arrangement in a split secondary circuit.

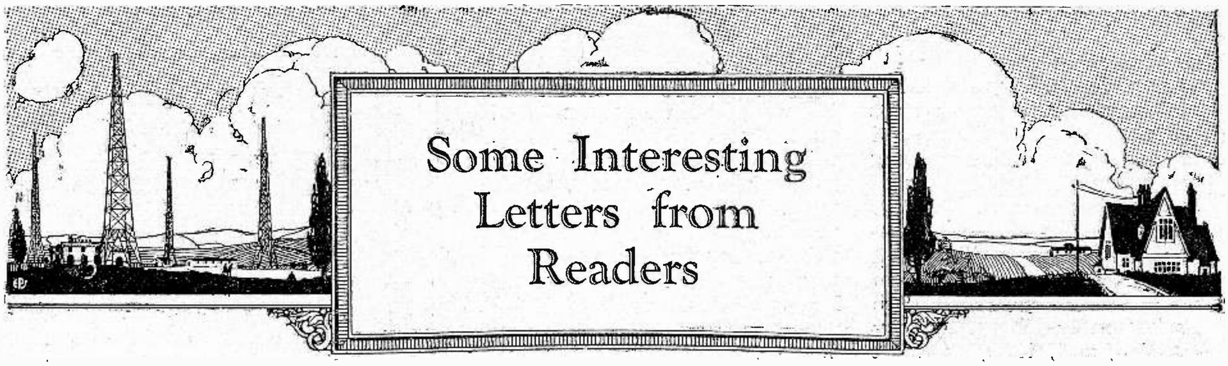
cuit as that outlined above will, in fair conditions, give satisfaction, but for consistent reception at great distances, two or even three stages of radio-frequency amplification should be employed, and again these should be neutrodyned.

Super-Heterodynes

Going one stage further, for the man who wants to hear everything possible, with as few controls as possible, one can do nothing but point to the super-heterodyne; it must, however, be pointed out that in the construction of such a receiver, many obstacles are met with, unless some standard design is followed, and the beginner is not advised to make a "super het." for his first receiver.

Follow a Design

When building your first set, it is advisable to follow someone else's design and see how that works, using the same parts as he used, or others equally good. Afterwards, when you have gained some experience you will be able to modify the design and build another set on your own lines and to suit your own desires.



Some Interesting Letters from Readers

The Seven-Valve T.A.T. in Chile

SIR,—I should just like to let you know the results I have obtained on first trials of the "Seven-Valve T.A.T. Receiver," by John Scott-Taggart, F.Inst.P., A.M.I.E.E., as described in MODERN WIRELESS of January, 1925.

The circuit was made with American components and almost exactly as described. Home-made "spider-web coils" were used for the tuning coils, and the tapped reactances were made exactly as described. Only *one stage* of audio-frequency amplification was used. Cunningham C301 A valves were used throughout, having 90 volts on the amplifier valves and 45 volts on the detector. Reaction was not used.

Local stations came in at full loud-speaker strength. These locals, I might add, are what are called here "Mosquitoes," and consist of two or more UV201A's, with the 220 volts of the lighting mains as H.T.

Santiago, "Radio Chilena CRC," came in very loud on the loud-speaker. Next I tuned Buenos Aires, and LOR and LOW came in wonderfully clear and as strong as Santiago. By strong I mean that in a large-sized room signals were just not too loud to be unpleasant. Santiago is about 60 miles distant, I suppose, and Buenos Aires 600 to 700 miles. I also received a small amateur station at Buin, south of Santiago, on the loud-speaker, and an American station giving a geography lesson, but I could not miss my dinner to get the name of this station, enthusiastic as I am. I forgot also to mention reception of the station of the newspaper *El Mercurio* from Santiago. This is a smaller powered station than CRC, but it came in at good loud-speaker strength.

I found the set very selective indeed, and was able to get through "local rubbish" with no trouble at all.

Static here is terrific, but on this receiver seemed to be less than on others I have.

I congratulate you on this receiver, as, honestly speaking, it is by far the best I have made to date. Yours faithfully,

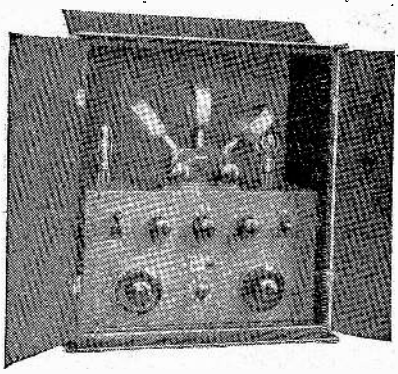
T. S. R. KNIGHT.

Valparaiso, Chile.

P.S.—The above are first-night trials with unsoldered joints, etc., and when I finish the set as it should be and add a stage of "push-pull" L.F. amplification, it should give even more wonderful results.

The Four-Valve T.A.T. Receiver

SIR,—The enclosed photograph depicts a four-valve T.A.T. receiver (Mr. John Scott-Taggart, MODERN WIRELESS for December,



Mr. Watson's Four-Valve T.A.T. Receiver.

1924) which has been in use with the utmost satisfaction for some months.

As will be apparent from the photograph, no plug-in type of coil is used as the aperiodic anode inductance, this being a tapped inductance contained internally and brought out to a switch and studs. The last stud cuts out the coil and brings into circuit a resistance.

Results indicate that your test reports are very conservative, and Mr. J. Scott-Taggart is deserving of all praise for this excellent circuit.

I hope to alter the set to include a wave-trap, but I find difficulty in keeping pace with your multifarious improvements.—Yours faithfully,

W. WATSON.

Harlesden.

The Three-Valve Dual

SIR,—Just a few lines to express my appreciation of your Three-valve Dual set (MODERN WIRELESS for March, 1924, by Mr. J. Scott-Taggart). I built this set early in the winter, and on a favourable night I could get all the B.B.C. main stations at loud-speaker strength, and several relay stations on 'phones, but since the long evenings have come results are not so good. With aerial and earth disconnected I have often picked up Belfast, 38 miles away (quite readable), and in the dark evenings with a 14 ft. indoor aerial, 7 ft. high, I have heard a number of the main stations on 'phones at good strength, and on one rare occasion London, Bournemouth, Manchester and Newcastle at loud-speaker strength. There are five of your sets in use close to me (in the country) all giving satisfaction.—Yours faithfully,

J. T. BURNS.

Co. Tyrone, Ireland.

The "Tri-Cell" Receiver

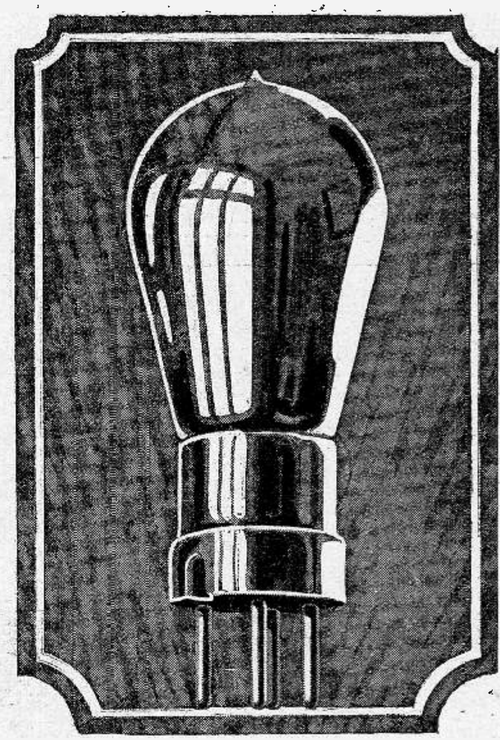
SIR,—I think it will interest you to know that I received the American Station KDKA on the "Tri-Cell" Reflex Set, for dull emitters, described in last September's issue of MODERN WIRELESS, by Mr. Percy W. Harris. I received the above station on June 17th, at 1 a.m. The dance music and singing were at good crystal set strength on my headphones.

A friend of mine (who is an expert in wireless) considers it a fine set in all its three functions—high-frequency amplification, rectification and low-frequency amplification. Trusting other users of your sets reap as much pleasure from them as I do.—Yours truly,

VICTOR G. GRIMBLY.

Bromley-by-Bow, E.3.

Louden Valves



The 6-volt Dull Emitter.

THE economy of the Dull-Filament Valve is undoubted. Its low current consumption, especially if you possess a multi-valve set, will save you several pounds a year in the recharging of your accumulators alone.

The economy, of course, is all the greater if you can fit the Dull-Emitter Valve straight on to your set without having to alter the Filament Resistances. For this reason we have recently placed on the market a Louden Dull Emitter which works at 6 volts. This means that if you are now using ordinary bright-emitting valves, getting their current from a 6-volt accumulator, you can substitute Dull-Emitting Loudens for them and reduce your accumulator bill to one-seventh. This, if you consider it, means quite a large saving in a year's broadcasting expenditure.

To effect this saving, incidentally, does not involve any large initial outlay. The Louden 6-volt Dull-Emitter only costs 13s. 6d., and this is not much more than you have to pay for the ordinary Bright Emitter. In addition you get a valve which has become famous for its qualities of Silver Clear Reproduction, and which will improve your reception beyond recognition.

If you desire a personal test of these valves visit your local retailer and ask to hear them. They are a revelation in clear reception.

LOUDEN DULL EMITTERS.

Type F.E.R.1 for Detection and L.F. Amplification.

Type F.E.R.2 for H.F. Amplification.

Filament Amps. 0.1

Please state whether you require them for a 4-volt or 6-volt Accumulator.

4-Volt Type 12/-

6 Volt Type 13/6

NOTE.—The Louden Bright-Emitter is now available at the wonderfully low price of **7/-**

Filament Volts	4.8—5
Filament Amps.	0.4

Types F1 and F2. Price 7/-

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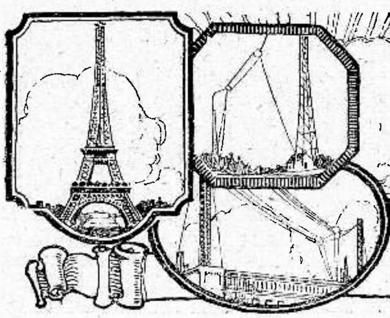
Advt. of the Fellows Magneto Co., Ltd., Park Royal, London, N.W. 10.

E.P.S. 52



Regular Programmes from Continental Broadcast Stations

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

All Hours of Transmissions reduced to British Summer Time.

Ref. No.	B. S. T.	Name of Station.	Call Sign and Wave-length.	Situation.	Nature of Transmission.	Closing Time or Approx. Duration.	Approx. Power used.
					WEEK DAYS.		
	a.m.						
1	5.45	Hamburg	—— 395 m.	Germany	Time Signal, Weather Report	5 mins.	1.5 Kw.
2	7.40	Eiffel Tower	FL 2650 m.	Paris	Weather Forecast	5 mins.	5 Kw.
9	7.55	Vaz Diaz	PCFF 1950 m	Amsterdam	Stocks, Shares and News	10 mins.	2 Kw.
211	9.0	Radio-Wien	—— 530 m.	Austria	Market Prices	10 mins.	1.5 Kw.
238	9.55	Vaz Diaz	PCFF 1950 m	Amsterdam	Time Signal	3 mins.	2 Kw.
8	10.23	Eiffel Tower	FL 2650 m. DBX	Paris	Time Signal in G.M.T. (Spark)	3 mins.	60 Kw.
10	11.0	Eiffel Tower	FL 2650 m.	Paris	Time Signal in Greenwich Sidereal Time (Spark)	5 mins.	60 Kw.
180	11.15	Breslau	—— 418 m.	Silesia	Weather Report—Exchange	10 mins.	1.5 Kw.
260	11.40	Hilversum	NSF 1050 m.	Holland	News Bulletin	10 mins.	5 Kw.
13	11.44	Eiffel Tower	FL 2650 m.	Paris	Time Signal in G.M.T. (Spark)	3 mins.	60 Kw.
14	11.55	Eiffel Tower	FL 2650 m.	Paris	Fish Market Quotations, Cotton Exchange (Monday excepted)	10 mins.	5 Kw.
15	11.55	Frankfurt	—— 470 m.	Frankfurt	Time Signal in C.E.T. (Spoken), followed by News	5 mins.	1.5 Kw.
	Noon.						
182	12.0	Leipzig	—— 454 m.	Germany	Concert	12.50 p.m.	1.5 Kw.
184	12.0	Zurich	—— 515 m.	Switzerland	Weather Report	5 mins.	500 Watts.
261	12.0	Helsingfors	—— 370 m.	Finland	Weather Report	5 mins.	1 Kw.
	p.m.						
249	12.5	Breslau	—— 418 m.	Silesia	Morning Concert	12.55 p.m	1.5 Kw.
20	12.15	Voxhaus	—— 505 m.	Berlin	Exchange Opening Prices	5 mins.	4.5 Kw.
30	12.30	Stockholm	SASA 427 m.	Sweden	Weather Forecast, followed by Exch. and Time Sig. from Nauen	1 p.m.	500 Watts.
32	12.30	Radio-Paris	SFR 1750 m. DBX	Clichy	Concert, followed by News	2 p.m.	8 Kw.
239	12.35	Royal Dutch Meteorological Inst.	KNML —— 1100 m.	Utrecht (De Bilt)	Night Frost Reports	10 mins.	2 Kw.
23	12.57	Nauen	POZ 3000 m.	Berlin	Time Signal in G.M.T. (Spark), This Signal is relayed by Zurich and all German stations except Munich and Stuttgart	8 mins.	50 Kw.
157	1.0	Zurich	—— 515 m.	Switzerland	Weather Forecast, Shares & News	5 mins.	500 Watts.
33	1.0	Haeren	BAV 1100 m.	Brussels	Weather Forecast in French and English.	8 mins.	150 Watts.
34	2.0	Munich	—— 485 m.	Bavaria	News and Weather Report	10 mins.	1.5 Kw.
202	2.0	Munster	—— 410 m.	Westphalia	Concert or Lecture	3 p.m.	1.5 Kw.
37	2.15	Voxhaus	—— 505 m.	Berlin	Stock Exchange News	5 mins.	4.5 Kw.
35	2.30	Komarow	—— 1800 m	Czecho-Slovakia	Stock Exchange and Late News	10 mins.	1 Kw.
39	2.45	Eiffel Tower	FL 2600 m.	Paris	Exchange Opening Prices (Saturday excepted).	8 mins.	5 Kw.
181	3.0	Breslau	—— 418 m.	Silesia	News and Exchange Quotations	10 mins.	1.5 Kw.
40	3.0	Munster	—— 410 m.	Westphalia	Stocks, Shares and News	10 mins.	1.5 Kw.
47	3.30	Eiffel Tower	FL 2650 m.	Paris	Exch. Quotations (Sat. excepted)	5 mins.	5 Kw.
250	4.0	Munich	—— 485 m.	Bavaria	Concert	6 p.m.	1.5 Kw.
159	4.10	Radio-Wien	—— 530 m.	Vienna	News, followed by Concert	6 p.m.	1.5 Kw.
240	4.10	Vaz Diaz	PCFF 1950 m	Amsterdam	Time Signal, Stocks and Shares	3 mins.	2 Kw.
42	4.30	Frankfurt	—— 470 m.	Germany	Light Orchestra	6 p.m.	1.5 Kw.
44	4.30	Voxhaus	—— 505 m.	Berlin	Concert, followed by News	6.30 p.m.	4.5 Kw.
46	4.30	Leipzig	—— 454 m.	Germany	Concert	6 p.m.	1.5 Kw.
52	4.30	Eiffel Tower	FL 2650 m.	Paris	Exch. Closing Prices (except Sat.)	8 mins.	5 Kw.

Ref. No.	B.S.T.	Name of Station	Call Sign and Wave-length	Situation	Nature of Transmission	Closing Time or Approx. Duration	Approx. Power used
			WEEK DAYS (Contd.)				
	p.m.						
226	4.30	Stuttgart ..	—— 443 m.	Wurtemburg	Concert	6.30 p.m.	1.5 Kw.
43	5.0	Konigsberg ..	—— 463 m.	East Prussia	Light Orchestra (Wed. and Sat., Children's Hour)	6 p.m.	1 Kw.
158	5.0	Zurich	—— 515 m.	Switzerland	Concert by Hotel Baur-au-Lac .. relayed	6 p.m.	500 Watts.
166	5.0	Breslau ..	—— 418 m.	Silesia ..	Light Orchestra	6 p.m.	1.5 Kw.
263	5.10	Hilversum ..	NSF 1050 m.	Holland ..	Concert, followed by News (Mon. excepted)	7.10 p.m.	5 Kw.
186	6.0	Frankfurt ..	—— 470 m.	Germany ..	Lectures	7.30 p.m.	1.5 Kw.
187	6.0	Hamburg ..	—— 395 m.	Germany ..	Music or Lecture	7.0 p.m.	1.5 Kw.
241	6.0	Warsaw ..	PTR 385 m.	Poland ..	Concert	7.0 p.m.	——
162	6.15	Eiffel Tower ..	FL 2650 m.	Paris ..	Concert, followed by News Bulletin	7.10 p.m.	5 Kw.
161	6.30	Munich ..	—— 485 m.	Bavaria ..	Lecture	7.15 p.m.	1.5 Kw.
298	7.0	Barcelona ..	EAJ 1325 m.	Spain ..	Concert	8 p.m.	650 Watts.
299	7.0	Komarow ..	—— 1800 m.	Brunn ..	Concert	8 p.m.	1 Kw.
264	7.15	Oslo ..	—— 382 m.	Norway ..	Time Signal and Concert ..	9 p.m.	1 Kw.
234	7.30	Strassnice ..	—— 550 m.	Prague ..	Concert	10 p.m.	1 Kw.
228	7.50	Hilversum ..	NSF 1050 m.	Holland ..	Concert on Monday, 6.40–8.40 p.m.	10 p.m.	5 Kw.
63	8.0	Stuttgart ..	—— 443 m.	Wurtemburg	Lecture, followed by Evening Programme.	11 p.m.	1.5 Kw.
58	8.0	Eiffel Tower ..	FL 2650 m.	Paris ..	General Weather Forecast ..	8 mins.	5 Kw.
188	8.0	Frankfurt ..	—— 470 m.	Germany ..	Lecture	8.30 p.m.	1.5 Kw.
61	8.0	Konigsberg ..	—— 463 m.	East Prussia	Concert and Late News ..	10 p.m.	1 Kw.
62	8.0	Hamburg ..	—— 395 m.	Germany ..	Concert, Late News and Dance Music.	11 p.m.	1.5 Kw.
66	8.0	Lausanne ..	HB2 850 m.	Switzerland	Concert (Wednesdays excepted)	9.30 p.m.	300 Watts.
73	8.0	Munich ..	—— 485 m.	Bavaria ..	Concert and News	11 p.m.	1.5 Kw.
300	8.0	Barcelona (Radio-Catalana)	EAJ13 460 m.	Spain ..	Concert	10 p.m.	1 Kw.
301	8.0	Bilbao ..	EAJ9 415 m.	Spain ..	Concert	10 p.m.	1 Kw
74	8.15	Radio-Belge ..	SBR 265 m.	Brussels ..	Concert, preceded and followed by News.	10.10 p.m.	2.5 Kw.
64	8.15	Zurich ..	—— 515 m.	Switzerland	Concert, followed by Late News	10 p.m.	500 Watts.
65	8.15	Leipzig ..	—— 454 m.	Germany ..	Concert and News (3 days a week until 11.30 p.m.)	10 p.m.	1.5 Kw.
76	8.15	Radio-Paris ..	SFR 1750 m.	Clichy ..	Detailed News Bulletin	8.45 p.m.	8 Kw.
242	8.15	Royal Dutch Meteorological Inst.	KNML 1100 m.	Utrecht (De Bilt)	Night Frost Report	5 mins	2 Kw.
252	8.15	Lyons	—— 280 m.	France ..	Concert	10 p.m.	300 Watts.
67	8.30	Frankfurt ..	—— 470 m.	Germany ..	Concert and News	11 p.m.	1.5 Kw.
59	8.30	Munster ..	—— 410 m.	Westphalia.	Concert, followed by News ..	10.45 p.m.	1.5 Kw.
72	8.30	Voxhaus ..	—— 505 m.	Berlin ..	Concert, followed by News and Weather Report	10.30 p.m.	4.5 Kw.
69	8.30	Breslau ..	—— 418 m.	Silesia ..	Concert	10 p.m.	1.5 Kw.
253	8.30	Agen	—— 318 m.	France ..	Exchange Quotations and News Bulletin (Concert once a week)	9 p.m.	250 Watts.
60	8.30	Radio-Wien ..	—— 530 m.	Vienna ..	Evening Programme	10 p.m.	1.5 Kw.
254	8.30	Radio-Toulouse	—— 275 m.	France ..	Concert Tests	10 p.m.	2 Kw.
77	8.45	Radio-Paris ..	SFR 1750 m.	Clichy ..	Concert. Time signal at 9 p.m.	10 p.m.	8 Kw.
164	9.0	Radiofonica Italiana	—— 425 m.	Rome ..	Concert, followed by News and Dance Music	11.30 p.m.	4 Kw.
75	9.0	Ecole Sup. des Postes	FPTT 458 m.	Paris ..	Concert, sometimes preceded by Lecture	11 p.m.	500 Watts.
245	9.0	Lyngby ..	—— 2400 m.	Denmark ..	Press News	9.15 p.m.	——
302	10.0	Seville ..	EAJ5 350 m.	Spain ..	Concert	11.30	1 Kw.
177	10.0	Radio-Barcelona	EAJ1 325 m.	Barcelona ..	Concert	Midnight	650 Watts.
79	11.0	Eiffel Tower ..	FL 2650 m. ..	Paris ..	Time Signal in Greenwich Sidereal Time (Spark)	5 mins.	60 Kw.
80	11.10	Eiffel Tower ..	FL 2650 m. ..	Paris ..	Weather Forecast	5 mins.	5 Kw.
81	11.44	Eiffel Tower ..	FL 2650 m. ..	Paris ..	Time Signal in G.M.T. (Spark) ..	3 mins.	60 Kw.
303	12.0	Radio Catalana	EAJ13 460 m.	Barcelona	Concert	1 a.m.	1 Kw.
82	12.57	Nauen ..	POZ 3000 m.	Berlin ..	Time Signal in G.M.T. (Spark) ..	8 mins.	50 Kw.

SUNDAYS.

Ref. No.	B.S.T.	Name of Station	Call Sign and Wave-length	Situation	Nature of Transmission	Closing Time or Approx. Duration	Approx. Power used
	a.m.						
83	8.0	Frankfurt ..	—— 470 m.	Germany ..	Morning Prayer	1 hour	1.5 Kw.
85	8.30	Leipzig ..	—— 454 m.	Germany ..	Morning Prayer	10.0 a.m.	1.5 Kw.
165	9.0	Konigsberg ..	—— 463 m.	E. Prussia	Morning Prayer	9.45 a.m.	1 Kw.

SUNDAYS (Contd.)

Ref. No.	B. S. T.	Name of Station.	Call Sign and Wave-length.	Situation.	Nature of Transmission.	Closing Time or Approx. Duration.	Approx. Power used.
	a.m.						
212	9.0	Voxhaus ..	— 505 m.	Berlin ..	Morning Prayer	10 a.m.	4.5 Kw.
265	9.0	Helsingfors ..	— 370 m.	Finland ..	Divine Service	9.30 a.m.	1 Kw.
214	9.0	Munster ..	— 410 m.	Westphalia	Morning Prayer	10.0 a.m.	1.5 Kw.
213	9.40	Bloemendaal ..	— 350 m.	Holland ..	Divine Service	1 hour	—
256	10.0	Copenhagen ..	— 775 m.	Denmark ..	Divine Service	11.15 a.m.	1.5 Kw.
87	10.23	Eiffel Tower ..	FL 2650 m.	Paris ..	Time Signal in G.M.T. (Spark) ..	3 mins.	60 Kw.
86	11.0	Komarow ..	— 1800 m.	Czecho-Slovakia	Sacred Concert	1 hour	1 Kw.
89	11.0	Eiffel Tower ..	FL 2650 m.	Paris ..	Time Signal in Greenwich Sidereal Time (Spark)	5 mins.	60 Kw.
207	11.0	Oslo	— 382 m.	Norway ..	Divine Service	Noon.	1 Kw.
90	11.0	Strasnice ..	— 550 m.	Prague ..	Classical Music	1 hour	1 Kw.
92	11.5	Radio-Wien ..	— 530 m.	Vienna ..	Concert	12.50 p.m.	1.5 Kw.
94	11.30	Stuttgart ..	— 443 m.	Wurtemberg	Classical Concert	1 hour	1.5 Kw.
192	11.30	Munich ..	— 485 m.	Bavaria ..	Sacred Concert	1.0 p.m.	1.5 Kw.
96	11.30	Konigswusterhausen ..	LP 1300 m.	Berlin ..	Concert	12.50 p.m.	5 Kw.
95	11.44	Eiffel Tower ..	FL 2650 m.	Paris ..	Time Signal in G.M.T. (Spark)	3 mins.	60 Kw.
97	11.55	Eiffel Tower ..	FL 2650 m.	Paris ..	Fish Market Quotations ..	4 mins.	5 Kw.
	Noon						
98	12.0	Stockholm ..	SASA 427 m.	Sweden ..	Divine Service	1.15 p.m.	500 Watts.
273	12.0	Breslau ..	— 418 m.	Silesia ..	Sacred Concert	12.55 p.m.	1.5 Kw.
	p.m.						
102	12.45	Radio-Paris ..	SFR 1750 m.	Clichy ..	Concert, followed by News ..	1.45 p.m.	8 Kw.
101	12.57	Nauen ..	POZ 3000 m.	Berlin ..	Time Signal in G.M.T. (Spark)	3 mins.	50 Kw.
215	2.0	Munster ..	— 410 m.	Westphalia	Concert	4.0 p.m.	1.5 Kw.
268	2.40	Hilversum ..	NSF 1050 m.	Holland ..	Concert	4.40 p.m.	5 Kw.
216	3.0	Lyngby ..	— 2400 m.	Denmark ..	News	10 mins.	500 Watts.
104	4.0	Breslau ..	— 418 m.	Silesia ..	Children's Stories, followed by concert	6.30 p.m.	1.5 Kw.
108	4.0	Munich ..	— 485 m.	Bavaria ..	Concert	5.0 p.m.	1.5 Kw.
197	4.0	Frankfurt ..	— 470 m	Germany ..	Children's Corner	5.0 p.m.	1.5 Kw.
106	4.0	Radio-Wien ..	— 530 m.	Vienna ..	Afternoon Concert	6.0 p.m.	1.5 Kw.
105	4.30	Stuttgart ..	— 443 m.	Wurtemberg	Light Orchestra	6 p.m.	1.5 Kw.
170	4.30	Leipzig ..	— 454 m.	Germany ..	Light Orchestra	6.0 p.m.	1.5 Kw.
217	4.40	Bloemendaal ..	— 350 m.	Holland ..	Divine Service	5.40 p.m.	—
169	5.0	Voxhaus ..	— 505 m.	Berlin ..	Light Orchestra	6.30 p.m.	4.5 Kw.
167	5.0	Zurich	— 515 m.	Switzerland	Hotel Baur-au-lac, Concert relayed	6.0 p.m.	500 Watts.
171	5.0	Frankfurt ..	— 470 m.	Germany ..	Light Orchestra	6.0 p.m.	1.5 Kw.
168	5.0	Konigsberg ..	— 463 m.	East Prussia	Light Orchestra	6.0 p.m.	1 Kw.
111	5.0	Radio-Belge ..	SBR 265 m.	Brussels ..	Concert	1 hour	2.5 Kw.
257	6.0	Hamburg ..	— 395 m.	Germany ..	Concert	7.0 p.m.	1.5 Kw.
219	6.0	Malmo	SASC 270 m.	Sweden ..	Concert	8.0 p.m.	1 Kw.
112	6.15	Eiffel Tower ..	FL 2650 m.	Paris ..	Concert, followed by News ..	1 hour	5 Kw.
180	7.0	Barcelona ..	EAJ1 325 m.	Spain ..	Concert	10.30 p.m.	650 Watts.
269	7.15	Oslo	— 382 m.	Norway ..	Lecture and Concert	9.0 p.m.	1 Kw.
270	7.50	Hilversum ..	NSF 1050 m.	Holland ..	Concert	9.50 p.m.	5 Kw.
237	8.0	Strassnice ..	— 550 m.	Czecho-Slovakia	Concert	9.0 p.m.	1 Kw.
176	8.0	Copenhagen ..	— 775 m.	Denmark ..	Concert, followed by News ..	9.30 p.m.	1.5 Kw.
114	8.0	Radio-Wien ..	— 530 m.	Vienna ..	Concert	10.0 p.m.	1.5 Kw.
118	8.0	Konigsberg ..	— 463 m.	E. Prussia	Concert	10.0 p.m.	1 Kw.
173	8.0	Frankfurt ..	— 470 m.	Germany ..	Lecture, followed by evening programme	10.0 p.m.	1.5 Kw.
119	8.0	Hamburg ..	— 395 m.	Germany ..	Concert, followed by News ..	11.0 p.m.	1.5 Kw.
120	8.0	Eiffel Tower ..	FL 2650 m.	Paris ..	General Weather Forecast ..	8 mins.	5 Kw.
125	8.0	Stuttgart ..	— 443 m.	Wurtemberg	Concert, Dance Music from 10.0 p.m.	11 p.m.	1.5 Kw.
174	8.0	Munich ..	— 485 m.	Bavaria ..	Concert	11.0 p.m.	1.5 Kw.
124	8.0	Breslau ..	— 418 m.	Silesia ..	Light Orchestra, Dance Music at 10.0 p.m.	10.30 p.m.	1.5 Kw.
116	8.0	Munster ..	— 410 m.	Westphalia	Classical Concert	10.0 p.m.	1.5 Kw.
128	8.15	Radio-Paris ..	SFR 1750 m.	Clichy ..	Detailed News Bulletin	9.0 p.m.	8 Kw.
122	8.15	Zurich ..	— 515 m.	Switzerland	Concert	10.0 p.m.	500 Watts.
123	8.15	Leipzig ..	— 454 m.	Germany ..	Symphony Concert	10.0 p.m.	1.5 Kw.
127	8.30	Radio-Belge ..	SBR 265 m.	Brussels ..	Concert, followed by News ..	10.10 p.m.	2.5 Kw.
220	8.30	Voxhaus ..	— 505 m.	Berlin ..	Evening Programme	11.0 p.m.	4.5 Kw.
129	8.30	Ecole Superieure	FPTT 458 m.	Paris ..	Concert or Lecture (May begin 15 mins. earlier or later)	10.30 p.m.	500 Watts.

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G. P. Kendall, B.Sc.

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Twin Flex, 12yds....... 1/9
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25 .. 4/10 35, 40, .. 4/10
50 .. 5/- 60 .. 5/4
75 .. 5/4 100 .. 6/9
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60 x 6/- 60 x 6/4
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Colvern Vernier........ 2/6
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If you buy 20/- goods at full list prices you can have one pair of high-class 'phones, value 12/6, 4,000 ohms, for 5/- extra.

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One hole fixing. Ebonite ends.

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Including knob and dial.

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Take up tiny space. Knob and dial free.

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Square Law low-loss.
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(including valves.)

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Indoor outdoor or frame, 49 strands

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Ebonite,
Stock sizes 3/16th.
6 x 6 7 x 5 each...... 1/2
8 x 6–9 x 6 each 1/10
10 x 8–12 x 6 .... 3/-
12 x 9................ 4/3
12 x 12 .... 5/6
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½ in. also stocked.

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			SUNDAYS (Contd.)				
	p.m.						
130	8.45	Radio-Paris ..	SFR 1750 m.	Clichy ..	Concert, followed by Dance Music	11.0 p.m.	8 Kw.
175	9.0	Radiofonica-Italiana	—— 425 m.	Rome ..	Concert, followed by Late News	11.30 p.m.	4 Kw.
131	9.15	Petit-Parisien ..	—— 345 m.	Paris ..	Concert (items announced in English as well as French)	11.0 p.m.	500 Watts.
132	10.0	Radio-Iberica ..	RI 392 m.	Spain ..	Concert	Midnight.	3 Kw.
133	11.0	Eiffel Tower ..	FL 2650 m.	Paris ..	Time Signal in Greenwich Side-real Time (Spark)	3 mins.	60 Kw.
134	11.44	Eiffel Tower ..	FL 2650 m.	Paris ..	Time Signal in Greenwich Mean Time (Spark)	3 mins.	60 Kw.
135	12.57	Nauen ..	POZ 3000 m.	Berlin ..	Time Signal in G.M.T. (Spark) ..	8 mins.	50 Kw.
			SPECIAL DAYS.				
	a.m.						
156	11.0	Radio-Wien ..	—— 530 m.	Austria ..	Tues., Thurs., Sat., Concert ..	12.50 p.m.	1.5 Kw.
	p.m.						
224	4.45	Munich ..	—— 485 m.	Bavaria ..	Wed., Children's Corner ..	½ hour	1.5 Kw.
142	5.40	Ned. Seintoes-Fabriek	NSF 1060 m.	Hilversum	Mon., Children's Hour	6.40 p.m.	3 Kw.
304	6.0	Radio-Iberica	RI 392 m.	Spain ..	Mon., Concert; Tues., Thur. (until midnight), Friday	9 p.m.	3 Kw.
203	6.0	Gotenborg ..	SASB 390 m.	Sweden ..	Tues., Concert	8 p.m.	500 Watts.
180	6.30	Belgrade ..	HFF 1650 m.	Serbia ..	Tues., Thurs. and Sat., Concert ..	1 hour	500 Watts.
271	7.0	Helsingfors ..	—— 370 m.	Finland ..	Tues., Thurs. and Sat., Concert	9.0 p.m.	1 Kw.
147	7.0	Stockholm ..	SASA 427 m.	Sweden ..	Wed., Thurs., Fri., Sat., Concert	8 p.m.	500 Watts.
221	8.0	Copenhagen ..	—— 775 m.	Denmark ..	Thurs. and Sat., Concert ..	9.30 p.m.	1.5 Kw.
258	8.0	Ravangen ..	—— 1095 m.	Denmark ..	Tues., Wed. and Fri., Concert	9 p.m.	800 Watts.
305	8.0	Komarow ..	—— 1800 m.	Brunn ..	Thurs., Fri. and Sat., Concert ..	9 p.m.	1 Kw.
225	8.45	Radio Paris ..	SFR 1750 m.	Paris ..	Sat., Special Gala Concert .. (Organised by *Le Matin*)	11 p.m.	10 Kw.
223	9.0	Malmo ..	SASC 270 m.	Sweden ..	Thurs. and Sat., Dance Music	11 p.m.	1 Kw.
154	9.15	Petit-Parisien	—— 345 m.	Paris ..	Tues. and Thurs., Concert (items announced in English as well as French)	11.0 p.m.	500 Watts.
210	10.0	Radio-Wien ..	—— 530 m.	Vienna ..	Wed. and Sat., Dance Music ..	11.30 p.m.	1.5 Kw.
155	10.0	Radio-Paris ..	SFR 1750 m.	Clichy ..	Two evenings per week, Dance Music	10.45 p.m.	8 Kw.
232	10.30	Voxhaus ..	—— 505 m.	Berlin ..	Thurs. and Sat., Dance Music ..	Midnight	4.5 Kw.
272	11.0	Munich ..	—— 485 m.	Bavaria ..	Wed. and Sat., Dance Music ..	Midnight to 1.0 a.m.	1.5 Kw.

The following are Relay Stations :—

Kassel, 288 m., 1 kw.; relays Frankfurt. Nuremberg, 340 m., 1 kw.; relays Munich.
Dresden, 292 m.; mostly relays Leipzig. Graz, 404 m.; relays Radio-Wien, occasionally.
Bremen, 330 m., 1 kw.; and Hanover 296 m., 1 kw.; relay Hamburg.

A READER'S SUCCESS

ENVELOPE No. 9.

SIR,—I think that after several months' use I should be able to give you a really accurate and fair description of the results with the "Single Valve Receiver," constructed according to Envelope No. 9.

I am seldom addicted to gushing, but I really must express my delight at having made such a splendid little set.

On three yards of ordinary bell wire, with an inferior earth, I have received during the past winter London, Cardiff, Manchester, Newcastle, Glasgow and many Continental stations, while the local relay station was received with strength sufficient to enable a "Junior" loud-speaker to be quite audible anywhere in a small room.

During the recent warm weather, usually considered unsuitable for long-distance reception, I have received several B.B.C. stations at surprising strength.

I have come to the conclusion that it is an "All Season Set," and one which does not need favourable conditions!—Yours faithfully,

EDWARD S. BRAMLEY.

Hull.

The Fate of the Broadcast Listener

THE possibility of serious over-crowding of the wavelength band allotted to the broadcasting stations already established or to be erected in the near future in Europe has excited considerable comment recently. Much apprehension has been expressed with regard to the ultimate fate of the broadcast listener, and there are those who predict that the day is not far distant when the local transmitting station will be the only one available to the listener for satisfactory reception.

Selectivity

Whatever may be the outcome of international investigation of the problem, there can be no doubt that even at the present day much experimental work is required in the direction of selectivity, while avoiding the inclusion of unmanageable complications in the receiver. In an article entitled "Selective Reception on the Broadcast Band," by A. D. Cowper, M.Sc., in the July 8 issue of *Wireless Weekly*, details were given of a receiver which was the outcome of experiments carried out to meet this pressing need for selectivity, without sacrificing stability or reasonable ease of handling. A different method of obtaining the required selectivity is to use a super heterodyne receiver, and an article in the same issue by G. P. Kendall, B.Sc., on the adjustment and operation of super heterodyne receivers should prove very helpful to any who are in difficulties with such sets.

The possibilities of reception on ultra-short waves without the employment of special valves or other components should appeal to many experimenters in this class of work. Practical details of a receiver designed along these lines were given by Stanley G. Rattee, M.I.R.E., in *Wireless Weekly* for June 24. In the July 1st issue current American practice in receivers for the short waves was illustrated by a full description of the Grebe "CR17" Receiver, details of which were supplied as first-hand information by Percy W. Harris, M.I.R.E., who was recently the guest of Mr. A. H. Grebe at the American broadcasting station WAHG, as recorded in the July issue of MODERN WIRELESS.

Curious feats of reception are from time to time recorded by users of crystal and one-valve sets. Some experiments carried out with a view to investigating the phenomena involved are recorded by D. J. S. Hartt, B.Sc., in an article entitled "Freak Reception and Neighbouring Aerials," which appeared in *Wireless Weekly* for July 1. This issue also contained the second of a series of articles on Wireless Measuring Instruments, by A. Johnson-Randall, who dealt with a subject which is worthy of study by all serious experimenters.

Losses

The problem of obtaining the utmost efficiency from a receiver involves a careful consideration of all parts of the circuit in detail, and particular attention to those points at which losses are liable to occur. In the August issue of the *Wireless Constructor* G. P. Kendall, B.Sc., discussed this problem and showed in a very interesting manner which of the various sources of loss should be regarded as the most important points.

.. Radio .. Construction
under expert guidance

The Radio Press envelopes are the most dependable guides for the radio constructor ever devised. Every step in the construction of a radio instrument is fully explained in a lucid manner by an expert. Providing the instructions are carefully carried out, a radio instrument described in an R.P. envelope will always be a great success.

RADIO PRESS ENVELOPES.

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3 **How to Build the "Simplicity" 3-Valve Set** .. .. .. By G. P. Kendall, B.Sc.	2/6	2/9
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11 **An Adaptable Crystal Set** .. .. .. By Percy W. Harris, M.I.R.E.	1/6	1/9

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1 For 2-Valve Set	1/-	1/3
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RADIO PRESS WIRELESS PANEL TRANSFERS	**6d.**	**8d.**
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All above can be obtained from Wireless Dealers, Booksellers—or direct from Dept. W,

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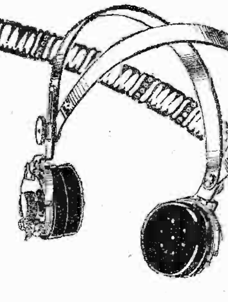

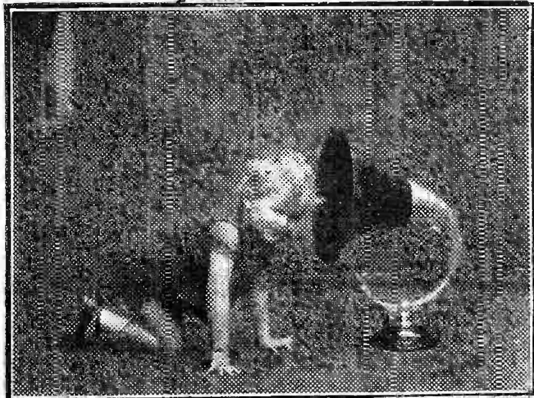

The incomparable Brown

IN every branch of industry there is inevitably some product which—by design, appearance or efficiency—is recognised as being beyond the range of competition. Radio proves to be no exception to the rule. You cannot compare other 'phones to Brown A-type. True, there may be some degree of external similarity—cords, headbands, and even cases can be produced to look very much alike. But the real essence of Brown superiority lies in its exclusive and fully patented tuned reed mechanism—a scientifically designed movement which permits the exact reproduction of even the faintest signals.

The same proved principles, which are also incorporated in every Brown Loud Speaker, are readily acknowledged by technical authorities as being one of the most brilliant contributions to the science of sound reproduction within recent years. Choose your Loud Speaker in no haphazard manner—do not consider it on external appearance alone—it is a serious investment worthy of your most careful attention. Your Dealer can demonstrate a Brown to you in one of its three sizes; hear it and then hear the others. We are confident that you'll agree that the incomparable Brown has no competitors.

LOUD SPEAKERS.

Type H.1, 21 in.
High, 120 ohms...£5 5 0
2000 ohms ...£5 8 0
4000 „ ...£5 10 0

Type H.2, 12 in.
High, 120 ohms £2 5 0
2000 ohms ...£2 8 0
4000 „ ...£2 10 0
Type Q.
All resistances...£15 15 0

CRYSTAVOX.

The Crystal Set Loud Speaker, requiring no valves or accumulators ...£6 0 0

HEADPHONES

A Type.
120 ohms ...50/- per pr.
2000&4000 ohms 50/- „
8000 ohms ... 60/- „
F Type.
120 ohms } 20/- „
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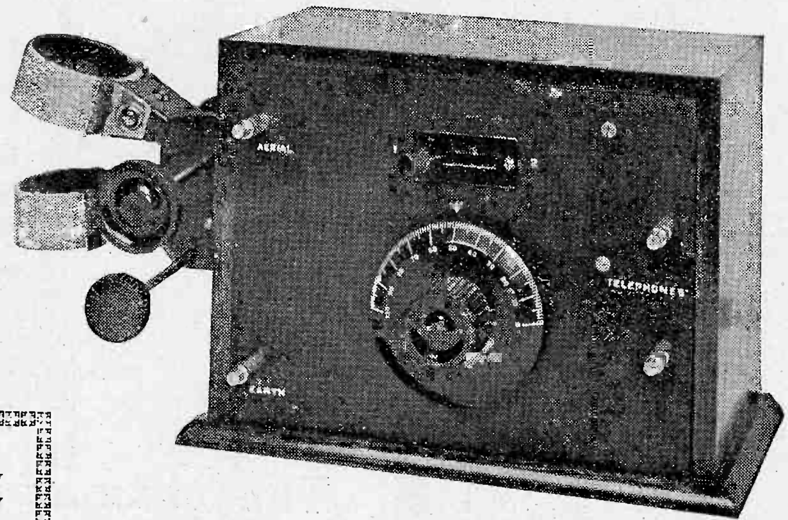
Gilbert Ad. 3163

A Crystal Set Employing Inductive Coupling

By EDWARD F. BURNETT

The type of aerial coupling incorporated in the receiver described gives very selective tuning, and will for that reason make especial appeal to coast dwellers and others who suffer from interference.



The switch provided permits either direct or loose coupling to be used.

THE receiver described below compares very favourably with other crystal sets which the author has tried, and should prove of special interest to readers who require a selective receiver which is, at the same time, simple to control. A method of switching is incorporated which provides an alternative circuit to the normal arrangement. This second circuit was found best for reception of the transmissions from the high power station, 5XX.

The first circuit employs the semi-aperiodic aerial coil method of coupling. This arrangement has been used in one or two previous sets, but on the whole it does not seem to have received much attention in crystal sets. It is not necessary to wind any special coils; all that is required is a two-way coil-holder and a set of plug-in coils, of which there are many good makes on the market.

In loose-coupled semi-aperiodic aerial tuning, the aerial circuit contains an untuned coil, variably coupled to a secondary or closed circuit consisting of a *tuned* coil.

The Circuit

The actual circuit employed is shown in the theoretical circuit diagram, Fig. 1, L_1 and L_2 being the aerial and secondary coils respectively. It will be seen that the lower side of the secondary coil L_2 is earthed, some slight benefit being gained occasionally by this means. The tuning condenser C_1 has a capacity of $\cdot 0005 \mu F$.

The high frequency currents received in the aerial circuit are transferred to the detector circuit via L_1 L_2, rectification being effected by the crystal detector D. The set is simple to tune, the only adjustments required being those of the variable condenser and the two-coil holder. The alternative circuit already referred to differs from that already described in that ordinary direct aerial coupling is employed. To bring this circuit into use the switch is placed in position 2, whereupon L_2 becomes the aerial coil, L_1 being removed.

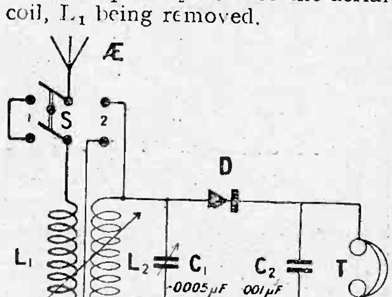


Fig. 1.—The simple method of obtaining either type of coupling is obvious from this theoretical diagram. When using direct coupling the coil L_1 may be omitted.

One of the now familiar permanent crystal detectors has been used, and is fixed behind the panel out of harm's way.

An ebonite panel 8 in. by 6 in. by ¼ in. thick is required, and should be of good quality and guaranteed free from surface leakage. If guaranteed ebonite is not used, it is advisable to rub each side with No. 0 glass paper, in order to remove the shiny surface, the insulating properties of the latter being doubtful. The black surface can be retrieved by rubbing with a little oil on a soft cloth.

The variable condenser is mounted on the panel as well as the change-over switch, crystal detector, and the necessary terminals. As will be seen from the photograph the two-way coil holder is mounted on the side of the box, two holes being drilled in the latter to take the flex leads from the two sockets. The lower holes take the leads from L_1 while the higher takes the leads from L_2.

List of Components

The components can be of any good make, but for those who wish to duplicate the receiver exactly, the makers' names are included in the following list:—

One ebonite panel 8 in. by 6 in. by ¼ in. (Paragon).

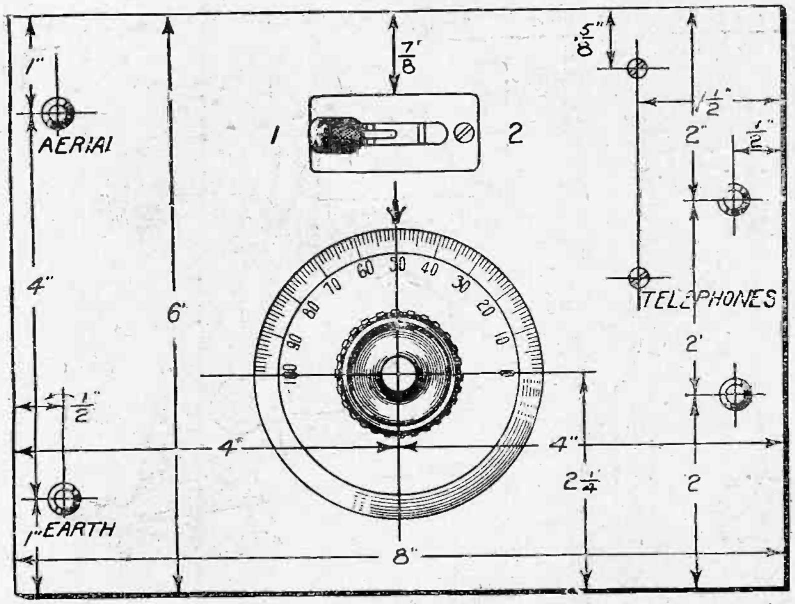


Fig. 2.—This diagram will facilitate the drilling of the panel. The dimensions given should be strictly adhered to.

One suitable containing cabinet (Camco).

One two-way coil-holder (London Electric Stores, Ltd.).

One permanent crystal detector ("Bronel," W. R. Bowman, Ltd.).

Four patent terminals (A. Butcher).

One "Utility" .0005μF variable condenser, square law pattern (Wilkins and Wright, Ltd.).

One "Utility" double-pole change-over switch (Wilkins and Wright, Ltd.).

One .001μF Paragon fixed condenser. This condenser is not of great importance and may be omitted if desired.

A quantity of V.I.R. flex.

A quantity of 16-gauge square section tinned copper wire.

One set Radio Press panel transfers.

Drilling

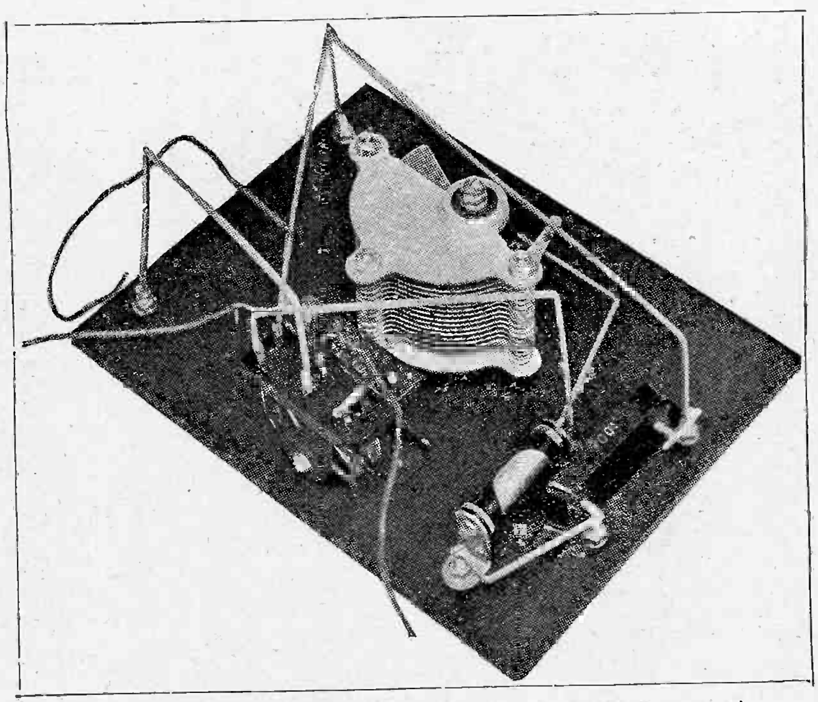
The panel may now be drilled in accordance with the diagram of Fig. 2, after which the various components may be laid on the back of the panel to see that they will fit correctly. If the components mentioned in the list are used no difficulty will be experienced in this direction.

If different makes are used, they will no doubt vary somewhat in size, and rearrangement may be necessary. If such is the case, care should be taken to keep the wiring as short as possible. The only components likely to give trouble in mounting are the change-over switch and the detector. For the change-over switch, an oblong must be cut from the ebonite. First unscrew the knob and remove the bolts holding the top plate to the framework. This top plate can be used as a template if desired. The first holes to drill are those through which the two bolts are fixed. These bolts not only hold the top plate to the framework but secure the whole to the ebonite. After this, scratch round the remaining hole in the top plate, on to the ebonite below. At each corner a hole is drilled and a fret saw used to remove the piece. If a fret saw is not available to the constructor a good plan is to drill a number of holes touching one another along the line scratched on the ebonite, until the piece drops out. The edges of the hole will be rather rough, but this is immaterial, for they will be covered by the top plate.

The fixed detector has at one end a screw which can be extended to vary the length of the detector for half an inch over its actual length. The clips for holding it, therefore, can be placed at any convenient distance apart within the half-inch limit, and are fixed to the panel from the front with 6BA countersunk head metal screws, holding the clips to the back with nuts. Nearly every variable condenser is either of the one-hole fixing type or supplied with a template.

Wiring up

The wiring can be carried out with square section wire if desired, or with thinner wire, using insulating sleeving. All connections where possible should be soldered. The practical wiring diagram, Fig. 3, shows clearly all the connections which require to be made. Flex leads are used to wire up the coil holder and should be passed through the holes in the side of the box and



Notice the positions of the fixed detector and flexible leads.

soldered to their respective terminals, leaving enough to enable the panel to be removed from the cabinet some little distance without undoing the wires from the coil holder.

If the coil holder is fixed on the side of the box, as described, then the lower socket holds the aerial coil, while that above it (the moving coil L_2) is the secondary coil. For the use of the first circuit the knob of the change-over switch is pushed to the left, while the opposite position gives the alternative circuit.

The operation of the circuit is very simple. The aerial, earth and telephone leads are connected to their respective terminals, and the switch placed to the left. The two coils are then arranged to form an angle of about 20 deg., when, by rotating the condenser knob, the local station should be heard, provided, of course, it is within crystal range. Suitable values for L_1 and L_2 are 35 or 50 and 75 respectively for the local station, while for 5XX Nos. 150 and 200 or 250 may be used. Selectivity may generally be improved by using a smaller aerial coil or by reducing the coupling between the coils. With the knob of the change-over switch on the right, L_2 is the only coil used, and should be a No. 35 or 50 for the local station or a No. 150 for Chelmsford. The detector will be found to be in a sensitive state when purchased, but if it should lose its sensitivity during operation, the panel should be given a gentle tap.

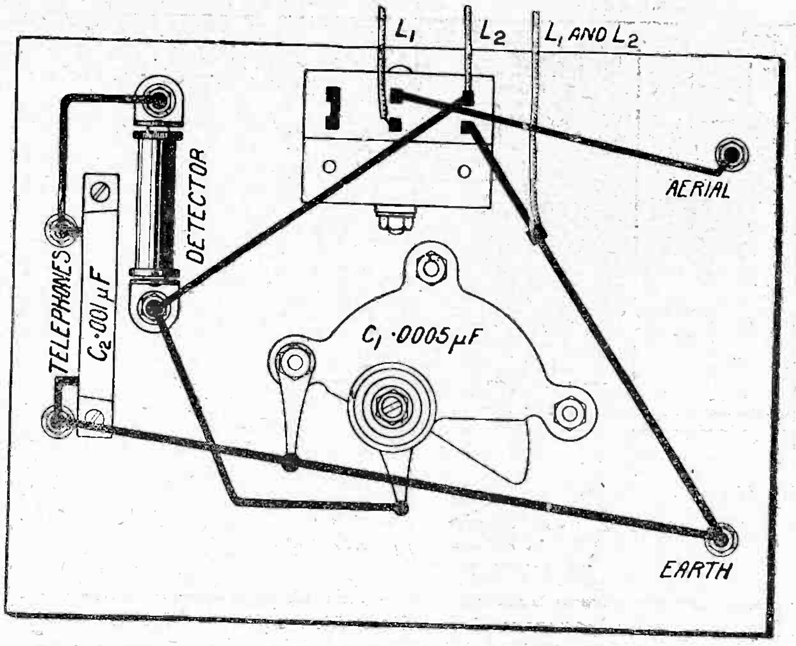
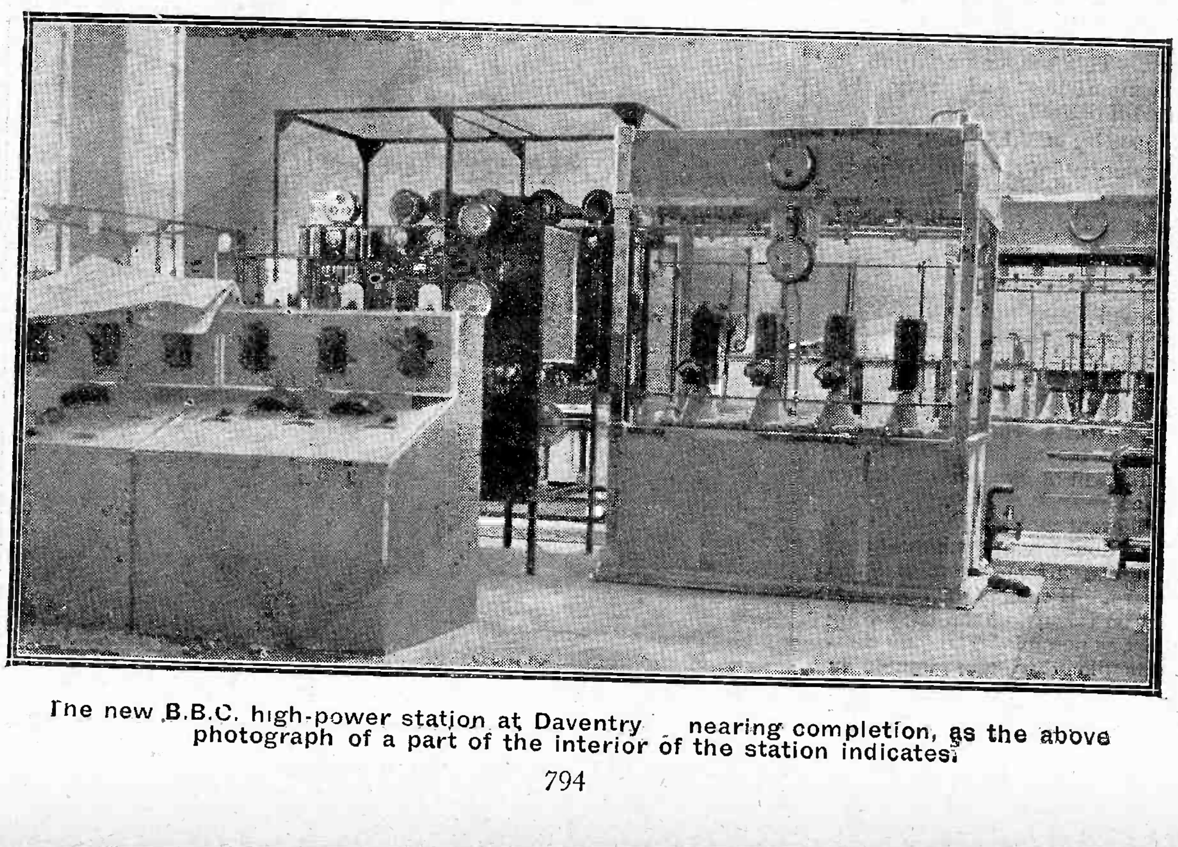


Fig. 3.—The wiring as shown is a very simple matter, and will present no difficulty.

Test Report

Tested on an average aerial seven miles from 2LO, results on the first circuit were louder than any I have ever heard on other crystal set, 2LO being very loud in the phones. Chelmsford on the same circuit came in well, but not quite so loud as London. On the second circuit 2LO was comfortable on the phones, but not so loud as before. Chelmsford, on the other hand, was slightly louder and clearer than on the previous circuit. During the afternoon, in bright daylight, several ships and amateurs were heard.

The constructor can, of course, use the galena and cat-whisker type of detector if he wishes. In this case the detector might occupy a position on the front of the panel opposite that of the present detector.



The new B.B.C. high-power station at Daventry nearing completion, as the above photograph of a part of the interior of the station indicates.

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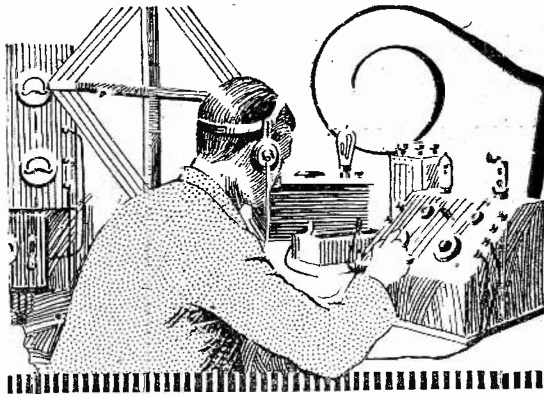


Tested by Ourselves

"Red Seal" Loud-Speaker

A No. 10 "Red Seal" Loud-Speaker has been submitted by Messrs. Sexton-Barnes, Ltd., and has been subjected to extensive practical tests. This is a small, moderately priced instrument, of the ordinary upright type, with metal horn, and standing about 20 in. high, and of approximately 2,000 ohms resistance. It is finished neatly in mottled black, and has the customary adjusting screw under the base. On practical trial, with receiving equipment as free from distortion as practicable, in comparison with the best loud-speaker equipment available in a practical form at the moment, the tone of this small instrument showed a marked improvement over that of some small loud-speakers, though the usual effect of a large, rather thick diaphragm with its characteristic resonance was noticeable. The sensitiveness was good, but the instrument was easily overloaded if too much signal-energy was applied.

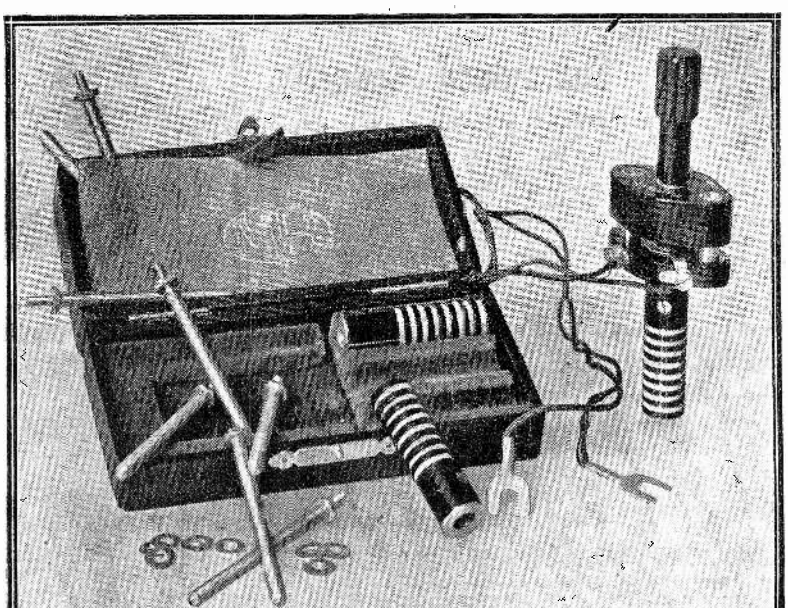
"M.H." Reactor and Damper

Samples of their "M.H." high-frequency Reactor and Damper devices, for use in conjunction with their well-known barrel type of small plug-in H.F. transformers, have been submitted by Messrs. Leslie McMichael, Ltd. The purpose of the first is to provide in a compact device a reaction effect on the tuned transformer coupling, in cases where this is necessary, instead of taking reaction direct on to the A.T.I. by means of the customary swinging coil. The makers claim that it gives only a very slightly radiating system when oscillating. The reactor has interchangeable barrels, marked 20, 30 and 150, for use on different wavelengths, which slide inside the H.F. transformer barrel, and have a coarse adjustment by sliding a bridge piece on two pins which replace the ordinary small screws fastening the ebonite top plate, and a fine adjustment by means of a knob and screw. Long flex leads are provided for connecting to the reaction terminals. On practical trial, with a heavily damped direct coupled aerial system (so

The McMichael H.F. Damper Device.

that stability was obtained when the one H.F. stage was critically tuned) oscillation could be obtained smoothly both on the short B.B.C. waves and on 1600 m., with the proper choice of reactor-barrel; and the customary degree of amplification and selectivity associated with these devices was obtained.

The Damper unit is designed to give exactly the opposite effect to the first unit for use in cases where a lightly damped aerial coupling is used, or where more than one stage of H.F. amplification is attempted. The resulting self-oscillation is controlled by introducing damping losses by sliding this metal foil covered damper barrel inside the H.F. transformer. The effect (together with a marked effect on the tuning) is to invite eddy-current losses which stabilise the system; so that the usual potentiometer-applied grid bias can be omitted. The amount of damping depends evidently on the position of the damper. On trial, with lightly damped grid circuit for the H.F. valve in an inherently unstable receiver, close control over reaction was obtained by sliding in the damper to the right point.

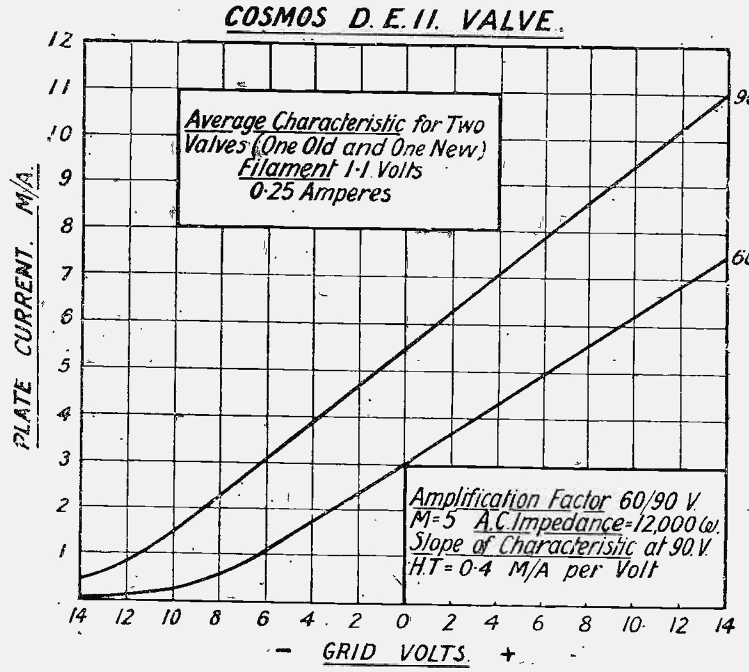


The McMichael Reactor Unit, in the case which the makers supply.

Care should be taken to round the edge of the transformer barrel in older patterns, as it was noticed that the metal foil was easily torn in introducing the damper.

Cosmos D.E. II. Valves

Some further specimens of the Cosmos D.E. II. "General Purpose" valve operating on 1.1 volts and ·25 amperes for filament heating, have been submitted by Messrs. Metro-Vick Supplies, Ltd., for comparative tests in connection with an early pattern tested and reported on some time ago in these columns. The filament emission in the latter specimen appeared to fall considerably short of what is accepted as an average for this type of valve: it was of interest therefore to compare another specimen of similar date and two fresh samples, under identical conditions. The small maximum emission (but just over 2½ milliamperes under operating conditions of high H.T. and positive grid-bias) of the original specimen was confirmed, after the lapse of a couple of months with occasional use; the other three samples, however, which can certainly be taken as more representative of the general issue in this period, showed an emission which did not reach saturation with 11 or 12 milliamperes when run at the rated heat of 1·1 volts and from 0·25 to 0·26 amperes. The characteristics of these valves fell extremely close together; the average of one of the new, and the second of the older, gave a composite characteristic



Composite curves of two Cosmos D.E.II. Valves, one valve being of the old issue, the other being a new sample.

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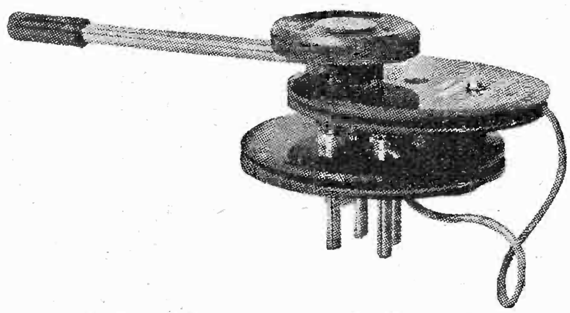
curve as shown in the figure, with an unusually long straight portion extending well over each side of the zero grid volts line. In practical trials for detection excellent results were obtained with the new valves with 25 volts H.T. and a high value grid-leak; for powerful loud speaking 100 volts H.T. and 6 volts grid-bias appeared to be a good combination, which would successfully handle considerable power. On 60 volts H.T. about 3 volts grid-bias was called for. The grid-current was minimal (a few microamperes only) up to above 1·4 volts positive. The valve was not noticeably microphonic. Evidently, judging from the more really representative samples available here, this valve will give excellent results (with moderate H.T.) for general use in detection and H.F. amplification, whilst with ample H.T. it is able to cope with a signal energy which would normally call for a small power-valve for distortionless amplification. The mean A.C. anode impedance, in the sample tested here, was unusually low for a general purpose valve, and the amplification factor is proportionately moderate, around 5-5·5, with a slope of the characteristic of 0·4 m/a per volt.

"Mellowtone" Reaction Unit

A tuned anode H.F. amplification reaction-unit has been submitted for test by Messrs. Midland Radiotelephone Manufacturers, Ltd., which plugs into an ordinary four pin valve-holder, and provides in the one unit a tuned anode coil and a swinging reaction coil. The anode coil is wound in a narrow slot in a disc, similar to the conventional mushroom plug-in H.F. transformer, the connections being taken to the "grid" and "plate" pins. The reaction-coil is of similar form, and is pivoted eccentrically on the first and controlled by a handle, connection being made via the pivot and a flex respectively to the "filament" pins of the mounting. Four sizes are made, described as 80-250, 250-650, 600-1650, and 1500-3000 metres respectively; of these the 250-650 unit was submitted for test, and was found to cover the short-wave B.B.C. range adequately with a ·0003 μF (actual) tuning condenser, and to give smooth control over regeneration within this range.

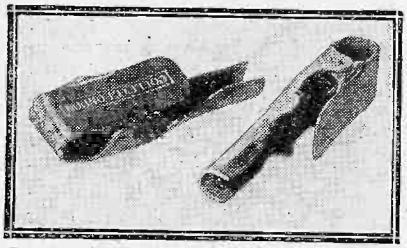


The "Mellowtone" Reaction Unit.

The unit was neatly made and finished. The makers point out that a considerable economy is effected by the use of this combined device over the cost of a two-coil holder and a set of coils.

Terminal Clips

From S.H. Collett have been received samples of spring clips for affixing to flex connectors and which are suitable for rapid wiring of experimental receivers and for temporary connections in general. These have a very powerful serrated jaw clip of the tie-clip type, and are also provided with a neck which can be readily clamped upon the end of cable or flex of varying sizes, so as to afford a firm grip. The device is neatly finished, and proved very convenient and reliable in actual use, a particularly useful application being that of making experimental tappings on an inductance, the



The Collett Spring Clips.

toothed jaws of the clip proving effective in making contact through a thin layer of insulation. For this, and for similar purposes, these clips can be strongly recommended.

H.T. Battery Inserts

An inconspicuous but important service is that rendered by the little conical bushes or inserts into which the wander-plug is pushed in making tappings on the ordinary block H.T. battery. Messrs. Autoveyors, Ltd., have brought to our attention some types of Clix H.T. Battery Inserts, both in machine turned and stamped patterns, which appear well adapted to give a certain and low-resistance electrical contact with a Clix plug-socket, used in place of the usual split wander-plug. They are fitted with serrations to give a good grip in the sealing composition in the battery.

Igranic "Freshman" Fixed Condensers

Messrs. Igranic Electric Co., Ltd., have sent for our inspection a sample of the ·0003 μF size of their Igranic-Freshman series of fixed condensers. These are small units, about $1\frac{1}{2}$ in. long by 1 in. wide, in a metallic wrapping, and are provided with triple soldering tags with holes for fixing screws spaced at the standard distance of 2 in. at the ends. The value of the sample submitted corresponded exactly with the nominal capacity, on measurement, and there were no signs of abnormal high-frequency losses when used in an oscillating valve-circuit. We would suggest that whilst the matter of providing convenient terminals of adequate dimensions on fixed condensers has scarcely received proper attention in the past, the type of somewhat flimsy soldering-tag connection provided here is hardly in keeping with the usual high standard shown by Messrs. The Igranic Electrical Co., Ltd., in their radio components, and that a more robust and convenient type might well have been provided in their new pattern. For permanent incorporation in a receiver with soldered connections made by experienced operators this may be unnecessary.

The "Freshman" Fixed Condenser.

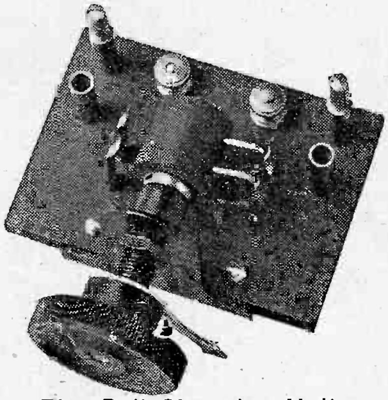
"Easitune" Anti-Capacity Handle

One of the neatest anti-capacity tuning devices that has come to our notice is the "Easitune" handle, marketed by Messrs. A. H. Hunt, Ltd. This has an insulating handle a little over 5 in. long, carrying at the lower end a clutch or spring-grip device fitting over the standard sized ebonite tuning-knob, and instantly released or applied by a sliding knob actuated by a small handle moving in a slot at the further end of the main handle, and which can be moved by the thumb. The whole device can be readily applied, experiment showed, by one hand; and it could be moved from one tuning knob to another without altering the tuning adjustment. Thus the one handle was available for fine tuning at any point in a complex receiver. With the long handle, not only were hand-capacity effects practically banished, but close, critical tuning was greatly facilitated. It was found that a ·001 μF condenser could be critically tuned in a secondary short-wave circuit using this handle. We can strongly advise every experimenter to have one of these useful handles by him, for critical work and for use in connection with short-wave reception. The sample submitted was well made and finished; we understand that future patterns are to be of rather heavier design, which is all to the good for delicate tuning operations.

"Utility" Coil Changing Unit

Messrs. Wilkins and Wright, Ltd., have sent for our trial and comment samples of their Coil-Changing Units, which enable alternative tuning inductances of the plug-in type to be rapidly connected in circuit, for comparative work and for alternative reception, *e.g.*, of 5XX and the short-wave B.B.C. stations, with the minimum of complication.

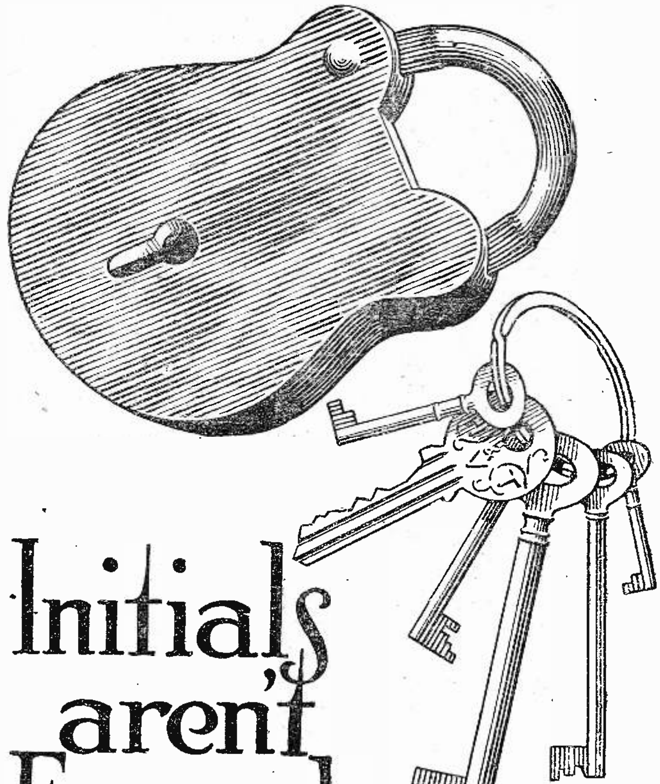
This unit combines the well-known "Utility" low-capacity switch, with two ordinary coil plugs and terminals on a small base panel, measuring 3¼ in. by 2¼ in. and with a one-hole-fixing device of the usual type mounted on a right angle bracket, so that the switch control handle projects through the panel, and the coils are each arranged vertically and at right angles to the panel, behind the latter. The clearance suffices for any but the very largest coils of ordinary types, or for certain types of basket coils, etc., of large diameter. The device worked excellently in practice, and is substantially built and nicely finished. It can be strongly recommended for the purposes indicated, and particularly for incorporation in a simple type of two-range broadcast receiver.



The Coil Changing Unit.

New Pattern M.H. Fixed Condensers

A new pattern of the familiar flat interchangeable type of fixed condenser has been introduced by Messrs. L. McMichael, Ltd., specimens of which have come to hand. Certain minor improvements have been effected in the condensers, whilst the general style and dimensions have remained unchanged. The necessary mounting clips are provided with each condenser. Those submitted had the nominal capacities of ·01 μF and ·0003 μF; on practical test and measurement these proved to have a value very close to the nominal, and operated well in their respective spheres in a receiver, the first in particular as grid-condenser in resistance-capacity L.F. amplification.



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A WIT once remarked that he could resist anything but temptation. Happily the world is not too full of such, though many have felt disposed to break the tenth commandment.

If imitation is the sincerest form of flattery, covetousness is the highest form of compliment; but it is a compliment we would gladly do without.

All of which is to point the moral—Don't be satisfied with putting your initials on good tools; buy a lock and key for them.

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Below is illustrated the Wade No. 2 Lathe. It is back-geared, self-acting and screw-cutting. It has 13 change wheels, which cut all threads, right- or left-hand, from 6 to 60 T.P.I., including metric pitches. It takes work up to 4 in. in diameter and 12 in. in length.

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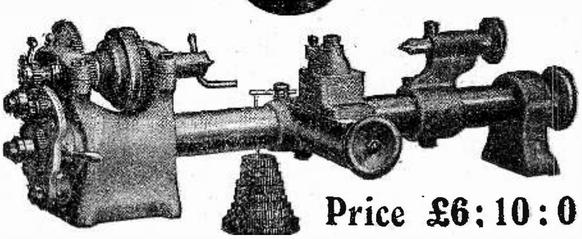

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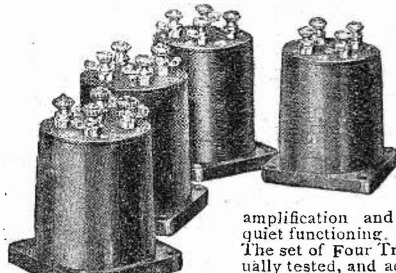

When you build with Bowyer-Lowe Super Heterodyne Transformers you will make an instrument more selective than any you have heard, and possessing strength and purity of signals that will astonish you. There is a good reason for this. These Transformers are built expressly for British Valves, with which it has been possible to increase greatly the amplification and yet obtain pure signals and quiet functioning.

The set of Four Transformers, matched, individually tested, and accompanied by full instructions for making a Seven Valve Super Het. Receiver, costs only £4. Order to-day from your dealer

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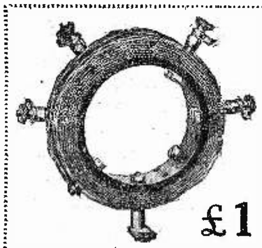

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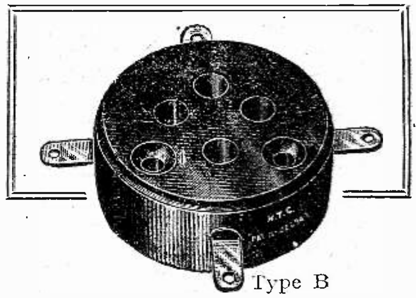
The Bowyer-Lowe Model II Oscillator Coupler is a later development of Super Het. design and operates on the direct coupled system without a pick-up coil, the plate current being an alternating one from the first valve. In a great many instances this type of coupler will be found more sensitive than the standard type.

The Coupler covers a wavelength range of 260-550 metres when tuned with a Bowyer-Lowe ·0005 Square Law Condenser.

Bowyer-Lowe Co. Ltd. **LETCHWORTH.**



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For such Circuits as the S.T.100, in fact for all reflex circuits using crystal rectification, the H.T.C. Fixed Detector is ideal. We find the "hot-spot" and test it on actual broadcast. You simply mount it—under the panel if you wish—and it will do the work as no other can do. The H.T.C. Fixed Detector employs a proved mineral crystal combination. Remember, it is a permanent detector.

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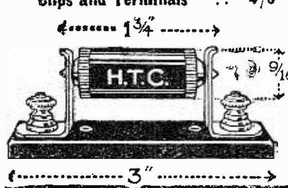
Complete with Ebonite Base, Clips and Terminals ..	4/6



It is wise to select radio components that have been proved by popular use to be of the highest radio efficiency. Such components are the H.T.C. products. Experienced experimenters and constructors have, by comparison with components of other makes, proved H.T.C. products to be all that we claim, and have thereby been eminently satisfied.

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Give your set range by fitting H.T.C. Low Capacity Valve Holders. For mounting the four-pin valve and the popular plug in H.F. Transformer you can only expect the best results if you use the H.T.C. Low Capacity Valve Holders. Covered by our patent No. 222545.

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(*Concluded from page* 729.)

up a set which does not work to blame the design or the designer. The Radio Press, however, so far as their own designs, etc., are concerned, forestall any criticism by placing the actual set on exhibition for two weeks after it has been described, and if the effectiveness of the set is challenged, offering to demonstrate it to any suitable and appropriate representative of the wireless public; most of the sets, as a matter of fact, have been demonstrated before different radio societies. We go further, however, and if any reader makes up a set according to our designs and it does not work, we are prepared to tell him what is wrong and, if it is desired, to put the set right, a small fee being charged which, however, only covers a fraction of the total cost of testing. If there is any criticism of a Radio Press set, let the criticiser approach the Radio Press themselves and they will satisfy him.

Expenditure

What more could any firm of publishers do? When the new laboratories at Elstree are ready the existing services will be further extended and, needless to say, the annual loss on this branch of our business will be greatly increased. We believe, however, that the increased prestige and influence of the Radio Press journals and publications will help largely to defray this heavy expenditure which in any case could not be undertaken by any organisation which did not concentrate entirely on the publication of radio literature. By owning a group of wireless papers the Radio Press are able to possess a highly-paid and efficient staff, the cost of which is distributed amongst the papers, each deriving the benefit of the staff.

Apart from the testing of apparatus and the willingness of the laboratories to accept responsibility for what is published in the Radio Press papers, these laboratories will undertake the testing of manufacturers' products and will report these tests in an impartial manner in the pages of Radio Press periodicals. Readers will have already seen that we do not merely print the pleasant things we have to say but also the unpleasant.

In addition, the laboratories will provide data and information and articles which will give precise results based on actual work done in wireless laboratories which, as regards equipment, will be second to none. The laboratories will be entirely and solely at the disposal of our readers.

Details of Dr. Robinson's Career

James Robinson was born at Seghill, in Northumberland, in 1884. His earlier work was concentrated on physics and mathematics, and he obtained his B.Sc. with distinction in both subjects in 1906. He was awarded a Fellowship of his University, and in 1907 he studied physics on the Continent. In 1909 he obtained the degree of Master of Science (M.Sc.), and also that of Doctor of Philosphy (Ph.D.), the latter being a science degree for his work in physics.

He lectured for a number of years in mathematics and continued research work in physics. About 1909 he commenced wireless work, and it is interesting to notice that he was associated at this period with Mr. Morris Airey, who is now Technical Adviser to the Admiralty, and Dr. Brydon, who is Technical Adviser to the Army. Abroad, one of Dr. Robinson's fellow students was Dr. Hoyt Taylor, who is now Technical Adviser in Wireless to the United States Navy. From 1910 to 1912 Dr. Robinson was lecturer and demonstrator of physics at the University of Sheffield, and after this period he was senior lecturer in physics at a college in the University of London. Dr. Robinson at this time became an Examiner in Physics at the University of London.

During the last ten years Dr. Robinson has concentrated on wireless work of an essentially practical character. In 1915 he was transferred from the Infantry to the Navy for wireless duties, and was mentioned in despatches, and also awarded the M.B.E.

Direction Finding

Much of Dr. Robinson's early wireless work was in connection with direction finding, and he was the first to fit wireless direction finding equipment to aeroplanes, his system being used throughout the war in the Royal Air Force. Dr. Robinson's direction finding system, which bears his name, is very largely used commercially to-day. His principal direction finding work, however, was carried out many years ago, and since the war he has been engaged in general research and design work in connection with wireless reception and transmission; direction finding has only been a small part of his activities, although his position has during the last few years prevented him from publishing details of his work. The great difficulties in connection with wireless reception on aircraft have necessitated the production of apparatus of a very high standard of efficiency and possibly the excellent training-ground which the Royal Air Force has provided is the explanation of why so many of our leading radio engineers to-day have come from the Royal Air Force.

When stationed at Biggin Hill, the Wireless Experimental Establishment of the Royal Air Force, at the end of the war, Dr. Robinson was made Chief Technical Assistant to the Commandant for general wireless experimental work. In 1920 the establishment was altered in character and its importance increased. Dr. Robinson then became Chief Experimental Officer. In 1922 the Wireless and Instrument Design Establishment of the Royal Air Force was moved to Farnborough, and Dr. Robinson became Head of this important department.

Practical Designs

As the Technical Head in wireless matters of the Royal Air Force, Dr. Robinson has been in charge of wireless laboratories, carrying out not merely general research work, but actual design of instruments and apparatus. His work has, therefore, been essentially practical, which places him in a different category from those scientists who have studied the art of wireless from the theoretical point of view and have done little practical work.

On different occasions two leading Universities in this country have offered professorships to Dr. Robinson, which he has declined, owing to his preference for practical work, which is a somewhat unusual attitude in the case of those who have won such high scientific distinction.

Dr. Robinson is now a D.Sc., a Ph.D., an F.Inst.P. (Fellow of the Institute of Physics), a Member of the Council of the Physical Society of London, and is a committee member of the Radio Research Board and also a member of the Wireless Board. These latter Boards are respectively national and Service committees, and membership implies eminence in wireless work. The Wireless Board acts, more or less, as a final authority on wireless matters in this country, and has on it representatives of the fighting Services. As a member of the Wireless Board and also in his official capacity as Head of the Wireless Research Laboratories of the Royal Air Force, Dr. Robinson has intimate knowledge of the results of the latest wireless research work carried out by the Army and Navy, as well as that carried out under his own control.

Using the All-Enclosed Super-Heterodyne

(Concluded from page 746.)

suit this arbitrarily fixed setting of the frame. Thus, in daylight Birmingham and Bournemouth alone could be heard at proper loud-speaker strength; after dark 2LO also came in at poor loud-speaker strength, whilst Cardiff was decidedly weak even on phones. None of the more distant stations, except Petit Parisien and Toulouse, could be heard.

Lechlade

The next day the set was tested at Lechlade, on the upper waters of the Thames. The receiver was first tried in the afternoon in the open and well away from all buildings, and here it was found that Birmingham, London and Bournemouth gave really adequate loud-speaking, Cardiff being heard upon phones only, as was also Manchester. The Nottingham relay station gave fair loud-speaker results. In the evening, but still in daylight, the set was tried indoors, and the same main stations were heard at slightly reduced strength, the Nottingham relay being now only heard upon the phones. In addition, Newcastle was picked up on the phones, and as darkness fell its signals steadily rose to fair loud-speaker strength.

At this point a special search was made for relay stations, and Sheffield and the Leeds station of the Leeds and Bradford pair were picked up at very good phone strength. This occurred during the twilight period, before full darkness had set in. It was interesting to note that here, as at Calne, Birmingham was the strongest station heard, while London and Bournemouth appeared to be just about equal in strength, and Cardiff was decidedly weak. The reception at quite fair loud-speaker strength of all the other main stations except Cardiff and Belfast (after dark) concluded the tests.

The Enclosed Frame Aerial

There remains the question of the frame aerial wound upon the door of the box, which I have mentioned at one or two points as being a useful accessory to enable one to receive the local station without any external apparatus other than the loud-speaker. This frame aerial has now been finally incorporated in the set, and it consists of a winding of 24 turns of number 22 double cotton-covered wire wound spirally upon the inside of the lid and supported under heads of four rows of 24 small brass screws, these screws being spaced ⅜ths of an inch apart along the diagonal lines of the door. This will become clear upon the inspection of Fig. 2, which gives the necessary information. The ends of the winding are fastened off by being screwed down against the wood under two little blocks of ebonite, about a foot of wire being left free for connections. These leads are then taken to the two frame terminals, and the arrangement is ready for use.

If any difficulty is experienced in reaching the longer wave stations with this frame, which may occur if a tuning condenser of different make is used which does not give the full rated capacity, various remedies may be adopted. A fixed condenser of ·0001 μF can be placed across the frame terminals (temporary expedient, not recommended), or a small loading coil may be connected in series between the frame and one of the frame terminals.

For Short Distances

This frame winding is really provided for quite short distance work, and in use it is intended that the door of the set shall be kept open and swung upon its hinges in order to set the frame aerial in the desired direction. I have obtained quite good loud-speaker results from the London station at a distance of 25 miles with this frame, but I do not think that such distances should be expected unless the operator is prepared to exercise a certain amount of skill and delicacy of control in working the set.

Regard it rather as a convenience for use on the local station, and treat its performance upon the more distant stations purely as a matter of interest, and it is quite possible that you will be agreeably surprised by the results actually obtained. For all general work by all means use a separate frame, of as large a size as is convenient, mounted in such a way that it may be revolved, and placed at a little distance from the set. Those who are interested in the small internal winding just described, and which I have introduced into the original set can, of course, avail themselves of the opportunity to inspect the receiver itself, since it will be on exhibition at the Radio Press Offices for a second period of fourteen days following the publication of this number of MODERN WIRELESS.

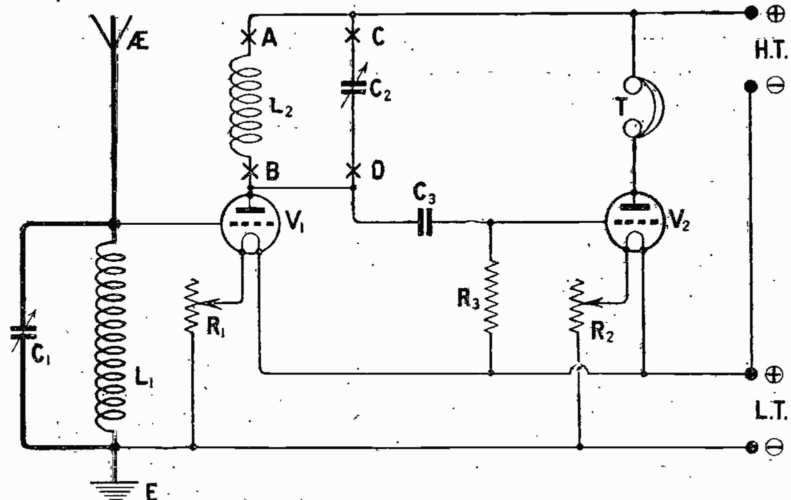


Fig. 1.—The points A, B, C and D indicate the location of the faults first referred to by the author.

Obscure Faults in Tuned Anode Receivers

By G. P. KENDALL, B.Sc., Staff Editor.

THE faults which may occur in receivers employing the tuned anode method of inter-valve coupling of course include all the usual ones common to any type of instrument, but in addition there are a number of troubles which may almost be described as peculiar to these circuits, which are apt to prove somewhat puzzling to those who experience them for the first time. It is proposed to give an outline in this article which will serve to show the symptoms produced by some of the more common of these faults, so that the reader may be able to gather a general idea of the special symptoms produced, and will thus be in a position to identify any particular fault which he may encounter.

Disconnections

Consider first the case of an actual break or disconnection in the tuned anode circuit. This provides a good example of the way in which tuned anode receivers behave in their response to quite common types of faults, and we will suppose that the break occurred at the point marked B in Fig. 1, that is to say, between the plate of the valve and the winding of the tuned anode coil. The connection from the plate of the valve to the tuning condenser of the anode circuit, however, remains intact.

The symptoms which will be produced by such a fault will probably be mainly that the first valve does not appear to be amplifying, that is to say, that its filament current can be turned off and little or no difference will be noticed in the signals heard. Signals will be considerably below normal strength, and it is possible that only the local station will be heard, while considerably more reaction will be required to make the set oscillate than when it is behaving in a normal manner. Incidentally, I should mention at this point that no reaction coils are shown in any of the diagrams, since the position of the reaction coil usually has little bearing upon the fault which we are considering. It will, of course, be present in most practical receivers, and may be coupled either to the aerial or the tuned anode cicuit.

Reaction Coupling

In the case of the particular fault which we are now considering, if the reaction coil is coupled to the aerial it will be found that somewhat tighter coupling than usual is required to make the set oscillate, whilst if it is coupled to the tuned anode coil it is probable that it will not be possible to make the set oscillate at all. It should, perhaps, be explained that the reason why signals continue to be heard when such a fault as this has taken place in the circuit is that the inter-electrode capacity of the first valve serves to pass the signals through from its grid circuit to the grid of the rectifying valve, so that they are heard in the normal way.

It will probably be found in this case that revolving the tuned anode condenser has a considerable effect upon signal strength, signals becoming progressively weaker as the capacity of this condenser is

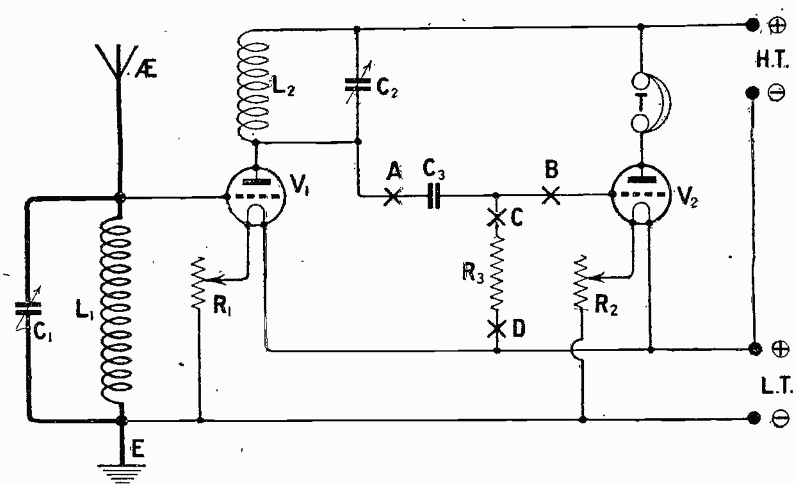


Fig. 2.—In tuned anode receivers the faults affecting the grid leak and condenser often produce very marked effects.

increased. Another symptom is that signals are very much stronger when the first valve is in its socket than when it is removed, it being quite possible that the removal of the valve will stop signals altogether.

Little difference in results will be noticed, whether the break occurs at the point A or the point B, that is to say, at either end of the tuned anode coil, in practice probably the connections to the socket in which the coil is mounted. When these symptoms are present the telephones and dry cell test will be quite adequate to locate it, and the first step should be to pull the first valve from the socket and test between the anode socket of the valve and the two ends of the coil socket. Strong clicks should be obtained from the one, that is by the point B, and none from the other, unless the coil is inserted in its socket. The test should therefore be carried out both with the coil out of the socket and with the coil inserted, and should be followed by tests upon the wiring beneath the panel, if necessary. Little difficulty will probably be experienced in locating this fault, so long as it is remembered that the usual trouble of a defective coil socket may be present.

Condenser Connections

A bad connection to the variable condenser of the tuned anode circuit will produce quite different results from those which we have been considering, and this fault is usually very easily identified. The main symptom is that turning the condenser produces no effect upon signals, while in addition it will probably be found that the set oscillates very easily upon the short wavelengths, but as the wavelength of the aerial circuit is increased it becomes very difficult to make it oscillate. A useful preliminary test in this case is to remove the usual size of coil from the anode circuit, and insert a No. 100 or its equivalent, and note where the set oscillates most easily. If it is found that it oscillates very easily indeed upon the very low broadcast wavelengths, and refuses to do so without fairly close reaction coupling upon the longer waves it is extremely probable that the variable condenser is disconnected.

The telephones and dry cell test will again serve, and the test should be made between the anode socket of the first valve and the fixed or moving plates themselves, touching directly upon the plates. A click should, of course, be obtained from the set of plates which are wired upon the anode side of the circuit, these being usually the fixed plates.

Continuity Test for Moving Plates

The continuity of the lead to the moving plates can be tested by applying the telephone and dry cell leads between the high-tension positive terminal and the moving plates themselves, and a good click is again expected. Failure to obtain this indication should lead to the usual investigation of the leads, and also to the customary points upon the variable condenser, such as the device making contact to the moving spindle, and so on.

Grid leak and grid condenser faults may also produce somewhat unusual results in a tuned anode receiver, although one more often finds that the effect is a complete absence of signals, in the normal manner. In general, faults at this point in the circuit produce much more marked effects than in a simpler receiver, such as one employing a rectifying valve followed by one or two stages of low-frequency amplification.

The Grid Condenser

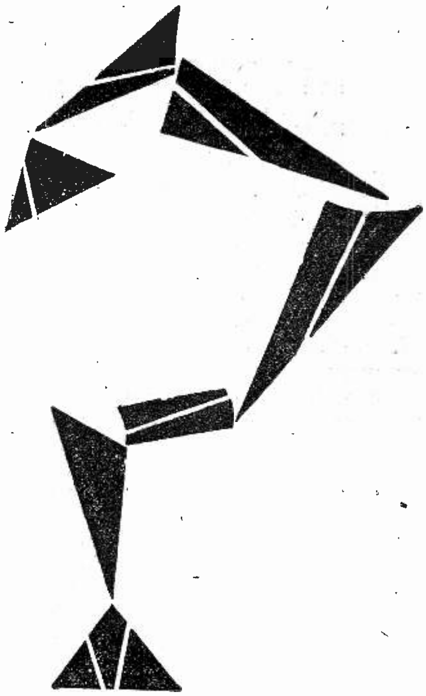
A short-circuit in the grid condenser in one of the last-mentioned types of sets may readily result only in a considerable reduction in signal strength, while in the case of the tuned anode receiver it will probably cause signals to cease entirely, since the effect is to bring the full potential of the anode battery through on to the grid of the rectifying valve, with obvious results. The dry cell and telephone test applied across the two tags of the condenser will determine whether it is broken down, and of course a simple substitution test will also decide the matter.

Breaks in the leads to the grid condenser at either point A or B (Fig. 2) will, of course, as a rule completely wipe out signals, and if this is the case the dry cell and telephone test should be applied between the plate of the high-frequency valve and the appropriate tag of the condenser, and between the other tag of the condenser and the grid socket of the rectifying valve, in the usual way.

The Grid Leak

Grid leak faults are also apt to produce somewhat marked effects in tuned anode circuits, since when reaction is used the degree of smoothness of reaction control is often considerably affected by the actual value of the grid leak. Variation in the value of the grid leak beyond certain figures may therefore have a considerable influence upon the convenience of operation of the set, and if it is found that reaction is extremely floppy and difficult to control with all available values of high and low tension supply, with different types of valves, and so on, the grid leak should come under suspicion, and it may be found that it is actually disconnected from the circuit. The effect is then to make the circuit behave as though an abnormally high resistance grid leak was being used, and again telephone and dry cell investigations between the grid of the valve and the upper clip of the grid leak marked C in Fig. 2., and between low tension positive and the other clip of the grid leak marked D in Fig. 2, should be undertaken. On the other hand, of course, the grid leak itself may have become defective, and the best procedure here is to replace it with another known to be in good condition, and note the result.

Grid leaks which have once given satisfactory results do not often become unusable through a reduction in their resistance, and therefore it is not likely such a fault will arise.



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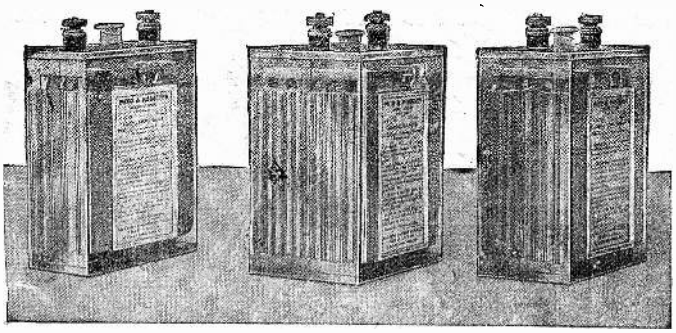

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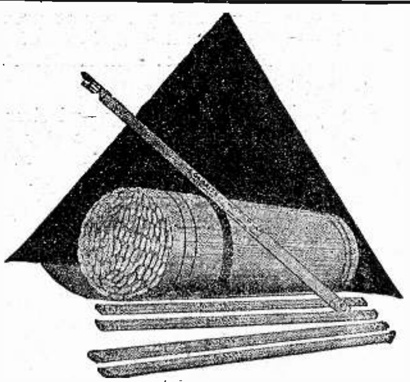

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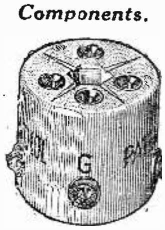

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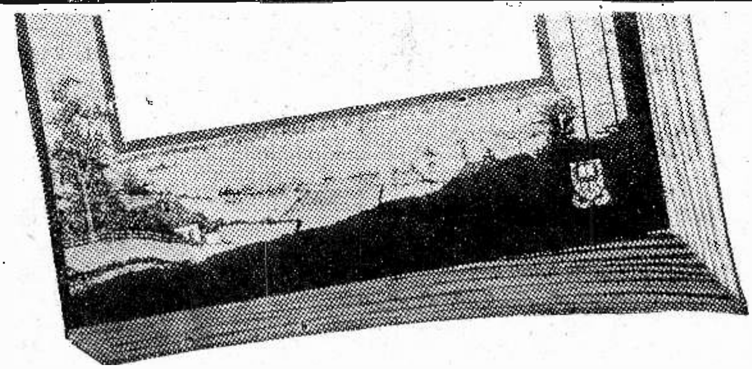

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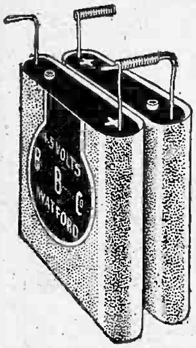

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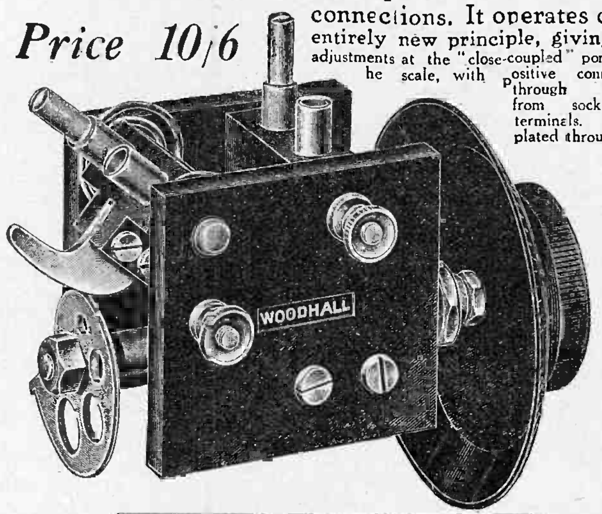

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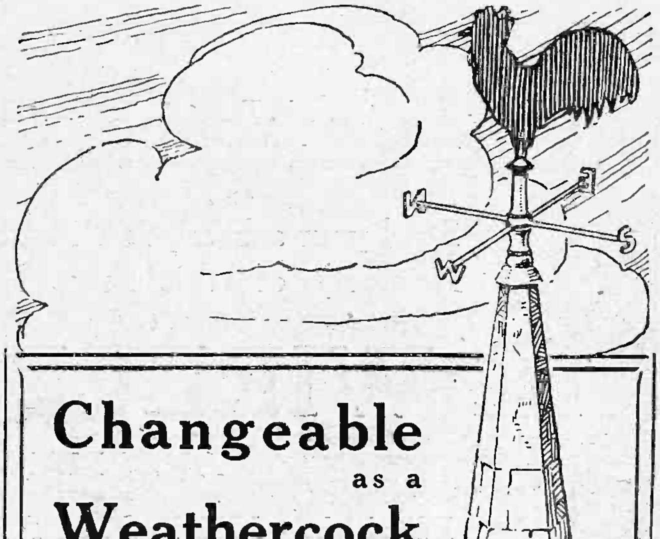

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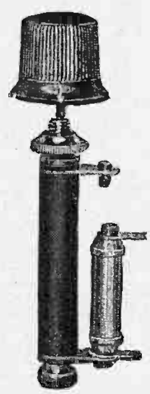

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